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المجلة الصحية لشرق المتوسط

La Revue de Santé de la Méditerranée orientale

The COVID-19 pandemic continues to pose multiple health challenges in the Eastern Mediterranean Region and is the focus of discussion at the 67th Session of the Regional Committee for the Eastern Mediterranean, examining how to mitigate the impacts of the pandemic and improve Member State preparedness and response.

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IS the official health journal published by the Eastern Mediterranean Regional Office of the World Health Organization. It is a forum for the presentation and promotion of new policies and initiatives in public health and health services; and for the exchange of ideas, concepts, epidemiological data, research findings and other information, with special reference to the Eastern Mediterranean Region. It addresses all members of the health profession, medical and other health educational institutes, interested NGOs, WHO Collaborating Centres and individuals within and outside the Region.

المجلة الصحية لشرق المتوسط

هى المجلة الرسمية التى تصدر عن المكتب الإقليمى لشرق المتوسط بمنظمة الصحة العالمية. وهى منبر لتقديم السياسات والمبادرات الجديدة في الصحة العامة والخدمات الصحية والترويج لها، ولتبادل الآراء والمفاهيم والمعطيات الوبائية ونتائج الأبحاث وغير ذلك من المعلومات، وخاصة ما يتعلق منها بإقليم شرق المتوسط. وهى موجهة إلى كل أعضاء المهن الصحية، والكليات الطبية وسائر المعاهد التعليمية، وكذا المنظمات غير الحكومية المعنية، والمراكز المتعاونة مع منظمة الصحة العالمية والأفراد المهتمين بالصحة فى الإقليم وخارجه.

La Revue de Santé de la Méditerranée Orientale

EST une revue de santé officielle publiée par le Bureau régional de l'Organisation mondiale de la Santé pour la Méditerranée orientale. Elle offre une tribune pour la présentation et la promotion de nouvelles politiques et initiatives dans le domaine de la santé publique et des services de santé ainsi qu'à l'échange d'idées, de concepts, de données épidémiologiques, de résultats de recherches et d'autres informations, se rapportant plus particulièrement à la Région de la Méditerranée orientale. Elle s'adresse à tous les professionnels de la santé, aux membres des instituts médicaux et autres instituts de formation médico-sanitaire, aux ONG, Centres collaborateurs de l'OMS et personnes concernés au sein et hors de la Région.

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Coming together in the Region to tackle COVID-19

Ahmed Al-Mandhari[1]

[1]Regional Director, World Health Organization Regional Office for the Eastern Mediterranean, Cairo, Egypt.

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The COVID-19 pandemic continues to pose multiple health challenges in the Eastern Mediterranean Region. Morbidity and mortality from the disease remain a serious cause for concern. As of 31 August 2020, a total of 1 924 511 laboratory-confirmed cases of SARS-CoV-2 virus infection had been reported in the Region, including 51 019 deaths (*1*). Moreover, there are worrying signs that cases are now rising again in some countries after a period of decline (*2*) and the indirect impact of the pandemic on health care is arguably even more troubling. Access to essential health services is being compromised as scarce resources are diverted to fight the pandemic, social restriction measures such as lockdowns disrupt service provision, while fear and rumour deter people from approaching health facilities. Initial studies indicate that services such as immunization, elective surgery and chronic disease management have been severely affected (*1*). The long-term consequences threaten to be grave indeed.

Therefore, it is no surprise that assessing and mitigating the impacts of the pandemic are prominent on the agenda for the upcoming 67th session of the Regional Committee for the Eastern Mediterranean (*3*), WHO's governing body in the Region. The Committee's annual meeting is a crucial formal mechanism for ensuring the Organization's accountability to our Member States in the Region; the core of each year's session is delegates' discussion, scrutiny and approval of reports and proposals regarding technical programmes of work. No less importantly, it also provides an opportunity for informal discussions among WHO staff, Member State policy-makers and technical experts, and valued partners including WHO's sister United Nations agencies, nongovernmental organizations and other stakeholders. Through side meetings, exhibitions and social events, experiences and ideas are shared to the great mutual benefit of participants.

Unfortunately, that broader interaction is going to be diminished this year, as the Regional Committee session has itself been impacted by the pandemic. In place of the normal three to four days of face-to-face meetings, which be both imprudent and logistically challenging at present, the 67th session will be a virtual event held through an online platform. To minimize the risk of connectivity problems and accommodate different time zones, the duration will be limited to two five-hour sessions held on 12 and 13 October. The agenda has been pared down to a minimum of essential items, and some of those items will not be discussed during the Committee meeting itself, but instead circulated as documents for Member States' consideration (*4,5*). With time at a premium, participants will be encouraged to submit written or video statements on agenda items in advance, rather than intervening during the session, and the WHO Secretariat is holding informal consultations with Member States in advance of the meeting to help ensure that technical proposals reflect a broad consensus.

Member States will be considering some bold new initiatives. COVID-19 has highlighted concerns about the limited availability of medicines and vaccines in the Region. There have been long-standing and deep-seated issues in this regard in most countries of the Region, but the pandemic has brought them into sharp relief. Countries rely heavily on imports of medicines, so the disruption of international supply lines has led to severe shortages, making policy-makers even more anxious to ensure that adequate stocks of any eventual COVID-19 vaccine can be delivered promptly to their populations in good time. In response, WHO has developed a regional strategy to improve access to medicines and vaccines in the Eastern Mediterranean Region, 2020–2030 (*6*). The new strategy is based on a comprehensive analysis of gaps and challenges in the Region, and specifies comprehensive actions for both national governments and WHO's technical staff to address them. In spurring its development, the pandemic may yet prove to have a very substantial silver lining.

There is also a proposal to establish a new regional Subcommittee on Polio Eradication and Outbreaks (*7*). Eradication of wild poliovirus from WHO's African region was formally certified in August 2020 (*8*), making the Eastern Mediterranean Region the only part of the world in which it remains endemic. Indeed, there has been an alarming spike in cases recently (*9*). It is hoped that the new subcommittee, to be comprised of ministers of health from countries of the Region and other senior figures, can help galvanize efforts to finally end this disease. The subcommittee will also work to ensure that the experience, reach and other assets of the polio programme benefit other immunization campaigns and public health projects as well.

Current circumstances are certainly not ideal but thanks to the engagement of WHO staff, our Member States and partners, we are looking forward to a constructive and productive Regional Committee session.

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Models of maternity care for pregnant women during the COVID-19 pandemic

Mona Larki,[1] Farangis Sharifi[2] and Robab Latifnejad Roudsari[1,2]

[1]School of Nursing and Midwifery; [2]Nursing and Midwifery Care Research Center, Mashhad University of Medical Sciences, Mashhad, Islamic Republic of Iran. (Correspondence to: Mona Larki: larkim951@mums.ac.ir).

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Introduction

COVID-19 was declared as a pandemic by the World Health Organization (WHO) in 2020 (*1*). The majority of countries in the Eastern Mediterranean Region (EMR) have crossed the initial three phases of transmission (as characterized by WHO) and are now heading towards the community/local transmission phase of the virus. Numerous countries within the Region have followed WHO's guidelines on containment by prioritizing the development of testing, isolation, treatment, contact tracing, and isolating close contacts (*2*).

As the disease evolves rapidly, new information is appearing that suggests pregnant women diagnosed as having coronavirus disease are likely to suffer high levels of morbidity (*1*). They are susceptible to respiratory infections due to reduced lung function, increased oxygen consumption, and alteration in immunological function due to pregnancy. The evidence indicates that if women do not attend antenatal services then they are at risk of maternal death, stillbirth and other adverse perinatal outcomes (*3,4*). In addition, all pregnant women, together with those with confirmed or suspected COVID-19 infections, have the right to high-quality care before, during and after childbirth (*3*).

However, pregnant women and their families are likely to encounter greater tension and stress due to the COVID-19 pandemic within the community (*5*), therefore maternity services should be prioritized as fundamental core health service (*3*). Antenatal care (ANC) is the most cost-effective approach for the prevention of neonatal deaths; if 90% of women receive ANC, 14% of neonatal deaths could be avoided (*6*). The United Nations Population Fund (UNFPA) emphasized the development of a sustainable ANC service delivery model according to the context of different countries, which defines how services will be organized to deliver a core ANC package. It focuses, specifically, on which set of interventions by whom (cadre), where (system level), and how (platform) should be provided at each ANC contact (*2*). Also, during the current COVID-19 pandemic, care planning needs to take into consideration the risk factors identified, the context and the woman's preferences (*7*).

Support models of care that provide maximum level of continuity of care are "midwifery continuity of care, case management, as well as models of cares provided by midwife navigator, general practitioner (GP), private practice midwives, also cultural support models of care such as supports by healthcare workers or a community organization" (*7,8*). Maternity systems need a process to triage women to the most appropriate models of care based on low risk and high-risk criterion. Models of care in low risk cases is limited to midwifery care only, however, in high risk cases is could be provided by GPs, obstetricians or obstetricians and midwifery Group Practice, if available(*7,8*). Maternity care experts (including midwives and all other health care workers providing pregnancy and infant care), whether based in health centers or within the community, are basic health care providers and must be protected and prioritized to continue providing of care to childbearing women and their infants (*8*).

Models of care in pandemic crisis, like the pandemic of COVID- 19, for pregnant women include: home visiting, Self-quarantine/ Isolation, community clinics and hybrid models.

Home visiting

In relation to home visits, it should be considered whether visits are necessary or can be delayed. The home visit is planned based on the risk management for women and staff. Also, consultations using telehealth, SMS and phone should be taken into account. It may be preferable, as providing care for the woman and everyone in her household is ideal (*3,7-9*) .General principles in home visiting during COVID-19 pandemic include: preparing the cares which likely to be required during the home visit, minimizing equipment to be taken into the home and maintaining infection prevention and control standards (e.g. hand hygiene, disposal of consumables, equipment cleaning, social distancing) (*5*). The required schedule and mode of care should be reassessed at each visit according to individual needs and current risks (*7*).

Health care experts attending homes should be mindful of exposure to COVID-19 in a home visit and should adhere to strict infection control procedures when entering and leaving homes. It has been declared that the coronavirus can survive on surfaces for up to 17 days. Health care providers should be provided with

convenient personal protection equipment (PPE) based on relevant guidelines when providing care for women with suspected infection or when entering homes, where other family members of pregnant women have Covid-19 symptoms (*9*).

Self-quarantine

Self-quarantine means that pregnant women must be isolated as much as possible and not go out, except for seeking medical care. This model is recommended when hospitalization or other clinical care of pregnant women is not required according to current recommendations. It is also recommended when pregnant women have had close contact with a confirmed or suspected case within the past 14 days. Close contact means more than 15 minutes face-to-face contact and more than 2 hours in a closed space (including households) (*7,8*). Self-isolation is defined as strictly avoiding contact, or residing only with other positive cases. It is recommended if positive COVID-19 is confirmed (*7,8*). Women with suspected or confirmed COVID-19 should be advised not to attend in clinics. In cases of self-quarantine and self-isolation, routine antenatal care should be postponed fortwo weeks if it is safe to do so (*7,9,10*).

For pregnant women who are self-quarantine at home, it should be guarantee that they remain well hydrated and are mobile during this period. Additionally, women with some chronic diseases such as diabetes and deep vein thrombosis should be identified as 'extremely vulnerable' to the severe effects of COVID-19 and be 'shielded'. Shielding refers to adults with co-morbidities stay at home at all times and should be supported to do so by members of family, friends and the local community. Pregnant women who fall into this group are advised to attend only those GPs and hospital visits, which are necessary (*10*). Also, if necessary, their prescriptions should be sent through the post along with a video link of how to self-inject drugs, or a video appointment following receipt (*9,10*). Records should be made electronically, making them accessible for future care (*10*).

Community clinics

In community clinics appointment scheduling, avoidance of patients awaiting and also ensuring of maintaining social distance (1.5-metre distance from others) should be considered. In this model, it should be encouraged to women to arrive on time (not early) for appointment and women with suspected or affirmed COVID-19 to not attend (*9*). In these clinics, social distancing rule need to be observed in the consulting room using appropriate technology and the obstetricians and physicians need not be in the same room (*10*). This reduces the chance of Covid-19 transmission to the maternity care providers and other women attending for care (*4*). Physicians rapidly become involved into acute or intensive care medicine and their availability will be increasingly limited (*8*). Women who have symptoms of COVID-19 and are suffering from pregnancy complications need to be seen separately in an isolated room or at the beginning or end of clinic when no other patients remain (*8*). The details of the antenatal care (ANC) models are shown in Table 1 (*3,7,9*).

Hybrid models

Hybrid models of care delivery refers to a combination of elements of community health services building, phone or Video Call (VC) and home visit. It is also may assist to minimize contact duration (*3,7,9*). Telehealth and telemedicine were integrated into maternity practices early on, in response to the needs of pregnant female for prenatal appointments outside of traditional health-care facilities in the COVID-19 outbreak (*3*). Subject to determining the most appropriate models for providing medical services, health care providers should use clinical judgment and consider the individual circumstances of pregnant women (*3,7,9*). It should be noted that, the required schedule and the models of care should be reassessed at each visit according to the individual needs and current risks. In hybrid models results of test should be given over the phone or by secure messaging and abnormal results should be given face-to-face or via secure video. Booking in and risk definition process for pregnant women have to achieved with a clinician (e.g. midwife) (*3,7,9*). One gainful result of this model could be that pregnant females frightful of entering health care centers could now get the care they required outside of the health facilities.

Schedule appointments

Given that, most instances of COVID-19 have resulted from human-to-human transmission, so decreased schedule of antenatal consideration visits at the facility is proper to minimize overcrowding in facilities and therefore the risk of virus transmission (*3,4*). In general, low risk pregnant women should have a minimum of six antenatal visits (*8*). Health department of some countries noted that visits in 28 weeks, 37 weeks and 40-41 weeks to be face-to-face and other visits could be done by phone or video call (*3,7*). During every face-to-face contact usual clinical assessment (e.g. measuring blood pressure, fundal height, fetal heart rate, weight, as well as urinalysis) should be done. Also fetal movements, mental wellbeing and domestic violence should be checked (*8*). In cases that ANC is not provided in pregnant women at the clinic, it can be undertaken on the phone, via what's app, skype, facetime (where available). It is best utilized for occasions when the person does not require physical clinical assessments and/or tests/investigations (*3*).

At present, additional face-to-face visits take place when there are significant risk factors in pregnant women (*7*). It is recommended that face to face visits be limited to less than 15 minutes and conducted with attendance of minimum number of people (preferably woman only), which could lead to minimizing time in appointment waiting areas (*8*). Some women with co-morbidities (e.g. obesity, gestational diabetes, and preeclampsia) have a condition or complication that may increase their risk for severe COVID-19 disease. Also, they may need to additional visits or multi-disciplinary care in pregnancy

Table 1 Models of ANC during COVID-19 pandemic(6)

Models of care	Specific Considerations	Common considerations
Home visiting	Plan home visits based on risk management for woman and personnel involved If COVID-19 risk identified during or after home visiting, advise patient regarding the use of PPE and other procedures (self-quarantine) to minimize the risk of transmission Prior to entering the woman's home, assess the clinical status and social circumstances for both woman and any support persons at home Use standard home visiting risk assessment tools If risk of transmission or safety concerns identified, postpone the home visit Maintain physical (social) distancing (1.5 meter from the woman) during the visit where possible	Assessment for danger signs in pregnancy Antenatal education Psychosocial screening Routine ultrasound Vaccination Screening tests Supply of Iron; Folic Acid; Calcium; and other context-specific recommended supplements
Self-quarantine/isolation	If face-to-face contact throughout self-isolation/quarantine is important, use droplet, contact and standard precautions. Resume scheduled healthcare when self-quarantine/isolation complete Provide data concerning infection prevention and management practices which will stop prevent transmission of COVID-19 Ventilate rooms by opening windows	
Community clinics	Consider appointment scheduling to avoid groups of patients waiting Advise women to arrive on time (not early) for appointment Advise to call ahead and present for care at hospital as advised by doctor or midwife	
Hybrid	Assess needs as well as history taking and explanation for physical examination process on the day prior to visit by phone or video call (VC) For hospital visits, advise patients to wait outside the building until to be called in (e.g. in personal car or safe social distance in grounds) Limit face to face visits to 15 minutes just for physical examination Do the follow-up after visit using phone or VC Schedule face-to-face visit for cares that needs physical association /care (e.g. vaccination)	

(*10,11*). Those visits that do not need measure of fundal height, blood or urine tests, or ultrasonography, should be performed remotely by video or teleconferencing. It is suggested that the hybrid models be considered in the management of prenatal care sessions based on women's needs and available health facilities (*3,10,11*). Current WHO guidance advises at least of eight antenatal care for low risk pregnant women. Because there is a shortage of evidence about rationalizing visit numbers, but evidence from lower and middle income countries suggests that attendance at five visits or less is associated with an increased risk of perinatal mortality (RR 1.15; 95% CI 1.01 to 1.32, three trials) (*12*).

Therefore, the number of visits and interval between them has not changed and only the method of delivery care has altered. Where efficient technology and facilities are available, some of these visits could be done through a remote contact. It is also recommended based on the guidelines WHO and UNFPA that the hybrid models could be considered in the management of prenatal care sessions based on women's needs and available health facilities (*3,8*). This guidance does not support disruption or reduction of care but different ways should be considered for women to have access to evidence-based prenatal care during the current COVID-19 pandemic (*3*). If necessary, services should develop a process for integrating remote contact documentation in women's hand-held records (*3*). The model expressed by WHO is also a hybrid model, because methods of care delivery are combined. Table 2 according to a statement from WHO shows the schedule of prenatal care including three face to face and three remote visits during the COVID-19 pandemic (*3*).

The general content of the ANC remains unchanged in the context of COVID-19. However, maternity care providers need to be aware of the increased risk of antenatal anxiety and depression and domestic violence due to the economic and social impacts of the COVID19 pandemic. These issues add to the normal stresses of pregnancy so that maternity care providers need to have guidance/referral mechanisms in place to support these women (*3,7*).

Conclusion

The long-term effects of maternal morbidity and mortality on families and communities should not be underestimated. Currently, concentrating on COVID-19 would possibly distract pregnant women from routine antenatal care. Also, it is important that they take precautions to protect themselves against COVID-19 and report symptoms of infection to healthcare workers. Therefore, it is necessary to provide appropriate antenatal care models for pregnant women depending on their circumstances

Table 2 Antenatal Care (ANC) schedule during COVID-19 based on WHO recommendation (3)

Visit	Method	Principles
12 weeks	Face to Face	Comprehensive history and plan for care Blood Pressure Blood tests Ultrasonographic Standard (USS) – where available Initial risk assessment
20 weeks	Remote contact	ongoing risk assessment
26 weeks	Remote contact	ongoing risk assessment
30 weeks	Face-to-Face	Blood Pressure Blood tests Abdominal Palpation including Fetal Heart Rate (FHR) measurement Ongoing risk assessment Birth planning
38 weeks	Remote contact	Unless risk factors for hypertension in pregnancy or growth restriction identified previously
40 weeks	Face-to-Face	Blood Pressure Blood tests Abdominal Palpation including fetal Heart Rate (FHR) measurement Ongoing risk assessment Birth planning

and available facilities, in order to prevent its complications in the current pandemic.

In the current situation, home based care model can be considered when pregnant women are stable enough to receive care and enough midwifes and adequate health care are available. Also, referral to community clinics should be limited to emergency cases with significant risk factors. On the other hand, self-quarantine/isolation should not lead to missing of prenatal care, especially in high risk pregnant women. It is important for mothers to be informed enough about the warning signs to go to the relevant centers when they feel threatened. Generally, it seems that the hybrid model can be an efficient and preferred model to manage prenatal care in pregnant women.

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Blood coagulation parameters in patients with severe COVID-19 from Kermanshah Province, Islamic Republic of Iran

Babak Sayad[1] and Zohreh Rahimi[2,3]

[1]Infectious Diseases Research Center, Kermanshah University of Medical Sciences, Kermanshah, Islamic Republic of Iran. [2]Fertility and Infertility Research Center, Health Technology Institute, Kermanshah University of Medical Sciences, Kermanshah, Islamic Republic of Iran. [3]Department of Clinical Biochemistry, Kermanshah University of Medical Sciences, Kermanshah, Islamic Republic of Iran. (Correspondence to: Zohreh Rahimi: zrahimi@kums.ac.ir; rahimizus@yahoo.com).

Abstract

Background: Infection with coronavirus disease 2019 (COVID-19) could be complicated with coagulopathy and high risk of thromboembolic events.

Aims: The main aim of the present study was to find the coagulation profile of intensive care unit (ICU) admitted patients with COVID-19 from Kermanshah, Islamic Republic of Iran.

Methods: Coagulation parameters were analyzed using appropriate methods in 74 patients (24 patients aged <60 years and 50 patients ≥60 years) and were compared with 35 survivors (severe COVID-19) and 39 non-survivors (severe COVID-19) historically admitted to the ICU.

Results: Forty-two percent of patients had abnormal prothrombin time and international normalized ratio. The rates of mortality and comorbidity in patients aged ≥ 60 years were 73.7% and 78.4% compared to 26.3% and 21.6%, respectively, in patients aged < 60 years.

Conclusion: We found an abnormal pattern of coagulation parameters and association of advanced age and comorbidities with a high rate of mortality in severe COVID-19 patients, which should be taken into consideration in their hospital management.

Keywords: COVID-19, coagulation, prothrombin time, international normalized ratio, D-dimer, mortality

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Introduction

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) that is responsible for coronavirus disease 2019 (COVID-19) resulted in systemic inflammatory response and imbalance between homeostatic mechanisms of procoagulant and anticoagulant. Moreover, it is complicated with thrombotic complications (*1*). In response to COVID-19 infection, activation of T cells along with massive production and release of cytokines occur with subsequent damage to internal organs, and primarily the lungs (*2*). Around 40% of hospitalized patients with COVID-19 are at a high risk of development of venous thromboembolism (VTE) (*3*). Among non-intensive care unit (ICU) COVID-19 French patients receiving thromboprophylaxis, the incidence of VTE and pulmonary embolism were 22.5% and 10%, respectively (*4*). Abnormal coagulation factors in Chinese patients with COVID-19 were associated with poor prognosis (*5*). In a number of studies (but not all) in-hospital death was associated with high level of D-dimer (> 1µg/ml) on admission (*6*).

There is an association between age and clinical severity of COVID-19 in patients aged ≥ 60 years, who demonstrate heavier clinical manifestations, higher severity and longer disease courses compared to patients aged < 60 years (*7*). The rate of mortality among ICU-admitted patients with COVID-19 has been reported to be from 10% to around 44%, varying according to age and the presence of comorbidities that resulted in multi-organ failure (*8-11*).

There is no available study related to the evaluation of coagulation parameters in COVID-19 patients from the Islamic Republic of Iran. Kermanshah Province in the west of the country borders Iraq and has extensive communication with the Iraqi Kurdistan region, which could be a challenge in disease control. More comparison of reports from various populations related to the clinical course, outcome of COVID-19 and blood coagulation profile in these patients are necessary to help the management and treatment of the disease.

Aims

The aims of the present study were to find the coagulation profile of 74 consecutive ICU-admitted patients with COVID-19 from Kermanshah Province, Islamic Republic of Iran, and to determine the influence of age and comorbidities on the level of these parameters. In addition, we aimed to compare coagulation parameters between survivors and non-survivors to detect their effects on the severity and outcome of the disease.

Methods

We studied 74 consecutive patients with confirmed COVID-19 admitted to the ICU of Farabi Hospital of Kermanshah University of Medical Sciences, being the second referral centre of COVID-19 in Kermanshah Province, from 7 March to 12 May 12, 2020. Patients consisted of 44 males and 30 females with a mean age of 65.1±17.1 years. There were 50 patients (67.6%) aged 60 years or older and 24 patients (32.4%) aged less than 60 years. Diagnosis of COVID-19 was made according to the chest CT scan and/or real time PCR. The samples for coagulation tests were collected at hospital admission. The prothrombin time (PT), aPTT, fibrinogen, and international normalized ratio (INR) were measured using Coatron M2 coagulation analyzer (TECO Medical Instruments, Germany). D-dimer was measured by a Siemens device (Germany) using *chemiluminescence* method. Although our research was an observational study, verbal consent was obtained from patients or from next-of-kin.

A two-tailed student's *t*-test and ANOVA were used to compare quantitative data between groups. Using the χ^2 test the categorical variables were compared between groups. The quantitative data were expressed as Mean±SD. *P*-value < 0.05 was considered as statistically significant. SPSS statistical software package version 16.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis.

Ethics approval

The Ethics Committee of Kermanshah University of Medical Sciences approved the study (Ethics code: IR.KUMS.REC.1399.049) and the study was in accordance with the principles of the Declaration of Helsinki II.

Results

Twenty-six out of 74 patients (35.1%) required tracheal intubation (64.1% non-survivors and 2.9% survivors, $P < 0.001$). Fifty-one out of 74 patients (around 69%) had comorbidities (hypertension, diabetes mellitus, coronary artery disease, cancer, renal transplantation, chronic obstructive pulmonary disease, and osteomyelitis). The overall rate of mortality was 52.7%. The mean days of hospitalization were 10.8 days (1-39 days). Table 1 indicates the levels of coagulation factors measured at admission in studied patients. Lower platelet (PLT) count was detected among non-survivors compared to survivors; in addition, patients with comorbidities had lower PLT count than patients without comorbidities (Table 1). Two (one male and one female, 70 and 68 years old, respectively) out of three patients with PLT count ≤36 $\times 10^3$/μL died. Twenty-two patients (around 30%), had thrombocytopenia (PLT<150$\times 10^3$/μL), of which 15 patients were aged 60 years or older and 7 patients less than 60 years old, including 16 patients with comorbidity (72.7%) and 6 patients without comorbidity (27.3%) ($P = 0.16$).

The PT = 15.6±3.9 (12.5-35.4) sec in all patients and was longer in non-survivors than survivors (Table 1). Forty-two percent of the patients (31 individuals) had abnormal PT and INR (> 14.5 sec, and > 1.2, respectively). There were 5 patients with a PT of 27-35 sec and an INR of 1.7-5.1 that all died except one. The only case with critical value of an INR of 5.1 was a 76-year-old female with a PT of 35.4 sec, and a D-dimer of 15 μg/ml who required tracheal intubation but died after 6 days' hospitalization.

In addition, significantly higher PT and INR levels were observed in patients with comorbidity compared to those without (Table 1). Comparing patients demonstrating the concomitant presence of two comorbidities with those who lack comorbidity indicated a PT of 17.5±6.1 vs.14.4±1.64 sec ($P = 0.045$) and an INR of 1.8±1.1 vs.1.22±0.21 ($P = 0.03$). The mean level of D-dimer available from 16 patients was 5.1±7.3 (0.1-25) μg/ml, which was higher in non-survivors than survivors (Table 1). The aPTT and fibrinogen levels in all patients were 39.1±9.2 (25-68) sec and 3.37±1.80 (135-751) g/L, respectively (Table 1). The abnormal pattern of coagulation parameters (higher PT, aPTT, INR, and D-dimer) observed in 30 out of 39 patients (77%) with comorbidities who died compared to 9 non-survived patients without comorbidities.

Table 1 Coagulation parameters in patients with severe COVID-19.

Variable	All patients (*n*=74) Mean±SD	Survivors (*n*=35) Mean±SD	Non-survivors (*n*=39) Mean±SD, *P*	Patients without comorbidities (*n*=23) Mean±SD	Patients with comorbidities (*n*=51) Mean±SD, *P*
Age (years)	65.1±17.1 (23-90)	63.6±18.7	66.5±15.5, 0.48	55.2±16	69.4±15.8, 0.001
Sex (male/female)	44/30	21/14 (47.7/46.7%)	23/16 (52.3/53.3%)	17/6 (38.6/20%)	27/24 (61.4/80%)
PLT counts (×10³/μL)	207.8±111.5 (13.5-707)	223.9±124.1	193±9.8, 0.24	218.7±117.7	186.9±97.3, 0.22
PT (sec)	15.6±3.9 (12.5-35.4)	15.1±2.8	16±4.6, 0.29	14.4±1.6	16.1±4.4, 0.024
aPTT (sec)	39.1±9.2 (25-68)	39±10.5	39.1±8.2, 0.98	38.2±11.2	39.4±8.5, 0.68
INR	1.42±0.62 (1-5.1)	1.4±0.47	1.5±0.72, 0.39	1.22±0.22	1.50±0.7, 0.02
D-dimer (μg/ml)	5.1±7.3 (0.1-25) *n*=16	4.8±9.9	5.3±5.9, 0.92	5.1±7	5.1±7.6, 0.99
Fibrinogen (g/L)	3.37±1.80 (135-751) *n*=16	3.38±2.39	3.36±1.28, 0.98	2.69	3.45±1.9, 0.71

PLT=platelet; PT=prothrombin time; aPTT=activated partial thromboplastin time;INR=international normalized ratio

In Table 2 the coagulation parameters have been compared between two age groups: patients aged ≥ 60 years old (n=50) and those below 60 years old (n=24). There were 50 patients (68%) aged 60-90 years (75.4±8.5 years) a PT of 16.1±4.4 sec and an INR of 1.51±0.71, which compared to 24 patients (32%) aged below 60 years with a mean age of 44.2±8.9 years and a PT level of 14.6±1.9 sec (P = 0.059) and an INR of 1.26±0.29 (P = 0.056). Among patients ≥ 60 years 80% needed a ventilator and 78.4% had comorbidities. The mortality rate was 73.7% compared to patients aged <60 years of whom 20% required a ventilator (P = 0.09), 21.6% (P = 0.002) had comorbidities, and the death rate was 26.3% (P = 0.2) (Table 2).

Discussion

The overall rate of mortality in severely affected patients in this study was 52.7%. Patients were mostly aged 60 years or older with a high rate of comorbidity (69%) and a mortality rate of 73.7%. The high mortality rate among ICU-admitted patients from the present study was due increased age and a high rate of comorbidities. In a referral centre for COVID-19 in Tehran, the two-week mortality rate was 25% among 72 ICU-admitted patients with COVID-19. However, the age of these patients had not been reported (*12*). Three studies from Italy reported a difference in mortality rate; in one study the ICU and the hospital mortality rate of COVID-19 patients with a mean age of 61 years were 10% and 12.5%, respectively (*8*). In a second study among patients with a mean age of 70 years the tracheal intubation rate was 8.5% and the overall mortality was 12.8%. All patients who died were on ventilation and had multiple comorbidities. Alterations in coagulation parameters were observed in 41% of cases (10). In a third study 43.7% of ICU-admitted patients with a mean age of 61 years did not recover and died due to hypoxia and multi-organ failure (*11*).

However, in one study from the Netherlands the mortality rate among ICU-admitted patients was 22% (*9*). It was noted that in older adults immune senescence and enhanced inflammatory responses associated with aging might increase the risk of infection and dysregulation of immune response to SARS-CoV-2 (*13,14*); in addition, comorbidities increase with aging (*13*). In a study from Mexico, higher age was found to be a predictor of disease mortality, but comorbidities and determinants of structural health had a greater role in the severity of disease in older patents (*13*).

Thus, there is an age-based exponential increase in the mortality rate. Around 80% and 90% of deaths due to COVID-19 occurred in patients aged > 70 years and ≥ 60 years in Korea and Italy, respectively. In Korea the overall case fatality rate was 2.37%, which was much higher in older patients (*15*).

Thrombocytopenia was detected in around 30% of mostly older patients with comorbidities and in non-survivors. The longer PT and higher INR was found in 42% of patients, especially in patients > 60 years with increased comorbidities and mortality, compared to patients < 60 years, also the PT >27 sec was fatal. Thrombocytopenia and abnormal coagulation parameters (PT, INR, D-dimer) could be considered as important indicators of severe COVID-19 associated with mortality. Using the cut-off value of D-dimer 1.5µg/mL for prediction of VTE, 8 out of 16 (50%) our patients had VTE. In a report from 81 severe COVID-19 ICU-admitted Chinese patients there were 20 (25%) with VTE (*16*).

Various reports have been published regarding the levels of D-dimer and the severity of COVID-19. While in some studies in-hospital mortality was associated with a high level of D-dimer (> 1µg/ml) on admission, other studies found no significant difference in D-dimer level between severe and non-severe patients (*4,5,6*). It should be considered that D-dimer assays are not necessarily comparable due to different calibrators, detection antibodies and methods (*6*). High levels of D-dimer have been associated with 28-day mortality among patients with infection or sepsis. The systemic pro-inflammatory cytokines contribute to plaque rupture through local inflammation, induced procoagulant pathway at multiple levels, such as induction of coagulation activation by proinflammatory cytokines of TNF, IL-1, IL-6 and IL-12, and haemodynamic alterations are mechanisms involved in predisposition to ischaemia and thrombosis (*17*). The most haemostatic abnormalities in patients with COVID-19 requiring greater mechanical ventilation, ICU admission, or death, were mild thrombocytopenia and increased levels of D-dimer, indicating the presence of some forms of coagulopathy with increased risk of thrombotic events (*3*).

Table 2 Coagulation parameters in patients with severe COVID-19 according to age

Variable	Less than 60 years (n=24) Mean±SD	60 years or more (n=50) Mean±SD	P value
PLT counts (×10³/µL)	229±144.2	196.9±92.2	0.32
PT (sec)	14.6±1.9	16.1±4.4	0.059
aPTT (sec)	37.8±7.4	39.6±10	0.42
INR	1.26±0.29	1.5±0.71	0.056
D-dimer (µg/ml)	7.65±9.5 n=7	3.2±4.7 n=9	0.28
Fibrinogen (g/L)	4.9±1.90 n=6	2.4±0.6 n=10	0.08

No prolonged aPTT (more than 70 sec) was observed in patients for this study, which might explain the absence of disseminated intravascular coagulation (DIC) bleeding in patients. In some patients with COVID-19 there was an associated coagulopathy, but even in those patients with DIC, bleeding was not manifested since these abnormalities could be the result of a profound inflammatory response that did not result in bleeding (*18*).

In Caucasian patients with COVID-19 and extended thrombo-prophylaxis with low molecular weight heparins, overt DIC rarely developed. However, in those patients with COVID-19 who developed DIC, this complication appeared during a late stage of the disease. A term of pulmonary intravascular coagulopathy was suggested for bilateral pulmonary inflammation observed in COVID-19 patients to discern from DIC (*19*).

Based on recommendations from the International Society on Thrombosis and Haemostasis, patients with markedly increased D-dimer (three to four-fold increase), should be considered for hospital admission even in the absence of other symptoms. In addition, all hospitalized COVID-19 patients with this elevation should receive thromboprophylaxis or full therapeutic-intensity anticoagulation (*20*).

Conclusion

The overall mortality rate in patients with severe COVID-19 was 52.7%. However, the rate of mortality was 73.7% in patients ≥ 60 years compared to 26.3% in patients aged <60 years. This study indicated that ages > 60 years were associated with high rate of comorbidities, abnormal level of coagulation parameters and poor prognosis. In addition, we detected a high rate of coagulopathy (42%) in severely affected patients with COVID-19. Furthermore, severe COVID-19 patients had low levels of PLT, high PT and INR that were associated with poor prognosis. The abnormal pattern of coagulation parameters was highly associated with comorbidities and mortality. Coagulation tests such as PLT, PT, PTT, D-dimer, and fibrinogen should be performed at hospital admission stage in patients suspected or confirmed to have COVID-19 infection in order to provide useful prognostic information. These patients should be treated with pharmacologic VTE prophylaxis unless there were specific contra-indications.

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Paramètres de coagulation sanguine chez des patients atteints de COVID-19 sévère dans la province de Kermanshah (République islamique d'Iran)

Résumé

Contexte : L'infection par la COVID-19 peut être compliquée par une coagulopathie et un risque élevé d'événements thromboemboliques.

Objectifs : L'objectif principal de la présente étude était de déterminer le profil de coagulation des patients atteints de COVID-19 admis en soins intensifs à Kermanshah (République islamique d'Iran).

Méthodes : Les paramètres de coagulation ont été analysés chez 74 patients (24 patients âgés de moins de 60 ans et 50 patients âgés de 60 ans et plus) à l'aide de méthodes appropriées et ont été comparés aux paramètres de 35 survivants (COVID-19 sévère) et 39 non-survivants (COVID-19 sévère) qui avaient été admis en soins intensifs.

Résultats : Pour quarante-deux pour cent (42 %) des patients, le temps de prothrombine et le rapport normalisé international étaient anormaux. Les taux de mortalité et de comorbidité chez les patients âgés de 60 ans et plus étaient de 73,7 % et 78,4 %, contre à 26,3 % et 21,6 %, respectivement, chez les patients âgés de moins de 60 ans.

Conclusions : Nous avons trouvé un schéma anormal des paramètres de coagulation et une association entre un âge avancé et des comorbidités avec un taux de mortalité élevé chez les patients atteints de COVID-19 sévère, qui devraient être pris en compte dans leur prise en charge à l'hôpital.

متثابتات تخثر الدم لدى الحالات الوخيمة لمرضى كوفيد19 – من مقاطعة كرمانشاه، جمهورية إيران الإسلامية

بابك سياد، زهرة رحيمي

الخلاصة

الخلفية: يمكن أن تتفاقم العدوى بمرض الفيروس التاجي 2019 (كوفيد–19) في وجود اعتلال التخثر ويرتفع خطر حدوث الانسداد التجلطي.

الأهداف: الهدف الرئيسي من هذا البحث هو الكشف عن مرتسم التخثر في المرضى بكوفيد–19 الذين أدخلوا في وحدة العناية المركزة من كرمانشاه في جمهورية إيران الإسلامية.

طرق البحث: حُللت متثابتات التخثر بطرق مناسبة في 74 مريضًا (24 مريضًا قلت أعمارهم عن 60 عامًا ، و50 مريضًا زادت عمرهم عن 60 عامًا أو ساوته) وقورنت مع 35 ناجيًا (من مرض كوفيد–19 الوخيم) و39 من غير الناجين (من مرض كوفيد–19 الوخيم) من الذين أدخلوا تاريخيًا في وحدة العناية المركزة.

النتائج: كان اثنان وأربعون في المائة من المرضى لديهم مستوى غير طبيعي في زمن البروثرومبين والنسبة المعيارية الدولية. وكانت معدلات الوفيات والاعتلال المشترك للمرضى في عمر أكبر من 60 عامًا أو يساويه 73.7٪ و78.4٪ مقارنة بنسبة 26.3٪ و21.6٪ على التوالي في المرضى الذين تقل أعمارهم عن 60 عامًا.

الاستنتاجات: لقد وجدنا نمطًا غير طبيعي لمتثابتات التخثر وارتباطًا بين تقدم العمر والاعتلالات المشتركة مع ارتفاع معدل الوفيات في الحالات الوخيمة لكوفيد–19، ويجب مراعاة ذلك أثناء التدبير العلاجي في المستشفى.

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COVID-19 in the Eastern Mediterranean Region: testing frequency, cumulative cases and mortality analysis

Pascale Salameh[1,2,3]

[1]Faculty of Public Health, Lebanese University, Fanar, Lebanon. [2]Faculty of Medicine, Lebanese University, Hadat, Lebanon. [3]INSPECT-LB: Institut National de Santé Publique, Epidémiologie Clinique et Toxicologie, Beirut, Lebanon. (Correspondence to: Pascale Salameh: pascalesalameh1@hotmail.com).

Abstract

Background: COVID-19 is now well documented in the Eastern Mediterranean Region; however, the incidence, mortality and fatality rates differ by country.

Aims: The study aimed to describe the COVID-19 pandemic in the Eastern Mediterranean Region, assessing the incidence, mortality-related and fatality rate in different countries, in comparison with the worldwide mean.

Methods: Data were sourced from the Worldometer surveillance page and from governmental reporting channels. Data were exported and analyzed using Statistical Package for Social Sciences (SPSS, version 23.0).

Results: In the Eastern Mediterranean Region, the testing frequency is heterogeneous between countries, in addition to the reported cases and death. Very few data are available from countries with political instability and security problems (Yemen, Syrian Arab Republic and Sudan), particularly for the testing frequency. Overall, despite similar rates of testing, there was a significantly lower incidence in the Eastern Mediterranean Region versus the rest of the world, in addition to a lower mortality per million-population, particularly in countries with low to moderate testing rates. However, in countries with higher testing than the world average, there is a higher incidence, a lower mortality, but an unexpected higher fatality rate.

Conclusion: The overall testing frequency was similar in the Eastern Mediterranean Region compared to the rest of the world; this would be expected to lead to a similar cumulative incidence and case fatality rate. Nevertheless, the average incidence was 70% lower than the rest of the world, and mortality per million-population was lower (90%). Moreover, in Gulf Cooperation Council high-testing countries, a similar case-fatality rate to other countries in the Region was noted, but was higher than the world average, although expected to be lower. Further studies are necessary to explain discrepancies in incidence, mortality and fatality rates among countries; principally, environmental, genetic and managerial reasons should be investigated.

Keywords: COVID-19; testing rate; fatality; Middle East; incidence

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Introduction

A newly discovered virus (SARS-CoV2) and its related disease (COVID-19) started in China in December 2019; it caused a pandemic that reached mainly high-income countries, but also a number of low and middle-income countries (*1*). COVID-19 was declared a pandemic by the World Health Organization (WHO) and has resulted in 2 500 448 cases and 171 504 deaths (as of 21 April 2020) (*2*). There have been recorded cases in the Eastern Mediterranean Region (EMR) countries, but so far at a relatively lower rate.

The EMR Member States are Arab nations (*3*), in addition to Afghanistan, the Islamic Republic of Iran, and Pakistan. From a cultural perspective, the Region is primarily Islamic (90% of the population), and the vast majority of the population lives in low- to middle-income countries, with the notable exception of the high-income Gulf Cooperation Council (GCC) countries. Health care systems vary from one country to another according to gross domestic product and the size of the private versus public health sector (*3*). Although conditions in low- to middle-income countries theoretically increase the risk of exposure to the highly infectious coronavirus (overcrowding, low socioeconomic status and health care system preparedness), it appears there are in fact lower incidences of related infections (*4*). However, under-testing and/or under-reporting to international instances might offer possible explanations for this anomaly.

To date, it would appear no analytic work has been conducted concerning the magnitude of the COVID-19 pandemic in the Region, although data are available for all the countries (http://www.emro.who.int/health-topics/corona-virus/index.html). Some recent articles analyzed and/or forecasted COVID-19 in individual countries such as Pakistan (*5*), Egypt (*6*), Gaza (*7*) and Sudan (*8*), but none did comparisons between the countries.

The objective of this study was to describe the COVID-19 pandemic in the EMR and assess the incidence, mortality-related and fatality rate in different EMR countries in comparison with the worldwide mean.

Methods

Country data were taken from the Worldometer surveillance page – a data source that is run by an international team of developers, researchers and volunteers with the goal of making world statistics available in a thought-provoking and time relevant format to a wide audience around the world (2). COVID-19 data were collected via the site from official reports, government communication channels, and local media sources when deemed reliable.

Data were exported and analyzed using Statistical Package for Social Sciences (SPSS, version 23.0). To establish a basic concept, regression analysis was conducted on worldwide data, taking the case fatality rate as a dependent variable, while testing frequency and cumulative cases were used as independent variables; regression assumptions were checked.

For the EMR a descriptive analysis was conducted; means and standard deviations were reported, in addition to medians and interquartile ranges. Reporting results per million-population allowed a better comparison with global figures. *t*-tests were used to compare between the Region mean and the rest of the world mean incidence, mortality, fatality and testing frequency per million, after checking homoscedasticity assumption (in case of heterogeneous variances, the corrected *t*-test was used). In addition, the testing frequency of the Region was divided into tertiles, allowing to compare the mean incidence and mortality between countries with high, moderate and low testing frequency, using the Kruskal-Wallis non parametric test, since the homoscedasticity assumption for using ANOVA was not met. Comparison with the world average was also conducted. A *P*-value <0.05 was considered significant.

Results

Worldwide data

On 21 April 2020 the mean cumulative number of cases was 681.53 cases per million persons (SD=1566.84), while the mean case fatality rate was 4.82% (SD=4.35). In addition, the mean number of tests per million/population was 9973.93 (SD=18405.75). The median [IQR] for these variables were respectively: 114.00[19.00;607.00], 3.51[1.71;6.31] and 3866[530.75; 11410.25].

However, the regression analysis applied to the world data showed that the case fatality rate could be represented using the following equation: Case fatality rate = 0.048 + $8.056.10^{-6}$ *cumulative cases/million-population – $1.061*10^{-6}$*Tests/Million-population. The adjusted R square of this regression model was 0.121, while the *P*-value for both factors was <0.001; the normality plots of residues were considered appropriate. The regression shows that the case-fatality rate was positively associated with reported cumulative cases (cumulative incidence), but negatively associated with testing frequency in the population. This result suggested that the higher the testing frequency, the lower the fatality rate.

The Eastern Mediterranean Region

The WHO EMR includes 22 countries: Afghanistan, Bahrain, Djibouti, Egypt, Islamic Republic of Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Pakistan, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syrian Arab Republic, Tunisia, the United Arab Emirates (UAE), and Yemen. The COVID-19 distribution in the Region is presented in Table 1. The highest numbers of cases were reported in the Islamic Republic of Iran, Saudi Arabia and Pakistan, while the lowest numbers were reported in Bahrain, Syrian Arab Republic and Yemen. As for case fatality numbers, Bahrain, Sudan and the Syrian Arab Republic reported the highest rates, while the lowest rates were shown in Kuwait, Djibouti and Qatar. Data for testing frequency were not available for all countries, namely Kuwait, Oman, Somalia, Sudan, Syrian Arab Republic and Yemen. Testing frequency was lowest for Afghanistan and Libya (<200 tests per million-population), and highest for Bahrain, Qatar and UAE (>20.000 tests/million-population) (Table 1).

Comparison between Eastern Mediterranean Region and worldwide data

Table 2 indicates comparison between EMR data and the rest of the world. Despite similar rates of testing, there was a significantly lower incidence in the EMR versus the rest of the world (cases per million-population), in addition to lower mortality per million-population and similar case-fatality rates (Table 2). It was noted that the ratios between the global and EMR figures were not proportionate; the incidence ratio was 2.90, the mortality ratio 8.95 and the case fatality ratio was 1.24.

Comparison between Eastern Mediterranean Region countries and the rest of the world according to testing frequency

Tertiles of testing frequency were the following: T1<1463 tests/million for Afghanistan, Libya, Egypt, Morocco, Pakistan, Tunisia (low testing rate); 1464<T2<4203 tests/million for Islamic Republic of Iran, Iraq, Jordan, Lebanon and Palestine (moderate testing rate); and T3>4204 test/million for Bahrain, Djibouti, Qatar, Saudi Arabia, and UAE (high testing rate).

Figure 1 presents the mean results of incidence, mortality and fatality rates according to the tertiles of testing frequency: *P*-value was 0.008 for incidence rates (higher cases/million were associated with higher testing frequency), while *P*-values were non-significant for mortality and fatality rates between EMR countries. It was noted that the mean case-fatality ratio is slightly but significantly higher than the world average (7.73 vs 6.86; *P* <0.001).

Note: Kruskall-Wallis test was used. *P*-value=0.008 for incidence rates (higher cases/million were associated with higher testing frequency); *P*-values non-significant for mortality (*P*=0.289) and fatality rates (*P*=0.193) between EMRO countries. Case fatality rate significantly

Table 1 COVID-19 cases and mortality in Eastern Mediterranean Region, 21 April 2020

Country	Total cases	Total deaths	Total recovered	Active cases	Serious critical	Cases /M	Death /M	Total test	Test/M	Millions population	Reported Fatality rate
Bahrain	1907	7	769	1131	2	1121	4	89 225	52 437	1.70156568	0.0037
Sudan	107	12	8	87		2	0.3				0.1121
Syrian Arab Republic	39	3	5	31		2	0.2				0.0769
Egypt	3333	250	821	2262		33	2	55 000	537	102.4208566	0.0750
Islamic Republic of Iran	83 505	5209	59 273	19 023	3389	994	62	353 012	4203	83.99048299	.0624
Iraq	1574	82	1043	449		39	2	59 055	1468	40.22820163	0.0521
Morocco	3046	143	350	2553	1	83	4	16 386	444	36.90540541	0.0469
Tunisia	884	38	148	698	34	75	3	17 287	1,463	11.81613124	0.0430
Somalia	237	8	4	225	2	15	0.5				0.0338
Afghanistan	1092	36	150	906	7	28	0.9	6422	165	38.92121212	0.0330
Yemen	1			1		0.03					0.0330
Lebanon	677	21	103	553	27	99	3	20 929	3,066	6.82615786	0.0310
Pakistan	9216	192	2066	6958	46	42	0.9	111 806	506	220.9604743	0.0208
Libya	51	1	15	35		7	0.1	808	118	6.847457627	0.0196
Jordan	425	7	282	136	5	42	0.7	33 000	3234	10.20408163	0.0165
Saudi Arabia	10 484	103	1490	8891	88	301	3	180 000	5170	34.81624758	0.0098
Palestine	461	4	71	386		90	0.8	17 329	3397	5.101265823	0.0087
United Arab Emirates	7265	43	1360	5862	1	735	4	790 000	79 875	9.890453834	0.0059
Oman	1,508	8	238	1262	3	295	2				0.0053
Kuwait	1995	9	367	1619	39	467	2				0.0045
Djibouti	846	2	102	742		856	2	8144	8243	0.98798981	0.0024
Qatar	6015	9	555	5451	37	2088	3	64 620	22 429	2.881091444	0.0015

different between high testing countries and worldwide average ($P<0.001$).

Discussion

In the Region the testing frequency is heterogeneous between countries, in addition to the reported cases and mortality rates. Data from individual countries were similar to that described by Dil et al. (5). Limited data were available from countries with political instability and security problems (Yemen, Syrian Arab Republic and Sudan), particularly for the testing frequency.

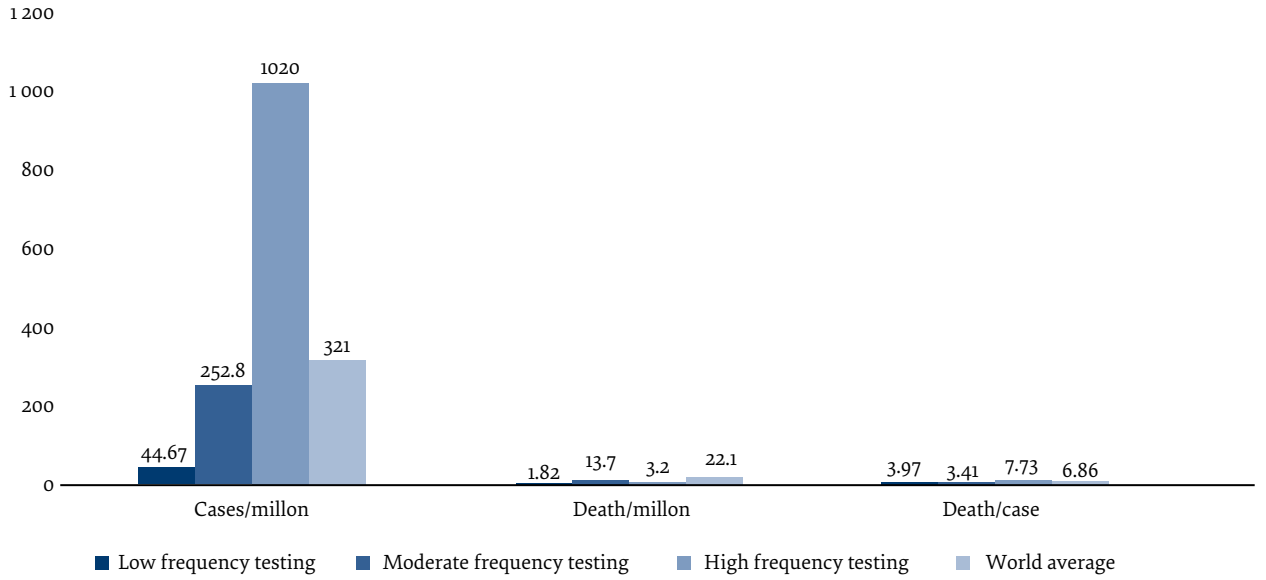
In this analysis, it is shown that globally the case-fatality rate is positively associated with reported cumulative cases (cumulative incidence), but negatively associated with testing frequency in the population. However, in the Region the testing frequency was similar on average to that reported in the rest of the world; this would be expected to lead to a similar cumulative incidence and case fatality rate. Nevertheless, the incidence in the EMR versus the rest of the world was lower by two thirds, whereas mortality per million-population was lower by 90%; only case-fatality rate

Table 2 COVID-19 cases cumulative incidence, mortality and testing comparison between Eastern Mediterranean Region and the rest of the world (average)

Region	Total population in million	Total cases	Total deaths	Mean cases per million	Mean death per million	Mean reported fatality rate (%)	Reported total tests	Mean reported tests per thousand
Eastern Mediterranean Region	700	125 108	6252	251.27	4.73	4.00	1 606 714	8.45
Rest of the World	7779	2 205 685	154 391	727.56	42.35	4.96	18 240 910	10.16
P-value				0.002*	0.001*	0.733**		0.347**

*P-value was calculated using corrected Student testing (variances were heterogeneous).
**P-value was calculated using Student testing (variances were homogeneous).

Figure 1 Comparison between Eastern Mediterranean Region countries and the rest of the world according to testing frequency



was similar. These results could be explained by high heterogeneity in terms of testing frequency.

In fact, when dividing the countries into tertiles of testing, results became clearer. In high-testing countries (higher than the world average testing rate), there was a higher incidence and similar mortality, which is expected according to the regression model. In addition, high-testing rates were expected to decrease overall fatality rate; the examples of Germany and South Korea are striking in this regard (*9*). Higher testing should generally lead to better identification of cases and to their early isolation, in addition to their contact tracing, which are related to lower fatality rate (*10*). Nevertheless, the fatality rate that was found in these countries was expected to be lower than other countries; however, this was not the case and was significantly higher than that of the world average.

This finding was intriguing, particularly knowing that these nations are high-income countries in general (GCC countries), with reported stricter confinement measures and an expected better health system (*11*). It is noted that some of these countries still witness community cases and hospital-acquired infections of Middle East Respiratory Syndrome coronavirus (MERS-CoV). This could present a significant challenge to dealing effectively with both coronaviruses, especially with the lack of standardized and approved point of care testing (*12*). Further studies are suggested to explain this unexpected result of higher fatality rate in high-testing Middle Eastern countries, looking at specific factors such as chronic diseases prevalence (cardiovascular or respiratory) (*13*), viral mutation, genetic variability, discrepancies in COVID-19 related death definition, and possible inappropriate tertiary care management (*14*).

In countries with moderate testing rates (close to the world average testing rates), there were lower incidence, mortality and fatality rates; these figures were significantly higher in countries with low testing rates. These results could denote either true lower incidence (and subsequent mortality) versus the world average; the Region might have conditions that favour a lower incidence of the disease; climatic factors (currently hotter than European and North American countries); more conservative social behaviours; viral mutation; or ethnic/genetic variations. Another more probable explanation would be under-notification of cases due to under testing in these countries, particularly under-notification of COVID-19 related death. Improvement in testing and notification is required to better judge the epidemic situation in these countries.

Limitations

The study took into account cases from the beginning of the pandemic until 21 April 2020; figures, case reporting, tests and many parameters may change with time. The study also relied on cumulative numbers of cases, death and testing rates, without taking time and the duration of the epidemics in specific countries into account. Thus, a change in testing rates could change the interpretation of epidemic curves (*15*). In addition, the study did not take into account the prevention measures applied by every country (*16*) and their effect on the epidemic curve. Security issues prevented availability of all data; thus, the results could underestimate the true burden of COVID-19 in the Region.

Conclusion

The overall testing frequency was similar in the EMR compared to the rest of the world. This would be expected to lead to a similar cumulative incidence and case fatality rate. However, the average incidence was 70% lower than the rest of the world, and mortality per million-pop-

ulation was lower (90%). Moreover, in GCC high-testing countries, a strikingly similar case-fatality rate to other countries in the world – and even higher than the world average – was indicated, although expected to be lower. Increasing the frequency of testing and improving notification of cases and of death is a necessity in order to better assess the situation in the EMR. In addition, taking into account country specificities would also offer greater insight into the COVID-19 situation in the Region.

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La COVID-19 dans la Région de la Méditerranée orientale : fréquence des tests, cas cumulés et analyse de la mortalité

Résumé

Contexte : La COVID-19 est maintenant bien documentée dans la Région de la Méditerranée orientale ; cependant, les taux d'incidence, de mortalité et de létalité diffèrent selon les pays.

Objectifs : La présente étude avait pour objectif de décrire la pandémie de COVID-19 dans la Région de la Méditerranée orientale, en évaluant les taux d'incidence, de mortalité et de létalité dans différents pays, en comparaison avec la moyenne mondiale.

Méthodes : Les données proviennent de la page de surveillance de Worldometer et des canaux de communication gouvernementaux. Elles ont été exportées et analysées au moyen du logiciel *Statistical Package for Social Sciences* (SPSS, version 23.0).

Résultats : Dans la Région de la Méditerranée orientale, outre les cas notifiés et les décès, la fréquence des tests est hétérogène entre les pays. Très peu de données sont disponibles pour les pays connaissant une instabilité politique et des problèmes de sécurité (République arabe syrienne, Soudan et Yémen), en particulier pour la fréquence des tests. Globalement, malgré des taux de dépistage similaires, on a observé une incidence considérablement plus faible dans la Région de la Méditerranée orientale par rapport au reste du monde, en plus d'une mortalité plus faible par million d'habitants, en particulier dans les pays où les taux de dépistage sont faibles à modérés. Cependant, dans les pays où le dépistage est plus fréquent que la moyenne mondiale, on observe une incidence plus élevée, une mortalité plus faible, mais un taux de létalité plus élevé, de manière inattendue.

Conclusion : La fréquence globale des tests était similaire dans la Région de la Méditerranée orientale par rapport au reste du monde, ce qui devrait entraîner une incidence cumulée et un taux de létalité similaires. Néanmoins, l'incidence moyenne était inférieure de 70 % à celle du reste du monde ainsi que la mortalité par million d'habitants (90 %). En outre, dans les pays du Conseil de Coopération du Golfe ayant une fréquence de tests élevée, un taux de létalité similaire à celui d'autres pays de la Région a été constaté ; toutefois, ce taux était supérieur à la moyenne mondiale, même s'il était inférieur aux prévisions. Des études plus approfondies sont nécessaires pour expliquer les différences des taux d'incidence, de mortalité et de létalité entre les pays ; il convient principalement d'étudier les raisons environnementales, génétiques et administratives.

كوفيد-١٩ في إقليم شرق المتوسط: تواتر الاختبار، والحالات التراكمية، وتحليل الوفيات

باسكال سلامة

الخلاصة

الخلفية: لقد جرى توثيق كوفيد-19 الآن توثيقًا جيدًا في إقليم شرق المتوسط؛ لكن معدلات الحدوث والوفيات و الوفيات بين الحالات تختلف حسب البلد.

الأهداف: هدفت هذه الدراسة إلى وصف جائحة "كوفيد-19" في إقليم شرق المتوسط، وتقييم معدلات الحدوث والوفيات والوفيات بين الحالات في مختلف البلدان، مقارنة بالمتوسط العالمي.

طرق البحث: جُمِعَت البيانات من صفحة مراقبة مقياس العالم (ورلد ميترز) ومن قنوات البلاغات الحكومية. وجرى تصدير البيانات وتحليلها باستخدام برنامج الحزمة الإحصائية للعلوم الاجتماعية (SPSS ، الإصدار 23.0).

النتائج: في إقليم شرق المتوسط، يتباين تواتر الاختبار بين البلدان، بالإضافة إلى الحالات والوفيات المُبلغ عنها. ولا يتوفر سوى القليل جدًا من البيانات من البلدان التي تعاني من عدم الاستقرار السياسي والمشاكل الأمنية (كاليمن، والجمهورية العربية السورية، والسودان)، لا سيّما فيما يتعلق بمعدل تواتر الاختبار. وعمومًا، وبرغم تشابه معدلات الاختبار، كان معدل الحدوث أقل في إقليم شرق المتوسط مقارنة ببقية العالم بدرجة يعتد بها، بالإضافة إلى انخفاض معدل الوفيات لكل مليون نسمة، لا سيّما في البلدان ذات معدلات الاختبار المنخفضة إلى المتوسطة. ومع ذلك، في البلدان التي لديها اختبارات أعلى من المتوسط العالمي، وجد معدل وقوع أعلى، ومعدل وفيات أقل، وكان معدل الوفيات بين الحالات أعلى على نحو غير متوقع.

الاستنتاج: كان معدل تواتر الاختبار الإجمالي مماثلًا في إقليم شرق المتوسط مقارنة ببقية العالم؛ ومن المتوقع أن يؤدي ذلك إلى حدوث معدلات تراكمية متماثلة للحدوث و الوفيات بين الحالات . ومع ذلك، كان متوسط معدل الحدوث أقل بنسبة 70٪ من بقية العالم، وكان معدل الوفيات لكل مليون نسمة أقل (90٪). وعلاوة على ذلك، لوحظ في البلدان التي لديها اختبارات عالية في مجلس التعاون الخليجي، أن هناك معدلًا مماثلًا للوفيات بين الحالات كما في البلدان الأخرى في الإقليم، ولكنه كان أعلى من المتوسط العالمي، مع أن المتوقع أن يكون أقل. ومن الضروري إجراء مزيد من الدراسات لتفسير التباينات في معدلات الحدوث والوفيات و الوفيات بين الحالات بين البلدان؛ ويجب بصفة رئيسية استقصاء الأسباب البيئية والوراثية والإدارية.

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Educational perspective for the identification of essential competencies required for approaching patients with COVID-19

Mayssoon Dashash,[1,2] Bashar Almasri, [2] Eman Takaleh,[2] Alaa Abou Halawah[2] and Amal Sahyouni[2]

[1]Damascus University, Damascus, Syrian Arab Republic. [2]Syrian Virtual University, Damascus, Syrian Arab Republic. (Correspondence to: Mayssoon Dashash: mdashash@yahoo.com, mede_pd@svuonline.org)

Abstract

Background: Health professionals are at the frontline of the COVID-19 pandemic and are directly exposed to infection hazards. Therefore, they should have the essential competencies for approaching patients.

Aims: The study aimed to identify essential competencies required for approaching patients with COVID-19.

Methods: All postgraduate health professionals at the Syrian Virtual University SVU (*n*=28) were invited to participate in the study during the Covid-19 lockdown in 2020, resulting in 20 postgraduates accepting. The Delphi technique was adopted for identifying competencies in medical education and a virtual meeting was undertaken through the University Management System in order to provide instruction and create a list of competencies. Competency domains were divided into 'knowledge', 'skills', and 'attitudes' and were classified into four categories: etiology, assessment and diagnosis, management, and prognosis.

Results: Fifty-two essential competencies were identified; 7 competencies on etiology, 7 related to assessment and diagnosis, 34 related to management, and 4 related to prognosis

Conclusion: It is hoped that the identified competencies would help health professionals to deliver the best health care for COVI-19 patients, as well as help policy-makers to support comprehensive training programmes that can equip health professionals with the required competencies to fight the pandemic.

Keywords: COVID-19, competencies, health professional, education, Syria

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Introduction

On December 12, 2019, health professionals started to investigate patients who developed viral pneumonia, after visiting the Human Seafood Wholesale Market (*1*). On December 31, 2019, the report published by the Wuhan Municipal Health Commission about viral pneumonia indicated that 27 patients were infected (*1*). In the first week of January 2020, Chinese officials identified a novel type of coronavirus called SARS-COV-2, which was spread outside of China the following week. On March 2020, the WHO announced COVID-19 as a pandemic (*1–3*).

It is currently believed that the virus's route of transmission is respiratory droplets (*4*). Infected patients may have symptoms such as fever (90%), fatigue and dry cough (80%), dyspnea (20%), sore throat, headache, or loss of smelling and taste (*5*). Disease manifestations range from asymptomatic cases to severe pneumonia accompanied by severe respiratory distress and septic shock, followed by multi-organ failure leading often to death (*1*). According to global statistics, 81% of patients have a mild infection that spontaneously recovers; 14% have a severe infection; and 5% are critical cases that need intensive care and mechanical ventilation (*6,7*).

Health professionals are directly responsible for facing infected patients and suspected persons. They are at the frontline of the COVID-19 pandemic and are exposed to hazards that put them at risk of infection (*8*). As of 23 August 2020, there were 23 408 376 confirmed cases of COVID-19 globally and 809 098 deaths; 8499 recorded infections per day, and 15 941 566 recovered cases (*9*). Moreover, a recent publication (6 May 2020) by the International Council of Nurses (*10*) indicated that more than 90 000 health-care workers around the world were infected with COVID-19, of which 260 nurses had died, amounting to 2.195% of total confirmed COVID-19 cases (*10*). In addition, the World Health Organization (WHO) indicated that 194 member states are not providing comprehensive figures on health worker infections while dealing with the unprecedented crisis (*11*).

It is clear that health professionals should be appropriately prepared to ensure that all necessary preventive and protective measures are taken to minimize occupational safety and health risks. In addition, they should be properly trained to provide the best health care during assessment, triage, and treatment (*11*). Health professionals should also be successful role performers, since they must possess performance abilities that allow them to operate across a broad range of situations over an extended period of time (*12*).

Today, competency-based medical education has emerged as a priority issue that should be adopted to overcome the COVID-19 pandemic. The traditional approach that begins with the question "what do health

professionals need to know about COVID-19?" should be modified to the question "what abilities are needed by health professionals to face COVID-19?" In this regard, an organized framework of competencies should be designed in which the observable abilities of health professionals, integrating multiple components such as knowledge, skills, values and attitudes, can be identified (*13–15*).

Methods

This study was undertaken by a research team in the Medical Education Program (MEP), Syrian Virtual University. The MEP is a distance-learning programme designed to enable health professionals to obtain a Master's degree in medical education at the same time as practicing medicine, dentistry, pharmacy or nursing in Syrian health centres or hospitals, which are related to the Syrian Ministry of Health, Ministry of Higher Education, Ministry of Defense or Ministry of Interior. Ethical approval was obtained from the Ethical Committee of the Syrian Virtual University, Damascus, Syrian Arab Republic April 2020.

The Delphi Technique is considered one of the most useful techniques for identifying competencies in medical education (*16,17*). It has many advantages over other decision-making methods, since it facilitates ownership and increases acceptance of the generated consensus rather than possible bias developed by dominant individuals (*17,18*). Therefore, the technique was employed to develop consensus about essential competencies required for approaching COVID-19 patients.

All MEP students were invited to take part in this study (n=28). Twenty postgraduates who represent different faculties in the Syrian Arab Republic and different health specializations accepted to participate in this study. During the lockdown, participants were virtually instructed, using the Virtual University Management System to study all recently published protocols and guidelines on COVID-19 by recognized health bodies such as WHO, Centers for Disease Control and Prevention, the UK National Health Service, and Cochrane collaboration (*19–22*). Advice was also received concerning the methodology for writing competencies and vocabulary to be used to describe functions (*18*) in order to create the initial list of competencies related to essential knowledge, skills and attitudes required for approaching patients with COVID-19.

To develop a general plan of competencies, participants were divided into three groups corresponding to knowledge, skills, and attitudes domains that can identify competencies for appropriate and safe practice when dealing with COVID-19 (*23*). To unify the work and style, responses were gathered, reviewed, and modified for each domain by the team leader. Repeated and inappropriate competencies were also deleted or reformulated. A second virtual meeting was undertaken to discuss switching any competency from its domain to another. It was also agreed to cross-match these groups with the classification of required competencies according to etiology, assessment and diagnosis, management, and prognosis of COVID-19. Each member in the meeting was asked to revise the list of competencies in each major group and under each classification separately.

The revised list was then sent to the participants to suggest any additional items or modification that should be considered and to rate each competency on a 4- point Likert scale: 0, 1, 2 and 3 corresponding to 'not important', 'less important', 'important', and 'essential', respectively (*23,24*).

In the third stage, the resulted list was sent again to all participants. Competencies suggested by at least 80% of participants were combined and merged. To obtain the weighted response for each competency, the number of responses in each level and the mean score for each competency (0.0–3.0) were calculated (*18,23,24*). All competencies required for COVID-19 were ranked and the relative importance for each competency was determined.

Results

The response rate was 71.4% for invited participants (n=20). The findings indicated 52 essential competencies suggested by at least 80% of participants required for approaching COVID-19 patients. The competencies for each domain were organized under three major categories including knowledge, skills and attitude, as outlined in Figure 1, which presents the 'Ability' with its purpose, process and commitment as previously documented (*25*). In addition, four subheadings including etiology, assessment and diagnosis, management, and prognosis were also outlined in Table 1.

The final identified competencies were as follows: 12 knowledge competencies, 20 skills competencies, and 20 competencies related to attitudes. According to competencies classification, 7 competencies were related to etiology, 7 competencies related to assessment and diagnosis, 34 competencies related to management, and 4 competencies related to prognosis.

Discussion

There is an extensive global effort to provide effective treatment and research for a vaccine to combat COVID-19. For this purpose, numerous scientific papers are published daily (*1*); however, efforts targeting health professionals exposed daily to the hazards of COVID-19 infection are still limited. To rectify this, it is important that occupational health and safety become a priority and health professionals should be equipped with all essential competencies before duties on the front line of COVID-19 disease response.

This is where the role of medical education needs to be highlighted. It can ensure that all health professionals directly involved in prevention or treatment of COVID-19 pandemic, whether patient intake, screening, inspection,

Table 1 Essential competencies required for approaching patients with COVID-19

Domain		Competency
Knowledge	1.	Recognize COVID-19 Epidemiology
	2.	Differentiate between epidemic, outbreak and pandemic of COVID-19
Etiology	3.	Recognize the virus etiology, origin, incubation period and transmission models
	4.	Apply the principles of isolation, quarantine, contacts, and contacts tracing
	5.	Identify high- risk groups of COVID-19 patients
Assessment & Diagnosis	6.	Recognize types of different diagnostic tests
	7.	Identify signs and symptoms of COVID-19
	8.	Apply infection control and prevention strategies
	9.	Recognize health and safety of medical equipments
Management	10.	Discuss isolation and quarantine periods, isolation conditions
	11.	Apply therapeutic protocols and empirical drugs
	12.	List indications and contraindications of medications and procedures
Skills	13.	Take accurate clinical history
Etiology	14.	Assess the readiness of health facility
	15.	Perform appropriate medical examination
	16.	Draw blood samples, nasal swaps and bronchial lavage safely and correctly
Assessment & Diagnosis	17.	Screen and triage at all points of access to the health system
	18.	Interpret results of laboratory tests and radiographic images correctly
	19.	Provide correct differential diagnosis in each medical case
	20.	Apply health and safety procedures
	21.	Educate patients to the extent that they can understand
	22.	Calculate therapeutic doses accurately
	23.	Apply treatment in the correct way and time and make appropriate adjustments for each case
Management	24.	Use medical equipment and devices for managing patients with COVID-19
	25.	Appraise and assimilate scientific evidence
	26.	Provide accurate diagnosis of COVID-19
	27.	Decide the right time for initiating and finishing treatment
	28.	Appraise the scientific publications about COVID-19
	29.	Perform triage and control origin of infection
Prognosis	30.	Manage clinical cases according to development and stage and complications
	31.	Start and terminate isolation precautions when necessary
	32.	Perform a plan to monitor health care staff who were in contact with definite cases of COVID-19
Attitude	33.	Provide protection measurements for health care workers
	34.	Demonstrate Professionalism to peers, staff, patients and patient's families
	35.	Work with health care professional including other disciplines
	36.	Keep patient safe and protect him/her from harm
Management	37.	Demonstrate respect to patients' privacy and confidentiality
	38.	Maintain patients' dignity during providing health care
	39.	Show sympathy and compassion to patients
	40.	Explain all information regarding COVID-19 to community

Table 1 Essential competencies required for approaching patients with COVID-19 *(concluded)*

Domain	Competency
Management	41. Demonstrate an investigatory and analytic thinking approaches to meet the needs of COVID-19 patients
	42. Provide the best health care to patients regardless of age, gender, cultures and economic situations without discrimination
	43. Provide spiritual support to patients and suspected infected persons
	44. Demonstrate Self-management and self-awareness
	45. Develop the required skills to prevent transmission of COVID-19
	46. Promote health against COVID-19 and anticipate when priorities should be changed
	47. Develop strategies for consultation, collaboration, and referral
	48. Provide optimal value care
	49. Communicate effectively with patients, their families and colleagues to inform them about case development
	50. Show leadership, initiative, optimism, and influence to control disease spread in the most effective manner
	51. Work flexibly under stress and under changing conditions and remain calm
	52. Apply the national health policy, guidelines and recommendations

testing, transport, treatment, nursing, specimen collection, pathogen detection, pathologic examination or technical personnel, should all have the necessary competencies to deal with this pandemic (*2*).

Participants were instructed to write competencies required for dealing with COVID-19 in the light of those competencies already constructed for professionals dealing with accidents and emergencies in the United States of America (*26*), United Kingdom (*27*) and Canada (*28*). For example, according to Clerkship Directors in Emergency Medicine (CDEM), six core competencies should be acquired when dealing with COVID-19 including patient care, medical knowledge, professionalism, systems-based practice, practice-based learning and improvement, and interpersonal and communication skills (*26*). In the present study, 52 essential competencies related to ethical behaviour, professionalism, personal development health promotion, disease prevention and management were identified.

To the best of our knowledge, this study is the first that has identified competencies examining knowledge, skills, and attitudes domains and categories, including etiology, assessment and diagnosis, management, and prognosis of COVID-19.

Following studies by George Miller (1990) (*29*), it is suggested that knowledge, competencies, performances and actions are required for health professionals at the frontline of the COVID-19 pandemic. This study has adopted the hierarchy proposed by Miller whereby three domains of learning competencies – including knowledge (cognitive), skills (psychomotor) and attitude (affective) – have been addressed (*29*). For example, if the health professionals are in the frontline of the pandemic they should know the etiology of the disease (cognitive domain), should be able to perform physical examination (psychomotor domain), and should have communication and teamwork skills in a trauma situation (affective domain). Health professionals who have the information 'know what' and expertise 'how to' will master the process. Through the skills 'knowing how' and attitudes 'knowing why', health professionals will be encouraged and remain committed to the patient. It is also clear that the unity of knowledge with attitudes can grant them an over-arching sense of purpose in patient care (*25*,*29*,*30*). Union of purpose, process and commitment provides the heath professional with the 'Ability', enabling effective disease control and maintain health and safety of patients and society in general (Figure 1).

The present study is unique in gathering core competencies needed for health-care workers to face COVID-19 patients. In the literature, a previous research article assessing knowledge, skills, and attitudes among 327 health-care workers about COVID-19 at District 2 Hospital in Ho Chi Minh City, Viet Nam (*31*), found that the majority of health-care workers had good knowledge and positive attitude toward COVID-19. However, researchers also found that the level of learning was lower than expectation. Therefore, they suggested updating knowledge and learning materials about this epidemic and as well as to communicate information to professionals who have a lack of knowledge or were not aware of COVID-19 (*31*).

Similarly, another study assessed the knowledge, attitude, and practice (KAP) of 1357 health professionals towards COVID-19 across ten hospitals in Henan, China (*32*). The study addressed the need to understand the KAPs of health workers and possible risk factors in order to deliver the relevant training and policies that can provide protection and decrease occupational exposure during the outbreak (*32*).

The current study has introduced a novel and practical model for development of training programmes during

Figure 1 Three components (knowledge, skills and attitudes) that enable competency in health professionals (purpose, process and commitment) when approaching patients with COVID-19

the pandemic. In addition, the consensus of participants upon all points through the Delphi technique increases the reliability and confidence of results, drawing from previous studies used the Delphi method to develop curriculum for undergraduate medical education. For example, Almoallim (2011) (*18*) determined competencies in undergraduate internal medicine curriculum in Saudi Arabia using the Delphi technique, identifying competencies based on a group (20 clinicians) utilizing textbooks (*18*). Similarly, Shah et al. (2019) (*33*) developed a national competency-based diabetes curriculum in undergraduate medical education.

Limitations

Sample size (*n*=20) was a limiting factor and an increase in the number of participants would be of critical importance to support our findings. Comprehensive understanding about COVID-19 is still not possible. Specific agreed treatments for COVID-19 patients are not yet fully available. Thus, there remains a concern that these competencies identified might require continuous revision in light of the ongoing understanding of the etiology, assessment and treatment to address the COVID-19 pandemic. Therefore, the present findings should be considered as a baseline for future work that aims to clearly identify competencies that can influence the process of curriculum reform in the Region adopted by schools, and the methods of assessment that can measure the knowledge, skills and attitude of health professionals.

It is hoped that the identified competencies would direct policy-makers to support and organize ad hoc comprehensive training programmes that can equip health professionals with the required knowledge, attitudes and skills competencies to enable them to effectively deal with the pandemic.

Conclusion

Future training development for health care professionals dealing with COVID-19 patients should consider utilizing the designed list of competencies highlighted in this study to assess and improve competencies.

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Perspective pédagogique concernant l'identification des compétences essentielles requises pour aborder les patients atteints de COVID-19

Résumé

Contexte : Les professionnels de santé sont en première ligne dans la lutte contre la pandémie de COVID-19 et sont directement exposés aux risques d'infection. Ils doivent donc posséder les compétences essentielles pour aborder les patients.

Objectifs : La présente étude visait à identifier les compétences essentielles requises pour aborder les patients atteints de COVID-19.

Méthodes : Tous les professionnels de santé postuniversitaires de la *Syrian Virtual University* (Université virtuelle syrienne) (n = 28) ont été invités à participer à l'étude lors du confinement pour la COVID-19 en 2020, ; 20 diplômés ont accepté l'invitation. La méthode Delphi a été adoptée pour identifier les compétences en matière d'éducation médicale et une réunion virtuelle a été organisée par le biais du système de gestion universitaire afin de fournir une instruction et de créer une liste de compétences. Les domaines de compétence ont été divisés en « connaissances », « compétences » et « attitudes » et ont été classés en quatre catégories : étiologie, évaluation et diagnostic, prise en charge et pronostic.

Résultats : Cinquante-deux compétences essentielles ont été identifiées : sept compétences sur l'étiologie, sept sur l'évaluation et le diagnostic, 34 sur la prise en charge et quatre sur le pronostic.

Conclusion : Nous espérons que les compétences identifiées aideront les professionnels de santé à fournir les meilleurs soins de santé aux patients atteints de COVID-19, ainsi que les responsables de l'élaboration des politiques à soutenir des programmes de formation complets susceptibles de doter les professionnels de santé des compétences nécessaires pour lutter contre la pandémie.

منظور تعليمي لتحديد الكفاءات الاساسية للتعامل مع مرضى كوفيد-19

ميسون دشاش، بشار المصري، آلاء أبو حلاوة، إيمان تقالة، أمل صهيوني

الخلاصة

الخلفية: يواجه المهنيون الصحيون في الخطوط الأولى لمجابهة جائحة كوفيد-19 مخاطر العدوى مباشرة. ومن ثَم يجب أن يكون لديهم الكفاءات الأساسية للتعامل مع المرضى.

الأهداف: هدفت هذه الدراسة إلى تحديد الكفاءات الأساسية المطلوبة للتعامل مع مرضى كوفيد-19

طرق البحث: دُعي جميع المهنيين الصحيين بعد تخرجهم في الجامعة الافتراضية السورية (عددهم = 28) للمشاركة في الدراسة خلال فترة الإغلاق في عام 2020 بسبب كوفيد-19، وكانت النتيجة قبول 20 طالبًا من طلاب الدراسات العليا المشاركة. وقد اعتمدت تقنية «دلفي» لتحديد الكفاءات في التعليم الطبي. وعُقد اجتماع افتراضي من خلال نظام إدارة الجامعة للتوجيه وإعداد قائمة بالكفاءات. وقُسِّمَت مجالات الكفاءة إلى "المعلومات" و"المهارات" و"المواقف" وصُنِّفت إلى أربع فئات: المسببات، والتقييم والتشخيص، والإنذار لتصبح: والعلاج والإنذار.

النتائج: حُددَت 52 كفاءة أساسية؛ 7 كفاءات تتعلق بالمسببات، وسبعة تتعلق بالتقييم والتشخيص، و34 تتعلق بالعلاج ، و4 تتعلق بالإنذار.

الاستنتاج: من المأمول أن تساعد الكفاءات التي حددت المهنيين الصحيين على تقديم أفضل رعاية صحية لمرضى كوفيد-19، فضلاً عن مساعدة واضعي السياسات على دعم برامج التدريب الشاملة التي تزوّد المهنيين الصحيين بالكفاءات المطلوبة لمكافحة الجائحة.

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Engagement of medical specialty trainees in research: experience at a Lebanese medical school

Fouad Fayad,[1] Ouidade Aitisha Tabesh,[1] Tamara Lotfi,[2] Fadi Haddad[3] and Elie Nemr[4]

[1]Department of Rheumatology, Hotel Dieu de France Hospital and Saint Joseph University of Beirut, Beirut, Lebanon. [2]Department of Internal Medicine, Faculty of Medicine, American University of Beirut, Beirut, Lebanon; The Global Evidence Synthesis Initiative (GESI) Secretariat, American University of Beirut. [3]Department of Internal Medicine, Hotel Dieu de France Hospital and Saint Joseph University of Beirut, Beirut, Lebanon. [4]Department of Urology, Hotel Dieu de France Hospital and Saint Joseph University of Beirut, Beirut, Lebanon. (Correspondence to: Fouad Fayad: fouadfayad@yahoo.fr).

Abstract

Background: Many challenges exist to engaging medical students and postgraduate trainees in research in low and middle-income countries.

Aims: This study aimed to assess the motivation of and opportunities for postgraduate medical specialty trainees to engage in medical research, and the perceived obstacles to undertaking research in Lebanon.

Methods: A questionnaire-based survey of all postgraduate clinical trainees was conducted at Saint Joseph University of Beirut medical school, Lebanon. Logistic regression analysis was used to determine factors associated with engaging in research. Odds ratios (OR) and 95% confidence intervals (CI) are presented.

Results: Of 290 trainees, 252 (87%) completed the questionnaire; 40.1% were specializing in medicine, 25.8% in surgery and 34.1% in other fields. A total of 122 trainees had participated in research projects: 85.2% in data collection, 83.6% in writing of abstracts, 69.7% in writing papers for publication, 58.2% in project design and 57.4% in data analysis. Most trainees had produced considerable research output (82.0%), with an average of 2.5 publications. Enhancing their curriculum vitae (OR = 1.90, 95% CI 0.84–4.30) and enjoying research (OR = 2.05, 95% CI 0.94–4.44) were not motivational factors for engaging in research. Trainees were frustrated by the limited research opportunities, citing lack of time as a main factor.

Conclusion: There is a need for additional formal and informal support programmes to encourage postgraduate trainees to engage more in research.

Keywords: biomedical research, medical schools, publications, postgraduate training, Lebanon

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Introduction

An active clinical research culture has clear benefits to health care delivery *(1,2)*. Patients benefit from the development of new therapies and the practice of evidence-based medicine, departments benefit from enhancement of their academic profile and clinicians benefit from career advancement. Involvement of clinicians in medical research as early as possible in their careers, even as medical students, is likely to maximize these benefits *(3)*. Although many countries include research training as a formal part of medical training, this is not universal and there are many challenges to engaging medical student in research *(4)*. Similar arguments apply to postgraduate trainees, who benefit from and contribute to research activity also.

Many barriers to undertaking medical research in developing countries exist, such as lack of funds and facilities, and inadequate training. In addition, little is known about the research needs of trainees in these countries during their specialization, as the opportunities for engaging in research have been less well studied. The aim of this study, therefore, was to assess the motivation of and opportunities for postgraduate specialty trainees to engage in medical research, the perceived obstacles to undertaking research, and the outcomes of their participation in medical research in Lebanon.

Methods

Participants and setting

Saint Joseph University of Beirut is one of the largest Lebanese medical schools, with postgraduate training that spans 4 to 6 years. This training consists of four semesters of general training followed by four to six semesters of medical specialization, and two semesters of general training followed by eight semesters of specialty training for surgical specialties. For paediatrics, anaesthetics, histopathology, radiology and other specialties, trainees start specializing immediately in their chosen field. All 290 postgraduate trainees from all specialties at Saint Joseph University of Beirut were invited to participate in the study during September and October 2015.

Questionnaire

A modified version of a previously developed questionnaire (*4*) was used (Appendix 1). The questionnaire was in English and consisted of multiple-choice questions with free text comments where applicable. Two questions addressed barriers to involvement in research with answers on a 5-point Likert scale. The questionnaire was validated by distribution to 25 trainees at Saint Joseph University of Beirut and modified according to their responses.

Statistical analysis

SPSS, version 22.0 was used for data analysis. To evaluate the relationship between the outcome of interest (involvement in research) and categorical covariates (year and type of specialization, type of hospital, reasons for engaging in research and usefulness of research), we used the chi-squared or Fisher exact tests as appropriate. We used logistic regression analysis to determine the association between the covariates and the outcome. Variables with *P*-value < 0.2 in the bivariate analysis were included in the logistic regression analysis. Odds ratios (OR) and 95% confidence intervals (CI) are presented. A Poisson regression approach was used to assess the relationship between number of publications and the following variables: year of specialization, type of specialty and place of work (central teaching hospital, peripheral hospital, or other institutions). An alpha level of 0.05 was considered statistically significant. Free text responses were analysed by the first author. Responses on a Likert scale are reported as: 1–2 = disagree with the statement; 3 = neither agree nor disagree; 4–5 = agree with the statement. Complete-case analysis was performed when dealing with missing data .

Ethical considerations

The research ethics committee of Saint Joseph University of Beirut approved the study. Participation was optional, and consent was assumed by completion of the questionnaire. Data were anonymized after collection to ensure confidentiality.

Results

The response rate was 87% (252/290). Most of the postgraduate participants (101, 40.1%) were trainees in medical specialties, 65 (25.8%) were surgical trainees, the rest (86, 34.1%) were trainees in nine other specialties (Table 1). All postgraduate years were represented (Table 1). Although 250 (99.2%) of the postgraduate trainees had been involved in research before their graduation in medicine, only 122 (48.4%) were engaged in research during their specialization. The rates of research engagement varied among specialties, with trainees in family medicine having the lowest rate (2/15, 13%); the differences, however, did not reach statistical significance (*P* = 0.054) (Table 1).

Year of specialization was significantly correlated with being involved in research (*P* < 0.001) and the number of publications (*P* < 0.001) (Table 1), with trainees in higher postgraduate years having more research experience and publications.

Table 1 Specialties and academic year the trainees, according to engagement in medical research

Variable	Engaged in postgraduate research (*n* = 252)		Publications per trainee[b] (*n* = 252)
	Yes	No	Median (min–max)
Specialty			
Medicine[a]	43	58	0 (0–25)
Surgery[a]	37	28	0 (0–13)
Anaesthesia[a]	8	11	0 (0–0)
Radiology[a]	8	9	0 (0–7)
Family medicine[a]	2	13	0 (0–0)
Paediatrics[a]	8	6	0 (0–1)
Obstetrics/gynaecology	8	2	1 (0–2)
Psychiatry	5	1	1 (0–1)
Radiotherapy	1	1	0 (0–0)
Histopathology	1	1	0.5 (0–1)
Paediatric surgery	1	0	0
Year of training			
1st	5	48	0 (0–0)
2nd	17	36	0 (0–3)
3rd	24	26	0 (0–2)
4th	32	18	0 (0–8)
5th	39	2	1 (0–16)
6th	5	0	13 (1–25)

There was no correlation between specialty and engagement in research (P = 0.054). Year of specialization was significantly correlated with engagement in research (P < 0.001) and number of publications (P < 0.001).
[a]*Chi-squared test; Fisher exact test for other comparisons.*
[b]*Excludes presentations, abstracts and thesis.*

Motivation

Most trainees stated that research experience was useful (281, 86.5%) or that it depends (26, 10.3%), though this was not associated with engagement in research (*P* = 0.937). Some trainees (189) chose only one option as reasons for engaging in research: 140 (55.6%) said that they would undertake research solely to improve their curriculum vitae (CV), 35 (13.9%) solely because they would enjoy it, and 14 (5.6%) solely because it is mandatory.

Univariate analysis showed that enjoying research (n = 73, *P* = 0.190) and perceiving research as mandatory to obtain the diploma (*n* = 42, *P* = 0.523) were not associated with engagement in research or not (*P* = 0.523); building a better curriculum vitae, however, was (*n* = 190, *P* = 0.028). Three variables were used in the multivariable logistic regression analysis (year of specialisation, improving the CV, enjoying research), which showed that building a better curriculum vitae (*n* = 190; OR = 1.90, 95% CI: 0.84–4.30; *P* = 0.123) and enjoying research (*n* = 73; OR = 2.05, 95% CI 0.94–4.44; *P* = 0.070) were not motivational factors for engaging in research.

Year of specialisation was still significantly correlated with engagement in research (n = 47; OR = 2.80, 95% CI: 1.26–3.63). Most respondents did not think that lack of personal motivation was an important obstacle to being involved in research: 129 (51.2%) of the trainees disagreed that it was an obstacle and 69 (27.4%) neither agreed nor disagreed. Many trainees (164, 65.1%) had approached a potential supervisor for research opportunities.

Opportunities

Most trainees had research experience (undergraduate or postgraduate) in central teaching hospitals (216/252, 85.7%); only a very few had research experience in peripheral hospitals (12/252, 4.8%) or in other institutions (24/252, 9.5%). Postgraduate-only research had similar distribution (central teaching hospital: 101/122, 82.8%; peripheral hospital: 5/122, 4.1%; other: 16/122, 13.1%). Reviewing patient notes and collecting data, and writing abstracts were the most usual forms of participation in research (83.6% and 83.6% of trainees, respectively; Table 2).

Out of the 122 trainees who had participated in post-graduate research, 100 (82.0%) generated output: publications (64, 52.4%), oral presentations (41, 33.6%), poster presentations (34, 27.9%), thesis (27, 22.1%) or abstracts (24, 19.7%). Trainees had published on average 2.5 papers (range: 1–25); 45 trainees had only one publication each and three trainees had more than 10 publications each. Only 27 (44.3%) trainees has published as the first author and 34 (55.7%) as co-authors (data missing for three participants). No significant difference was found in the number of publications generated by trainees working in different specialties or places of work.

Perceived obstacles to engaging in research

Trainees felt frustrated by the lack of opportunities to engage with research: 136 (54.0%) agreed that they felt frustrated while 80 (31.7%) neither agreed nor disagreed. Lack of research within their respective departments was another main concern, with 119 (47.2%) respondents agreeing that there was a lack of research in their department.

Many trainees (110, 43.7%) felt there was a lack of competent advisers, although 80 (31.7%) thought there were competent advisers available. About half of the trainees (127, 50.4%) thought that supervisors were not interested in involving trainees in research. Lack of time for research was the commonest obstacle reported by the trainees (176, 69.8%).

Suggestions on how to increase engagement in research included more time for research (35.1%), more funding (26.0%), implementation of a mandatory research course (23.4%), more competent and motivated advisers (18.2%) and creation of a research department (14.3%) (Table 3).

Discussion

Institutions and individuals benefit greatly when clinical staff, including medical students, are involved in active research *(3,5,6)*. We examined perceptions of postgraduate trainees about research opportunities in a medical school in Lebanon. Although trainees were motivated to participate in research, fewer than half had the opportunity to do so because of lack of opportunities, time and support.

A study in Pakistani medical universities found comparable results to ours regarding the value of research and being actively involved in research; only 41.5% of junior faculty in Pakistan were currently involved in research *(7)* compared with 48.4% of our trainees. A report from Saudi Arabia found more respondents recognized the value of research (97.9%) than our trainees (86.5%) but only 30.4% were involved in any research activity *(8)*. The Saudi study reported the same barriers as our study *(8)*.

Engagement in research as an undergraduate was associated with greater engagement with academia after graduation *(9–11)*. Medical students in Lebanon have to complete a thesis to graduate, as in other countries such as Peru, Germany and some universities in the United States of America *(9)*, and our trainees had positive attitude towards the value of research. However, this attitude did not translate into high levels of involvement in research in our study. Evidence on the relationship

Table 2 Participating roles in postgraduate medical research project

Research role	No. (%) (n = 122)
Reviewing patient notes and collecting data	104 (85.2)
Writing abstracts	102 (83.6)
Analysing data	70 (57.4)
Writing papers for publication	85 (69.7)
Designing research project protocol	71 (58.2)
Handing out questionnaires	52 (42.6)
Conceiving research project idea	56 (45.9)
Undertaking laboratory work	19 (15.6)

Table 3 Trainees' suggestions on how to increase postgraduate involvement in medical research

Suggestion	No.[a] (%)
More time dedicated to research	27 (35.1)
Providing funds for research	20 (26.0)
Implementing a (mandatory) course for research in medical school	18 (23.4)
More competent and motivated advisers	14 (18.2)
Creating a research department	11 (14.3)
Enhancing the value of research	3 (3.9)
Having statisticians available	2 (2.6)
Creating computerized database in each department	1 (1.3)

[a] *77 trainees responded to this free text question. Some respondents gave more than one suggestion.*

between mandatory thesis submission for graduation and future participation in research is lacking and it would be useful to evaluate this relationship further.

The most frequently cited barrier to research in our study was lack of time, which is similar to other studies *(4,12–14)*. Lack of funds and facilities, inadequate training and a lack of recognition of the value of academic activity are also commonly reported barriers to engagement in research in developing countries *(12,15)*. The complex process of securing funding is not limited to developing countries *(16)* as it is also reported as a major obstacle in developed countries *(17)*. Informal support programmes, such as journal clubs and research interest groups, benefit undergraduates *(18)* and could be useful in postgraduate training.

Trainees did not think that their own lack of motivation was a barrier to engaging in research, but thought that a lack of interest of potential supervisors was a particular problem. However, only 65.1% had approached a potential supervisor to get involved in research and 55.6% said they would undertake research just to improve their curriculum vitae. These attitudes risk demotivating potential supervisors in investing their time and support for such trainees.

Maintaining an active environment conducive to research is important. This environment is possibly lacking in Lebanon as suggested by the trainees' concerns about lack of competent advisors and research carried out in their department. It appears that there is a need for additional formal and informal support programmes to encourage postgraduate trainees to engage more in research.

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Participation des étudiants des spécialités médicales à la recherche : expérience dans une école de médecine au Liban

Résumé

Contexte : Il existe de nombreux défis à relever pour inciter les étudiants en médecine et les étudiants de cycle supérieur à participer à la recherche dans les pays à revenu faible et intermédiaire

Objectifs : La présente étude avait pour objectif d'évaluer la motivation et les opportunités des étudiants de cycle supérieur dans les spécialités médicales pour s'engager dans la recherche médicale, ainsi que les obstacles perçus dans l'accès à la recherche au Liban.

Méthodes : Une enquête basée sur un questionnaire et incluant tous les étudiants de cycle supérieur en médecine clinique a été menée à l'école de médecine de l'Université Saint-Joseph de Beyrouth (Liban). L'analyse de régression logistique a été utilisée pour déterminer les facteurs associés à un engagement dans la recherche. Les odds ratios (OR) et les intervalles de confiance (IC) à 95 % sont présentés ci-dessous.

Résultats : Sur un total de 292 étudiants, 252 (87 %) ont rempli le questionnaire. Parmi eux, 40,1 % étaient des étudiants en médecine, 25,8 % en chirurgie et 34,1 % dans d'autres disciplines. Au total, 122 étudiants avaient participé à des projets de recherche : 85,2 % avaient contribué à la collecte de données, 83,6 % à la rédaction de résumés, 69,7 % à la rédaction d'articles de recherche destinés à la publication, 58,2 % à la conception de projet et 57,4 % à l'analyse de données. La majorité des étudiants (82 %) avaient produit un travail de recherche considérable, avec en moyenne 2,5 publications. L'implication dans la recherche de ces étudiants n'était motivée ni par l'amélioration de leur curriculum vitae (OR = 1,90 ; IC à 95 % : 0,84–4,30), ni par un goût pour la recherche (OR = 2,05; IC à 95 % : 0,94–4,44). Les étudiants étaient frustrés par la limitation des opportunités de recherche, principalement due, selon eux, à un manque de temps.

Conclusion : Il est nécessaire de mettre en place des programmes de soutien supplémentaires, formels et informels, pour encourager les étudiants de cycle supérieur à s'engager davantage dans la recherche.

إشراك المتدربين في التخصصات الطبية في إجراء البحوث: تجربة في إحدى كليات الطب في لبنان

فؤاد فياض وداد ايتصحا طبش، تمارا لطفي، فادي حداد، إيلي نمر

الخلاصة

الخلفية: يواجه المتدربون من طلاب كليات الطب والأطباء المُسجلين في الدراسات العليا عدة تحديات بشأن إشراكهم في إجراء البحوث في البلدان النامية.

الأهداف: هدفت هذه الدراسة إلى تقييم سبل التحفيز والفرص المتاحة لمتدربي الدراسات العليا في التخصصات الطبية من أجل إشراكهم في البحوث الطبية، وتحديد العقبات التي تحول دون إجراء البحوث في لبنان.

طرق البحث: أُجري مسحٌ قائمٌ على استبيان وشملَ جميع المتدربين من الأطباء السريريين في الدراسات العليا في كلية الطب بجامعة القِدِّيس يُوسُف

في بيروت، لبنان. واستُخدم تحليل الانحدار اللوجستي لتحديد العوامل المرتبطة بالمشاركة في البحوث. واحتُسبَت نسبة الأرجحية وفواصل الثقة بنسبة 95 ٪.

النتائج: من بين المتدربين البالغ عددهم 292 متدرباً، استكمل 252 (87٪) الاستبيان؛ وشمل هذا العدد متخصصين في الطب العام بنسبة 40.1٪، وفي الجراحة بنسبة 25.8٪، وتخصصات أخرى بنسبة 34.1٪. وبلغ مجموع المتدربين الذين شاركوا في مشروعات بحثية 122 متدرباً، وكان دورهم كالتالي: 85.2٪ في جمع البيانات، و83.6٪ في كتابة الخلاصات، و69.7٪ في كتابة الأوراق لنشرها، و58.2٪ في تصميم المشروعات، و57.4٪ في تحليل البيانات. وقد قدَّم معظم المتدربين مُخرَجات بحثية مهمة (82.0 ٪)، وبلغ متوسط المنشورات 2.5. وبيّن تحليل الانحدار اللوجستي أن تحسين السيرة الذاتية للمتدربين (OR = 1.90, 95٪ CI: 0.84–4.30) والاستمتاع بإجراء البحوث (OR = 2.05, 95٪ CI: 0.94–4.44) لم يكونا من العوامل التحفيزية للمشاركة في البحوث. وكان المتدربون يشعرون بالإحباط نظراً لقلة فرص مشاركتهم في البحوث، وأرجعوا ذلك بشكل أساسي إلى ضيق الوقت.

الاستنتاجات: هناك حاجة إلى المزيد من برامج الدعم الرسمية وغير الرسمية لتشجيع متدربي الدراسات العليا على المشاركة بصورةٍ أكبر في البحوث.

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Appendix 1

Questionnaire

Involvement of specialty trainees in medical research: The experience at a Lebanese medical school

(1) What is your medical specialty?

☐ Medicine ☐ Surgery ☐ Pediatrics ☐ OBG ☐ Family Medicine
☐ Psychiatry ☐ Anesthesia ☐ Radiology

(2) What is your year of specialization?

☐ R1 ☐ R2 ☐ R3 ☐ R4 ☐ R5 ☐ R6

(3) Do you think research experience is useful for specialty trainees?

☐ Yes ☐ No ☐ It depends to the future medical career

(4) Why do you want to carry out research work?

☐ You enjoy research
☐ You want your CV to look better
☐ It is mandatory to obtain the diploma
☐ Other . . . . . .

(5) Have you approached anyone about getting involved in research work?

☐ Yes ☐ No

(6) Have you ever been involved in research?

- Before medical graduation? ☐ Yes ☐ No

If yes, please select and specify the number in brackets:

Published Paper ( ) Published abstract ( ) Oral Presentation ( )
Poster Presentation ( ) Thesis ( )

- During specialty? ☐ Yes ☐ No

If yes, please select and specify the number in brackets:

Published Paper ( ) Published abstract ( ) Oral Presentation ( )
Poster Presentation ( ) None ( )

(7) If your research work was presented/published, where were you on the list of authors?

☐ First author ☐ Co-author ☐ None

(8) Where did you carry out the research work?

☐ Central Teaching Hospital ☐ Peripheral Hospital ☐ Other . . . . . .

(9) What specialty or specialties have you undertaken your research work?

☐ Medicine ☐ Surgery ☐ Pediatrics ☐ OBG ☐ Family Medicine
☐ Psychiatry ☐ Anesthesia ☐ Radiology

(10) What level in training was the individual who got you involved in research work?

☐ MD ☐ MD, MSc ☐ MD, PhD ☐ PhD

(11) What part did you play in the research work? (You can choose more than one)

☐ Conception of the idea

☐ Design of the research project

☐ Going through patient notes and collecting data

☐ Handing out questionnaires

☐ Lab work

☐ Analyzing data

☐ Writing of abstracts

Designing posters for presentation

(Local / National / International) please circle type of meeting

Delivering oral presentation

(Local / National / International) please circle type of meeting

☐ Writing of papers for publication

(12) Have you been frustrated by lack of opportunities available to carry out research work?

('1' = completely disagree, '5' = completely agree) 1 2 3 4 5

(13) What do you think are the main obstacles in getting involved in research work? (Indicate to what extent you agree with the following statements: '1' = completely disagree, '5' = completely agree)

Lack of motivation on your behalf	1 2 3 4 5
Lack of competent advisors	1 2 3 4 5
Lack of research carried out in your department	1 2 3 4 5
Lack of interest by the supervisors to get specialty trainees involved in research work	1 2 3 4 5
Lack of time due to other commitments	1 2 3 4 5

Other . . . . . .

(14) Do you have any recommendations for increasing specialty trainees' opportunities for involvement in research?

. . . . . .

(15) Any other comments:

. . . . . .

An analysis of financial protection before and after the Iranian Health Transformation Plan

Zhaleh Abdi,[1] Justine Hsu,[2] Elham Ahmadnezhad,[1] Reza Majdzadeh[1,3] and Iraj Harirchi[4]

[1]National Institute of Health Research; [3]Department of Epidemiology and Biostatistics, School of Public Health; [4]Cancer Research Centre of Cancer Institute, Tehran University of Medical Sciences, Tehran, Islamic Republic of Iran (Correspondence to: Zhaleh Abdi: zh-abdi@sina.tums.ac.ir). [2]Department of Health Systems Governance and Financing, World Health Organization, Geneva, Switzerland.

Abstract

Background: Protecting people against the financial consequences of health-care payments is a key objective of health systems.

Aims: We carried out a descriptive analysis of changes in health spending associated with the implementation of the latest health sector reform in the Islamic Republic of Iran, the Health Transformation Plan (HTP).

Methods: The study relied on 2 rounds of data from the Household Expenditure and Income Survey (2014 and 2015). Key indicators of financial protection in health expenditure were estimated. The Kakwani index was used for out-of-pocket (OOP) health expenditure to measure the degree of progressivity in the distribution of such payments.

Results: Total OOP per capita health expenditure showed a 2.5% relative decrease in real terms in 2015 compared to 2014. Estimation of the Kakwani index suggested OOP spending became slightly more progressive over the time period of HTP reform. The share of the population facing catastrophic health expenditure also decreased significantly from 2.9% to 2.1% at the national level. However, the incidence of impoverishment due to OOP payments increased slightly between pre- and post-HTP, from 0.2% to 0.5%.

Conclusion: Our findings suggest that the new policies have a positive association in improving financial protection against health costs among Iranians, albeit slightly less so for the poor. Future efforts to increase public spending for financial protection would be challenging and should rely on efficiency gains such as a move from fee-for-service to performance-based payment systems and more organized OOP collection mechanisms involving prepayment and risk pooling.

Keywords: health expenditure, health equity, health policy, health transformation plan, Iran

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Introduction

The design of health systems has a fundamental impact on population access to health services and thus their health status. Unfortunately, accessing these services can sometimes lead to some individuals having to pay catastrophic proportions of their available income and/or push many into poverty (*1–4*). Globally it has been estimated that 150 million people suffer financial catastrophe each year due to health care payments and 100 million are pushed into poverty because of out-of-pocket (OOP) payments (*5*).

One of the main goals of a health system is fair financing, i.e. providing financial protection against the costs of ill-health. This concept of fairness or equity in health financing promotes the idea that the burden must be shared across society, and that individuals should be protected against financial hardship that threatens their living standards as a result of paying for health care (*6,7*). Empirical evidence highlights that OOP payment is not only the most inequitable but also the least efficient means of financing health care (*8*). A more equitable and efficient health financing system requires effective health financing strategies that shift from a reliance on OOP payments at the time of service to more organized forms of revenue collection involving pre-payment and risk pooling mechanisms (*8,9*). With the goals of financial protection and equity in mind, a number of countries have implemented health sector reforms and have reported promising results in reducing OOP payments. For instance, in Thailand, universal coverage was launched in 2001 to ensure equitable access to health care for the entire population. Since its introduction, the policy had a major impact on reducing the overall incidence of catastrophic expenditure among population (*10*). In Turkey, following the implementation of the health transformation programme in 2003, which aimed at reducing total OOP expenditure and increasing access to health care, there was a diminishing trend in catastrophic and impoverishing health expenditures (*11*). Similarly, Indonesia implemented a reform to restructure its health care financing system and improve access to health services by establishing several health insurance programmes, which were relatively successful in providing financial protection for their members against the cost of medical services (*12*).

In the Islamic Republic of Iran, major sources of financing the health sector are OOP health expenditures

and government expenditures, which respectively represented 47.0% and 38.9% of total health spending in 2013 (*13*). Social health insurance accounted for 19.7% of total health spending. In recognition of the Iranian health system being predominantly financed by OOP payments, the country's fifth 5-year development plan has mandated the government to decrease the share of such payments in total health expenditures to 30% or less (*14*). In addition, with the aim of ensuring that health care is more accessible and its provision more equitable to the population, the 11th government launched the health transformation plan (HTP) in May 2014 (*15*). One of the major aims of this plan is to reduce OOP payments, a target which is mainly supported by a substantial increase in the budget of the Ministry of Health and Medical Education (i.e. 59% increase in annual budget), financed from a targeted energy subsidies law and an earmarked 1% of value added tax, together contributing an additional US$ 3 billion (*16*).

Protecting the population against the impact of high OOP payments is an important goal of the HTP. First, insurance coverage was extended for approximately 10 million people (*17*). Recognising that spending on inpatient services and medicines are the main components of total OOP expenditure, the Ministry of Health and Medical Education also took major steps to reduce inpatient costs by reducing co-payments for hospitals affiliated with the Ministry of Health and Medical Education to a maximum of 10% for residents of large and medium cities and a maximum of 5% for residents of rural areas. These co-payment rates were reduced to 6% and 3% respectively at the end of 2014. In addition, modification of the tariffs paid for medical services started in November 2014. The main objective of revising health tariffs was to regulate physicians' payments and reduce informal payments, which are estimated to be high (*18*). The HTP also reduced the shortage of essential drugs stemming from international sanctions against the Islamic Republic of Iran, and reduced the price of medicines at the beginning of 2014.

In this study, we aimed to analyse preliminary changes observed around the time of the implementation of the HTP, particularly in regard to changes in the level and distribution of OOP payments and catastrophic and impoverishing health expenditures by comparing 1 year before and after implementation. Equity in the distribution of such payments was also examined to understand the degree of progressivity.

Methods

Data are from 2 rounds of the Household Expenditure and Income Survey, which is conducted 4 times a year by the Iranian Statistics Centre. Each round is nationally representative, and our analysis relied on data from the Persian calendar's winter season, corresponding to Gregorian calendar months January–April 2013 (sample size 9535 households) and from January–April 2015 (sample size 9543 households). Since the HTP was initiated in April 2014, and with expenditure recall periods of a maximum of 1 year, the majority of data thus represents the period of a year before and a year after the implementation of reforms.

Health expenditures refer to OOP payments made by individuals to health providers at the time of service use. They include direct payments (including gratuities and payments in kind) to formal medical professionals, informal traditional or alternative healers, clinics, health centres and pharmacies and exclude prepayment for health services (e.g. in the form of taxes or specific insurance premiums or contributions) and, where possible, are net of any reimbursements to the individual who made the payments. All expenditure variables were annualized and baselined to 2011, adjusting for urban and rural inflation rates based on an annual average of quarterly consumer price indices.

Key indicators of financial protection in health spending concern catastrophic and impoverishing health expenditures, where the former is concerned with the impact of health expenditures causing a person to forego spending on other necessities and the latter is concerned with health expenditures pushing a person below the poverty line. Indicators were constructed following established methods. For catastrophic health expenditures, the methodology developed by the World Health Organization (WHO) was applied when catastrophic health expenditures were equal to or exceeded 40% of a household's capacity to pay (*19*). The WHO approximates capacity-to-pay as total expenditure net of nondiscretionary food spending. The latter is estimated as the average food expenditure per equivalent adult across households in the 45th–55th percentile of the food budget share distribution. When actual food spending is below this amount, capacity-to-pay is defined as total expenditure net of actual food spending. Health expenditures are considered impoverishing when they push a person below the poverty line, i.e. expenditures gross of spending on health are above the poverty line but expenditures net of health spending are below the line. In this analysis, the international poverty line of US$ 1.90 (2011 purchasing power parity) per capita, per day was used. Population headcount ratios were estimated for both indicators and *t*-tests conducted to assess whether changes were significant or not.

Equity in the distribution of OOP payments was also analysed by estimating the Kakwani index. This index is based on the Gini coefficient of income and the concentration index of OOP expenditures (*20*). A Gini index ranks income distribution on a scale between 0 and 1, where 0 indicates perfect equality and 1 indicates perfect inequality. We proxied income using total consumption expenditure. A concentration index assesses the distribution of OOP payments across the population taking a value between −1 and 1, where a negative value suggests OOP is concentrated in the poor and a positive value suggests OOP is concentrated in the rich. The Kakwani index is then the difference between the Gini coefficient and the concentration index for OOP

health payments, and ranges from –2 (indicating severe regressivity) to +1 (indicating strong progressivity). If OOP payments are a progressive way to finance the health services, the Kakwani index will have a positive value. This research analysed changes in the degree of progressivity in OOP financing in the 2 time periods associated with the HTP reform.

Results

One of the main objectives of the HTP is to reduce OOP health payments, especially those due to inpatient costs in public hospitals, across the Iranian population. Table 1 shows total OOP and OOP payments on inpatient services before and after HTP implementation. The results indicate a positive association with a relative decrease in total OOP per capita expenditure of 2.5% in real terms at the national level (from 2 099 569 rials to 2 047 120 rials). Almost all subpopulation groups benefited from the reduction in total OOP expenditure except for the richest quintile and those living in urban areas. The more vulnerable groups of the population, those living in rural areas and the poorest, benefitted from the greatest relative reduction in total OOP expenditure.

The Iranian HTP had an initial focus on reducing inpatient costs in public hospitals. The Household Expenditure and Income Survey collected data on spending on inpatient health services (covering both public and private sectors). Table 1 also shows that OOP on inpatient services per capita decreased in the year after HTP compared with the year before HTP at the national level, from 429 323 rials to 288 310 rials, representing a 32.8% relative reduction. All subnational population groups saw a decrease, with the greatest relative change observed for middle socioeconomic status populations: quintile 3 (–39.7%) and quintile 4 (–46.8%), followed by those in rural areas (–38.8%).

Examining OOP payments reveals that the positive impact of the HTP on inpatient spending seems to be counter-balanced by the opposite effect on other outpatient fees and services (Figure 1). The focus of the HTP on inpatient services and medicines saw a reduction in related OOP expenditures. However, OOP on outpatient fees increased, as did such payments for ancillary services and dentistry.

This increase, however, was not observed for all subnational population groups. Figure 1b shows that for the poorest quintile OOP payments for services (with the exception of ancillary services) decreased,

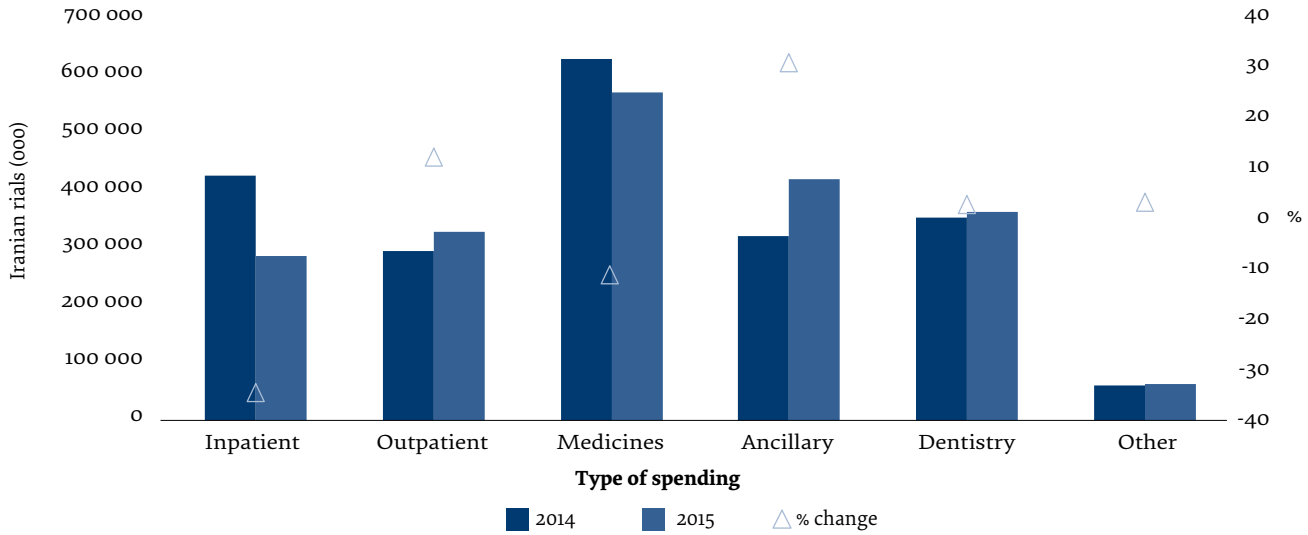
Table 1 Out-of-pocket (OOP) payments on health (Iranian rials) per capita, 2011 terms

Area or quintile	Total OOP				Inpatient OOP			
	Population mean; (confidence interval)		Relative change (%)	Absolute change	Population mean; (confidence interval)		Relative change (%)	Absolute change
	2014	2015			2014	2015		
National	2 099 569; (1 991 382–2 207 755)	2 047 120; (1 841 276–2 252 963)	–2.5	–52 448	429 323; (387 962–470 683)	288 309; (250 610–326 008)	–32.8	–141 013***
Urban	2 408 992; (2 241 114–2 576 871)	2 431 556; (2 090 422–2 772691)	0.9	22 563	485 648; (422 187–549 109)	332 273; (272 244–392 303)	31.6	–153 374**
Rural	1 311 841; (1 204 820–1 418 862)	1 055 955; (980 911.3–1 130 999)	–19.5	–255 886**	285 930; (241 443–330 418)	174 959; (143 877–206 042)	–38.8	–110 971***
Q1	438 865.2; (409 112.6–468 617.9)	369 734; (342 403–397 064.9)	–15.8	–69 131*	83 593; (69 476–97 710)	57 278; (43 934–70 621)	–31.5	–26 315
Q2	812 659.5; (760 721.4–864 597.7)	764 072.3; (709 819.5–818 325.1)	–6.0	–48 587	160 437; (131 542–189 332)	137 876; (109 626–166 127)	–14.1	–22 560
Q3	1 312 266; (1 227 578–1 396 954)	1 127 601; (1 040 901–1 214 302)	–14.1	–184 664*	297 044; (251 250–342 838)	179 241; (136 798–221 685)	–39.7	–117 802**
Q4	2 223 898; (2 049 588–2 398 208)	1 888 749; (1 744 725–2 032 773)	–15.1	–335 148	541 328; (434 074–648 582)	287 844; (227 972–347 717)	–46.8	–253 483*
Q5	5 716 025; (5 164 361–6 267 689)	6 095 431; (4 920 629–7 270 232)	6.6	379 405	1 065 280; (867 278–1 263 282)	780 481; (580 108–980 854)	–26.7	–284 798

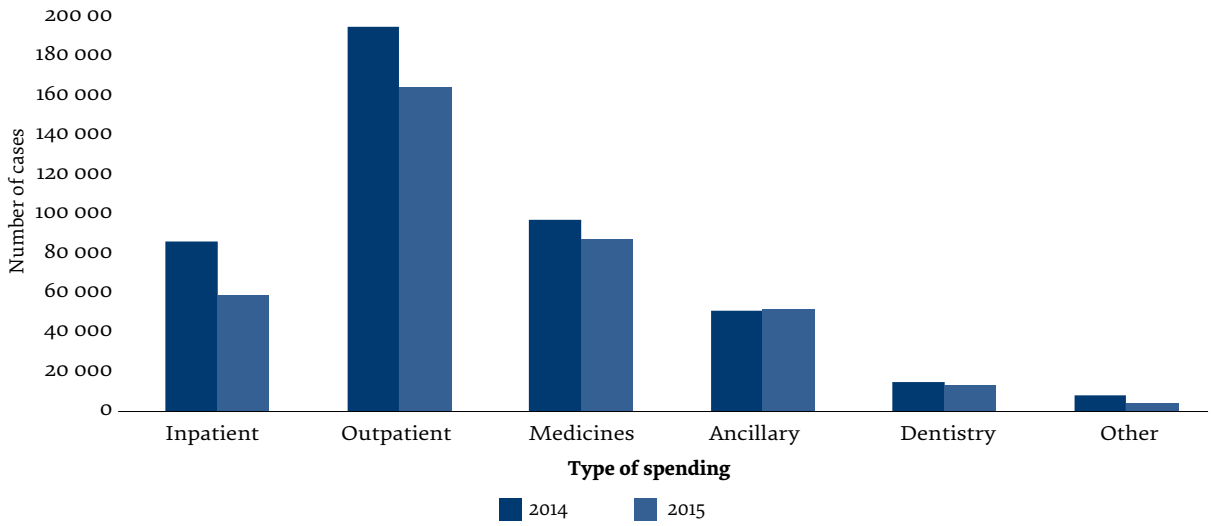
Expenditure variables were annualized and baselined to 2011, adjusting for urban and rural inflation rates based on an annual average of quarterly consumer price indices.
Quintiles are constructed based on per capita consumption expenditure.
**P < 0.05, **P < 0.01, ***P < 0.001.*

Figure 1 Out-of-pocket payments in the Islamic Republic of Iran according to type of health spending

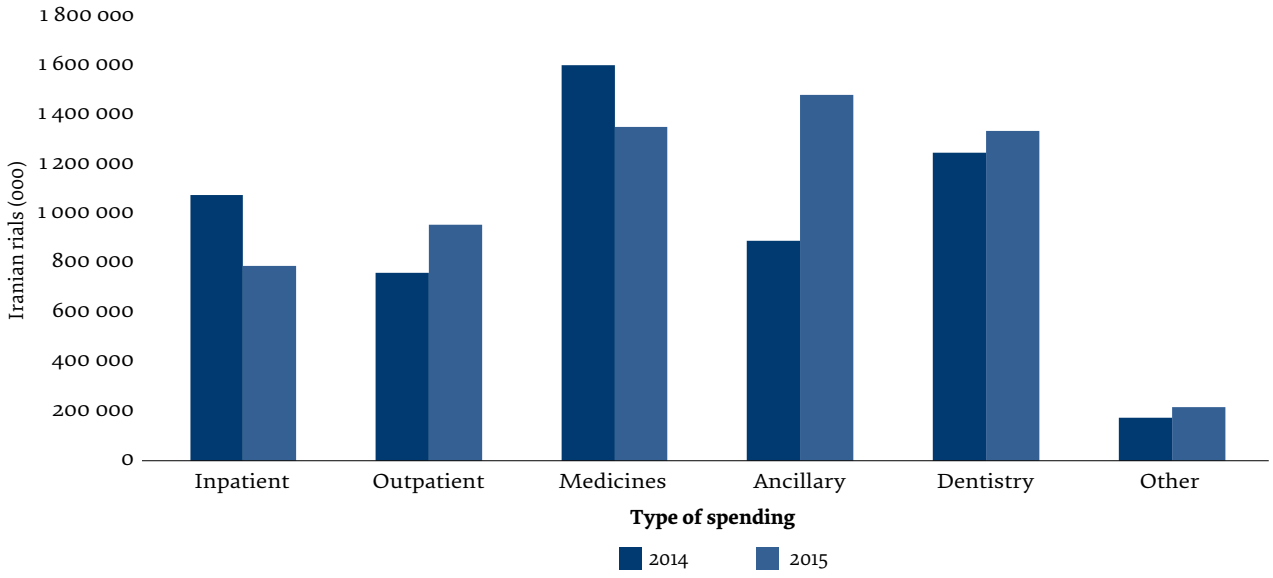
a. National averages



b. Quintile 1



c. Quintile 5



whereas Figure 1c shows that for the richest quintile OOP payments increased for outpatient fees, ancillary services and dentistry during the same period.

To understand the impact of OOP health spending on living standards, catastrophic health expenditures was calculated following the WHO capacity-to-pay approach. Comparison of the share of the population experiencing catastrophic health expenditures showed there was a statistically significant reduction after the implementation of the HTP (Table 2), decreasing from 2.9% to 2.1%. More importantly, all population groups benefitted from this reduction, although the richest 40% of the population and those in urban areas benefitted the most with greater absolute decreases. In terms of impoverishing health expenditure using the US$ 1.90 international poverty line in 2011 purchasing power parity, the incidence of impoverishment due to OOP payments increased slightly.

Table 3 shows the distributional analysis with estimations for the Gini coefficient for total expenditure, the concentration index for OOP payments and the Kakwani index. The Gini coefficient for total expenditure was estimated as 0.38 in 2014 and 0.39 in 2015, suggesting that the distribution generally remained the same after the implementation of the HTP. The concentration index for OOP payments was estimated as 0.49 in 2014 and rose to 0.55 in 2015, suggesting that such payments were more concentrated in the wealthy than in the poor. The Kakwani index is the difference between the two and was estimated to be 0.12 in 2014, rising to 0.15 in 2015. The positive index indicates OOP was already a progressive source of financing pre-reforms, and the slight increase suggests an increase in the degree of progressivity of OOP as a source of financing.

Discussion

This analysis presents preliminary results observed during the implementation of the Iranian HTP, including changes in the level and distribution of OOP and catastrophic and impoverishing health expenditures across the population. Preliminary results indicate that the HTP is associated with reductions in OOP and catastrophic health expenditures. Our results are consistent with those of similar studies that reported a reduction in

Table 2 Key indicators of financial protection in health spending, Islamic Republic of Iran

Area or quintile	Catastrophic health expenditures[a] (%)			Impoverishing health expenditures[b] (%)		
	Headcount ratio		Absolute change[c]	Headcount ratio		Absolute change[c]
	2014	2015		2014	2015	
Area						
National	2.9	2.1	−0.8*	0.2	0.5	0.3**
Urban	2.6	1.7	−0.9*	0.1	0.1	0.0
Rural	3.8	3.2	−0.5	0.6	1.5	0.9***
Quintile						
Q1	2.3	2.2	−0.1	1.1	2.2	1.1**
Q2	2.1	1.5	−0.6	0.0	0.1	0.1
Q3	2.1	1.7	−0.4	0.0	0.0	
Q4	3.4	2.2	−1.3	0.0	0.0	
Q5	4.9	3.3	−1.6	0.0	0.0	

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.
[a]*Defined as 40% or more of nonsubsistence food expenditure.*
[b]*Using the 2011 international poverty line of US$ 1.90 purchasing power parity.*
[c]*Subject to rounding.*

Table 3 Distributional analyses of out-of-pocket payments

Year and index	Estimate	Standard error	$P > t$	95% CI
2014				
Gini coefficient	0.38	0.0053	0.0001	0.366–0.387
Concentration index	0.49	0.0182	0.0001	0.459–0.530
Kakwani index	0.12	0.0179	0.0001	0.083–0.153
2015				
Gini coefficient	0.39	0.0065	0.0001	0.381–0.406
Concentration index	0.55	0.0442	0.0001	0.459–0.632
Kakwani index	0.15	0.0403	0.0002	0.073–0.231

the proportion of households experiencing catastrophic health expenditure following the implementation of health reforms (*10–12*). Distributional analyses also suggest that there were progressive changes in the nature of OOP financing. Impoverishing health expenditures increased slightly, but general poverty levels did as well (*21*).

These initial positive results can be linked with a number of interventions of the HTP. One of the main interventions was the extension of free basic health insurance to all uninsured Iranians by the Iranian Health Insurance Organization. Government reports and household surveys suggest an increase in population coverage from 83.2% to 90.1% (*22*). During the first year of HTP, co-payments for inpatient services were reduced for hospitals affiliated with the Ministry of Health and Medical Education from 10% to 6% for urban areas and from 5% to 3% for rural areas. In terms of purchasing health services, tariffs paid by the Iranian Health Insurance Organization to health facilities for the provision of health services were increased in November 2014 to better reflect the cost of services provided. The main objectives of such initiatives were to regulate provider payments and reduce informal payments, which had been estimated to be high (*18*). These reforms in provider payments along with the tighter regulation of what public hospitals could charge patients all aimed to reduce OOP and informal (under-the-table) payments in public hospitals.

Our analyses further demonstrated that the decrease in OOP payments for inpatient services was partially counterbalanced by a slight increase for OOP payments on various outpatient services. Considering the fact that most of the HTP interventions targeted the inpatient sector in the first year of HTP implementation, this initial trend was expected. Relatively higher OOP spending on outpatient care was observed for wealthier population groups and on services related to ancillary and dentistry care.

The distributional analyses of OOP spending showed this to be a progressive source of financing in the country and with OOP payments mainly concentrated among the rich. A similar study conducted in Turkey found that OOP payment was progressive in the first year of the health reform and it tended to be regressive 6 years afterwards (*11*). In countries of the Organisation for Economic Co-operation and Development (OECD), the analysis of progressivity using the Kakwani index revealed that, although health care payments were almost proportional to ability to pay, private payments included, OOP payments and private insurance premiums were highly regressive (*23*). Several studies in low- to middle-income countries reported that OOP payments were a regressive financing mechanism (*24–26*). Given the Iranian health system is predominantly financed by OOP payments, it would be important to explore mechanisms to transform the collection of such resources from individuals at the time of service use to more organized collection forms involving pre-payment and risk-pooling.

In this study, the share of the population experiencing catastrophic health expenditures decreased from 2.9% to 2.1% over 2 time periods. More importantly, all population groups benefitted from this reduction, although the richest 40% of the population and those in urban areas benefitted the most with greater absolute decreases, suggesting that the observed reductions in OOP payments in the poor were not as effective in reducing their levels of catastrophic health expenditures in comparison with those population. Strategies aimed at improving financial access for the poor should pursue equity gains by improving financial protection for those harder to reach population groups. The increase in the incidence of impoverishment before and after HTP might be a reflection of the general poverty levels in the Islamic Republic of Iran, which also slightly increased over the same period, from 1.7% to 3.4% (*21*). As expected, impoverishment was only observed in the poorest quintiles.

Key strengths and limitations of this study are worth noting. First, the study relied on a robust and comprehensive national household survey conducted by the Iranian Statistics Centre. Second, the methods used for analysing financial protection are well established, dating back to the 1990s and used in several other country studies (*27–29*). Some limitations to note are that the study could not isolate the impact of the HTP, which would have required either a randomized control study or a quasi-experimental model. Working with policy-makers to conduct more rigorous impact evaluations in the future would be welcome. Additionally, the relatively short time period covered by the study does not allow for full understanding of the impact of the reform and thus, regular monitoring and evaluation are strongly recommended. Nevertheless, this study still presents important preliminary findings of changes associated with reforms. It provides timely insight to inform the future direction of HTP.

Conclusion

This study provides preliminary evidence regarding the level and distribution of OOP payments, as well as their catastrophic and impoverishing effects during a period before and after implementation of the latest health sector reform in the Islamic Republic of Iran. Results suggest that the new policies are associated with a positive impact in reducing total OOP expenditure. Catastrophic health expenditures also decreased for all subnational population groups, albeit slightly less so for the poor. In addition, impoverishing health expenditures slightly increased for the poor and near-poor. The results thus suggest efficiency rather than equity improvement was made as the reduction in OOP was less effective in extending financial protection for these more vulnerable groups. The distribution of OOP was progressive pre-HTP and slightly increased post-HTP.

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Analyse de la protection financière avant et après le plan national de transformation du secteur de la santé en République islamique d'Iran

Résumé

Contexte : La protection de la population contre les conséquences financières des paiements de soins de santé est un objectif essentiel des systèmes de santé.

Objectifs : Nous avons mené une analyse descriptive des changements dans les dépenses de santé liés à la mise en œuvre de la dernière réforme du secteur de la santé en République islamique d'Iran, connu sous le nom de plan national de transformation du secteur de la santé.

Méthodes : La présente étude s'est appuyée sur deux séries de données issues de l'enquête sur les dépenses et les revenus des ménages (2014 et 2015). Les principaux indicateurs de la protection financière en matière de dépenses de santé ont été évalués. L'indice de Kakwani a été utilisé pour les dépenses de santé à la charge des patients afin de mesurer le degré de progressivité dans la distribution de ces paiements.

Résultats : En 2015, le montant total des dépenses de santé non remboursées par habitant a enregistré une diminution en valeur réelle de 2,5 % par rapport à 2014. D'après l'estimation de l'indice de Kakwani, les dépenses de santé non remboursées sont devenues légèrement plus progressives sur la période du plan national de transformation du secteur de la santé. Au niveau national, la part de la population confrontée à des dépenses de santé catastrophiques a également diminué de manière significative, de 2,9 % à 2,1 %. Cependant, l'incidence de l'appauvrissement dû aux dépenses de santé directement à la charge des patients a légèrement augmenté, de 0,2 % à 0,5 % avant et après le plan national de transformation du secteur de la santé, respectivement.

Conclusion : D'après nos observations, les nouvelles politiques ont participé à l'amélioration de la protection financière contre le coût des soins de santé dans la population iranienne, bien que l'effet soit moins marqué chez les habitants les plus pauvres. À l'avenir, les efforts d'augmentation des dépenses publiques en faveur de la protection financière devraient être ambitieux et s'appuyer sur des gains d'efficacité, par exemple en passant d'un système de paiement à l'acte à un système axé sur le rendement, ou en améliorant l'organisation des mécanismes de recouvrement des dépenses de santé non remboursées grâce au paiement anticipé et à la répartition des risques.

تحليل الحماية المالية قبل خطة التحول الصحي في جمهورية إيران الإسلامية وبعدها

جاله عبدی، جاستین سو، الهام احمدنجاد، رضا مجدزاده، ایرج حریرشی

الخلاصة

الخلفية: تُعتبر حماية الناس من التعرض للعواقب المالية التي تترتب على المدفوعات في مجال الرعاية الصحية أحد الأهداف الرئيسية للنظم الصحية.

الأهداف: هدفت هذه الدراسة إلى إجراء تحليل وصفي للتغيرات التي تحدث في الإنفاق على الصحة، والتي تقترن بتنفيذ أحدث إصلاح في قطاع الصحة في جمهورية إيران الإسلامية، ألا وهو خطة التحول الصحي.

طرق البحث: استندت الدراسة إلى جولتين لجمع البيانات من المسح الخاص بإنفاق الأسرة ودخلها (عامي 2014 و2015). وقُدِّرت المؤشرات الرئيسية للحماية المالية في الإنفاق على الصحة. كما استُخدم مؤشر كاكواني لقياس نسبة التدرجية في توزيع المدفوعات التي تُسدَّد من خلال الدفع المباشر للإنفاق على الصحة.

النتائج: أظهر إجمالي الدفع المباشر للإنفاق على الصحة للفرد حدوث انخفاض نسبي بالقيمة الفعلية بنسبة 2.5٪ في عام 2015، مقارنةً بعام 2014. وأشار تقدير مؤشر كاكواني إلى أن الإنفاق بالدفع المباشر قد أصبح متدرجاً بشكل أكبر بعض الشيء خلال الفترة الزمنية للإصلاح وَفْقاً لخطة التحول الصحي. كما انخفض بصورة كبيرة نصيب السكان من النفقات الصحية الباهظة على المستوى الوطني حيث بلغ 2.1٪ بعد أن كان 2.9٪. وعلى الرغم مما سبق، فقد زاد معدل حدوث الإفقار زيادةً طفيفةً بسبب المدفوعات المباشرة في الفترة السابقة على خطة التحول الصحي وبعدها، حيث ارتفع من 0.2٪ إلى 0.5٪.

الاستنتاجات: تشير النتائج التي توصلنا إليها إلى أن السياسات الجديدة ارتبطت ارتباطاً إيجابياً بتحسين الحماية المالية من التكاليف الصحية على مستوى الإيرانيين، وإن كان ذلك قد تحقق بقدر أقل بعض الشيء بالنسبة للفقراء. ولكن ستواجه جهود زيادة الإنفاق العام لتحقيق الحماية المالية تحدياً، وينبغي أن تعتمد على المكاسب المُحقَّقة من حيث الكفاءة مثل، التحول من نُظم الرسوم مقابل تقديم الخدمات إلى نُظم الدفع استناداً إلى الأداء وآليات تحصيل المدفوعات المباشرة على نحو أكثر تنظيماً، ومنها الدفع المُسبق وتجميع المخاطر.

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Prevalence of hypohydration in adolescents during the school day in Cyprus: seasonal variations

Pinelopi S. Stavrinou,[1] Christoforos D. Giannaki,[1] Eleni Andreou[1] and George Aphamis[1]

[1]Department of Life and Health Sciences, University of Nicosia, Nicosia, Cyprus. (Correspondence to: Pinelopi S. Stavrinou: stavrinou.p@unic.ac.cy).

Abstract

Background: Evidence on the hydration status of adolescents and seasonal and time variations is scarce.

Aims: This study aimed to assess variations in the hydration status and total water intake of adolescents in Cyprus between winter and summer and between the morning and end of the school day. Subjective feelings and cognitive function associated with hypohydration were also examined.

Methods: Fifty-three adolescents (39 boys) with a mean age (standard deviation, SD) of 15.1 (1.9) years were included in the study. Participants provided urine samples and completed a cognitive function test and a questionnaire on subjective feelings upon arrival at school and at the end of the school day. Data were collected in winter and summer in 2016–2017. Hydration level was determined by urine specific gravity and cognitive function was assessed with a symbol cancellation test. Total water intake was estimated from a food and fluid record kept by the participants.

Results: A high prevalence of hypohydration was found in both seasons ranging from 72% to 94%. Hypohydration was associated with perceptions of lower concentration and alertness (P = 0.008 and P = 0.047, respectively). Adolescents had significantly higher mean urine specific gravity in winter than in summer: 1.026 (SD 0.007) versus 1.023 (SD 0.007), respectively (P = 0.002). Hydration status was not associated with cognitive function or total water intake.

Conclusions: The high prevalence of hypohydration and the associated feelings of lower concentration and alertness in adolescents suggests that educational measures are needed to promote good drinking behaviour and improve hydration.

Keywords: adolescents, cognitive function, hydration, water intake, Cyprus

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Introduction

Body water is tightly regulated and daily fluctuations are maintained around 0.5% of body mass even in hot weather conditions. Water is essential for cellular homeostasis as well as for thermoregulation of the human body *(1)*. Hydration status reflects the balance between water intake and loss *(2)*. Body water content deficit beyond the normal fluctuation is called hypohydration *(3)* and is associated with a number of negative effects on health *(4)*. Fluid restriction leading to hypohydration has been shown to be associated with increased feelings of fatigue, decreased alertness and concentration, and lower levels of vigour/activity *(5,6)*. Cognitive function has also been shown to be negatively affected by low hydration status *(7)*, especially when combined with heat stress *(8)*. Children with hypohydration living in a warm climate have been shown to perform more poorly in cognitive tests *(9)*, while children's performance in cognitive tasks appears to improve after drinking water *(10)*.

Many children appear to have a low hydration status at some point during a typical school day *(11,12)*. Water intake and drinking behaviour of children and adolescents varies substantially between countries and most studies have been done in countries with a temperate climate, or outside summer months *(12,13)*. In addition, data on hydration in adolescents are scarce.

Living in a hot climate increases water loss and the risk of dehydration *(14)*. Adolescents living in the eastern Mediterranean may face a higher risk of water loss and dehydration, as this area is characterized by mild winters and hot summers. School in Cyprus starts early in the morning and ends at 13:30 when the temperature exceeds 30 °C from April–May onwards. If adolescents fail to maintain a normal level of hydration (euhydration), their overall health, concentration and cognitive performance at school could be adversely affected *(9,11,15,16)*.

The primary aims of our study were to compare hydration status of adolescents and total water intake from fluids and solid food during school hours between winter and summer. Our secondary aim was to investigate the relationship between hydration status and cognitive function and subjective feelings relevant to hypohydration.

Methods

Fifty-three adolescents from three main cities of Cyprus (39 boys) volunteered for the study. Their mean age and standard deviation (SD) was 15.1 (1.9) years, mean height was 165 (SD 10) cm, mean body mass was 55.7 (SD 13.1) kg and mean body mass index was 20.4 (SD 3.4) kg/m^2. The study was carried out between

2016 and 2017. Data were collected on two occasions, once in the winter time (February) and once in the summer time (during the first two weeks of June – the end of the school year), in random order to avoid any potential learning effect. Half of the participants provided data first in winter and then in summer, and the other half gave data first in the summer and then in the winter. This way we aimed to avoid potential learning effect on the cognitive tests, and any changes in drinking behaviour following the first set of data collection. On each occasion data were collected in the morning, at the beginning of the school day (about 07:30) and at the end of the school day (about 13:30). The outdoor temperature was measured to the nearest 0.1 °C using a portable hygro thermometer (Radiance Instruments Ltd, Hong Kong). The temperature ranged between 10 °C and 15 °C from morning to 13:30 during the winter period, and between 26 °C and 30 °C during the summer period.

Hydration level assessment

Hydration level was assessed by urine specific gravity from the first morning void and from one sample at the end of the school day, before leaving the school premises. Urine collection bottles (60 mL) were given to the participating students at the appropriate time. Urine specific gravity was determined shortly after urine collection and the remaining urine samples were immediately disposed of by the researchers. Urine specific gravity was assessed using a urine refractometer (DIGIT 0-12, Medline Scientific Limited, United Kingdom of Great Britain and Northern Ireland). The participants were then assigned into three groups according to their urine specific gravity level: euhydrated (urine specific gravity < 1.020), slightly hypohydrated (urine specific gravity 1.020–1.029) and very hypohydrated (urine specific gravity ≥ 1.030) (3).

Total water intake assessment

Total water intake was estimated from both solid food and fluid intake. Upon arrival at school, the participants were provided with a food-and-fluid record on which they were asked to record in detail all solid food and all fluid intakes from the time they woke up until the end of the school day. Before the data collection day, all participants had attended an educational session on how to keep a detailed food-and-fluid record, which was organized and delivered by a registered dietitian. Morning water intake at home (before coming to school) and total water intake (from waking up and during the time that the students were at school) was estimated using DietPlan6 software (Forestfield Software Ltd, Horsham, United Kingdom), which accesses food tables from multiple sources. This software allows insertion of additional data from any source, any recipe, menu or personal food diary without restriction.

Subjective feelings assessment

The participants completed a subjective feelings questionnaire as described in detail elsewhere (5). Participants self-graded their feelings on an arbitrary linear scale ranging from 0 (not at all) to 100 mm (very much), to questions such as – how thirsty do you feel now? We assessed the following subjective feelings: thirst, dry mouth, fatigue, head numbness, ability to concentrate and alertness. The reliability and validity of visual analogue scales in assessment of subjective feelings have been previously shown (17).

Cognitive function assessment

We assessed cognitive function with a symbol cancellation test (18), where the participants were asked to identify 60 target stimuli that were embedded in a background of over 300 distractor stimuli. The participants were allowed 45 s to cross through as many targets as they could, while ignoring distractors. We marked each target omission or incorrectly identified distractor as 1 error point. The test was scored on the number of errors/omissions.

Statistical analysis

We used two-way repeated-measures ANOVA (season × time) and post-hoc tests with the Bonferroni correction to compare the variables measured. We compared hydration groups using one-way ANOVA with Tukey post-hoc test. We used *SPSS*, version 20 for all statistical analyses. All data are reported as mean (SD). Statistical significance was set at $P < 0.05$.

Ethical considerations

We conducted our study according to the guidelines laid down in the Declaration of Helsinki (as revised in 2013). We obtained ethical approval for the study from the national bioethics committee (ΕΕΒΚ/ΕΠ/2016/12). We obtained parental approval and written informed consent from the adolescents.

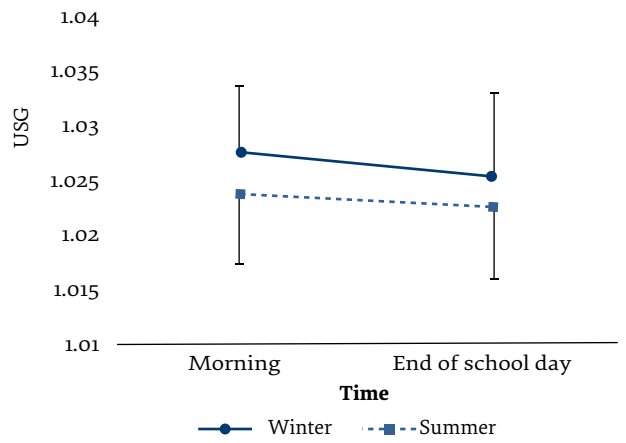
Results

Subjective feelings, water intake and cognitive function

With regard to urine specific gravity, the two-way repeated measures ANOVA showed significant differences between season ($P = 0.002$) and time ($P = 0.046$). A post-hoc Bonferroni analysis showed a higher urine specific gravity in the morning in winter compared with the end of the school day ($P = 0.030$) and compared with the morning in the summer period ($P = 0.001$) (Figure 1).

Subjective feelings and water intake during the winter and summer periods in the morning and at the end of the school day are shown in Table 1. Participants felt less thirsty ($P = 0.039$) and less fatigued ($P = 0.022$) in the winter compared with the summer. Participants felt more fatigued at the end of the school day than in the morning ($P = 0.031$); the post-hoc tests showed that the participants felt more fatigued at the end of the school day than in the morning in winter ($P = 0.043$). We found no significant difference in cognitive function between seasons. However, the participants performed better on cognitive function tests at the end of the school day than in the morning in both seasons ($P < 0.001$). We found no significant seasonal effect for total water intake.

Figure 1 Urine specific gravity (USG) during winter and summer in the morning and at the end of the school day. Difference in the morning in winter compared with in summer ($P = 0.001$). Difference in the morning in winter compared with the end of the school day ($P = 0.030$).



However total water intake was significantly higher at the end of the school day than in the morning in both seasons ($P < 0.001$).

Hydration status

During the winter period, more adolescents were very hypohydrated and fewer adolescents were hydrated than the summer period in the morning and at the end of the school day (Table 2).

Table 3 shows the effect of hydration status on subjective feelings and cognitive function. Hydration status significantly affected concentration and alertness, with participants who were euhydrated having better scores ($P < 0.05$). Euhydrated participants also had lower scores for feelings of dry mouth. Cognitive function did not differ between the categories of hydration status ($P > 0.05$). No significant difference was found between the total water intake and the hydration status categories in the morning and at the end of the school day, independently of season (Table 4).

Discussion

The main finding of our study was that adolescents had a higher urine specific gravity during the winter period compared with the summer period, with no difference in total water intake between the seasons. We found a high prevalence of raised urine specific gravity in both seasons. In addition, hydration status had a significant negative affect on perceived feelings of concentration and alertness. However, we found no association between hydration status and cognitive function.

The evaluation of seasonal variations on urine specific gravity was one of the main aims of our study. In the literature, data on seasonal variations are scarce and we aimed to add to the available knowledge. Cyprus has a Mediterranean climate with mild winters and hot summers and one would assume that the hot weather would induce more dehydration *(19)*. Moreover, the high temperatures in Cyprus during the summer could lead to greater water loss through sweating and more thermal stress which would be expected to lead to higher fluid intake. However, our results show that adolescents in Cyprus had a higher urine specific gravity – indicating potentially more hypohydration – during the winter period than the summer period, as well as similar total water intake. Physiologically, dehydration occurs through passive exposure to a hot environment, exercise, or water restriction *(20)*. It could be hypothesized that children were more physically active during school time in the winter, when the temperature is around 15 °C, and physical activity could decline in hot weather *(21)*, especially in the Middle East *(22)*. Despite this hypothesis, the etiology behind the higher urine specific gravity in the winter needs to be investigated. However, the above finding should be interpreted with caution, as urine specific gravity in both seasons indicated

Table 1 Subjective feelings, water intake and cognitive function in winter and summer, in the morning and at the end of the school day

Variable	Winter		Summer		Seasonal effect	Time effect
	Morning	End of school day	Morning	End of school day	*P*-value[a]	*P*-value[a]
Subjective feeling of						
Thirst	3.7 (1.8)	3.0 (2.2)	4.1 (2.3)	4.1 (3.0)	**0.039**	0.369
Dry mouth	3.7 (2.3)	3.4 (1.8)	3.7 (2.1)	3.8 (3.0)	0.495	0.814
Head numbness	1.5 (1.6)	1.6 (1.9)	1.8 (2.0)	2.6 (2.7)	0.062	0.222
Concentration	5.7 (1.9)	6.3 (2.5)	6.4 (2.5)	6.0 (2.5)	0.568	0.745
Fatigue	2.7 (2.2)	3.6 (2.2)	3.6 (2.5)	4.3 (2.9)	**0.022**	**0.031**
Alertness	5.5 (2.4)	6.6 (2.2)	5.8 (2.2)	5.7 (2.1)	0.372	0.150
Water intake (mL)	203.0 (199.2)	856.0 (524.7)	174.1 (175.6)	891.8 (524.8)	0.950	**< 0.001**
Cognitive function (no. of errors)	10 (9)	6 (5)	11 (10)	6 (5)	0.729	**< 0.001**

[a]*P-values in bold indicate significant seasonal and time effects at P < 0.05.*

Values shown are means (standard deviations).

Table 2 Distribution of participants (*n* = 53) according to hydration status in winter and summer, in the morning and at the end of the school day

Hydration status[a]	Winter		Summer	
	Morning	End of the school day	Morning	End of the school day
	No.	No.	No.	No.
Euhydrated	3	9	11	15
Slightly hypohydrated	26	21	35	26
Very hypohydrated	24	23	7	12

[a]*Euhydrated: urine specific gravity < 1.020; slightly hypohydrated: urine specific gravity 1.020–1.029; very hypohydrated: urine specific gravity ≥ 1.030.*

slight hypohydration, and the statistical finding on urine specific gravity might not translate into a real physiological or clinical finding.

Our results clearly indicate a high prevalence of raised urine specific gravity; most of the adolescents had raised urine specific gravity in both winter and summer, in the morning and at the end of the school day, with nearly half of them having extremely high urine specific gravity and being potentially very hypohydrated. The prevalence of dehydration in children has been shown to be high in many countries regardless of the climate *(9,11,12)*. However, data on adolescent dehydration are scarce compared with other populations *(23,24)*. Evaluating hydration status, especially in children and adolescents, is important because dehydration has been suggested to have adverse effects on general health *(4)*. More specifically in adolescents, acute dehydration may negatively affect brain function *(13)*. Therefore, more studies are needed to evaluate adolescent health in relation to their hydration status.

According to our study, many adolescents arrive at school hypohydrated and remain so for the duration of the school day, both in winter and summer. These findings are in agreement with previous findings from countries where climate conditions are similar to Cyprus *(9,11)*. One could argue that urine specific gravity measured at the end of the school day could have been affected by food and fluid intake both at breakfast and during school hours. Research has shown that 600 mL of water can restore urine specific gravity to < 1.020 within 40 min *(25)*. Our participants had 174 and 203 mL of water intake in the morning in summer and winter, respectively, and less than 1 L of water during the school day. This was apparently inadequate to restore urine specific gravity as evidenced by the high urine specific gravity at the end of the school day. Even though a statistically significant reduction in urine specific gravity was found at the end of the school day compared with the morning, urine specific gravity values remained high and indicated slight hypohydration status. Therefore it appears that adolescents do not drink enough to restore euhydration during their time at school.

Most people rely on the sensation of thirst to prompt them to drink fluids *(26)*. However, even though our participants had an increased feeling of thirst during the summer period, this perception was insufficient and did not lead to higher total water intake. It has been suggested that ratings of thirst perception do not always show predictable patterns of voluntary drinking following dehydration *(26)*; this is probably because the sense of thirst is not an adequate reflection of the water

Table 3 Urine specific gravity, subjective feelings and cognitive function according to hydration status, independent of season and time

Variable	Euhydrated[a]	Slightly hypohydrated[a]	Very hypohydrated[a]	*P*-value[b]
Urine specific gravity	1.013 (0.005)[cd]	1.025 (0.003)[d]	1.032 (0.002)	**< 0.001**
Subjective feelings				
Thirst	3.2 (2)	3.7 (2.7)	4.4 (2.5)	0.069
Dry mouth	2.8 (1.9)[d]	3.5 (2.6)[d]	4.5 (2.5)	**0.009**
Head numbness	2.2 (2.6)	1.7 (2)	2.2 (2.3)	0.246
Concentration	7.4 (2.1)[cd]	5.9 (2.5)	5.8 (2.4)	**0.008**
Fatigue	3.2 (2.4)	3.4 (2.7)	4.2 (2.7)	0.164
Alertness	6.8 (2.2)[d]	6.2 (2.4)	5.5 (2.2)	**0.047**
Cognitive function (no. of errors)	8.6 (8.0)	8.7 (8.2)	6.9 (5.9)	0.325

[a]*Euhydrated: urine specific gravity < 1.020; slightly hypohydrated: urine specific gravity 1.020–1.029; very hypohydrated: urine specific gravity ≥ 1.030.*
[b]*P-values in bold indicate significant differences between all groups at P < 0.05.*
[c]*Compared with the slightly hypohydrated group.*
[d]*Compared with the very hypohydrated group).*
Values shown are means (standard deviations).

Table 4 **Total water intake according to hydration status, independently of season**

Time of day	Total water intake (mL)			*P*-value[b]
	Euhydrated[a]	Slightly hypohydrated[a]	Very hypohydrated[a]	
Morning	299 (338)	176 (155)	165 (147)	0.163
End of the school day	1119 (667)	834 (490)	758 (402)	0.086

[a]*Euhydrated: urine specific gravity < 1.020; slightly hypohydrated: urine specific gravity 1.020–1.029; very hypohydrated: urine specific gravity ≥ 1.030.*
[b]*P-values are for differences between all groups.*
Values shown are means (standard deviations) for total water intake.

needs *(27)* and relying on thirst alone may not be enough to ensure adequate total water intake and body hydration.

Although it has been suggested that children living in hot environments are prone to chronic hypohydration *(9)*, our data do not support or suggest chronic voluntary hypohydration. However, data from other studies suggest that day-to-day intrapersonal variability in water intake is probably quite low *(28)* and morning values of urine specific gravity have very good repeatability over 5 consecutive days *(25)*. Therefore, it cannot be totally rejected that the data collected in our study may provide an indication of fluid drinking behaviour over time. Furthermore, our results can provide a stimulus for design and implementation of effective school-based interventions to promote appropriate drinking behaviour, especially in warm weather. For instance, it has been reported that children drink more water if they are allowed water bottles on their desk *(29)*. Moreover, intervention programmes or school-based education campaigns have been found to be effective in modifying drinking behaviour and improving hydration status *(23,30)*.

Hypohydration in our study was associated with effects on subjective feelings. Hypohydrated students felt less alert and less able to concentrate during school time. These results agree with the findings of a previous study in men *(5)*. It has also been reported that dehydration may affect mood state with high levels of hydration linked with high levels of vigour in children *(11)* and adults *(31)*. These findings are important because negative feelings may have an adverse effect on the ability of adolescents to concentrate during class time and to perform well at school.

The impairment of these important aspects of cognitive function such as concentration and alertness, due to hypohydration, indicate that they may alter cognitive performance. Previous studies in children, reported a beneficial effect of hydration on short-term memory (*9,11*). However, our results did not show any difference between hydrated and hypohydrated students in cognitive performance. This could be attributed either to the significant difference in group size (we had very few euhydrated students compared with many hypohydrated students), or to a lack of sensitivity of the test used in the study. However, other studies have also shown a lack of association between hydration status and cognitive test scores *(11,32)*. It has been suggested that the relationship between hydration levels and cognitive outcomes may not be totally linear, since hypohydration seems to affect some cognitive performance but not others *(11)*.

We based hydration status on measured urine specific gravity. Although urine specific gravity is not the gold standard to assess hydration, it can be easily measured and is not invasive as is plasma osmolality. For practical reasons, plasma osmolality could not be measured in a school environment. Urine specific gravity data can provide useful and valuable information on hydration status in free-living conditions *(33)*, which was pertinent to the aim of our study. The participants provided a sample of first morning urine which is well accepted for setting urine concentration threshold to assess hydration status *(34)*. The second sample was obtained at the end of the school day before lunch. This time point has been shown to have a good diagnostic ability for detecting hypohydration in children *(35)*.

A limitation of our study was that we did not measure physical activity during the school day. Therefore, we do not know if there were seasonal variations in physical activity levels during the school hours and how these variations could affect the hydration status of the adolescents. Another limitation is that the total water intake was based on self-reported food-and-fluid record. We do not know if the students were able to accurately self-assess, even though the procedure was fully explained.

Future research should focus on demonstrating effective measures to improve the hydration status of students during school time. Educational measures should be taken to promote proper drinking behaviour and improve hydration in adolescents both in Cyprus and internationally, which can positively affect not only concentration and school performance, but overall health as well.

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Competing interests: None declared.

Variations saisonnières dans la prévalence de l'hypohydratation chez les adolescents au cours de la journée d'école à Chypre

Résumé

Contexte : Il existe peu de données factuelles sur l'état d'hydratation des adolescents et ses variations au cours des saisons et de la journée.

Objectifs : La présente étude avait pour objectif d'évaluer les variations dans l'état d'hydratation et les apports en eau chez les adolescents à Chypre, entre l'hiver et l'été et entre le matin et la fin de la journée d'école. Les ressentis subjectifs et les fonctions cognitives liés à l'hypohydratation ont également été examinés.

Méthodes : 53 adolescents (39 garçons) d'âge moyen 15,1 ans (écart type : 1,9) ont été inclus dans l'étude. Les participants ont fourni des échantillons d'urine, passé un test de fonctions cognitives et rempli un questionnaire sur leurs ressentis subjectifs, à l'arrivée à l'école et à la fin de la journée. Les données ont été recueillies en hiver et en été en 2016-2017. Le niveau d'hydratation a été déterminé par la mesure de la densité de l'urine. Les fonctions cognitives ont été évaluées au moyen d'un test de barrage de symboles. Les apports totaux en eau ont été estimés à partir d'un journal où les participants notaient leur prise d'aliments et de liquides.

Résultats : Une forte prévalence de l'hypohydratation, allant de 72 % à 94 %, a été observée aux deux saisons. L'hypohydratation allait de pair avec des ressentis de concentration et de vigilance diminuées (p = 0,008 et p = 0,047, respectivement). La densité de l'urine chez les adolescents était significativement plus élevée en hiver qu'en été : 1,026 (écart type : 0,007) contre 1,023 (écart type : 0,007), respectivement (p = 0,002). L'état d'hydratation n'était corrélé ni avec les fonctions cognitives, ni avec les apports totaux en eau.

Conclusions : Les liens entre la forte prévalence de l'hypohydratation et les ressentis de diminution de la concentration et de la vigilance chez les adolescents portent à croire que des mesures sont nécessaires en milieu scolaire afin d'encourager des apports en liquides satisfaisants et d'améliorer l'hydratation.

انتشار الجفاف في صفوف المراهقين أثناء اليوم الدراسي في قبرص: التغيرات الموسمية

بينولبي ستافرينو، كريستفورس جيانكي، إليني آندرو، جورج آفاميس

الخلاصة

الخلفية: لا يوجد سوى قدر قليل من الدلائل بشأن حالة الإماهة في المراهقين والتغيرات الموسمية والزمنية.

الأهداف: هدفت هذه الدراسة إلى تقييم التغيرات في حالة الإماهة وإجمالي مدخول الماء للمراهقين في قبرص في الفترتين بين الشتاء والصيف، وبين الصباح ونهاية اليوم الدراسي. كما خضعت المشاعر الذاتية والوظيفة المعرفية المرتبطة بالجفاف للدراسة والفحص.

طرق البحث: شملت الدراسة ثلاثة وخمسين مراهقاً (39 من الفتيان) بمتوسط عمري (انحراف معياري) 15.1 (1.9) عام. وقدّم المشاركون عينات بول، وخضعوا لاختبار الوظيفة المعرفية، وأجابوا عن استبيان حول المشاعر الذاتية عند الوصول إلى المدرسة وفي نهاية اليوم الدراسي. وجُمعت البيانات في موسمي الشتاء والصيف في الفترة بين عامي 2017–2016. كما تحدد مستوى الإماهة عن طريق الثقل النوعي للبول، وقُيمت الوظيفة المعرفية باستخدام اختبار إلغاء الرموز. وقُدر إجمالي مدخول الماء من سجل الأغذية والسوائل الذي احتفظ به المشاركون.

النتائج: تبين ارتفاع نسبة انتشار الجفاف في كلا الموسمين بما يتراوح بين 72٪ إلى 94٪. وارتبطت الإماهة بنسبة أقل من التركيز والانتباه (القيمة الاحتمالية = 0.008، والقيمة الاحتمالية = 0.047 على التوالي). كما كان متوسط الثقل النوعي للبول أعلى بنسبة كبيرة لدى المراهقين في الشتاء عنه في الصيف: 1.026 (انحراف معياري 0.007) مقابل 1.023 (انحراف معياري 0.007)، على التوالي (القيمة الاحتمالية = 0.002). ولم تكن حالة الإماهة مرتبطة بالوظيفة المعرفية أو إجمالي مدخول الماء.

الاستنتاجات: يتبين من ارتفاع نسبة انتشار الجفاف والشعور المرتبط به من انخفاض التركيز والانتباه في المراهقين ضرورة اتخاذ تدابير تثقيفية لتعزيز السلوكيات الجيدة لشرب الماء وتحسين الإماهة.

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Medical management of pneumonia in children aged under 5 years in Alexandria, Egypt: mothers' perspective

Noha Fadl,[1] Ayat Ashour[1] and Yasmine Muhammed[1]

[1]Family Health Department, High Institute of Public Health, Alexandria University, Alexandria, Egypt (Correspondence to: nohaosama@alexu.edu.eg).

Abstract

Background: Pneumonia is among the top causes of morbidity and mortality among the under-fives worldwide.

Aims: A cross-sectional study was conducted to assess health-seeking behaviour and first medical management of pneumonia among children aged under 5 years in Alexandria, Egypt from the mothers' perspectives.

Methods: Using a pre-designed questionnaire, we interviewed 507 mothers of pneumonic children aged under 5 years who had been admitted at 4 governmental children's hospitals. The study was conducted during August–November 2017.

Results: We found that 57.2% of children received home treatment before seeking medical advice. Around 26% of mothers waited ≥ 2 days before seeking medical advice; insufficient knowledge about the disease was their main contention (89%). Factors significantly associated with the delay were: rural residence (P = 0.006); low income (P = 0.002); home treatment given before seeking medical advice (P < 0.001) and previous episodes of pneumonia (P = 0.002). Diagnosis of pneumonia had not been made by more than half of the first consulted sources (52.7%).

Conclusion: There is an urgent need to improve mothers' knowledge and train physicians for appropriate management of pneumonia in children under 5 years.

Keywords: pneumonia, management, under-fives, Egypt

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Introduction

Acute respiratory tract infection (ARI) is one of the leading causes of morbidity and mortality among children under 5 years in developing countries. ARI is classified into upper and lower respiratory tract infections (*1*). Pneumonia, a common and severe lower respiratory tract infection, is recognized as "the forgotten killer of children" (*2*), killing 1.1–1.4 million children every year and accounting for 17–19% of all deaths among children under 5 years of age (*3*). Most of these deaths occur in low- and middle-income countries (*4*). A recent systematic review indicated 0.22 pneumonia episodes per child–year in low- and middle-income countries, with nearly 1 in 8 cases progressing to severe disease (*5*).

In the Eastern Mediterranean Region (EMR), reduction of under-five mortality remains an unfinished agenda, with 923 000 children under-five year still dying every year in the Region, with pneumonia as the major killer (20%) (*6*). The Child Health Epidemiology Reference Group (CHERG) estimated 0.28 episodes per child-year for the EMR. These estimates translate into about 20 million cases of childhood pneumonia each year, with approximately 10% of cases requiring hospitalization (*7*). In Egypt, children under 5 years account for nearly 13.4% of the total population (*8*), and pneumonia constitutes 19% of under-five mortality (*9*). The incidence of pneumonia in Egypt has been estimated at 0.11–0.20 pneumonia episodes per child-year (*7*).

Given the frequency of this illness among children under 5 years, the care that must be provided for them imposes a significant burden on parents and health services. In addition, the care provided by the family and the health services is not always the most efficient way to treat this illness (*1*). Effective antibiotic treatment for pneumonia exists, thus timely recognition of the signs and symptoms by primary care givers and subsequent care-seeking for treatment from appropriate providers can prevent many of these deaths (*10*). Yet, worldwide, only 3 in 5 children receive the necessary help and care (*11*).

According to the Egypt Demographic and Health Survey 2014, 68% of children under 5 years with suspected pneumonia sought care from a health provider (*8*). This implies that many children with potential pneumonia remain untreated (*12*). Therefore, it is imperative to identify barriers in seeking and receiving the appropriate health care to manage children under 5 years with pneumonia. The aim of the current study was to address mothers'/primary care givers' health-seeking behaviours for children under 5 years with suspected pneumonia and first medical management received from the mothers' perspective.

Methods

Study design

A cross-sectional descriptive study design was used. The study was conducted over a 4-month period, August–November 2017. The study was conducted in the inpatient departments of the following hospitals in Alexandria; El-Shatby Univerity Hospital, Al-Raml Paediatric Hospital, Al-Anfoshy Paediatric Hospital and Fawzy Moaz General Hospital. The sampled hospitals are the main government hospitals providing low-cost health services to the paediatric population from Alexandria and surrounding rural areas.

Study population

The study population included mothers/primary care givers of all children aged 2–59 months with established diagnosis of pneumonia admitted to the sampled hospitals. Hospital records were checked first to ensure that pneumonia was diagnosed according to WHO diagnostic criteria (i.e. cough and/or difficulty breathing with at least one of the following signs: fast breathing, ≥ 50 breaths/minute in a child aged 2–11 months, ≥ 40 breaths/minute in a child aged 12–59 months; or lower chest indrawing) (*13*).

Exclusion criteria were:

- children with confirmed diagnosis of congenital malformation, tuberculosis, HIV, cardiac or other chronic conditions that might be complicated by pneumonia;
- children with reported cough because of a recent history of aspiration of a liquid or a foreign body;
- mothers or primary care givers refusing to participate in the study.

Sample size

Based on a prevalence rate of 13.6% for ARIs among children under 5 years in Egypt (*8*) and using degree of precision 5%, the minimum required sample size was 362. The sample size was calculated using *EpiInfo*, version 7. All sampled hospitals were visited at least twice weekly to cover all cases of pneumonia during the study period. The total sample size was 507 cases fulfilling the predetermined inclusion criteria. No one refused to participate in the present study and only 10 children were not accompanied by their mothers/primary care givers to complete the questionnaire; these were excluded from the study.

Data collection

Mothers/primary care givers were interviewed by trained data collectors using a pre-designed questionnaire to collect data on sociodemographic characteristics, child's health status, mother's knowledge, health-seeking behaviour and first management received before hospital admission from the mother's perspective. The questionnaire was designed based on data from other similar studies (*10,14,15*). For content validity, the questionnaire was revised by an expert paediatrician. Then, the questionnaire was translated from English to Arabic by trained bilingual staff. A pilot test (n = 10) was conducted on a different group to assure clarity of the questions and check for language errors. Digital scales appropriate for the child age were used for weight measurement.

Definition of measured variables

- Diagnosis of pneumonia was based on hospital records in which pneumonia was diagnosed according to WHO criteria (*13*) with or without radiological findings.
- Child's nutritional status was assessed according to WHO child growth standards weight for age. Children below the 5th percentile were categorized as underweight; those plotted above 95th percentile were considered to be overweight (*16*).
- Exclusive breastfeeding was defined as no other food or drink, not even water, except breast milk (including milk expressed or from a wet nurse) for the first 6 months of life, but allowing the infant to receive oral rehydration salts, drops and syrups (vitamins, minerals and medicines) (*17*).
- Inappropriate health- seeking behaviours included self-administered treatment, delay in seeking medical advice, seeking advice from inappropriate providers, and noncompliance with the prescribed treatment. Appropriate providers included government and private health providers, but not traditional healers and pharmacists.
- Delay in seeking medical advice was considered if mother/primary care giver of a pneumonic child sought medical help ≥ 2 days after onset of symptoms.

Statistical analysis

Collected data was reviewed for completeness and accuracy, coded, computed, cleaned and analysed using SPSS, version 21.0. Descriptive statistics (mean and standard deviation for normally distributed data and median for skewed data) were used for quantitative data and frequency for qualitative data. The Chi squared test was used to test for association in qualitative variables while independent t-test was used for quantitative variables. Statistical significance was set at $P < 0.05$.

Ethical considerations

Before recruiting participants for the study, approvals were obtained from the ethics committee of the High Institute of Public Health, the director of El-Shatby University Hospital and the Ministry of Health and Population. After explaining the purpose of the study, informed consent was obtained from every mother/primary care giver in her own right and on behalf of her child. Participation in the study was entirely voluntary. All information was handled with strict confidentiality.

Results

Sociodemographic characteristics

A total of 507 mothers with under-five pneumonic children were interviewed, (Table 1). The mean age of participating mothers was 28.36 [standard deviation (SD) 5.76] years; 82.1% were urban residents. Regarding parents' education status, 29.4% of mothers and 32.1% of fathers were illiterate. The majority of mothers (91.7%) were housewives. For paternal occupation, 58% were skilled workers, 20.3% were employees (office workers and other staff working for any organization) and 3.6% were unemployed. The household crowding index was ≤ 2 in 92.5% of respondents. However, 16.8% of mothers reported having bad ventilation and 57.4% reported paternal smoking at home.

Two-thirds of the 507 children under 5 years enrolled in the study (66.1%) were males (Table 2). Mean age was 18.2 (SD 16.8, range 2–59) months.

Child's health status

We found that 15.4% of the children were underweight and 6.1% were overweight. A quarter of children (25.6%)

Table 1 Sociodemographic characteristics of parents of pneumonic children aged under 5 years (*n* = 507), Alexandria 2017

Characteristic	No.	%
Residence		
Urban	416	82.1
Rural	91	17.9
Mean (SD) age of mother (years)	28.36 (5.76)	
≤ 20	38	7.5
21–35	401	79.1
> 35	68	13.4
Mother's education		
Illiterate	149	29.4
Primary	40	7.9
Preparatory	104	20.5
Secondary	171	33.7
University	43	8.5
Father's education		
Illiterate	163	32.2
Primary	28	5.5
Preparatory	64	12.6
Secondary	212	41.8
University	40	7.9
Mother's occupation		
Housewife	465	91.7
Working	42	8.3
Father's occupation		
Not working	18	3.6
Employee	103	20.3
Professional	92	18.1
Skilled	294	58.0
Home ventilation[a]		
Bad	85	16.8
Good	422	83.2
Paternal smoking at home		
Yes	291	57.4
No	216	42.6

SD = standard deviation.
[a]*Subjective assessment.*

Table 2 Health status of pneumonic children under 5 years (*n* = 507), Alexandria 2017

Quality	No.	%
Sex		
Male	335	66.1
Female	172	33.9
Age (months)		
2 months- less than one year	254	50.1
12–36 months	180	35.5
37–59 months	73	14.4
Mean (SD) (months)	18.2 (16.8)	
Nutritional status (weight for age)		
Normal	398	78.5
Underweight	78	15.4
Overweight	31	6.1
Mean (SD) (kg)	10.0 (4.4)	
Breastfeeding		
Exclusive breastfeeding	130	25.6
Non- exclusive breastfeeding	269	53.1
No breastfeeding at all	108	21.3
Vaccination status		
Fully immunized up to age	438	86.4
Partially immunized	62	12.2
Not immunized	7	1.4
First time to acquire pneumonia?		
Yes	348	68.6
No	159	31.4
If no, state no. of episodes (n = 159)		
1–2	93	58.5
3–5	52	32.7
> 5	14	8.8
The first symptoms of illness[a]		
Fever	257	50.7
Cough	210	41.4
Fast breathing/difficult breathing	256	50.5
Nasal blockage	54	10.7
Chest retraction/indrawing	40	7.9
Refusal to feed	75	14.8
Other (cyanosis, wheezes, irritability, vomiting, diarrhoea)	20	4.0

SD = standard deviation.
[a]*Multiple response variable.*

were exclusively breastfed, and the majority (86.4%) were vaccinated up to their age.

Around one-third of the children in the study had acquired pneumonia previously; 32.7% of these had experienced 3–5 episodes and 8.8% had experienced > 5 episodes (Table 2). About half of the mothers reported fast breathing/difficult breathing and fever as the first symptoms of illness followed by cough (41.1%) and refusal to feed (14.8%).

Knowledge and health-seeking behaviour of mothers

About half of the mothers (49.3%) had heard of pneumonia before the onset of their children's recent pneumonia (Table 3); in 60.8% of those who knew about pneumonia, this was because of their previous experience with their child. Pneumonia was perceived as a serious illness by nearly 70% of mothers. The most commonly recognized symptoms reported by the mothers were fast breathing/difficult breathing, fever and cough (46.7%, 21.1% and 20.0% respectively). Weather changes/cold weather, poor immunity and smoking were thought to be responsible for pneumonia by 24.1%, 17.0% and 10.8% of the mothers, respectively. Only 12.0% stated that infectious agents caused pneumonia. On the other hand, about 38% had no idea about causes.

On reviewing the mothers' health-seeking behaviour, 57.2% of the children were given home treatment before seeking medical advice. Antipyretics, cough-relieving drugs and herbs were the most frequently given medications (39.6%, 19.7% and 13.0% respectively) (Table 3). Antibiotics were given by only 4.9% of the mothers. With reference to timing of the first consultation, 26.8% of mothers waited for ≥ 2 days before seeking medical advice. Insufficient knowledge about the signs and symptoms of pneumonia/waiting until their child got better (89.0%) was the main stated reason for delay, followed by cost of health services/transportation (17.6%), unavailability of a nearby health facility (10.3%), inappropriate clinic appointments (7.3%) and previous negative experiences (6.6%).

Sociodemographic characteristics, mother's health-seeking behaviours and child's health status were compared with care-seeking timing for pneumonia. Factors that were significantly associated with delay in seeking medical care for suspected pneumonia were: living in a rural area (P = 0.006); low income (P = 0.002); treatment given at home before seeking medical advice (P < 0.001) and repeated episodes of pneumonia (P = 0.002) (Table 4).

Government hospitals/general health care units were the first source consulted by 62.7% of the mothers followed by private hospitals/clinics (35.1%) (Table 3). Only 2.2% sought help from inappropriate providers (pharmacists). In terms of mothers' compliance to the first consulted source, the majority of mothers reported high compliance practices, only 5.6% of were not compliant with the prescribed treatment (Table 5).

Table 3 Knowledge and health-seeking behaviour of mothers of pneumonic children under 5 years (*n* = 507), Alexandria 2017

Knowledge and health-seeking behaviour	No.	%
Previous knowledge about pneumonia		
Yes	250	49.3
No	257	50.7
If yes, what was their source of knowledge?[a] (n = 250)		
Previous experience	152	60.8
Relatives/neighbourhoods	89	35.6
TV/media	11	4.4
Perceived seriousness of pneumonia		
I don't know	91	18.0
Not dangerous	70	13.8
Dangerous	346	68.2
Knowledge of pneumonia symptoms[a]		
I don't know	197	38.8
Fast breathing/difficult breathing	237	46.7
Fever	107	21.1
Cough/common cold	101	20.0
Other (cyanosis, vomiting)	15	3.0
Knowledge of possible causes of pneumonia[a]		
I don't know	195	38.5
Malnutrition	14	2.8
Air pollution	42	8.3
Smoking	55	10.8
Overcrowding	24	4.7
Poor immunity	86	17.0
Weather changes/cold weather	122	24.1
Infection	61	12.0
Other (ice cream, cold water, neglect, perfumes)	27	5.3
Treatment given at home before seeking medical help[a]		
None	217	42.8
Antipyretic	201	39.6
Antibiotic	25	4.9
Herbs	66	13.0
Cough-relief drugs	100	19.7
Other (bronchodilator, antihistaminic)	37	7.3
Timing of first consultation		
First day of child illness	371	73.2
2–3 days after child illness	105	20.7
4–5 days after child illness	21	4.1
6 days or more after child illness	10	2.0
Causes of delay in seeking medical advice[a] (n = 136)		
Insufficient knowledge of signs and symptoms of pneumonia/waiting until child got better	121	89.0
Cost of health services/transportation	24	17.6
Unavailability of a nearby health facility	14	10.3
Clinic appointments are not appropriate	10	7.3
Previous negative experience	9	6.6

Table 3 Knowledge and health-seeking behaviour of mothers of pneumonic children under 5 years (*n* = 507), Alexandria 2017 *(continued)*

Knowledge and health-seeking behaviour	No.	%
Social norms	2	1.5
Others	6	4.4
Source of first consultation		
Government hospital/general health care unit	318	62.7
Private hospital/private clinic	178	35.1
Pharmacy	11	2.2

[a]*Multiple response variable.*

First medical management of pneumonia from mothers' perspective

Diagnosis of pneumonia had not been made by more than half of the first consulted sources (52.7%). Around 60% of the first consulted sources did not request investigation (Table 5). Chest X-ray was the most common request (37.1%) followed by blood tests (17.5%).

In terms of treatment prescribed by the first consulted source, two-thirds of the children (63.7%) received home treatment: antipyretics, antibiotics and cough-relieving drugs were the most commonly prescribed treatments (78.0%, 70.0% and 53.9% respectively) (Table 5). About one-quarter of the children (23.5%) were admitted directly to the hospitals in our sample and received hospital treatment; for 11% of the sample, the first consulted source referred them to a specialized hospital without prescribing treatment. Only 1.8% did not receive any treatment at all. The majority of mothers reported high compliance practices: only 5.6% did not comply with the prescribed treatment.

Discussion

This study highlighted mothers' perceived barriers in seeking and receiving the proper management of their pneumonic children. We found that nearly one-third of

Table 4 Factors associated with mother's health care-seeking timing, Alexandria 2017

Independent variable	Seeking medical advice after first day of illness (*n* = 371)		Delay in seeking medical advice (*n* = 136)		*P*-value
	Mean (SD)		Mean (SD)		
Age of mother (years)	28.44 (5.97)		28.21 (5.48)		0.682
Age of child (months)	18.93 (17.32)		16.34 (15.24)		0.124
Child order	1.94 (0.73)		2.01 (0.71)		0.303
	No.	%	No.	%	
Sex of child					0.277
Male	240	71.6	95	28.4	
Female	131	76.2	41	23.8	
Place of residence					0.006
Urban	315	75.7	101	24.3	
Rural	56	61.5	35	38.5	
Income					0.002
Not enough & borrow	84	64.6	46	35.4	
Not enough	57	67.8	27	32.2	
Enough only	218	79.0	58	21.0	
Enough and saving	12	70.5	5	29.5	
Mother's education					0.358
Illiterate	112	75.2	37	24.8	
Primary	24	60.0	16	40.0	
Preparatory	75	72.1	29	27.9	
Secondary	129	75.4	42	24.6	
University	31	72.1	12	27.9	
Treatment given at home before seeking medical help					< 0.001
No	190	87.6	27	12.4	
Yes	181	62.4	109	37.6	
First time to have pneumonia?					0.002
No	102	64.2	57	35.8	
Yes	269	77.3	79	22.7	

SD = standard deviation.

Table 5 **Medical management of pneumonia: mothers' perspective (*n* = 507), Alexandria 2017**

Medical management of pneumonia	No.	%
Diagnosis by the first consulted source		
Pneumonia	240	47.3
Common cold	202	39.9
Others (asthma, bronchiolitis)	65	12.8
Investigation requested by the first consulted source[a]		
No	305	60.1
Chest X-ray	188	37.1
Blood test	89	17.5
Other	4	0.8
Type of medical treatment received at the first consulted source		
Home treatment	323	63.7
Directly admitted to hospital and received hospital treatment (the study setting was their first consulted source)	119	23.5
Referral to specialized hospital without treatment	56	11.0
No prescribed treatment	9	1.8
***Prescribed home treatment* (n = *323*)**[a]		
Antipyretics	252	78.0
Antibiotics[b]	226	70.0
Cough-relieving drugs	174	53.9
Fluid intake	11	3.4
Others (anti-histaminic, bronchodilator, nebulizer)	69	21.4
***Explanation of prescribed treatment by the first consulted source* (n = *323*)**		
Yes	302	93.5
No	21	6.5
***Mothers' compliance with prescribed treatment* (n = *323*)**		
Yes	305	94.4
No	18	5.6

[a]*Multiple response variable.*
[b]*Median duration of prescribed antibiotics = 3 days.*

mothers had no idea about the symptoms, causes and seriousness of pneumonia. This lack of knowledge and poor perceived seriousness may be related to the high number of mothers without any formal education or any awareness about pneumonia. In accordance with our findings, poor knowledge about pneumonia (71%) has been reported in another developing country, Bangladesh (*18*). A UNICEF/WHO report showed that only 1 in 5 care givers knew the 2 tell-tale or indicative symptoms of pneumonia: fast breathing and difficult breathing (*2*).

More than half of the mothers were reluctant to seek medical advice and they tended to give treatment at home before seeking medical advice, which agrees with findings that health care in developing countries occurs at home (*19*). Most of the home treatments were related to symptomatic relief (antipyretics, cough relief drugs, herbs), which can be beneficial are but not sufficient for improving health outcomes in pneumonic children. It may imply poor perceived seriousness of the disease among the mothers.

Unexpectedly, antibiotics were used before seeking medical help by only 5% of the mothers in our study. Mothers were aware of antibiotics but expressed limited experience of handling these drugs at home without a prescription from a health provider, especially during this critical young age. This might be related to the large number of mothers with limited income, low education level and poor knowledge. However, home treatment with antibiotics has been reported in a variety of previous studies (*14,20*).

Reviewing health care-seeking timing, nearly one-quarter of the mothers reported a delay in seeking medical care. Previous studies have reported delay in the decision to seek care of 2 or 3 days (*21,22*). In the present study, the main claim for delay was mothers' insufficient knowledge about signs and symptoms of pneumonia. Similarly, Hill et al. report that, in addition to poor maternal recognition, health beliefs may also act as barriers to care-seeking for childhood illnesses; for example, some illnesses are categorized as "not for hospital", and past experience with similar illnesses can motivate mothers to play a waiting game to see if the illness subsides on its own (*23*).

It was further noted that mothers from rural areas or those with low incomes were more likely to postpone visiting health professionals. This may be explained by poorer accessibility to health care facilities (cost of health services/transportation or unavailability of a nearby health facility). Similarly, an Ethiopian study showed that more care givers in urban areas (75.0%) sought medical care for children with ARI compared with those in rural areas (34.4%) (*24*). Additionally, Noordam et al. stated that there is a strong association between wealth and care-seeking in Ethiopia, Tanzania, Nigeria and Burkina Faso (*10*).

It is not unexpected that mothers giving home treatment were more likely to delay seeking an outside health provider. Our results were similar to the findings of Pajuelo et al. and Källander et al. in Peru and Uganda (*21,25*). The latter study indicated that giving treatment at home was a risk factor for the delay in seeking medical care for fatal pneumonia (*25*).

Mothers of children with recurrent episodes of pneumonia tended to defer their health care visits. This might be related to the mothers' poor perception of the seriousness of the disease and/or using previous prescriptions at home. It is worth noting that repeated pneumonia in a child was not uncommon in the present study. Similar findings have been reported in Bangladesh and Peru (*18,21*); this may be attributed to persistent exposure to environmental risk factors such as exposure to tobacco smoke (*26,27*), overcrowding (*28*) or indoor and outdoor pollution (*29,30*).

In terms of compliance, the vast majority of the mothers (94.4%) were compliant with the health provider's instructions. This is further strengthened by the finding of Onwunaka et al in a study in Nigeria (*31*). The reason for the high compliance practices among mothers in our study could be a result of the excellent attention given by health care providers to mothers or the perceived seriousness of the disease.

Reviewing medical management, there was a lack of recognition of pneumonic children by nearly half of the first consulted sources, although most of these were medical providers. In accordance to our finding, previous studies have shown that many developing countries still face significant challenges in the provision of effective health care in the diagnosis and treatment of pneumonia (*21,32*). The diagnostic challenge of childhood pneumonia lies in the broad range of presenting features. Children can present with pneumonia at different stages of illness and with clinical features that might be difficult to discriminate from other common paediatric conditions (*33*).

Although chest X-ray is the most commonly used diagnostic tool for childhood pneumonia, nearly two-thirds of the first consulted sources did not ask for any investigation. The use of chest X-ray in the clinical context is controversial, with recent guidelines advocating that chest X-ray for the diagnosis of pneumonia in the community setting are warranted. Its use should be confined to children with clinical signs suggesting severe pneumonia who require hospitalization (*34*).

A recent UNICEF report states that only 39% of children with suspected pneumonia received antibiotics (35). In contrast, our findings showed that antibiotics were prescribed by nearly three-quarters of first consulted sources, with a median duration of 3 days. However, children were not improved and were referred to the sampled hospitals; questioning the appropriateness of the prescribed antibiotics and their efficacy.

The findings from the current study should be interpreted in light of the following limitations. The study was hospital-based, so we recruited only individuals who had actually made it to the hospital. Also, the retrospective nature of the questionnaire might have resulted in some reporting bias. Finally, the current study was susceptible to social desirability bias.

Despite these limitations, the present study indicated that the main barriers that hinder proper management of pneumonia among children under 5 years in Egypt are delay in health care-seeking, mainly due to mothers' poor knowledge about pneumonia, combined with delay in reaching the proper diagnosis and prescribing appropriate treatment by the health provider. Community-based health education campaigns complementing clinic-based Integrated Management of Childhood Illness programmes can reinforce mothers' abilities to recognize childhood pneumonia, raise awareness regarding causes, predisposing factors and preventive measures of the disease, appreciate seriousness of the disease and subsequently enhance mothers' health-seeking behaviour. Media also could play an important role in raising mothers' awareness about the disease. We believe it is imperative to embark on continuous training for health providers to improve their capability to accurately identify, diagnose and treat fast breathing and chest indrawing pneumonia with proper antibiotics and thus avoid antibiotic misuse.

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Competing interests: None declared.

Prise en charge de la pneumonie chez les enfants de moins de 5 ans à Alexandrie (Égypte) : le point de vue des mères

Résumé

Contexte : La pneumonie est l'une des causes principales de morbidité et de mortalité chez les moins de 5 ans au niveau mondial.

Objectifs : Une étude transversale a été menée pour examiner le comportement de recours aux soins et la prise en charge initiale de la pneumonie chez les enfants âgés de moins de 5 ans à Alexandrie (Égypte), du point de vue des mères.

Méthodes : Au moyen d'un questionnaire conçu à cet effet, nous avons interrogé 507 mères d'enfants atteints de pneumonie de moins de 5 ans qui avaient été admis dans quatre hôpitaux pédiatriques publics. La présente étude a été réalisée entre août et novembre 2017.

Résultats : D'après nos observations, 57,2 % des enfants avaient reçu un traitement à domicile avant de consulter un médecin. Près de 26 % des mères avaient attendu deux jours ou plus avant de consulter un médecin. Dans la majorité des cas (89 %), elles estimaient manquer de connaissances sur la maladie. Les facteurs associés de manière significative à ce retard à la consultation étaient les suivants : vie en milieu rural (p = 0,006), faibles revenus (p = 0,002), administration d'un traitement à domicile avant la consultation d'un médecin (p < 0,001) et épisodes précédents de pneumonie (p = 0,002). Le diagnostic de pneumonie n'avait pas été établi par plus de la moitié (52,7 %) des sources initialement consultées.

Conclusion : Afin de prendre en charge la pneumonie chez les enfants âgés de moins de 5 ans de manière satisfaisante, il est urgent d'améliorer les connaissances des mères et de mieux former les médecins.

العلاج الطبي للالتهاب الرئوي في الأطفال الذين تقل أعمارهم عن ٥ سنوات في الإسكندرية، مصر: من منظور الأمهات

نهى فضل، ياسمين محمد، آيات عاشور

الخلاصة

الخلفية: يُعتبر الالتهاب الرئوي من أهم أسباب المراضة والوفيات في الأطفال الذين تقل أعمارهم عن 5 سنوات على مستوى العالم.

الأهداف: هدفت هذه الدراسة إلى تقييم سلوك التماس الرعاية الصحية والعلاج الطبي الأول لحالات الالتهاب الرئوي بين الأطفال الذين تقل أعمارهم عن 5 سنوات في الإسكندرية، مصر، من منظور الأمهات.

طرق البحث: استُخدم استبيان مُصمم مسبقاً لعقد مقابلات مع 507 أمهات لأطفال مصابين بالالتهاب الرئوي وتقل أعمارهم عن 5 سنوات، والذين كانوا موجودين في 4 مستشفيات حكومية للأطفال. وقد أُجريت الدراسة في الفترة من أغسطس/ آب إلى نوفمبر/ تشرين الثاني 2017.

النتائج: تبيَّن من نتائج الدراسة أن 57.2٪ من الأطفال قد تلقوا علاجاً منزلياً قبل التماس المشورة الطبية. وانتظرت 26٪ من الأمهات لمدة يومين أو أكثر قبل التماس المشورة الطبية؛ ويرجع ذلك في الأساس في 89٪ من الحالات إلى عدم إلمام الأمهات بطبيعة المرض. وقد تضمنت العوامل التي ارتبطت ارتباطاً وثيقاً بتأخر التماس المشورة الطبية ما يلي: الإقامة في الريف (P=0.006)، وانخفاض الدخل (P=0.002)، وإعطاء علاج في المنزل قبل التماس المشورة الطبية (P=0.001 >)، والإصابة السابقة بنوبات من الالتهاب الرئوي (P=0.002). ولم يتمكن أكثر من نصف المصادر التي تمت مشاورتها أولاً من تشخيص الإصابة بالالتهاب الرئوي (52.7 ٪).

الاستنتاجات: هناك حاجة ماسة إلى تحسين معلومات الأمهات، وتدريب الأطباء على تقديم العلاج المناسب لحالات الالتهاب الرئوي في الأطفال الذين تقل أعمارهم عن 5 سنوات.

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Audit of antibiotic prophylaxis and adherence of surgeons to standard guidelines in common abdominal surgical procedures

Zakir Khan[1,3] Naveed Ahmed,[1] Shaista Zafar,[2] Asim ur Rehman[1], Faiz Ullah Khan[1,4] Muhammad Saqlain,[1] Sohail Kamran[1] and Hazir Rahman[5]

[1]Department of Pharmacy, Quaid-i-Azam University, Islamabad, Pakistan (Correspondence to: Z. Khan: zakirkhank300@gmail.com). [2]Department of Surgery, Pakistan Institute of Medical Sciences, Islamabad, Pakistan. [3]Institute of Health Sciences, Department of Pharmacology (Pharmacovigilance), Çukurova University, Adana, Turkey. [4]Department of Pharmacy Administration and Clinical Pharmacy, School of Pharmacy, Health Science Centre, Xi'an Jiaotong University, China. [5]Department of Microbiology, Faculty of Chemical and Life Sciences, Abdul Wali Khan University, Mardan, Pakistan

Abstract

Background: Prophylactic use of antibiotics before surgery is evidence-based practice for prevention of surgical site infections (SSIs).

Aims: To investigate adherence to and surgeons' perception of antibiotic prophylaxis guidelines.

Methods: A two-phase, cross-sectional prospective study conducted in two teaching hospitals. Phase 1: 6-month audit of prescriptions to investigate adherence rate to evidence-based guidelines. The important information was collected from medical charts through a predesigned proforma. Phase 2: self-administration questionnaire was used to investigate the surgeons' perception. Descriptive statistics, independent-sample Kruskal–Wallis test and multivariate linear regression analysis were performed using SPSS version 21.0.

Results: A total of 866 eligible surgical cases (acute appendectomy; n = 418; 48.2%), laparoscopic cholecystectomy (*n* = 278; 32.1%) and inguinal hernia (n = 170; 19.7%) were investigated. Surgical antibiotic prophylaxis was prescribed in 97.5% of procedures. Out of these, 9.5% adhered to guidelines with respect to correct choice, 40% for timing, and 100% for dose and route (optimal value 100%). Most patients received ceftriaxone (*n* = 503; 59.5%) as prophylactic antibiotic. The questionnaire (good internal consistency; $\alpha \geq 0.7$) was filled out by 200 surgeons. More than half (69%) of participants thought that antibiotics were overused. Most surgeons perceive that poor adherence to treatment guidelines is due to poor awareness, underestimation of infection, lack of consensus, and disagreement with guidelines recommendations.

Conclusions: Surgeons have positive perception that antibiotics should be used according to guidelines recommendations. However, we found poor treatment adherence to antibiotic prophylaxis guidelines.

Keywords: abdominal surgery, adherence, antibiotic prophylaxis, surgeons' perception, treatment guidelines

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Introduction

Globally, every year > 200 million individuals undergo surgical procedures (*1*). About 70% of the world's population belongs to low- and middle-income countries, and most of them have surgery-associated disorders (*2*). Postoperative infections are a major public health concern and account for ~7 million complications around the world (*2,3*). The most common cause of hospital-acquired infections in surgical patients is surgical site infections (SSIs), and surgical antibiotic prophylaxis (SAP) is used as standard practice to combat SSIs (*4*).

Per capita consumption of antibiotics is generally higher in high-income countries, but the greatest increase in antibiotic use between 2000 and 2010 was in low-income countries, where use continues to rise, and often, heavy use of antibiotics substitutes for infection control (*3*). It is reported that antibiotics constitute one third of all drugs used in hospitals and 80% of antibiotics are used in surgery-associated cases (*5*). Appropriate use of antibiotics provides optimal benefits, when administered for an appropriate indication, with correct choice, dose, time and duration (*4,6,7*). The antibiotic stewardship programme focuses on the appropriate use of antibiotics. Prevention of misuse, fighting against resistance, and promotion of appropriate use of antibiotics are the main goals of the stewardship programme (*8*). Various approaches being tried to tackle this health threat, such as understanding the factors that influence prescribing behaviour. Behaviour changes during prescribing are effective (*8,9*).

Despite the availability of guidelines, compliance rates with appropriate selection, timing, duration and use of antibiotics in surgical procedures are low among surgeons (*6,10*). Such practices in the healthcare system ultimately lead to increases in adverse events, antibiotic resistance, and costs of treatment (*4,6,7*). Due to the increased use of antibiotics in surgical procedures, it is necessary to address the compliance of SAP with evidence-based guidelines and investigate the perceptions of surgeons about determinants of antibiotic use.

The main objectives of this study were to compare current antibiotic prophylaxis practices with international standard treatment guidelines and evaluate the perception of surgeons in 2 tertiary care teaching hospitals in Islamabad, Pakistan.

Methods

Phase 1: observational study phase

Study design and settings

A 6-month prospective, observational, medical record-based study from January 1, 2017 to June 30, 2017 was conducted to investigate adherence of SAP practices with treatment guidelines. The study was conducted in national referral hospitals with 600 beds, providing medical facilities to Islamabad, Khyber Pakhtunkhwa, Azad Jammu and Kashmir, and Punjab.

Sample size, sampling technique and patient characteristics

According to the National Population Census 2017, the population of Pakistan was 207 776 954 and that of Islamabad 2 001 579 (https://www.citypopulation.de/php/pakistan-admin.php?adm1id=5). The minimum obligatory sample size calculated was 601 based on 95% confidence interval and 4% margin of error using the formula [n = N x/((N − 1) E2 + x)]; where N is the population size and E the margin of error. Rao soft sample size calculator was used to estimate sample size (http://www.raosoft.com/samplesize.html).

We aimed to highlight current prescribing practice; therefore, the minimum required sample size was calculated according to the World Health Organization (WHO)/International Network of Rational Use of Drugs methodology, which states a sample size of at least 600 encounters/prescriptions of patients are required to conduct a cross-sectional prospective study describing current treatment practice (*11*). Rather than specifying the number of patients, a time period was selected and all the patients who underwent 1 of 3 types of surgery in that period were enrolled according to the inclusion and exclusion criteria. A universal random sampling technique was used and patients who underwent 1 of the 3 most commonly performed abdominal surgical procedures (appendectomy, laparoscopic cholecystectomy and inguinal hernia repair) were assessed during the study period. Inpatients who met the inclusion criteria during the study period were invited to participate. After explaining the purpose and nature of the study, patients gave verbal and written consent to participate. The inclusion criteria were as follows: patients who underwent the selected abdominal surgeries; age > 16 years; and no previous infection or surgery. We excluded patients who did not give their consent and those undergoing palliative care.

Data collection tool

Medical records of selected patients were obtained and the desired information was collected on a predesigned standardized data collection form (Additional File 2). The type of surgery, details of antibiotic prophylaxis (antibiotic agents, administration route, dosage, time), and length of hospital stay were recorded.

Appropriateness and adherence to prescription guidelines

SAP was judged as appropriate if the antibiotic, dose, route and timing were in accordance with the recommendations of international guidelines (*4*,*12*). These guidelines emphasize the following aspects: (1) use of inexpensive narrow-spectrum antibiotics; (2) intravenous single dose prophylaxis; (3) administration of SAP within 1 hour before the first incision; (4) cefazolin as the first drug of choice; however, if there is allergy to beta-lactams then vancomycin or clindamycin are appropriate alternatives (metronidazole should be added against anaerobic bacteria); and (6) dose of SAP. A prescription was confirmed to be adherent to guidelines if SAP was administered as per the guidelines. All the prescriptions were evaluated against each aforementioned recommendation and adherence rate for each recommendation, that is, indication, choice, timing, route and dose, was calculated by dividing the adherent cases by total cases. A simplified scheme for reviewing the prescription of SAP to investigate adherence to the guidelines is presented in Figure 1. WHO Anatomical Therapeutic Classification was also used to report antibiotic utilization (*13*).

Phase 2: Questionnaire-based study

Study design, and study population

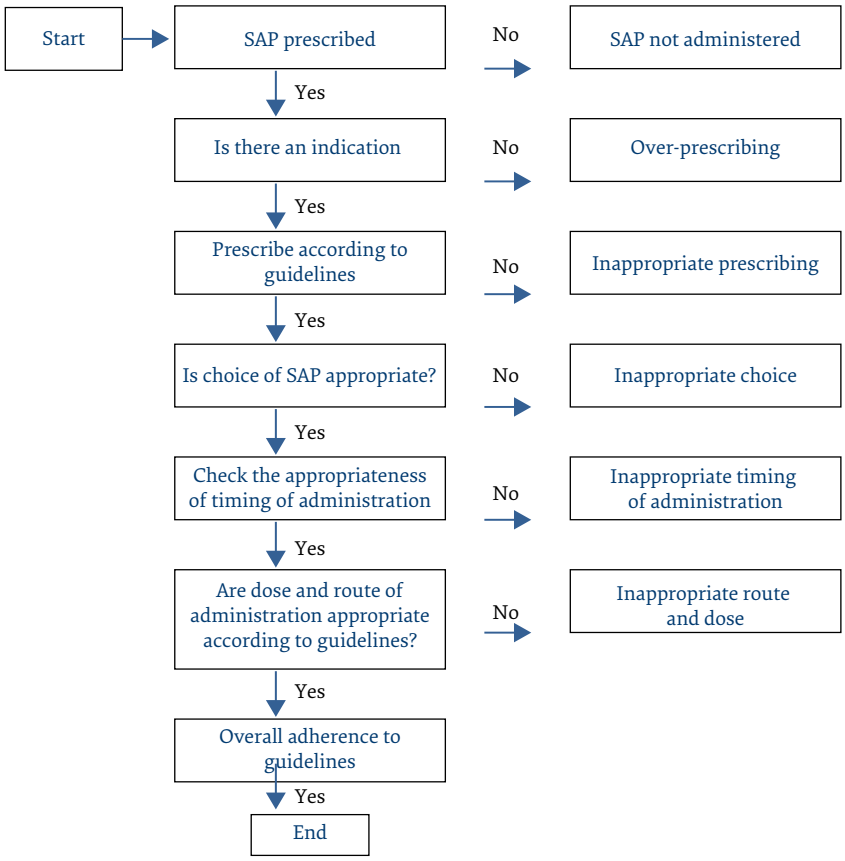
After completion of Phase 1, a 2-month prospective questionnaire-based survey was carried out to assess surgeons' perception regarding antibiotic use, guidelines adherence and other factors related to antibiotic practices. Surgeons working at the selected hospitals were recruited on a daily basis, using a simple random sampling technique, on their ward rounds by the principal investigator from July 1 to August 30, 2017. A participant information leaflet was provided to all surgeons before the study.

Data collection tool

Investigators systematically and thoroughly reviewed the available literature (*8*,*14*) for development of a self-administered questionnaire (Additional File 2). The questionnaire was modified through content and face validity. The content was further validated by 2 academic experts. For modification, feasibility, and adjustment, the questionnaire was administered to a small group of 20 prescribers (10 from each hospital). After that, the recommended modifications were included in the questionnaire.

Reliability coefficients and internal consistency were measured by Cronbach's α in SPSS version 21.0. Cronbach's α was set at 0.76. The questionnaire was divided into 2 main sections: the first included questions regarding demographic characteristics, and the second was divided into three subsections: (a) included questions regarding antibiotic use in surgical procedures; (b) included items regarding guideline adherence; and (c) included questions about the hospital pharmacist's role.

Figure 1 Steps for reviewing the prescription of surgical antibiotic prophylaxis (SAP) to assess adherence with guidelines



The responses were recorded on a 14-item Likert scale. Each item was scored separately as 1 (strongly disagree) to 5 (strongly agree); thus, total score ranged from 14 to 70, with higher scores indicating more positive perception.

Statistical analysis

Descriptive statistics were calculated as frequency and percentages for categorical variables and mean and standard deviation for numerical variables. Likert scale response often provides non-normally distributed data; therefore ,independent-sample Kruskal–Wallis tests were performed to find difference in surgeons' response to each item in the questionnaire according to demographic characteristics. Multivariate linear regression analysis was performed to find factors that affected surgeons' overall perception of antibiotic guideline adherence. $P \leq 0.05$ was defined as statistically significant. Statistical analysis was performed using SPSS version 22.0.

Ethical approval

The study was carried out in accordance with Declaration of Helsinki and approved by the Institutional Review Boards and Ethics Committees of Hospital A (Pakistan Institute of Medical Sciences, Islamabad, Pakistan: No. F.1-1/2015/ERB/SZABMU/), Hospital B (Shifa international hospital Islamabad, Pakistan: No. IRB-637-085-2016) and the Bioethical Committee of the Quaid-i-Azam University, Islamabad, Pakistan: No. DFBS/2016-623) (Additional File 3).

Results

Phase 1

Pattern of surgical procedures

A total of 1015 patients underwent common abdominal surgery. Among these, 149 (14.7%) were excluded due to incomplete medical records (n = 62), having previous surgery (n = 34) and age < 16 years (n = 53). Finally, 866 cases were recruited for the present study. Appendectomy (n = 418; 48.2%) was the most commonly performed operation followed by laparoscopic cholecystectomy (n = 278; 32.1%) and inguinal hernia repair (n = 170; 19.7%).

SAP practice according to guidelines

SAP was prescribed in 845 (97.5%) surgical procedures (Table 1). However, appropriate antibiotics according to evidence-based guidelines were given to only 80 (9.5%) patients. Seven hundred and sixty-five (90.5%) patients received the wrong antibiotics with respect to guidelines, and they were not included in the calculation of the correct dose. Of the 80 patients to whom the correct antibiotic was administered, the right dose was administered in all cases. The route of administration was correct and according to recommendations. The timing of SAP was according to guidelines in 40% of patients (within 1 hour before surgical incision).

Table 1 Antimicrobial prophylaxis practices in surgery (*n* = 866)

Surgical antibiotic prophylaxis practices	Appendectomy *n* (%)	Laparoscopic cholecystectomy *n* (%)	Inguinal hernia *n* (%)	Total *n* (%)	Optimal values
Use of antibiotics	418 (100)	267 (96)	160 (94)	845 (97.5)	100%
Nonuse of antibiotic	0 (0)	11 (4)	10 (6)	21 (2.5)	0%
Antibiotic correct choice	35 (8.4)	27 (10.1)	18 (11.2)	80 (9.5)	100%
Correct dose	35 (100)	27 (100)	18 (100)	80 (100)	100%
Intravenous administration	418(100)	267 (100)	160 (100)	845 (100)	100%
Timing					
30–60 min before incision	162 (38.7)	109 (40.8)	67 (41.9)	338 (40)	100%
More than 30–60 min before incision	256 (61.3)	158 (59.2)	93 (58.1)	507 (60)	100%

Pattern of antibiotics prescribed as SAP

Details of prescribed SAP are listed in Table 2. The most commonly prescribed class of antibiotics was cephalosporins. In the case of individual antibiotics, ceftriaxone was the most frequently prescribed, to 503 (59.5%) patients.

Table 2 Frequency and percentages of various SAP prescribed in selected surgical procedures

SAP (dose)	WHO/ATC code	Hospital A *n* (%)	Hospital B *n* (%)
	Appendectomy		
Ceftriaxone (2 g)	J01XD04	195 (84)	128 (68.8)
Cefoperazone+sulbactam (1g)	J01DD62	18 (7.7)	29 (15.6)
Ceftriaxone (2 g) + metronidazole	J01XD04+ J01XD01	6 (2.6)	22 (11.8)
Ciprofloxacin (500 mg)	J01MA02	5 (2.1)	4 (2.1)
Cefazolin (2 g)	J01DB04	4 (1.7)	3 (1.6)
Piperacillin + sulbactam (4.5 g)	J01CR05	4 (1.7)	–
Total		232 (100)	186 (100)
Laparoscopic cholecystectomy			
Ceftriaxone (2 g)	J01DD04	79 (50.9)	64 (52)
Cefuroxime (1.5 g)	J01DC02	23 (14.8)	–
Azithromycin (500 mg)	J01FA10	19 (12.2)	27 (21.9)
Cefazolin (2 g)	J01DB04	16 (10.3)	11 (8.9)
Amoxicillin + clavulaunic acid (1.2 g)	J01CR02	8 (5.1)	7 (5.7)
Amikacin (500 mg)	J01GB06	3 (1.9)	1 (0.8)
Piperacillin + sulbactam (4.5 g)	J01CR05	–	9 (7.3)
Nonuse of SAP	–	7 (4.5)	4 (3.2)
Total		155 (100)	123 (100)
Inguinal hernia			
Amoxicillin + clavulaunic acid (1.2 g)	J01CR02	41 (42.7)	33 (44.6)
Cefuroxime (1.5 g)	J01DC02	8 (8.3)	15 (20.3)
Ceftriaxone (2 g)	J01DD04	25 (26)	12 (16.2)
Amikacin (500 mg)	J01GB06	–	8 (10.8)
Cefazolin (2 g)	J01DB04	14 (14.6)	4 (5.4)
Nonuse of SAP	–	8 (8.3)	2 (2.7)
Total		96 (100)	74 (100)

Terms in bold are drugs of choice for selected surgeries according to evidence-based guidelines. SAP = surgical antibiotic prophylaxis; WHO/ATC = World Health Organization/Anatomical Classification System.

Phase 2

Demographic characteristics of surgeons

There were more male (*n* = 110; 55%) than female (*n* = 90; 45%) prescribers. There were more respondents aged < 30 years (*n* = 171; 85.5%) than >30 years (*n*=29; 14.5%). Level of education was associate degree (*n* = 93; 46.5%), bachelor's degree (*n* = 80; 40%) and postgraduate degree (*n* = 27; 13.5%). The highest proportion of respondents had < 10 years' experience (*n* = 148; 74%) as compared to 11–20 years (*n* = 48; 24%) and >20 years (*n* = 4; 2%).

Surgeons' perception of antibiotic guideline adherence

Strongly positive perceptions regarding many factors were demonstrated by all participants (Table 3). Most surgeons agreed that antibiotics are overused in surgical procedures. A total of 194 (97%) surgeons agreed that they preferred broader-spectrum antibiotics instead of low spectrum antibiotics in a surgical procedure. One hundred and eighteen (59%) surgeons agreed that low availability of antibiotics in the hospital pharmacy affected the choice of antibiotics according to guidelines.

One hundred and twenty-eight (64%) surgeons agreed that evidence-based guidelines should be followed before prescribing antibiotics in surgery; 186 (93%) agreed that prescribing antibiotics without evidence-based guidelines is responsible for a high financial burden on patients; 135 (67.5%) agreed that lack of consensus by surgeons about the recommendation in the guidelines is a factor for inappropriate use of antibiotics; and nonavailability of consensus local hospital guidelines was reported by 193 (96.5%). A total of 194 (97%) surgeons agreed about the important and crucial role of the hospital pharmacist in the development of evidence-based guidelines.

The significant relationship between sex, age, final academic degree, experience and hospital setting and all items in the questionnaire was invetigated through independent-sample Kruskal–Wallis tests analysis. Many factors were statistically significant ($P < 0.05$)

Table 3 Surgeons perception regarding guidelines adherence and other determinants (Questionnaire Section 2)

Variables	Strongly disagree	Response, n (%)		Agree	Strongly agree
		Disagree	Uncertain		
Section A: Antibiotic-related items					
Q1: Antibiotics are overused in surgical procedures?	0 (0)	2 (1)	60 (30)	126 (63)	12 (6)
Q2: Do you prefer broader-spectrum antibiotics instead of low spectrum antibiotics in surgical procedure?	2 (1)	1 (.5)	3 (1.5)	170 (85)	24 (12)
Q3: Does low availability of antibiotics in the hospital pharmacy affect the choice of an antibiotic according to guidelines?	1 (.5)	17 (8.5)	64 (32)	109 (54.5)	9 (4.5)
Section B: Guideline-adherence-related items					
Q4: Do you agree to prescribed antibiotic prophylaxis with accurate choice, dose and timing according to guidelines?	1 (.5)	0 (0)	17 (8.5)	171 (85.5)	11 (5.5)
Q5: Evidence-based guidelines should be followed before prescribing antibiotics in surgery?	0 (0)	24 (12)	48 (24)	92 (46)	36 (18)
Q6: Prescribing antibiotics without evidence-based guidelines is responsible for a high financial burden on patients?	2 (1)	9 (4.5)	3 (1.5)	162 (81)	24 (12)
Q7: Poor awareness about guidelines is a cause of irrational use of antibiotics in surgery?	1 (.5)	29 (14.5)	48 (24)	94 (47)	28 (14)
Q8: Is lack of consensus by surgeons about the recommendations in the guidelines a factor in inappropriate use of antibiotics?	0 (0)	27 (13.5)	38 (19)	107 (53.5)	28 (14)
Q9: Disagreement with guidelines is a contributing factor for inappropriate use of antibiotics?	0 (0)	50 (25)	43 (21.5)	92 (46)	15 (7.5)
Q10: Underestimation of infection rate is a factor for nonadherence with guidelines?	1 (.5)	1 (.5)	21 (10.5)	169 (84.5)	8 (4)
Q11: Are guidelines good educational tools and a convenient source of advice?	0 (0)	14 (7)	29 (14.5)	126 (63)	31 (15.5)
Q12: I use the guidelines on a daily or weekly basis?	0 (0)	3 (1.5)	42 (21)	125 (62.5)	30 (15)
Q13: There are no available hospital-based guidelines for antibiotic use in surgery?	1 (.5)	0 (0)	6 (3)	167 (83.5)	26 (13)
Section C: Hospital-pharmacist-role-related item					
Q14: Hospital pharmacists can play an important role in development of evidence-based hospital guidelines?	0 (0)	0 (0)	6 (3)	51 (25.5)	143 (71.5)

(Additional File 4). Multivariate linear regression analysis was applied to find factors that affected surgeons' overall perception score (Table 4). Age, final academic degree, hospital settings and work experience were independent predictors ($P < 0.05$) of positive perception towards antibiotics use.

On comparison of findings of the 2 phases of the study (Tables 2 and 3), there was a difference between perception and prescribing behaviour of surgeons toward evidence-based prescribing. Assessment of prescriptions showed poor adherence to treatment guidelines, while most surgeons had a positive perception toward rational prescribing as per guideline recommendations.

Discussion

The current study focused on assessment of adherence to and surgeons' perceptions of SAP guidelines. We observed a substantial proportion of inappropriate SAP practices with evidence-based standard treatment guidelines. Findings revealed poor compliance to treatment guidelines, with only 9.5% (n = 80) of patients receiving SAP as per guidelines. These findings are consistent with other studies conducted in Italy (*15*) and Brazil (*16*), which reported adherence rate of 5.7% and 3–5.8%, respectively. However, in contrast, higher adherence rates were reported in Qatar (68%) (*17*), India 52% (*18*) and Philippines (44%) (*19*). To ensure appropriate use of SAP, the first step is to provide educational training with an antibiotic stewardship programme and awareness regarding its importance. Previous studies have demonstrated the benefits of educational intervention for appropriate antibiotic prophylaxis. Studies in Nigeria (*10*) and Italy (*15*) found that compliance with antibiotic prophylaxis guidelines improved with increased awareness among surgeons and other healthcare team members.

Appropriate timing of administration of SAP was 40% (n = 338) in our study. Mixed results were found in the literature. The current findings are comparable with studies in the Philippines and Australia (*19*, *20*). Studies in Northern Nigeria (16.5%) (*10*) and Egypt (5%) (*21*) reported lower adherence rates, whereas higher adherence rates were reported in Jordan (99%) (*22*), France (76.6%) (*23*) and Palestine (60%) (*24*). This is evidence that delayed administration of SAP is associated with a 2 times greater risk of SSIs as compared to timely administration (*10*). Appropriate time of administration of SAP could also reduce the duration of stay and hospitalization cost (*4*,*12*).

A possible explanation of the poor adherence rate in the present study is nonavailability of standard guidelines and protocols for antibiotic prophylaxis in these hospitals (*10*,*25*). Lack of knowledge, unavailability of clinical pharmacists and poor collaboration with healthcare teams are other possible reasons for noncompliance. Further, large scale and multicentre studies are needed to identify other contributing factors to noncompliance.

The most commonly prescribed SAP was ceftriaxone, which was administered to 503 (59.5%) cases. In line with our findings, studies in Ethiopia (*6*) and Turkey (*26*) also reported that ceftriaxone was excessively and inappropriately used in their settings. Antibiotics should be cost-effective, nontoxic and with a limited spectrum (*4*, *24*). Cefazolin is sufficient to cover pathogens involved in SSI. Inappropriate use of antibiotics provides a favourable environment for microbial resistance and increases the possibility of adverse reactions (*4*,*12*). However, we observed a low level of cefazolin use in our study, which is in line with studies in the Islamic Republic of Iran (*27*) and Saudi Arabia (*28*). These findings revealed that the surgical team is not keeping up to date with standards of best practice.

The second phase of our study aimed to assess surgeons' perception regarding antibiotic prescribing according to standard guidelines in surgical wards in Pakistani hospitals. Most of the respondents perceived that overuse of antibiotics, preference of broad-spectrum antibiotics and nonavailability of antibiotics were the main problems in surgical wards. Similar findings are also reported in other studies worldwide (*8*,*14*,*18*). Studies in Malaysia and India reported that surgeons perceived that broad-spectrum antibiotics with long duration are more effective than narrow-spectrum antibiotics (*14*,*18*). These findings are important to address because overuse, broad-spectrum antibiotics, and nonavailability problems have a potential impact on patient care and infection control activities.

The importance of evidence-based treatment guidelines cannot be denied. Prescribers scored highly for the guideline adherence items in the current study, which suggests a general acceptance of evidence-based guidelines. Guideline adherence scores were similar to other studies conducted in the United Kingdom of Great Britain and Northern Ireland (*8*) and France (*29*). This reflects a positive attitude and preference of prescribers towards guidelines. Standard treatment guidelines are crucial for rational use of therapy. Updated and evidence-

Table 4 Multivariate linear regression analysis to find factors affecting surgeons overall perception

Variables	β	Standard error	*t*	*P*
Age	−3.439	0.987	−3.484	0.001
Sex	0.559	0.593	0.943	0.347
Final academic degree	1.410	0.476	2.962	0.003
Work experience	1.904	0.760	2.505	0.013
Hospital setting	−2.688	0.581	−4.625	0.000

Bold values shown significant factors.

based guidelines should be provided to prescribers that ultimately enhance effective and quicker appropriate use of antibiotics (*30*). Most of the participants in our study reported that they used guidelines on a daily basis but also reported nonavailability of hospital-based local guidelines. Similar results were reported in the Philippines (*31*). Although positive attitudes towards guidelines were shown in our study they had a limited impact on practice. However, the reasons behind nonadherence to guidelines in our study may be lack of awareness of appropriate guidelines, lack of consensus by the surgeons with the guidelines, ineffective distribution system for the latest version of guidelines, and lack of regular educational training sessions (*14*).

The current findings of alarmingly low adherence rates to treatment guidelines imply that serious practical measures should be taken by hospital administrators and policy-makers to improve prescribing practice. Poor prescribing practice results in poor treatment outcomes and serious consequences such as higher incidence of adverse reactions, waste of resources and increased treatment costs. Most surgeons perceived that local hospital-based treatment guidelines are a prerequisite to improve prescribing practice and ultimately patient care. Also, measures should be taken to fill the gap between prescribers' perception and practice. Pharmacists could play a vital role in the development of evidence-based hospital guidelines and antibiotic stewardship programmes (*32–34*). Most of the participants in our study agreed about the important role of hospital pharmacists in the development of guidelines. However, in our setting, the pharmacists' role was mainly confined to dispensing drugs and not development of guidelines and decision-making. There is an urgent need for policies to be implemented by governments, hospital administrations and clinical teams of surgeons to acknowledge and support the vital role of hospital pharmacists. Prolonged working time, decreased workload and increased numbers of hospital pharmacists may be important strategies to monitor antibiotic use and development of guidelines for surgical patients. Such interventions are the key to success of antimicrobial stewardship programmes (*33*).

The current study had access to well-reported data on SAP and was adequately powered; however, some limitations must be acknowledged. First, the present study only focused on compliance rate of SAP in 3 common surgical procedures. Second, we used published recommendations of evidence-based international guidelines to measure against the appropriate use of SAP in selected operations because there were no local consensus guidelines available in both hospitals. However, the possibility exists that recommendations given by the guidelines were not practicable in our patients or for the situation in Pakistan. Third, the study did not monitor postoperative infection rate. Therefore, we do not know if nonadherence to the guidelines had any clinical consequences. Moreover, the questionnaire was only distributed to 2 tertiary care hospitals in Islamabad. Therefore, these findings cannot be generalized for the whole country. However, these findings do add useful information, particularly around appropriate antibiotic use, adherence to standard guidelines, perception of surgeons, and factors that affect antibiotic prescribing in surgery and health systems in developing countries.

Conclusions

Our findings indicates poor adherence to evidenced-based guidelines for administration of SAP. Surgeons have positive perception that antibiotics should be used according to guideline recommendations. Most surgeons perceive that poor adherence to treatment guidelines is due to poor awareness, underestimation of infection, lack of consensus and disagreement with guideline recommendations. The results provide evidence that healthcare providers should be aware of their larger role in reducing inappropriate antibiotic prescription prior to surgery. Good prescribing practices are crucial for patient safety and better health outcomes, although prescribers still rely on their own personal experiences while prescribing therapeutic agents. Compliance with guidelines by surgeons remains a challenge, as reported by previous studies worldwide and in the present study. Nonadherence with guidelines may have increased antibiotic resistance and healthcare-associated infection rates. Real actions are urgently needed for the implementation of guidelines and to address the related factors of such practices. Continuous educational training, availability of appropriate antimicrobials, and implementation of local and international treatment guidelines and antimicrobial stewardship programmes are required for appropriate utilization of SAP. Furthermore, our findings suggest that large-scale multicentre studies should be conducted to evaluate the factors that affect antibiotic prescribing across the provinces of Pakistan.

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Audit de l'antibioprophylaxie et de l'observance des lignes directrices standard par les chirurgiens dans les actes courants de chirurgie abdominale

Résumé

Contexte : L'usage prophylactique des antibiotiques préalablement à un acte chirurgical est une pratique fondée sur des données probantes, qui permet de prévenir les infections du site opératoire (ISO).

Objectifs : Étudier l'observance des lignes directrices en matière d'antibioprophylaxie et le point de vue des chirurgiens sur cette pratique.

Méthodes : Une étude prospective transversale en deux phases, a été menée dans deux hôpitaux universitaires. Phase 1 : Audit des ordonnances sur six mois, afin d'évaluer le taux de d'observance des lignes directrices fondées sur des données probantes. Les informations importantes ont été recueillies à partir des dossiers médicaux au moyen d'un formulaire conçu à cet effet. Phase 2 : un auto-questionnaire a été utilisé pour étudier le point de vue des chirurgiens. Des statistiques descriptives ont été produites, un test de Kruskal-Wallis sur échantillons indépendants et une analyse de régression linéaire multivariée ont été réalisés à l'aide du logiciel SPPS, version 21.0.

Résultats : Au total, 866 cas chirurgicaux répondant aux critères de l'étude ont été examinés : appendicectomies aiguës, (n = 418, soit 48,2 %), cholécystectomies laparoscopiques, (n = 278, soit 32,1 %) et hernies inguinales (n = 170, soit 19,7 %). Une antibioprophylaxie chirurgicale a été prescrite dans 97,5 % des interventions. Parmi ces dernières, le respect des lignes directrices était de 9,5 % pour le choix de l'antibiotique, de 40 % pour le moment de l'administration et de 100 % pour la dose et la voie d'administration, la valeur optimale étant 100 %. La majorité des patients ont reçu de la ceftriaxone (n = 503, soit 59,5 %) comme antibiotique prophylactique. Le questionnaire a été rempli par 200 chirurgiens, avec une cohérence interne satisfaisante ($\alpha \geq 0,7$). Plus de la moitié (69 %) des participants estimaient que les antibiotiques étaient surutilisés. La majorité des chirurgiens pensent que l'observance médiocre des lignes directrices de traitement est due à un manque de sensibilisation, à une sous-estimation de l'infection, à l'absence d'un consensus et à un désaccord avec les recommandations de ces lignes directrices.

Conclusions : Les chirurgiens approuvent l'usage des antibiotiques conformément aux recommandations des lignes directrices de traitement. Cependant, notre étude révèle une observance médiocre de ces textes dans les traitements d'antibioprophylaxie.

مراجعة استعمال المضادات الحيوية الوقائية ومدى امتثال الجراحين للمبادئ التوجيهية القياسية في الإجراءات الجراحية المعتادة في منطقة البطن

ذاكر خان، نافيد أحمد، شايستا ظفار، عاصم الرحمن، فايز الله خان، محمد صقلان، سُهيل قامران، حاضر رحمن.

الخلاصة

الخلفية: يُعتبر استعمال المضادات الحيوية على سبيل الوقاية قبل الجراحة من الممارسات المُسنَدة بالبيّنات للوقاية من حدوث عدوى المواضع الجراحية.

الأهداف: هدفت هذه الدراسة إلى تحرّي مدى الامتثال للمبادئ التوجيهية الخاصة باستعمال المضادات الحيوية الوقائية ومنظور الجراحين في هذا الشأن.

طرق البحث: أُجريت دراسة استباقية مقطعية على مرحلتين في اثنين من المستشفيات الجامعية. المرحلة 1: مراجعة الوصفات الطبية التي حُررت على مدار 6 أشهر لتحري معدل الامتثال بالمبادئ التوجيهية المُسنَدة بالبيّنات. وجُمعت المعلومات المهمة من المخططات الطبية للمرضى باستخدام استمارة مُصمَّمة مسبقاً لهذا الغرض. المرحلة 2: استخدام استبيان يُستكمل ذاتياً لتحرِّي منظور الجراحين في هذا الشأن. وقد استُخدم الإصدار 21.0 من برنامج SPSS لإجراء إحصاءات وصفية، واختبار كروسكال واليس القائم على العينات المستقلة، وتحليل الانحدار الخطي المتعدد المتغيرات.

النتائج: بلغ مجموع الحالات الجراحية التي تصلح للخضوع لهذه الدراسة 866 حالة، تراوحت بين استئصال الزائدة الدودية الملتهبة التهاباً حاداً (العدد=418؛ 48.2٪)، واستئصال المرارة بالمنظار (العدد= 278؛ 32.1٪)، والفتق الأربي (العدد=170؛ 19.7٪). وقد وُصفت المضادات الحيوية الوقائية في 97.5٪ من الإجراءات الجراحية. ومن بين هذه الإجراءات الجراحية، كانت نسبة الامتثال للمبادئ التوجيهية من حيث الاختيار الصحيح، والتوقيت، والجرعة والمسار 9.5٪، و40٪، و100٪ على التوالي (القيمة المُثلى 100٪). وتلقى معظم المرضى دواء سيفترياكسون (العدد= 503؛ 59.5٪)، بوصفه أحد المضادات الحيوية الوقائية. وقد أجاب عن الاستبيان 200 جراح (اتساق داخلي جيد؛ $\alpha \geq 0.7$). ورأى أكثر من نصف الجراحين المشاركين في الاستبيان (69 ٪) أن هناك زيادة في استعمال المضادات الحيوية. كما رأى معظم الجراحين أن السبب وراء ضعف الامتثال بالمبادئ التوجيهية للعلاج يرجع إلى ضعف الوعي، وعدم تقدير الحجم الحقيقي للعدوى، وغياب التوافق في الآراء، والاختلاف مع التوصيات الخاصة بالمبادئ التوجيهية.

الاستنتاجات: لدى الجراحين منظور إيجابي بشأن ضرورة استعمال المضادات الحيوية وفقاً لما ورد في التوصيات الخاصة بالمبادئ التوجيهية، لكن لوحظ ضعف الامتثال للمبادئ التوجيهية الخاصة بالعلاج بالمضادات الحيوية الوقائية.

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Comparison of validity of the Food Frequency Questionnaire and the Diet History Questionnaire for assessment of energy and nutrients intakes in an Iranian population

Fatemeh Toorang,[1,2] Bahareh Sasanfar,[1] Ahmad Esmaillzadeh,[2,3,4] Soraiya Ebrahimpour-Koujan[2] and Kazem Zendehdel[1,5,6]

[1]Cancer Research Center; [5]Cancer Biology Research Center; [6]Breast Diseases Research Center, Cancer Institute of Iran; [2]Department of Community Nutrition, School of Nutritional Sciences and Dietetics; [3]Obesity and Eating Habits Research Center, Endocrinology and Metabolism Molecular-Cellular Sciences Institute, Tehran University of Medical Sciences, Tehran, Islamic Republic of Iran (Correspondence to: Kazem Zendehdel: kzendeh@tums.ac.ir). [4]Department of Community Nutrition, School of Nutrition and Food Science, Isfahan University of Medical Sciences, Isfahan, Islamic Republic of Iran.

Abstract

Background: Dietary intakes are important for development and prevention of chronic disease. The Food Frequency Questionnaire (FFQ) has been suggested as an acceptable feasible method for assessing the association of dietary intake and disease. However, FFQs are sensitive to dietary habits and culture and should be valid in the study population.

Aims: We investigated the validity of the Diet History Questionnaire (DHQ) and the Food Frequency Questionnaire in healthy Iranians.

Methods: Participants were healthy relatives of cancer patients in the Cancer Institute of Iran. They participated in face-to-face interviews. We took telephone based 24-hour recalls every 2 months over a 1-year period. Assuming the mean intakes of 24-hour recalls as the gold standard, we estimated Pearson correlation coefficients to measure the reliability of the FFQ and the DHQ. We investigated how the FFQ or DHQ categorized individuals in different intake groups comparing with the 24-hour recalls.

Results: Overall, 102 subjects took part in our study. Deattenuated Spearman correlations were ≥ 0.5 for energy, carbohydrate, protein, carotene, niacin, folate, vitamin B_{12}, biotin, vitamin C, iron, zinc and selenium in both DHQ and FFQ. Level of agreement with 24-hour recall in classifying individuals into different categories of intakes ranged from 0.81 for riboflavin and carotene to 0.92 for carbohydrate and zinc in the DHQ and from 0.75 for riboflavin to 0.96 for carbohydrate in the FFQ.

Conclusions: Both DHQ and FFQ were valid in assessing most nutrient intakes and classifying individuals in different categories of intakes in the Iranian population.

Keywords: food frequency questionnaire, diet history questionnaire, validation

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Introduction

Dietary intakes are increasingly recognized as key contributing factors in the development of several chronic diseases (*1*). However, assessment of long-term dietary intakes in epidemiologic studies is always challenging (*2,3*).

The Food Frequency Questionnaire (FFQ) has been suggested as an acceptable (and the most feasible) method for collecting usual dietary intake data in epidemiologic studies (*4*). Several valid FFQs are available in the Islamic Republic of Iran, however, most have been designed for special groups or were used for assessing only a few nutrients or food groups. Two of these FFQs were used in the Golestan Cohort Study and the Tehran Lipid and Glucose Study (*5,6*). Both were designed to examine usual dietary intakes that are related to the risk of cancer or cardiovascular disease. The validity of the FFQ in the Golestan Cohort Study has been examined only in Golestan province, a small state in the northern part of the country (*5*); the one in the Tehran Lipid and Glucose Study has been validated for people living in Tehran (*6*), however, FFQs are sensitive to the dietary habits and dietary culture of the studied population (*7*). It seems that these FFQs are not appropriate for capturing dietary data from a socioeconomically diverse population with a wide range of variations in dietary intake. It must also be borne in mind that these FFQs do not have information on cooking methods, which might be an important contributing factor to disease incidence (*4*).

We developed a new FFQ for finding dietary determinants of cancer, based on the one suggested by American National Cancer Institute, in which we incorporated a food list along with questions about dietary habits and cooking methods. Its innovative ability to measure added fats and cooking methods makes it superior to available FFQs (*8*). However, its validity needs

to be examined before application in large-scale studies in the country.

This study aimed to examine the validity of a newly developed Diet History Questionnaire (DHQ) against 24-hour recall to assess energy and nutrient intakes in healthy Iranian participants. We also compared the accuracy of the DHQ and the Golestan FFQ for estimating nutrient intakes in this study.

Methods

Study participants

We recruited 102 apparently healthy adults aged 20+ years who were selected from relatives of patients admitted to the Cancer Institute in Tehran between April 2011 and February 2012. According to Willet, the number of participants required to detect validation of a food frequency questionnaire is 110; a sample size larger than 150 subjects provides little additional precision and precision level in validation studies with less than 30 subjects is unacceptable (3). We initiated the study with larger sample size as we expected a sizable number would be lost to fallow-up. We recruited individuals from different age groups in 5-year strata. The participants were recruited after evaluation of the study criteria and signing written informed consent. Required information on demographic variables and medical history was obtained via a questionnaire. Exclusion criteria were pregnancy or lactation among women or being on a special diet for any reason.

Developing food questionnaires

The DHQ was developed by a group of nutritionists based on the Diet History Questionnaire of the American National Cancer Institute. Initially, a comprehensive list of food and mixed dishes was prepared based on earlier studies in the country (5,6). Then, those with greater nutrient density and the highest frequency consumption were included in the questionnaire. We also considered foods that contributed to between-person variations. Ultimately, this DHQ comprised 146 main questions related to mixed dishes and food items. For each food item in the questionnaire, multiple choice frequency response categories along with specified portion sizes were included. Frequency response categories were not the same for all items, varying from never to every day, and the number of choices was increased for more frequent foods like bread. Portion sizes were chosen based on normal portion size of that food item in the community. We also included questions along with every food item about dietary habits, including some information on fat content and cooking methods.

The FFQ was a 116-item semi-quantitative questionnaire asking about average frequency and portion size. It is based on food items rather than mixed dishes. Both the FFQ and the DHQ probe information related to average consumption during the previous 12 months.

Study protocol

The study was approved by the ethical committee of Tehran University of Medical Sciences. The interviewer explained the study procedures and obtained written informed consent from all participants. Face-to-face interviews were conducted to complete the DHQ. These were carried out by interviewers who had a degree in public health from the Cancer Institute of Iran. Subsequently, the participants were asked to take part in an additional interview to complete the FFQ one week after the first interview. It took about 45 minutes to complete the DHQ and 35 for the FFQ.

After this, participants were called by trained nutritionists every 2 months for one year to report their 24-hour food recalls. Each recalls interview took around 40 minutes. In all, 105 participants completed all the recalls. The participants provided detailed descriptions of each food, including the method of preparation and recipe for mixed dishes. All DHQ, FFQ and 24-hour recalls were checked by a trained nutritionist and incomplete questionnaires were rechecked through a phone call.

We used home measures such as spoon, ladle, platter, plate or bowl to help people remember the amount they ate. For mixed dishes, we asked women about how much of each ingredient they used to make the dish and how much they ate from it. For men, we asked questions related to the cooking methods and ingredients of mixed dishes from the person who was responsible for preparing the food.

Calculation of food and nutrient intakes

All questionnaires and recalls were checked by a trained nutritionist. Recalls were converted to grams/day and proper codes from a food composition table were allocated to each food by trained nutritionists in accordance with uniform procedures. As the Iranian food composition table is only for raw foods and covers limited nutrients and foods, we used the translated version of McCance and Widdowson's food composition table (9). However, we used the Iranian food composition table for some traditional Iranian foods such as *kashk* (10). For analysing mixed dishes, the ingredients reported by the participants were considered. For the DHQ, mixed dishes were analysed based on a standard recipe, modified based on recalls.

Data from the FFQ and DHQ were converted into grams/day in separate programs devised by the authors in *STATA* statistical software. Consumption of seasonal foods like fruits were asked based on their use in season and daily intakes were estimated according to the season these foods were available. For example, we asked. "How many times are you eating a given fruit (for instance peach) when it is available". The availability of each type of fruit was then discussed among a group of nutritionists and we determined the number of months each fruit was available in a given time, then we considered the frequency for 3 months of the year rather than whole year. For the DHQ, participants were asked 2

questions about each food item, one about the season the food item was easily accessed in the market and another about other occasions. In both the DHQ and FFQ, we used the median portion size in cases where there was no answer to the portion size question. Based on grams of foods, we computed total energy and nutrient intakes for each participant.

Statistical analysis

Mean, median and standard deviation of intakes estimated by DHQ, FFQ and 24-hour recalls were reported. The log transformed data was used to reduce skewedness. Data were re-checked and cleaned after initial entry and after each step of the analysis. We excluded data from energy intakes outliers (3 persons) where the energy intake was > 2 standard deviations (SDs) from the mean. They constituted less than 5% of participants and correlations were not extremely affected by the exclusion. All statistical analyses were performed in *STATA*, version 11.2.

The validity of FFQ and DHQ was estimated by comparing data with the average of 5 days of 24-hour recalls using Pearson correlation coefficients (*11*). Nutrient intakes were adjusted for energy intake and age using the residual method. Since reference methods like food records or 24-hour recalls are subject to day-to-day variations in dietary intake, the correlation between data from FFQs and dietary recall might be underestimated (*12*). Therefore, deattenuated correlation coefficients were estimated to modify the within-person variations in recalls (*13,14*). To estimate the attenuated correlations, we estimated within- and between-person variations by 1-way analysis of variance, then we used the formula suggested by Willet for the calculation of deattenuated correlation coefficients (*13*).

We also classified participants in terms of their dietary intakes into tertiles. Then, we investigated how FFQ or DHQ allocated individuals in different intake groups, considering the 24-hour recalls as the standard method. We reported the results as percentage disagreement, adjacent agreement, and complete agreement. Agreement was computed by summing adjacent agreement and complete agreement.

Results

The mean age of the 102 participants in our study was 43.2 (SD 12.2) years. There were 62 males and 40 females. Their characteristics are shown in Table 1.

Estimated intakes of energy and nutrients by the 3 methods are shown in Table 2. The average energy intake was higher using the FFQ (2943 kcal) than recall (2762 kcal) and DHQ (2027 kcal). Participants reported the highest intakes of carbohydrate and protein in their recalls. The highest fat intake was estimated based on data from the FFQ.

Crude Spearman correlation coefficients between DHQ and 24-hour recall ranged from 0.15 for riboflavin to 0.55 for carbohydrate (Table 3). Deattenuated Spearman correlation coefficients between DHQ and 24-hour recall ranged from 0.31 for fat to 0.87 for biotin. Crude Spearman correlation coefficients between FFQ and 24-hour recall ranged from 0.02 for riboflavin to 0.61 for carbohydrate. Deattenuated Spearman correlation coefficients between DHQ and 24-hour recall ranged from 0.03 for riboflavin to 0.74 for iron.

Table 1 Characteristic of Iranian adult participants (*n* = 102) in the validity study for the Food Frequency Questionnaire and the Diet History Questionnaire

Characteristic	No.	%
Marital status		
Single	20	19.6
Married	82	80.4
Sex		
Male	62	60.8
Female	40	39.2
Education level		
Illiterate	2	2.0
Lower than high school	34	35.1
High school	35	36.1
University	27	27.8
	Mean	**SD**
Age (years)	43.2	12.3
Body mass index (kg/m^2)	25.3	0.5

SD = standard deviation

Deattenuated Spearman correlation coefficients ≥ 0.5 were obtained for energy, carbohydrate, protein, fibre, vitamin A, carotene, niacin, folate, vitamin B_{12}, biotin, vitamin C, sodium, magnesium, iron, zinc and selenium between DHQ and the average for 24-hour dietary recalls.

Comparing FFQ and the average of 24-hour dietary recalls, we found that the deattenuated Spearman correlation coefficients were > 0.5 for energy, carbohydrate, protein, carotene, niacin, vitamin B_6, folate, vitamin B_{12}, biotin, vitamin C, calcium, iron, zinc and selenium.

The fraction of participants classified into the correct or adjacent category, expressed as agreement, ranged from 0.81 for riboflavin and carotene to 0.92 for carbohydrate and zinc, comparing DHQ data with the 24-hour recall data (Table 4). The corresponding figures for FFQ ranged from 0.75 for riboflavin to 0.96 for carbohydrate.

Discussion

We studied the validity of the DHQ and FFQ for assessment of dietary intakes among the Iranian population. We found that both DHQ and FFQ were valid instruments for assessing long-term dietary intakes of several nutrients. There were slight differences between the DHQ and FFQ in assessing most of the nutrients; however, DHQ had additional questions about food preparation methods, which could be an advantage for studies on specific disease like cancer. The FFQ was slightly better

Table 2 Estimated daily intake of energy and nutrients for Iranian adults (*n* = 102) using 24-hour recall, the Diet History Questionnaire (DHQ) and the Food Frequency Questionnaire (FFQ)

Nutrient	Method								
	24-hour recall			DHQ			FFQ		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Energy (kcal)	2761.9	771.8	2784.9	2026.4	587.7	1926.7	2942.5	1502.7	2610.1
Carbohydrate (g)	448.6	218.6	402.5	320.3	127.5	289.4	367.2	162.1	331.4
Protein (g)	151.2	65.5	145.3	75.2	31.0	71.0	111.2	67.3	90.4
Fat (g)	105.9	48.4	97.2	60.9	24.0	57.9	129.5	145.9	86.7
Fibre (g)	27.1	11.9	24.3	15.9	5.56	15.3	23.8	7.6	22.6
Sucrose (g)	47.6	25.5	41.2	39.85	28.3	34.7	62.6	43.1	50.5
Cholesterol (mg)	419.2	242.4	374.9	200.3	141.5	166.7	207.6	287.3	123.0
Vitamin A (RE)	1121.6	553.7	1020.8	650.4	337.8	574.6	8995.2	5770.2	7991.6
Carotene (µg)	4689.0	2608.0	4119.9	3071.7	2636.1	2449.2	4114.5	2067.0	3864.9
Thiamine (mg)	0.2	0.3	0.10	0.7	0.1	0.74	0.2	0.3	0.1
Riboflavin (mg)	0.1	0.3	0.04	1.4	0.8	1.22	0.2	0.2	0.2
Niacin	27.4	15.5	23.76	18.4	9.9	16.71	23.8	12.7	20.9
Vitamin B_6	0.3	0.30	0.20	1.3	0.5	1.24	0.3	0.3	0.2
Folate (µg)	520.4	213.6	487.9	263.4	119.7	236.3	422.4	225.6	375.5
Vitamin B_{12}	3.5	2.4	2.92	3.3	5.2	1.8	3.86	5.6	2.4
Biotin	71.5	35.9	66.5	30.2	16.30	26.0	43.6	19.1	39.4
Vitamin C (mg)	256.4	116.2	237.7	137.2	87.5	121.3	225.1	121.3	196.3
Sodium (mg)	3251.7	1668.3	2949.0	2107.7	831.1	1960.3	4670.4	2303.1	4023.9
Potassium (mg)	6992.3	2983.4	6644.8	2990.6	1176.2	2697.0	4813.8	1676.3	4623.2
Calcium (mg)	2295.0	1280.2	2201.4	752.0	263.7	717.3	948.3	541.7	802.9
Magnesium (mg)	521.3	237.2	477.8	245.2	107.1	221.6	369.0	155.0	328.4
Iron (mg)	24.7	16.4	20.8	19.9	7.8	18.9	25.2	14.7	21.2
Zinc (mg)	17.7	8.4	17.5	8.0	3.2	7.35	9.4	5.5	7.8
Selenium (mg)	123.0	73.8	103.5	89.1	43.5	79.9	110.2	69.3	92.4

SD = standard deviation; RE = retinol equivalent.

in assessing dietary intakes of carbohydrate, vitamin B_{12}, calcium and iron; however, DHQ was better in assessing other nutrient intakes. Both questionnaires were appropriate for classifying individuals based on their dietary intakes.

Previous studies on the validity of the FFQ in the Iranian population (Golestan Cohort Study and Tehran Lipid and Glucose Study) showed higher correlations between data obtained from FFQ and those from 24-hour dietary recalls (*5,6*). However, participants in the Tehran Lipid and Glucose Study were more familiar with nutritional assessment as they frequently answered questionnaires related to dietary intake (*6*). The FFQ used in Golestan was designed and developed based on the local foods of Golestan province (*5*) and were different from our population. Moreover, both studies had a greater number of 24-hour recalls than our study, which can result in realistic correlations (*3*). Individual dietary intakes usually vary on different days; therefore, by increasing the number of recalls, a better estimate of mean usual intake of a person could be achieved. The attenuated correlations we reached in the current study were closer to those reported in previous studies. This indicates that differences in within-person variations in dietary intakes between these studies contributed to different findings (*6,15*).

We applied the 24-hour dietary recall as a reference method, which could be considered a weakness in this study. It is known that there are several sources of bias common between FFQ and dietary recalls. Some studies used biomarkers as the gold standard, however there is no valid biomarker for most nutrients as they are controlled by biological homeostasis and absorption abilities. Therefore, validation studies generally use food records as a reference method (*16*) due to the less common biases between this method and the FFQ. Unlike the FFQ, however, dietary records do not rely on memory and are the most accurate method in assessing food intakes (*3*). However, we still believe that 24-hour dietary recall is the method of choice in our society due to the lack of adequate nutritional information and lack of experience in recording food consumption (*3,6*). Iranian validation studies usually use 24-hour recalls as a reference method, and even National Cancer Institute of America has used it (*5,6,17*). We took recalls year round, which is the strength of our study (*18*). Although self-administration of the

Table 3 Correlation coefficients of energy and nutrient intake between mean 24-hour recall and the Diet History Questionnaire (DHQ) and the Food Frequency Questionnaire (FFQ) among Iranian adults (*n* = 102)

Nutrient	Method							
	DHQ				FFQ			
	Crude	Deattenuated	Energy and age adjusted	Energy and age adjusted and deatenuated	Crude	Deattenuated	Energy and age adjusted	Energy and age adjusted and deatenuated
Energy	0.51	0.81	0.51	0.81	0.34	0.54	0.36	0.58
Carbohydrate	0.55	0.63	0.09	0.10	0.61	0.69	0.09	0.10
Protein	0.39	0.59	0.09	0.14	0.34	0.51	0.18	0.27
Fat	0.16	0.31	0.10	0.20	0.22	0.42	0.22	0.42
Fibre	0.35	0.70	0.22	0.44	0.11	0.22	0.06	0.11
Sucrose	0.31	0.43	0.20	0.28	0.23	0.33	0.07	0.09
Cholesterol	0.26	0.37	0.02	0.03	0.30	0.42	0.20	0.28
Vitamin A	0.29	0.77	0.25	0.67	0.12	0.31	0.08	0.20
Carotene	0.23	0.62	0.26	0.69	0.19	0.50	0.11	0.30
Thiamine	0.35	0.41	0.42	0.50	0.18	0.22	0.07	0.08
Riboflavin	0.15	0.32	0.03	0.06	0.02	0.03	0.05	0.11
Niacin	0.46	0.61	0.17	0.22	0.38	0.50	0.23	0.31
Vitamin B_6	0.28	0.49	0.23	0.41	0.30	0.52	0.11	0.19
Folate	0.31	0.68	0.31	0.68	0.25	0.54	0.08	0.17
Vitamin B_{12}	0.20	0.50	0.15	0.38	0.25	0.64	0.19	0.48
Biotin	0.27	0.87	0.19	0.61	0.21	0.68	0.28	0.91
Vitamin C	0.20	0.52	0.14	0.37	0.19	0.50	0.07	0.19
Sodium	0.44	0.57	0.20	0.25	0.32	0.42	0.06	0.08
Potassium	0.36	0.44	0.26	0.31	0.20	0.25	0.07	0.09
Calcium	0.28	0.42	0.14	0.20	0.34	0.50	0.25	0.38
Magnesium	0.41	0.55	0.20	0.27	0.25	0.34	0.09	0.12
Iron	0.39	0.70	0.03	0.05	0.42	0.74	0.26	0.47
Zinc	0.30	0.84	0.03	0.09	0.22	0.61	0.08	0.21
Selenium	0.51	0.68	0.19	0.26	0.49	0.65	0.28	0.37

DHQ is easy and low cost, we preferred the interviewer-administered approach due to low literacy level in our study population.

Conclusion

In conclusion, we found that the DHQ was a valid tool for measurement of long-term nutrient intakes in epidemiological studies in the Iranian population. Both questionnaires were too long and time-consuming and, thus, the approach to administering these questionnaires should be chosen cautiously. The DHQ provides detailed information about cooking methods and seasoning habits of individuals, which is more appropriate for epidemiological studies on cancer and other noncommunicable diseases.

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Table 4 Agreement, adjacent agreement and complete disagreement of the Food Frequency Questionnaire (FFQ)-, the Diet History Questionnaire (DHQ)-driven intakes and average 24-hour recall among Iranian adults (*n* = 102)

Nutrient	Method							
	DHQ				FFQ			
	Agreement	Complete agreement	Adjacent agreement	Complete disagreement	Agreement	Complete agreement	Adjacent agreement	Complete disagreement
Energy	0.90	0.50	0.40	0.09	0.86	0.44	0.43	0.14
Carbohydrate	0.92	0.48	0.44	0.07	0.96	0.61	0.35	0.04
Protein	0.88	0.43	0.45	0.11	0.87	0.51	0.36	0.13
Fat	0.83	0.38	0.45	0.17	0.77	0.46	0.32	0.18
Fibre	0.85	0.43	0.42	0.14	0.87	0.43	0.45	0.13
Sucrose	0.90	0.50	0.40	0.09	0.86	0.44	0.43	0.14
Cholesterol	0.86	0.40	0.46	0.13	0.85	0.44	0.42	0.15
Vitamin A	0.82	0.39	0.43	0.18	0.80	0.36	0.45	0.20
Carotene	0.81	0.36	0.45	0.18	0.82	0.42	0.41	0.18
Thiamine	0.83	0.36	0.47	0.16	0.83	0.34	0.49	0.17
Riboflavin	0.81	0.37	0.44	0.18	0.75	0.24	0.51	0.25
Niacin	0.87	0.45	0.42	0.12	0.88	0.48	0.41	0.12
Vitamin B_6	0.86	0.45	0.42	0.13	0.84	0.40	0.45	0.16
Folate	0.80	0.37	0.43	0.19	0.88	0.38	0.50	0.12
Vitamin B_{12}	0.85	0.43	0.41	0.15	0.84	0.49	0.36	0.16
Biotin	0.82	0.39	0.43	0.17	0.81	0.41	0.41	0.19
Vitamin C	0.90	0.45	0.45	0.09	0.85	0.44	0.42	0.15
Sodium	0.87	0.44	0.43	0.12	0.86	0.42	0.45	0.14
Potassium	0.85	0.46	0.39	0.14	0.87	0.47	0.41	0.13
Calcium	0.88	0.45	0.43	0.11	0.84	0.42	0.43	0.16
Magnesium	0.87	0.49	0.38	0.12	0.90	0.47	0.44	0.10
Iron	0.87	0.43	0.44	0.13	0.84	0.44	0.41	0.16
Zinc	0.92	0.51	0.41	0.08	0.89	0.45	0.45	0.11
Selenium	0.87	0.42	0.45	0.13	0.85	0.37	0.49	0.15

Comparaison de la validité du questionnaire de fréquence alimentaire et du questionnaire sur les habitudes alimentaires dans l'évaluation des apports en énergie et en nutriments dans une population iranienne

Résumé

Contexte : Les apports alimentaires sont essentiels au développement, ainsi qu'à la prévention des maladies chroniques. Le questionnaire de fréquence alimentaire a été proposé comme une méthode acceptable et pratique pour évaluer le lien entre les apports alimentaires et les maladies. Cependant, les questionnaires de fréquence alimentaire sont soumis à l'influence des habitudes alimentaires et de la culture ; ils devraient donc être validés pour la population d'étude.

Objectifs : Nous avons examiné la validité du questionnaire sur les habitudes alimentaires et du questionnaire de fréquence alimentaire chez des Iraniens en bonne santé.

Méthodes : Les participants à cette étude étaient des proches en bonne santé de personnes touchées par le cancer, soignées au centre anticancéreux de la République islamique d'Iran. Ils ont participé à des entretiens en présentiel. Nous avons ensuite effectué des rappels de 24 heures par téléphone tous les deux mois sur une période d'un an. En prenant pour référence les apports moyens obtenus au moyen des rappels de 24 heures, nous avons estimé les coefficients de corrélation de Pearson afin de mesurer la fiabilité du questionnaire de fréquence alimentaire et du questionnaire sur les habitudes alimentaires. Nous avons examiné la manière dont les deux questionnaires répartissaient les participants en différentes catégories d'apports alimentaires, par comparaison avec les rappels de 24 heures.

Résultats : Au total, 102 sujets ont participé à notre étude. Les corrélations de Spearman corrigées pour l'atténuation étaient supérieures ou égales à 0,5 pour l'énergie, les glucides, les protéines, le carotène, la niacine, le folate, la vitamine B_{12}, la biotine, la vitamine C, le fer, le zinc et le sélénium dans les deux questionnaires. Le niveau de concordance avec le rappel des 24 heures pour la classification des sujets dans les différentes catégories d'apports alimentaires allait de

0,81 pour la riboflavine et le carotène à 0,92 pour les glucides et le zinc dans le questionnaire sur les habitudes alimentaires, et de 0,75 pour la riboflavine à 0,96 pour les glucides dans le questionnaire de fréquence alimentaire.

Conclusions : Le questionnaire de fréquence alimentaire et le questionnaire sur les habitudes alimentaires convenaient tous deux pour évaluer la plupart des apports nutritionnels ainsi que pour classifier les participants en différentes catégories d'apports alimentaires dans la population iranienne.

التحقق من صحة استبيان تواتر الغذاء مقابل استبيان تاريخ النظام الغذائي لتقييم الطاقة ومدخولات العناصر الغذائية لدى مجموعة من السكان الإيرانيين

فاطمة تورنج، بهاريح ساسنفر، أحمد إسماعيل زاده، ثريا إبراهيم بور كوجان، كاظم زنديهدل

الخلاصة

الخلفية: تُعتبر المدخولات الغذائية ضرورية للنماء والوقاية من الأمراض المزمنة. وقد اقتُرح استخدام استبيان تواتر الغذاء بوصفه إحدى الطرق المُجدية المقبولة لتقييم العلاقة بين المدخول الغذائي والإصابة بالأمراض. ولكن نظراً لأن استبيانات تواتر الغذاء تتأثر بالعادات الغذائية والثقافة، فينبغي أن تكون ملائمة للاستخدام مع السكان الذين تشملهم الدراسة.

الأهداف: هدفت هذه الدراسة إلى تحري صحة استبيان تاريخ النظام الغذائي، واستبيان تواتر الغذاء لتطبيقهما على مستوى الإيرانيين الأصحاء.

طرق البحث: كان المشاركون من الأقارب الأصحاء لبعض مرضى السرطان في المعهد الإيراني للسرطان. وقد شاركوا في مقابلات أُجريت وجهاً لوجه. كما أُجريت مكالمات هاتفية لاستعراض النظام الغذائي على مدار الأربع وعشرين ساعة المنصرمة كلَّ شهرين لمدة عام كامل. وباعتبار المكالمات الخاصة باستعراض النظام الغذائي على مدار الأربع وعشرين ساعة المنصرمة مقياساً دقيقاً، قُدّر مُعامل ارتباط بيرسون لقياس مدى معوَّلية استبيان تواتر الغذاء واستبيان تاريخ النظام الغذائي. وقد تحرينا كيفية تصنيف الأفراد في فئات المدخولات المختلفة عن طريق استبيان تواتر الغذاء واستبيان تاريخ النظام الغذائي مقارنةً باستعراض النظام الغذائي على مدار الأربع وعشرين ساعة المنصرمة.

النتائج: كان إجمالي عدد المشاركين في الدراسة 102 شخصاً. وقد بلغت قيم ارتباط سبيرمان الضعيفة ≤ 0.5 للطاقة، والكربوهيدرات، والبروتين، والكارُوتين، والنياسين، والفولات، وفيتامين ب12، والبيوتين، وفيتامين ج، والحديد، والزنك، والسيلينيوم، وذلك في كلٍّ من استبيان تاريخ النظام الغذائي واستبيان تواتر الغذاء. وتراوح معدل التوافق بالنسبة لاستعراض النظام الغذائي على مدار الأربع وعشرين ساعة المنصرمة لتصنيف الأفراد إلى فئات مختلفة حسب المدخولات من 0.81 للريبوفلافين والكارُوتين إلى 0.92 للكربوهيدرات والزنك في استبيان تاريخ النظام الغذائي، ومن 0.75 للريبوفلافين إلى 0.96 للكربوهيدرات في استبيان تواتر الغذاء.

الاستنتاجات: كان كلٌّ من استبيان تاريخ النظام الغذائي واستبيان تواتر الغذاء صالحَين للاستخدام في تقييم أغلب مدخولات العناصر الغذائية في الفئات المختلفة للمدخولات بين السكان الإيرانيين.

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Adherence to the Mediterranean diet of school-age children in Moroccan oases, Draa-Tafilalet Region

Karima Azekour,[1] Zahra Outaleb,[1] Mohamed Eddouks,[1] Farid Khallouki[1] and Bachir El Bouhali[1]

[1]Department of Biology, Faculty of Sciences and Techniques, Moulay Ismail University, Errachidia, Morocco (Correspondence to: B. El Bouhali: bachirbouhali@hotmail.com)

Abstract

Background: Dietary patterns, eating behaviour and lifestyle are changing in Morocco. It would be interesting to identify and evaluate this transition in its Mediterranean context.

Aims: To assess adherence to the Mediterranean diet (MedDiet) and analyse associated factors in school-age children living in oasis environments.

Methods: A cross-sectional survey was conducted among 3684 school-age children between May 2015 and November 2017 in Tafilalet Oasis. The mean age was 9.81 (2.13), 51.3% were girls, and 62.7% were from urban areas. Participants were recruited from public primary schools. Adherence to the MedDiet was evaluated by Mediterranean Diet Quality (KIDMED) index. Socioeconomic characteristics and anthropometric measurements were obtained.

Results: Only 2.12% had a poor KIDMED index, 57.9% had an average index and 39.98% had a high index. Maternal ethnicity was associated with degree of adherence to the MedDiet. Poor adherence was seen in 2.17% of urban participants compared with 2.04% of rural participants. Participants with high income were more likely to have good adherence to the MedDiet. Low levels of parental education were more likely to result in higher levels of poor adherence. There was no significant correlation between body weight and KIDMED index.

Conclusions: Most of the study population had medium to good adherence to MedDiet, but low KIDMED index was observed. Interventions and strategies should be devised for preserving and promoting healthy eating habits in this target population.

Keywords: Mediterranean diet, school-age children, oasis, Draa-Tafilalet, Morocco.

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Introduction

The Mediterranean diet (MedDiet) is widely studied and is considered to be the healthiest dietary model in the world. It incorporates the traditional healthy living habits of populations from the Mediterranean Region. In 2013, it was included on the United Nations Educational, Scientific and Cultural Organization Intangible Cultural Heritage list (1). The MedDiet varies among countries bordering the Mediterranean Sea, but in general, it is known by abundant consumption of vegetables, fresh or dried fruits, cereals, olive oil as the main source of fats; moderate intake of fish, meat and dairy products; and low intake of eggs and sweets (2). It is recognized as having several beneficial effects on health. Numerous studies have concluded that the MedDiet is a protective factor against many chronic illnesses, such as diabetes, cancer and cardiovascular diseases (3,4). In a particular sample of 3042 participants, adherence to the MedDiet was associated with 15% lower incidence of cardiovascular disease (5). Nonetheless, data about children's MedDiet adherence, especially in Morocco, are lacking.

Therefore, the aim of the present study was to investigate the level of adherence to the MedDiet among school-age children living in Tafilalet Oasis, which is located far from major cities and considered to be the largest oasis in the world. It has several specific features that differ considerably from those in other Moroccan regions, such as low level of urbanization, high poverty and specific culinary habits based on high consumption of vegetables, in particular, dates, okra, collards and alfalfa. The study was carried out to investigate socioeconomic and anthropometric factors associated with adherence to the MedDiet. School-age children were selected because they developed in a poor and precarious context, and the impact of these conditions was more important in children than adults. Furthermore, childhood is a period of cognitive and physical development accompanied by increasing nutritional needs.

Methods

Description of the study site

The Drâa-Tafilalet Region is located in the Southeast of Morocco and consists of an area of 88 836 km^2. According to the general census of the population and the habitat of 2014, the region had 1 635 008 inhabitants (4.83% of the national population); of whom, 34.30% were urban dwellers, which was significantly lower than the national rate

of 60.36%. The region is dominated by oasis that occupies 88% of the surface area (46% of the Moroccan oases). At the administrative level, the Region is divided into 5 provinces (Figure 1) (*6*).

Study design

This cross-sectional study was conducted between May 2015 and November 2017 in Tafilalet Oasis. The random sample was produced to represent at least 1% of the target population. We randomly selected 39 public primary schools from a total of 284 from urban and rural areas of the Oasis. Moreover, one class by level was chosen in each elementary school (1, 2, 3, 4, 5 and 6 levels). The number of students per classroom varied from 28 to 50, and 30–50% of the students per class were sampled. The study sample was taken from mixed-sex classes. Face-to-face interviews were conducted using an assisted questionnaire, and anthropometric measurements noted. Authorization was obtained from the regional and local education authorities, and oral consents of parents or tutors was required.

Study population

The study group included 3684 school-age children. There were 1890 (51.3%) girls and 1794 (48.7%) boys, with an average age of 9.81 (2.13) years. Over the study period, only children with parents who had agreed to participate were included. Children whose parents/tutors did not consent to answer the questionnaire were excluded. All children included in the sampling were apparently healthy with no physical diseases or disabilities.

Questionnaire

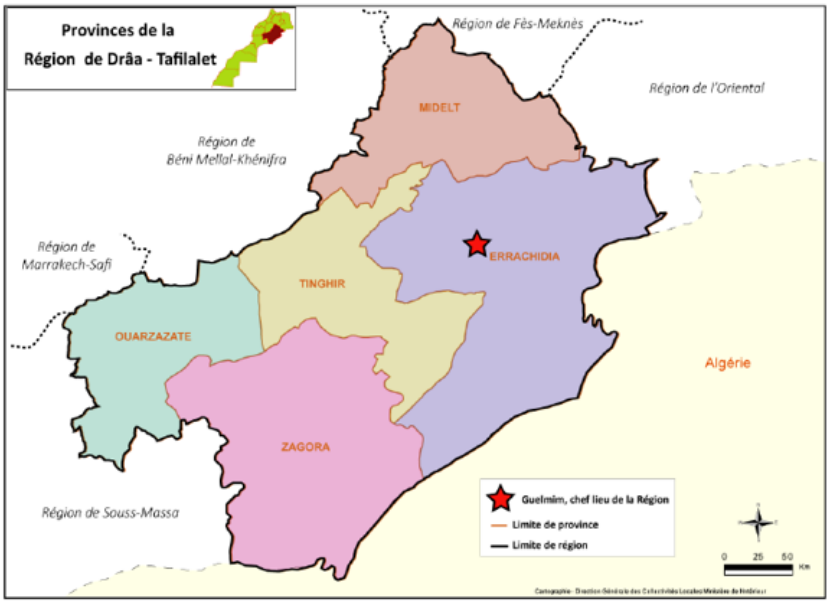
The questionnaire was divided into 2 sections: the first comprised questions for assessing socioeconomic status, and the second measured the degree of dietary adherence. Dates of birth of all children were noted from the list given by the teachers. Education of parents was classified into 4 categories: university, secondary, primary and illiterate. Other questions were: ethnicity of mother's children (people who spoke Arabic were considered Arab and those who spoke Amazigh were considered Amazigh); urban or rural residence; occupation, employed or not; school time (morning, afternoon or both); type of family **(**nuclear or joint); family size (3 or 4, 5 or 6, or ≥ 7 persons); and monthly family income: > 5000 Moroccan Dirham (MAD) was considered to be high, 2001–4999 MAD medium, and < 2000 MAD low.

The degree of adherence to the MedDiet was evaluated by the Mediterranean Diet Quality Index (KIDMED). It is one of the most recent methods, which is widely used to evaluate adherence to the MedDiet, and has proven reliability (*7*). The KIDMED questionnaire was translated into Arabic and Amazigh languages (reliability test was performed to ensure translations). It contains 16 items, and evaluates frequency of intake of 8 food groups: vegetables, beans, fruits, nuts, cereal, fish, dairy products and olive oil. Consumption of fast food, baked goods and sweets, and skipping breakfast are scored as 1 and remaining questions as +1. According to the KIDMED classification, a score of 0–3 reflects low adherence to the MedDiet, 4–7 average adherence that needs improvement, and 8–12 strong adherence that reflects optimal quality diet (higher scores indicating greater adherence) (*8*).

Pilot sample

Before the survey, the questionnaire was administered to a pilot sample of 43 children from the same survey population with the same conditions as those for the total survey, and they were not included in the study population.

Figure 1 Geographical location of the region Drâa-Tafilalet in Morocco



Anthropometric measurements

Measurements of weight and height were taken carefully, as described previously (*9*). Children were weighed without shoes, wearing a few clothes, using a weight scale (seca 804). Height was measured standing upright, feet together using a height measuring board. The body mass index (BMI) for age was calculated for all children and z scores were determined using World Health Organization (WHO) AnthroPlus software. Rates of obesity and overweight were assessed among children based on the new WHO standards of growth. Overweight was indicated by a z score > +1 standard deviation (SD), obesity by > +2 SD, underweight by < 2□, and severe underweight < 3□ SD (*10*).

Data analysis

Data were entered, coded, checked, and analysed using appropriate statistical software. A descriptive analysis of all variables was performed. Categorical variables were expressed as numbers and percentages. Associations and correlations between studied variables were assessed using the χ^2 test. $P < 0.05$ was considered significant. Multiple regression analysis was performed to detect which of the socioeconomic characteristics or weight was the most associated with adherence to the MedDiet.

Results

The total study population was included in the analysis (Table 1). Children who refused to participate or were absent were not included in the survey. The total sample included 3684 scholars (response rate, 94%) and 62.7% were from urban areas. For fathers' occupation, 67.4% were unemployed, and 85.99% of the mothers were housewives. Concerning maternal education, 38.6% were illiterate compared with 21.9% of fathers. Only 16.56% of parents earned > 5000 MAD, 66.07% earned 2001–4999 MAD and 17.37% earned < 2000 MAD. The average family size was 6.4 (2.63) persons/household, and 82.4% of the families were nuclear. Concerning socioeconomic characteristics, only ethnicity of mothers (P=0.043) and schooltime (P=0.017) were significantly associated with sex (Table 1).

Table 2 shows the results of KIDMED according to sociodemographic and economic factors. KIDMED classification was good in 39.98% of the population, medium in 57.90% and poor in 2.12%. There was no significant correlation between KIDMED scores and sex, family size and maternal education. However, urban region showed a significant increase (2.17%) in poor adherence to MedDiet compared with rural region (2.04%) (P = 0.002). The percentage of the population with a low KIDMED score was 1.22% among those that spoke Arabic versus 2.57% among those that spoke Amazigh, and this correlation was highly significant (P < 0.001). Medium and low monthly family incomes were less likely to result in good adherence to the MedDiet (P < 0.001). Lower parental educational level had lower KIDMED scores. The association with school period was strongly significant, with children at school full time tending to have lower MedDiet adherence (P < 0.001). Finally, significant differences were observed for KIDMED scores according to age group, occupation and type of family (P = 0.031, 0.015 and 0.019, respectively).

According to multiple logistic regression, adherence to the MedDiet was more associated with maternal ethnicity and school time (Table 3).

The associations between KIDMED scores and BMI classification are shown in Table 4. Two hundred and eighty-five (7.74%) children were underweight, 2930 (79.53%) had normal corpulence, 399 (10.83%) were overweight and 70 (1.90 %) were obese according to WHO growth reference for school-aged children and adolescents. There was no significant association between body weight and KIDMED score (P > 0.05). Consumption of fruit, vegetables, fish (at least 2 or 3 times per week), pulses/beans, pasta or rice (≥ 5 times per week), nuts/dry fruits (at least 2 or 3 times per week) were correlated with body weight of children (P = 0.004, 0.008, 0.004, 0.002, 0.040 and 0.025, respectively).

Discussion

The main purposes of the present study were to evaluate the level of adherence to the MedDiet in school-age children in Tafilalet Oasis and to analyse associated factors such as socioeconomic characteristics and body weight. The degree of adherence to the MedDiet differs among Mediterranean countries and even within the same country. In the current study, 2.1% of school-age children had low adherence to the MedDiet. In national studies, despite their rarity, low adherence to the MedDiet was more frequent than in the present study at 29.90% in Fez (*11*) and 14.50% in Ouarzazate (*12*). These findings may be explained by the particular features of Tafilalet Oasis related to degree of urbanization, and food and culinary culture that may have an impact on food habits and food preparation rather than resistance to changes in dietary intake and nutritional transition. Our results also differ from other Mediterranean countries, especially the Eastern Mediterranean Region and Arab countries. A meta-analysis of 41 countries showed that most have tended to drift away from a Mediterranean-like dietary pattern (*13*). The Mediterranean European countries, especially Greece, experienced the greatest decrease in Mediterranean Adequacy Index value (an assessment of how close a diet is to the MedDiet (*13*). Poor adherence was noted at 46.8% in Greece among 4786 children aged 10–12 years (*14*); 32.8% in Italy in 1740 children aged 8–9 years (*15*); 42.7% in 354 Turkish medical school students (206 first year and 148 third year) with a mean age of 19.57 (1.65) years (*16*); and 21.8% in 193 students enrolled in public and private universities in Cyprus (*17*).

There was no significant association between adherence to the MedDiet and sex. The same result was found in other studies (*15,18*). This trend is more likely to be closer to the reality in this Oasis population, probably because of the chosen age of the participants. However, there was a significant correlation between age and

Table 1 Sociodemographic and economic characteristics according to sex of school children (*n* = 3684).

Characteristics	Girls *n* (%)	Boys *n* (%)	Total *n* (%)	*P*
Place of residence				0.293
Urban	1200 (51.97)	1109 (48.03)	2309 (62.70)	
Rural	690 (50.18)	685 (49.82)	1375 (37.30)	
Age groups (years)				0.479
5–9	872 (52.28)	796 (47.72)	1668 (45.3)	
10–12	841 (50.78)	815 (49.22)	1656 (45.0)	
≥ 13	177 (49.17)	183 (50.83)	360 (9.80)	
Father's occupation				0.692
Employed	610 (50.83)	590 (49.17)	1200 (32.60)	
Unemployed	1280 (50.12)	1204 (49.88)	2454 (67.40)	
Ethnicity				0.043
Arab	659 (53.66)	569 (44.75)	1228 (33.30)	
Amazigh	1231 (50.12)	1225 (49.88)	2456 (66.70)	
Type of family				0.484
Nuclear	1550 (51.04)	1487 (48.96)	3037 (82.40)	
Joint	340 (52.55)	307 (47.45)	647 (17.60)	
Family size				0.651
3 or 4	306 (53.03)	271 (46.97)	577 (15.70)	
5 or 6	928 (51.13)	887 (48.87)	1815 (49.30)	
≥ 7	656 (50.77)	636 (49.23)	1292 (35.10)	
School time				0.017
Morning	140 (44.16)	177 (55.84)	317 (8.60)	
Afternoon	241 (54.28)	205 (45.72)	444 (12.10)	
Full time	1509 (51.62)	1414 (48.38)	2923 (79.30)	
Maternal education				0.245
University	122 (45.35)	147 (54.65)	269 (7.30)	
Secondary	339 (51.75)	316 (48.25)	655 (17.80)	
Primary	696 (51.98)	643 (40.02)	1339 (36.30)	
Illiterate	733 (51.58)	688 (48.42)	1421 (38.60)	
Paternal education				0.250
University	377 (48.77)	396 (51.23)	773 (21.00)	
Secondary	498 (50.82)	482 (49.18)	980 (26.60)	
Primary	600 (53.42)	523 (46.58)	1123 (30.50)	
Illiterate	415 (51.36)	393 (48.64)	808 (21.90)	
MFI (MAD)				0.072
High (≥ 5000)	290 (47.54)	320 (52.46)	610 (16.60)	
Medium (2001–4999)	1255 (51.56)	1179 (48.44)	2434 (66.10)	
Low (≤ 2000)	345 (53.91)	295 (46.09)	640 (17.40)	

MAD = Moroccan dirham; 1 US$ = 9.36 MAD; MFI = median family income.

MedDiet adherence, children aged > 9 years were more likely to have a good MedDiet score. Similar results were found in the study of Bibiloni et al. (*19*) but contrary to the studies of Farajian et al. (*14*) and Grosso et al. (*20*). There were significant differences in adherence to the MedDiet according to monthly family income and paternal education and occupation. Low standard of living and education were less likely to lead to good adherence to the MedDiet. This is in agreement with previous studies that correlated high consumption of non-Mediterranean food with low socioeconomic status (*21*, *22*) but contrasted with the results of El Rhazi et al. (*11*) who did not find any correlations. Regarding place of residence, lower adherence was associated with living in an urban area compared to rural area. Outcomes were in line with the findings of Grosso et al. (*20*) but were in disagreement with those reported by El Rhazi et al. (*11*). Significant differences in adherence to the MedDiet were noted with

Table 2 **KIDMED index in school children in Tafilalet Oasis according to sociodemographic and economic factors (*n* = 3684)**

Characteristics	MedDiet score category			*P*
	Good (≥ 8) *n* (%)	Average (4–7) *n* (%)	Poor (≤ 3) *n* (%)	
Place of residence				0.002
Urban	973 (42.14)	1286 (55.69)	50 (2.17)	
Rural	500 (36.36)	847 (61.60)	28 (2.04)	
Sex				0.264
Female	778 (41.17)	1070 (56.61)	42 (2.22)	
Male	695 (38.74)	1063(59.25)	36 (2.01)	
Age groups (years)				0.031
5–9	623 (37.35)	1003 (60.13)	42 (2.52)	
10–12	700 (42.27)	925 (55.86)	31 (1.87)	
≥ 13	150 (41.67)	205 (56.94)	5 (1.39)	
Father's occupation				0.015
Employed	516 (43.00)	665 (55.42)	19 (1.58)	
Unemployed	957 (38.53)	1468 (59.10)	59 (2.37)	
Ethnicity				<0.001
Arab	731 (59.53)	482 (39.25)	15 (1.22)	
Amazigh	742 (30.21)	1651 (67.22)	63 (2.57)	
Type of family				0.019
Nuclear	1188 (39.12)	1789 (58.91)	60 (1.97)	
Joint	285 (44.05)	344 (53.17)	18 (2.78)	
Family size				0.069
3 or 4	227 (39.34)	334 (57.89)	16 (2.77)	
5 or 6	692 (38.13)	1087 (59.89)	36 (1.98)	
≥ 7	554 (42.88)	712 (55.11)	26 (2.01)	
School period				<0.001
Morning	101 (31.86)	210 (66.25)	6 (1.89)	
Afternoon	109 (24.55)	331 (74.55)	4 (0.90)	
Full time	1263 (43.20)	1592 (54.46)	68 (2.34)	
Maternal education				0.106
University	121(44.98)	143 (53.16)	5 (1.86)	
Secondary	275 (41.99)	372 (56.79)	8 (1.22)	
Primary	543 (40.55)	767 (57.28)	29 (2.17)	
Illiterate	534 (37.58)	851 (59.89)	36 (2.53)	
Paternal education				0.004
University	337 (43.60)	424 (54.85)	12 (1.55)	
Secondary	418 (42.65)	540 (55.10)	22 (2.25)	
Primary	440 (39.19)	658 (58.59)	25 (2.22)	
Illiterate	278 (34.40)	511 (63.24)	19 (2.36)	
MFI (MAD)				<0.001
High (≥ 5000)	303 (49.67)	296 (48.52)	11 (1.81)	
Medium (2001–4999)	923 (37.92)	1458 (59.90)	53 (2.18)	
Low (≤ 2000)	247 (38.59)	379(59.22)	14 (2.19)	
Total	1473 (39,98)	2133 (57.90)	78 (2,12)	–

MAD = Moroccan dirham; 1 US$ = 9.36 MAD; MFI = median family income.

regard to maternal ethnicity. This may be explained by the effect of cultural differences in food preparation, food habits and consumption patterns. Body weight was not associated with adherence to the MedDiet, but 9 components of KIDMED score were correlated with BMI of children, unlike the study conducted by

Table 3 Results of logistic regression analysis

Variables		B	SE	P	OR	95% CI
Ethnicity	Arab	0.860	0.293	0.003	2.364	1.331–4.199
	Amazigh	0[a]				
School time	Morning	0.513	0.460	0.265	1.670	0.876–4.111
	Afternoon	1.321	0546	0.016	3.749	1.285–10.935
	Fulltime	0[a]				

[a]*This parameter is set to o because it is redundant. B = β coefficient; CI= confidence interval; OR = odds ratio; SE = standard error.*

Anzid et al. (12) who found only one positive correlation with fish consumption. In fact, high consumption of Mediterranean food was associated with normal weight.

The present study had some limitations. First, the validity of the KIDMED questionnaire has not been previously assessed in Morocco. Second, children who had specific diets under certain conditions (e.g. low glycaemic diet for diabetes management) were not excluded.

Conclusion

The level of low adherence to the MedDiet in the present study was lower than in other studies in Morocco and the Mediterranean Region, especially in the Eastern Region. High adherence to MedDiet by oasis children can be explained by preserving eating habits. The socioeconomic factors were the most associated with adherence to the MedDiet, especially maternal ethnicity and school time.

Table 4 KIDMED scores according to BMI classification in school children in Tafilalet Oasis (*n* = 3684)

KIDMED test (16 questions)	BMI class			P*
	Thinness *n* (%)	Normal *n* (%)	Ov/Ob *n* (%)	
Takes a fruit or fruit juice every day	233 (81.54)	2526 (86.21)	410 (87.42)	0.076
Has a second fruit every day	156 (54.74)	1827 (62.35)	314(66.95)	0.004
Has fresh or cooked vegetables regularly once a day	273 (95.79)	2765 (94.37)	427 (91.04)	0.008
Has fresh or cooked vegetables more than once a day	205 (71.93)	2111 (72.04)	329 (70.15)	0.697
Consumes fish regularly (at least 2 or 3 times/week)	79 (27.72)	1032 (35.22)	186 (39.66)	0.004
Goes more than once a week to a fast-food	47 (16.49)	486 (16.59)	117 (24.95)	< 0.001
Likes pulses and eats them more than once a week	266 (93.33)	2620(89.42)	400 (85.28)	0.002
Consumes pasta or rice almost every day (≥ 5 times/week)	78 (27.37)	950(32.42)	170 (36.25)	0.040
Has cereals or grains (bread, etc.) for breakfast	259 (90.88)	2703 (92.25)	426 (90.83)	0.449
Consumes nuts regularly (at least 2 or 3 times/week)	148 (51.93)	1399(47.75)	253 (53.94)	0.025
Uses olive oil at home	265 (92.98)	2668(91.05)	423 (90.19)	0.421
Skips breakfast	97 (34.04)	1118(38.16)	193 (41.15)	0.148
Has a dairy product for breakfast (yoghurt, milk, etc.)	131 (45.96)	1447(49.39)	230 (49.04)	0.544
Has commercially baked goods or pastries for breakfast	26 (9.12)	329 (11.23)	83 (17.70)	< 0.001
Takes two yoghurts and/or some cheese (40 g) daily	49(17.19)	626(21.37)	102 (21.75)	0.240
Takes sweets and candy several times every day	31(10.88)	328 (11.13)	76 (16.20)	0.007

**Significance at 5%. BMI = body mass index; Ov/Ob = overweight and obesity.*

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Observance du régime méditerranéen chez les enfants d'âge scolaire dans les oasis au Maroc, région de Draa-Tafilalet

Résumé

Contexte : Au Maroc, les habitudes alimentaires, le comportement alimentaire et le mode de vie sont en train de changer. Il serait donc intéressant d'identifier et d'évaluer cette transition dans son contexte méditerranéen.

Objectifs : Examiner l'observance du régime méditerranéen et analyser les facteurs associés chez les enfants d'âge scolaire résidant dans des environnements d'oasis.

Méthodes : Une étude transversale a été menée auprès de 3 684 enfants d'âge scolaire entre mai 2015 et novembre 2017 dans l'oasis de Tafilalet. L'âge moyen des enfants était de 9,81 (2,13), dont 51,3 % de filles, et 62,7 % résidaient en zone urbaine. Les participants ont été recrutés dans des écoles primaires publiques. L'observance du régime méditerranéen a été évaluée au moyen de l'indice KIDMED, qui mesure la qualité du régime méditerranéen. Des caractéristiques socioéconomiques et des mesures anthropométriques ont également été obtenues.

Résultats : Seulement 2,12 % des enfants avaient un indice KIDMED médiocre, 57,9 % avaient un indice moyen et 39,98 % avaient un indice élevé. L'appartenance ethnique de la mère était associée au degré d'observance du régime méditerranéen. Une observance médiocre a été notée chez 2,17 % des participants vivant en milieu urbain, contre 2,04 % en milieu rural. Les participants disposant de revenus élevés étaient plus susceptibles d'avoir une bonne observance du régime méditerranéen. En outre, les familles où les parents avaient de faibles niveaux d'éducation étaient plus susceptibles d'avoir des niveaux plus élevés d'observance médiocre. Il n'y avait pas de corrélation entre le poids des enfants et l'indice KIDMED.

Conclusions : La majorité de la population d'étude avait une observance du régime méditerranéen comprise entre moyenne et bonne , mais nous avons également observé de faibles niveaux d'indice KIDMED. Des interventions et des stratégies devraient être mises au point afin de préserver et de promouvoir des habitudes alimentaires saines dans cette population cible.

التزام الأطفال في سن المدرسة بالنظام الغذائي المتوسطي في الواحات المغربية، جهة درعة تافيلالت

كريمة أزقور، زهراء أبو طالب، محمد الدوقس، فريد خلوقي، بشير البوهالي

الخلاصة

الخلفية: يشهد المغرب حالياً تغيراً في الأنماط الغذائية، وسلوكيات تناول الطعام، وأنماط الحياة. وقد يكون من المهم تحديد هذا التحول في السياق المتوسطي وتقييمه.

الأهداف: هدفت هذه الدراسة إلى تقييم الالتزام بالنظام الغذائي المتوسطي، وتحليل العوامل المرتبطة بذلك في صفوف الأطفال في سن المدرسة الذين يعيشون في بيئة الواحات.

طرق البحث: أُجري مسحٌ مقطعي على 3684 طفلاً في سن المدرسة في الفترة من مايو/ أيار 2015 إلى نوفمبر/ تشرين الثاني 2017 في واحة تافيلالت. وكان متوسط عمر الأطفال الذين شملهم المسح 9.81 (2.13)، وشكلت الفتيات 51.3٪ من الأطفال. وبلغت نسبة الأطفال من المناطق الحضرية 62.7٪. وقد تم اختيار المشاركين في المسح من المدارس الابتدائية العامة. وقُيّم مدى الالتزام بالنظام الغذائي المتوسطي باستخدام مؤشر جودة النظام الغذائي المتوسطي (KIDMED). وحُصل على الخصائص الاجتماعية والاقتصادية والقياسات الأنثروبومترية.

النتائج: تراوحت نسب مؤشر جودة النظام الغذائي المتوسطي (KIDMED) بين منخفضة، ومتوسطة ومرتفعة في 2.12٪، و57.9٪، و39.98٪ من المشاركين على التوالي. وارتبط الانتماء العرقي للأمهات بدرجة الالتزام بالنظام الغذائي المتوسطي. ولوحظ ضعف الالتزام في 2.17٪ من المشاركين الذين ينتمون إلى مناطق حضرية، مقابل 2.04٪ من المشاركين الذين ينتمون إلى مناطق ريفية. كما تبين أن المشاركين الذين يتمتعون بدخل أعلى من الأرجح أن يلتزموا أكثر بالنظام الغذائي المتوسطي. ورُجح أيضاً ارتباط انخفاض المستوى التعليمي للأبوين بارتفاع مستويات عدم الالتزام بالنظام الغذائي المتوسطي. ولم يكن هناك ترابط واضح بين وزن الجسم ومؤشر جودة النظام الغذائي المتوسطي (KIDMED).

الاستنتاجات: تراوح التزام السكان الذين شملهم المسح بالنظام الغذائي المتوسطي بين متوسط إلى جيد، ولكن لوحظ انخفاض مؤشر جودة النظام الغذائي المتوسطي (KIDMED). وينبغي إعداد تدخلات واستراتيجيات للحفاظ على العادات الغذائية الصحية في هذه الفئة السكانية المُستهدَفة وتعزيزها.

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Dentist availability in Egypt: a 20-year study of supply, potential demand and economic factors

Maha El Tantawi,[1] Nourhan M. Aly,[1] Dina Attia,[1] Hams Abdelrahman[1] and Mohamed Mehaina[2]

[1]Department of Pediatric Dentistry and Dental Public Health, Faculty of Dentistry, Alexandria University, Egypt (Correspondence to: M. El Tantawi: maha_tantawy@hotmail.com). [2]Alexandria and Mediterranean Research Center, Bibliotheca Alexandrina, Egypt.

Abstract

Background: Egypt is one of the most populated countries in the Eastern Mediterranean Region with historically large numbers of trained professionals providing services in and outside the country. Data about dentist availability are needed to plan for workforce production and training.

Aims: We assessed dentist availability in Egypt including (1) changes over 20 years; (2) spatial distribution; and (3) association with supply, potential demand for care and economic conditions.

Methods: In an ecological study (1995–2014), we used data from the Central Agency for Public Mobilization and Statistics. The outcome variable was dentist availability (dentists per 1000 population). The explanatory variables were: (1) population size; (2) number of dental graduates; (3) previous dentist availability; (4) increase in wages; and (5) percentage of population migrating internally seeking jobs. We assessed variation in availability using statistical process control and spatial autocorrelation. The impact of explanatory variables was assessed using general linear models with partial η^2 to measure effect size.

Results: Dentists per 1000 population were randomly distributed over the country and the ratio reached 0.18 in 2014, indicating a shortage despite the increasing number of dental graduates since 1995 (667.1%). Previous dentist availability ($\eta^2 = 0.60$) and increase in wages ($\eta^2 = 0.48$) had the greatest impact on dentist availability.

Conclusions: Egypt faces a problem of dentist shortage that has not been offset by the increase in dental graduates. Improving the economic conditions and incorporating health care into the national development plan may improve the situation.

Keywords: Dentists/supply and distribution, Egypt, students, dental schools, dental economics.

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Introduction

Dentist availability facilitates dental care provision and has a positive impact on demand for services (*1*), according to the theory of supplier-induced demand (*2*). Dentist to population ratio is one of the most commonly used methods to assess dentist availability (*3*), and to classify regions into those with adequate dentist availability and areas of shortage where dentist number may not meet population needs (*4*).

Macrolevel analysis at community level has shown that human healthcare resources are affected by the population ecology theory including: (1) structural attributes of the healthcare system, such as personnel supply, which determines growth; (2) demand for services where demographics determine consumption; and (3) economic profile as a determinant of resource availability (*5*). Previous studies have confirmed the effect of demographic factors, particularly population size and income, on healthcare provider availability (*6*).

Most studies assessing dentist availability were cross-sectional, focusing on a single point in time, and were conducted in developed countries with high numbers of dentists and high dentist to population ratios (*1,6*). Few cross-sectional studies have assessed dentist availability in less-developed countries (*7,8*). One longitudinal study described the change in dental workforce in Oman and predicted future trends (*9*), whereas another in Austria followed dentist availability over time and assessed differences between public and private dentists (*10*). A longitudinal study in Taiwan, China investigated the impact of global budgeting on dental workforce distribution (*11*).

Egypt was the 14th most populated country in the world and the 7th among lower middle income countries in 2017 (*12*). It ranked 11th out of 47 in dentist to 1000 population among lower middle income countries (*13*). Over the last 2 decades, Egypt has witnessed economic challenges that became more pronounced after the political instability that started in 2011, with a large trade deficit, high rate of unemployment and rising prices (*14*). During this period, private dental schools were opened for the first time and by 2014, they were training 58.6% of all dental students (*15*). State-funded health insurance covered 58.2% of the population in 2015 for minimal fees with facilities all over the country (*14*). The complex

interaction of these factors poses challenges for oral healthcare policy setting.

Longitudinal studies are needed to assess dentist availability in developing countries with limited economic resources, large population size and low dentist to population ratios. This is important to plan global dental workforce needs where large populations are involved. Such studies would also add to the knowledge about the impact on dentist availability of graduating more dentists, building more dental schools, and country-level economic changes.

The null hypothesis of the study was that dentist availability in Egypt is affected by supply measured by the number of dental graduates and population size but not by the economic condition of the country. This study aimed to conduct a macrolevel analysis of major administrative units in Egypt, governorates, to assess (1) the trend in dentist availability over 20 years in Egypt; (2) spatial distribution of dentist availability during these 20 years; and (3) factors affecting availability.

Methods

Study design

The present study was based on publicly available data from the Central Agency for Public Mobilization and Statistics (CAPMAS), Egypt covering from 1995 to 2014 (*16*). When data for these years were not available, we used those for the nearest available year. We obtained the following for each of the top-level administrative units in Egypt (governorates, n = 27 in 2014) at aggregate level following an ecological design (Supplementary Table 1 online). Supply and potential demand indicators: (1) number of dentists for 1995–2014; (2) total number of dental graduates per dental school in each governorate; and (3) population data from 1995 to 2014. Economic indicators: (1) mean weekly wages in 1995 and 2013 corrected for inflation; and (2) percentage of individuals who internally migrated to another governorate seeking jobs.

Data analysis

We calculated the number of dentists per 1000 population and assessed its variation over time using statistical process control (SPC). SPC aims at monitoring processes to detect if there are changes beyond those expected because of normal variation. Process is a term based on the origin of SPC techniques from industrial production. However, it applies to other variables that are measured across time points or across units at the same time point. SPC uses charts where measurements are plotted against the multiple units or time points. These charts show departures from normal variation when the measurement goes beyond 3 adjusted standard deviations or 3 σ. The σ levels are shown as dotted lines above and below the mean, which is represented by a solid line (*17*). Control charts were plotted to identify the years and/or governorates when/where the number of dental graduates, population size and dentists per 1000 population changed beyond normal variation (> 3 σ or below σ 3 σ levels).

The number of dentists per 1000 population was averaged over 4 intervals; 1995–1999, 2000–2004, 2005–2009 and 2010–2014. The ratio of the number of dentists per 1000 population was categorized into 4 classes: 0.03–0.06, 0.07–0.12, 0.13–0.20 and 0.21–0.41 and plotted using ARG GIS (Esri, Redlands, CA, USA) on 4 maps; 1 for each time interval. The distribution pattern of dentist availability was assessed (as a quantitative variable) for governorates using Moran's Index (*18*). This index is a correlation coefficient that quantifies how much a governorate is similar to neighbouring governorates. Its values ranges from +1, indicating perfect similarity to −1, indicating perfect dissimilarity or dispersion. Zero indicates perfect random distribution (*18*).

Dentists per 100 000 population in 2010–2014 was the outcome variable in general linear models. Univariate models were fitted including the explanatory variables: (1) number of graduates 1995–2014; (2) average population in 2010–2014; (3) dentist availability in 1995; (4) increase in wages between 1995 and 2013; and (5) percentage of internal migrants seeking jobs in 2006. Increase was calculated as [(recent value–earlier value)/ earlier value] *100. As well as the univariate models (model 1), 2 multiple regression models were fitted; model 2 including the number of graduates, average population size in 2010–2014, and dentist availability in 1995; and model 3 in which economic indicators were added to model 2. Regression coefficients (B) were calculated to show the change in dentist to population ratio in 2010–2014 associated with a unit change in the explanatory variables, 95% confidence intervals, P values and partial η^2 as measure of effect size. Standardized regression estimates (β) were also calculated to compare the relative strength of explanatory variables included in each model (*19*). Statistical analysis was performed using SPSS version 22.0.

Table 1 Dentists, population and economic indicators in Egypt at beginning and end of study

	Beginning of study 1995	End of study 2014	Percent increase
No. of dental graduates: total per year	499	3828	667.13
Dentists (total)	3866	15 317	296.20
Population (total)	57 509 998	86 813 723	50.95
Dentists per 1000 population, mean (SD)	0.07 (0.05)	0.18 (0.08)	209.65 (118.25)
Weekly wages in LE (adjusted for inflation), mean (SD)	636.5 (111.03)	1691.41 (1142.68)	164.54 (202.40)

LE = Egyptian pounds; SD = standard deviation.

Results

Table 1 shows that in 1995 there were 499 dental graduates and 3866 dentists serving 57.5 million people, with a mean dentists per 1000 population ratio of 0.07. After 20 years, there was a 667.13% increase in the number of graduates, 296.20% increase in the number of dentists and 50.95% increase in the population, with a 209.65% increase in dentists per 1000 population. During these 20 years, 32 848 dentists graduated from 17 dental schools including 8 private schools (Supplementary Table 2 online). Weekly wages (adjusted for inflation) increased by 164.54% (Table 1). Of 4 769 497 persons migrating from one governorate to another, 22.2% were seeking jobs.

With reference to the changes over 20 years, the numbers of graduates and population size were significantly lower before 2001 and higher after 2009 compared to the numbers between 2001 and 2009 (Figure 1). The number of dentists per 1000 population followed a more or less similar pattern with significant increase after 2009. Figure 2 shows dentist availability from 1995 to 2014. For the 4 time periods, Moran's Index indicated random distribution; in 1995–1999, Index = −0.05; in 2000–2004, Index = 0.002; in 2005–2009, Index = −0.013; and in 2010–2014, Index = 0.02 (all $P > 0.05$). During all 4 time periods, some governorates, such as Alexandria, consistently had the highest dentist to population ratio, whereas other governorates such as Fayoum and Qina consistently had the lowest ratio. Governorates that had dentist to population ratio significantly higher than all others are marked by red circles (Figure 3): South Sinai in 1995–1999, Cairo and New Valley in 2000–2004 and Alexandria in 2005–2014. In general, dentist to population

Figure 1 Control charts of number of dental graduates, population size and dentist availability, 1995- 2014

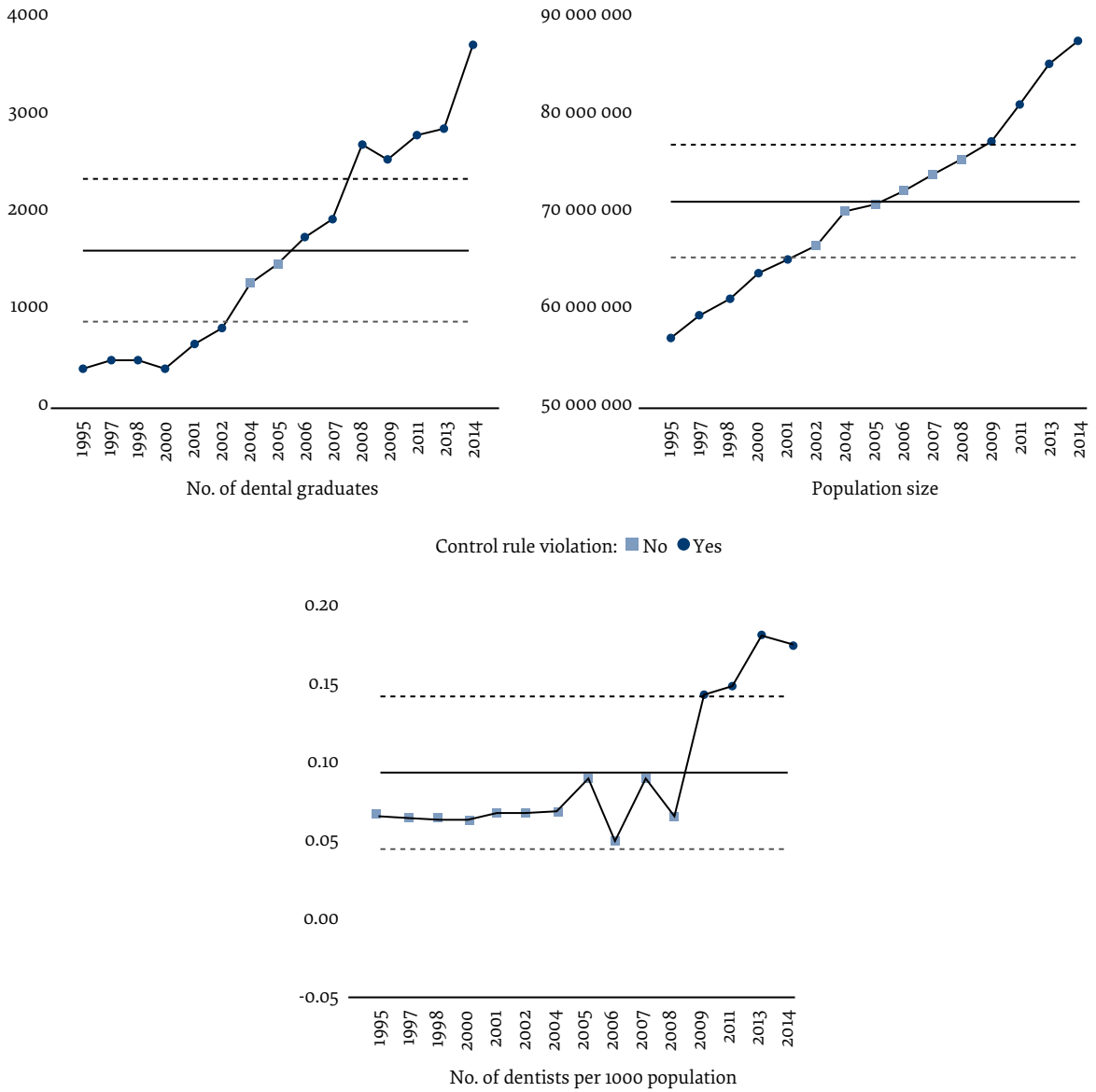


Table 2 Demographic, supply and economic factors affecting dentist per 100 000 population in 2010–2014

Factor	Model 1			Model 2			Model 3		
	B (95% CI)	*P*	η^2	B (95% CI)	*P*	η^2	B (95% CI)	*P*	η^2
No. of dental graduates (1995–2014)	0.001 (-0.0003, 0.002)	0.11	0.10	0.001 (-0.0004, 0.003)	0.15	0.09	0.00003 (-0.001, 0.001)	0.97	< 0.0001
Average population size in 2010–2014	-0.0000003 (-0.000002, 0.000001)	0.61	0.01	-0.000001 (-0.000003, 0.000001)	0.19	0.08	-0.0000004 (-0.000002, 0.000001)	0.51	0.02
Dentists to 1000 population in 1995	101.30 (50.45, 152.15)	<0.0001*	0.41	80.03 (21.79, 138.26)	0.01*	0.27	150.44 (93.16, 207.72)	< 0.0001*	0.60
Increase in weekly wages corrected for inflation (1995–2014)	-0.001 (-0.02, 0.02)	0.89	0.001				-0.03 (-0.04, -0.02)	< 0.001*	0.48
Percentage of internal migrants seeking jobs in 2006	0.23 (-0.03, 0.49)	0.08	0.12				0.22 (-0.01, 0.45)	0.06	0.17
Adjusted R^2	0.40						0.66		

Model 1: univariate linear regression including individual variables 1 at a time.
Model 2: Multivariable model including number of graduates (1995–2014), average population size (2010–2014) and dentists to 1000 population in 1995.
Model 3: Multivariable model including variables in Model 2 in addition to the economic indicators; increase in weekly wages, percentage of population migrating to seek jobs out of all migration to governorate in 2006.
**Statistically significant at P< 0.05.*
B = regression coefficient, CI = confidence interval, η^2 = partial η^2 as measure of effect size.

ratio increased over time until, in 2010–2014, 9 (33.3%) governorates had a ratio > 0.2.

In Model 1, dentist to population ratio in 1995 had the greatest association with dentist to population ratio in 2010–2014 (η^2 = 0.41) followed by the percentage of internal migrants who were seeking jobs (η^2 = 0.12) and the number of dental graduates (η^2 = 0.10, Table 2). Model 2 shows less variation in dentist availability compared to Model 3 in which economic factors were added (adjusted R^2= 0.40 and 0.66). When all factors were simultaneously considered in Model 3, higher dentist to population ratio in 2010–2014 was significantly associated with higher dentist to population ratio in 1995 (B = 150.44) and lower increase in weekly wages (B = −0.03). Internal migration to seek jobs (B = 0.22) and number of graduates (B = 0.00003) were associated with higher dentist to population ratio, whereas population size was associated with lower ratio (B = −0.0000004), although these were not significantly associated. Comparison of standardized regression coefficients (β) showed that the greatest effect on the outcome variable was for dentist to population ratio in 1995 (β = 0.97), followed by change in weekly wages (β = −0.62) and population size (β = −0.36) whereas the percentage of internal migrants seeking jobs (β = 0.15) and number of graduates (β = 0.15) had weaker effects.

Discussion

Starting from 2009, dentist availability in Egypt significantly increased reaching the highest level in 2014 but that still indicated a national shortage. This shortage was randomly distributed, although some governorates had better availability, such as Alexandria, and others had inadequate availability, such as Qina and Fayoum. Past dentist availability was the strongest predictor of future availability. Economic factors explained more variation in dentist availability than supply and potential demand, so the null hypothesis can be rejected.

The number of graduates significantly increased after 2009 when 5 new private dental schools were opened (*15*), although only 46.6% of dental graduates were retained in the workforce over 20 years. Because of this high attrition rate, the national dentist to 1000 population ratio reached 0.18 in 2014, signifying a shortage of dentists (*20*) and placing 64.6 million (74.3%) Egyptians in areas of dentist shortage. The present study disagrees with a Chilean study that projected 77.5% dentist oversupply after increasing dental schools from 5 to 34 over 15 years (*21*), and with an Indian study reporting a surplus of 100 000 dentists after a 10-fold increase in dental schools over 25 years (*22*). This difference in attrition rate may be explained by dentists' migration outside Egypt, which is supported by a previous study showing that the highest percentage of Arab expatriates working as dentists in 8 Arab countries were Egyptian (*23*), and a United Nations report showing brain drain in some Middle East and North Africa (MENA) countries, such as Egypt and Jordan, resulting from migration to the Gulf countries (*24*). The impact of mobility on dentist availability in source

Figure 2 Spatial distribution of dentist availability in Egypt showing random distribution, 1995–2014

countries witnessing political and economic instability should be addressed by co-ordinated global efforts.

At governorate level, the number of dental graduates had a weak association with dentist availability. This disagrees with previous reports that the presence of a dental school had a positive effect on dentist availability at county level in the United States of America (*1*) and in Japanese prefectures (*25*). However, it agrees with a study assessing the relationship at the American state level (*26*); a larger unit that may be more similar to the areas in our study. The lack of association may also be explained by the clustering of 9/17 (52.9%) dental schools in the greater Cairo area.

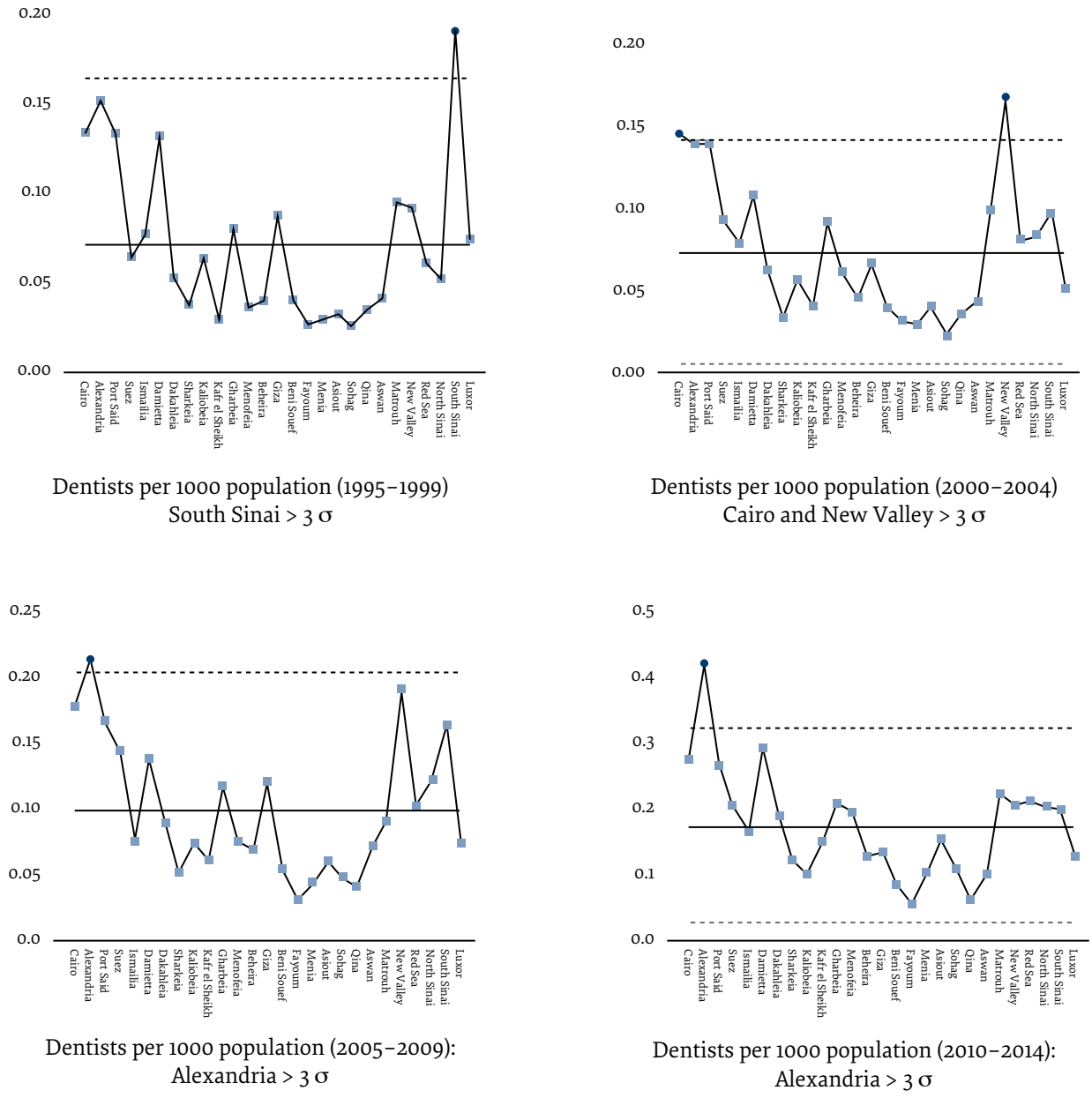
In the current study, previous dentist availability had the strongest positive impact on future dentist availability. This agrees with research showing that scarcity of healthcare providers predicts their future scarcity, and that physicians are more likely to move into locations where physician availability is already high (*27*). This finding, however, disagrees with a previous report of negative correlation between the number of medical specialists and their previous number in the same location, suggesting competition among specialists (*6*).

The present study showed an association between dentist availability and the percentage of migrants seeking jobs. This may be attributed to the greater convenience of using dental services near workplaces rather than at home towns, thus creating demand for dentists (*1*). It agrees with another study that reported an association between health worker to population ratio and emigration rates at country level (*28*).

In the present study, greater dentist availability was associated with lower increase in wages. Most dentists in Egypt work in the public sector (*29*), providing national health insurance whose coverage increased 10 times between 1995 and 2014 and included mainly employees (*14*). The dental care expenses of these employees were covered regardless of wages increase. Sixty percent of health expenditure in Egypt is out of pocket (*14*), and for this segment, increasing wages would help cover dental care costs. Thus, the negative association between increased wages and availability of mostly public sector dentists indicates a positive impact on the availability of private sector dentists. This disagrees with research reporting an association between dentist availability and higher income (*6*). Alternatively, this inverse relationship may be because the least increase in wages occurred in governorates that had the highest wages in 1995. Thus, dentists might have settled in governorates with established good economic conditions where other dentists have already settled, confirming the positive association between past and future dentist availability.

The present study was limited by data availability. Because of changes in CAPMAS definitions or units of

Figure 3 Governorates showing variation in number of dentists to 1000 population in 1995–1999, 2000–2004, 2005–2009 and 2010–2014



reporting, it was not possible to split dentist availability by sector (public vs private) or specialty or urban/rural location, and this might have obscured some associations. The study was also liable to ecological fallacy since data were reported at aggregate level. Some of the nonsignificant associations may be explained by study power issues, which might have caused some false-negative associations. The inability to increase sample size because of the fixed number of governorates was addressed by reporting partial η^2 as a measure of effect size to show the relative strength of the explanatory variables, even in the absence of statistical significance. Ecological studies demonstrate macrolevel associations and give insights into the impact of large-scale changes on healthcare systems. The strength of this study lay in its duration, which allowed assessment of long-term effects of supply, potential demand and economic changes on dentist availability. The longitudinal design also made possible before and after study of changes in response to naturally occurring events, such as extending health insurance coverage, opening new dental schools, and major political changes. The present findings may apply to developing countries with economic challenges, large population size and shortage of dentists. These conditions may coexist to various degrees so that direct generalization to neighbouring countries should be avoided.

The present study has implications for oral health services research in Egypt and other MENA countries to assess the extent and impact of within-region

dentist mobility on oral health outcomes. Research is needed to assess the number of dentists in the public and private sectors in addition to perceptions about dentist availability, how patients have their needs covered in dentist-shortage areas, and the impact of interventions aimed at workforce retention. The study also has healthcare policy implications. Some of the factors affecting dentist availability may be beyond the direct control of policy-makers but should be considered during workforce planning. For example, geopolitical factors limiting the development of some southern governorates, such as Qina and Fayoum, cannot be redressed only by health policy planners but need a holistic development framework. Similarly, the impact of unrest on the population size and number of dentists in North Sinai cannot be reversed within the healthcare system. Concerted efforts are needed to retain graduates in the national workforce and encourage them to settle in governorates with chronic shortage of dentists. There is a need to revisit the existing law of compulsory service for recent graduates and mandatory service in remote locations as a prerequisite for promotion (*30*). These laws do not seem to be enough to address the problem of shortage of dentists, although reports from Thailand, South Africa and Indonesia show that compulsory service supported by financial incentives may be successful (*31–33*).

In 2018, the Universal Health Care (UHC) law was enacted in Egypt. It includes dental care provided through the family health model (*34*). Previous research showed that dentists working in family health clinics expressed concerns about the availability and affordability of services to patients (*35*). If the new law can reduce the financial burden to patients, and the accompanying restructuring of the healthcare system provides adequate financial incentives to dentists, the economic constraints affecting the shortage of dentists may be addressed. Prospective and controlled studies assessing the impact of UHC and healthcare system restructuring are needed.

Conclusion

Despite the increase in dental graduates in Egypt over 20 years, about 75% of the population live in governorates with a shortage of dentists. Our study suggests that the problem is related to high attrition rates. With the high rate of population growth in Egypt, differences between governorates in dentist availability were mostly explained by previous availability and economic conditions. Offering financial incentives to dentists to encourage settling in areas of shortage and extending UHC to larger segments of the population may reduce the impact of economic constrains on providers and users of dental care, leading to better dentist availability.

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Disponibilité des dentistes en Égypte : étude sur 20 ans de l'offre, de la demande potentielle et des facteurs économiques

Résumé

Contexte : L'Égypte est l'un des pays les plus peuplés de la Région de la Méditerranée orientale, avec des nombres historiquement élevés de professionnels qualifiés fournissant leurs services sur le territoire national et à l'étranger. Des données sur la disponibilité des dentistes sont nécessaires à la planification de la production et de la formation des professionnels.

Objectifs : Nous avons examiné la disponibilité des dentistes en Égypte au moyen des paramètres suivants : 1) changements sur 20 ans ; 2) répartition territoriale ; et 3) liens avec l'offre, la demande potentielle de soins et les conditions économiques.

Méthodes : Dans la présente étude écologique (1995-2014), nous avons utilisé des données de l'Agence centrale pour la mobilisation du public et la statistique. Le critère de jugement était la disponibilité des dentistes (nombre de dentistes pour 1 000 habitants). Les variables explicatives étaient les suivantes : 1) taille de la population ; 2) nombre de diplômés en médecine dentaire ; 3) disponibilité de dentistes précédente ; 4) augmentation des salaires ; et 5) pourcentage de la population se déplaçant dans le pays afin de trouver du travail. Pour évaluer la variation dans la disponibilité des dentistes, nous avons utilisé le contrôle statistique du processus et l'auto-corrélation spatiale. L'effet des variables explicatives a été évalué au moyen de modèles linéaires généraux avec η^2 partiel pour mesurer la taille de l'effet.

Résultats : Le nombre de dentistes pour 1 000 habitants était réparti de manière aléatoire sur le territoire national et atteignait 0,18 en 2014, ce qui indique une pénurie malgré un nombre de diplômés en médecine dentaire en augmentation depuis 1995 (667,1 %). La disponibilité des dentistes précédente (η^2 = 0,60) et l'augmentation des salaires (η^2 = 0,48) avaient les effets les plus importants sur la disponibilité des dentistes.

Conclusions : L'Égypte est confrontée à un problème de pénurie de dentistes, qui n'a pas été compensé par l'augmentation du nombre de diplômés en médecine dentaire. La situation pourrait être améliorée par de meilleures conditions économiques ainsi que par l'intégration des soins de santé dans le plan de développement national.

توافر أطباء الأسنان في مصر: دراسة على مدى ٢٠ عاماً حول العرض والطلب المُحتمل، والعوامل الاقتصادية

مها الطنطاوي، نورهان علي، دينا عطية، همس عبد الرحمن، محمد مهينة

الخلاصة

الخلفية: تُعد مصر واحدةً من أكبر البلدان من حيث الكثافة السكانية في إقليم شرق المتوسط، وقد عُرفت على مر التاريخ بأنها غنيةٌ بأعداد كبيرة من المهنيين المُدرَّبين الذين يُقدّمون الخدَمات داخل مصر وخارجها. وكان من الضروري الحصول على بيانات بشأن مدى توافر أطباء الأسنان للتخطيط بشأن إعداد القوى العاملة وتدريبها.

الأهداف: قدَّرنا مدى توافر أطباء الأسنان في مصر، وشمل ذلك: (1) التغيرات التي حدثت على مدار العشرين عاماً الماضية، (2) التوزيع المكاني، (3) العلاقة بين العرض والطلب المُحتمل على الرعاية، بالإضافة إلى الظروف الاقتصادية.

طرق البحث: في دراسة إيكولوجية (1995–2014)، استخدمنا البيانات الواردة من الجهاز المركزي للتعبئة العامة والإحصاء. وبيَّن متغير المخرجات توافر أطباء الأسنان (عدد أطباء الأسنان لكل 1000 نسمة). وتمثلت المتغيرات التفسيرية في ما يلي: (1) حجم السكان، (2) عدد خريجي كليات طب الأسنان، (3) مدى توافر أطباء الأسنان في الماضي، (4) زيادة الأجور، (5) نسبة السكان الذين يهاجرون داخلياً بحثاً عن وظائف. وقدَّرنا التغير في توافر أطباء الأسنان من خلال مراقبة العمليات الإحصائية والترابط التلقائي المكاني. وقُدّر أثر المتغيرات التفسيرية باستخدام نماذج خطية عامة مع مربع إيتا الجزئي لقياس حجم التأثير.

النتائج: تبين توزيع أطباء الأسنان لكل 1000 نسمة بصورة عشوائية في جميع أنحاء مصر، بنسبة بلغت 0.18 في عام 2014، مما يدل على عدم كفاية عددهم على الرغم من ارتفاع أعداد خريجي كليات طب الأسنان منذ عام 1995 (667.1٪). وقد كان لتوافر الأطباء في الماضي (مربع إيتا= 0.60) وزيادة الأجور (مربع إيتا= 0.48) أكبر الأثر على مدى توافر أطباء الأسنان.

الاستنتاجات: تواجه مصر مشكلةً تتمثل في نقص أعداد أطباء الأسنان، وهو ما لم تعوّضه زيادة أعداد خريجي كليات طب الأسنان. وقد يساعد تحسين الظروف الاقتصادية ودمج الرعاية الصحية في الخطة الوطنية للتنمية في تحسين الوضع.

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Malnutrition and food insecurity in child labourers in Sindh, Pakistan: a cross-sectional study

Meesha Iqbal,[1] Zafar Fatmi,[1] Kausar Khan,[1] Yusra Jumani,[2] Neelma Amjad[1] and Asaad Nafees[1]

[1]Department of Community Health Sciences, Aga Khan University, Karachi, Pakistan. [2]Dow University of Health Sciences, Karachi, Pakistan. (Correspondence to: Meesha Iqbal: meesha.iqbal@aku.edu; meesha_jazz@hotmail.com).

Abstract

Background: Child labour is common in low- and middle-income countries. Although child labour is widespread in Pakistan, no data are available on the health of child labourers.

Aims: This study aimed to assess the food security, food intake and nutritional status of child labourers aged 5–14 years working in lower Sindh, Pakistan.

Methods: Child labourers aged 5–14 years working in agriculture, manufacturing industry, hotels and restaurants, domestic work and migrant child labourers working in vegetable markets were recruited using a respondent-driven sampling technique. Sociodemographic and nutrition information was obtained by an interviewer questionnaire. The children's height and weight were measured to assess stunting (height-for-age z scores less than –2) and wasting (weight-for-height z scores less than –2).

Results: A total of 634 child labourers were included: 184 worked in agriculture, 120 in industry, 67 in hotels and restaurants, 63 in domestic work and 200 were migrant child labourers. Overall, 15.5% of the children were stunted and 30.0% were wasted. The prevalence of stunting was highest in children working in agriculture (27.2%) and the prevalence of wasting was highest in migrant child workers (35.0%). About half the children (51.1%) were suffering from food insecurity. Food inadequacy was mainly in consumption of vegetables/potatoes (98% of the children had inadequate intake), legumes (97%), fruits (96%), meat/ poultry (95%) and milk/dairy products (82%).

Conclusion: The nutritional status and food insecurity of the child labourers of Pakistan are comparable with the general population, highlighting the grave situation of the country with regard to food security.

Keywords: child labour, nutritional status, food supply, Pakistan

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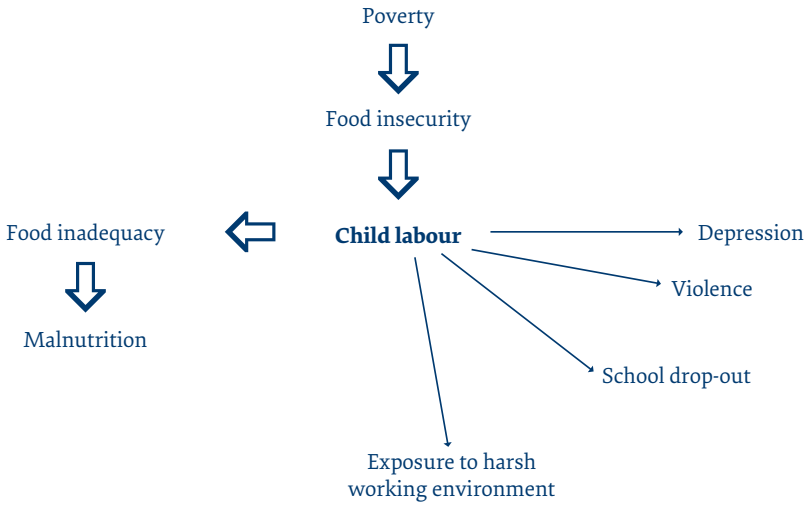
Introduction

The International Labour Organization (ILO) classifies child labour as "work that deprives children of their childhood, their potential and their dignity, and that is harmful to physical and mental development" *(1)*. Globally, 152 million children (58% boys, 42% girls) aged 5–17 years were involved in child labour in 2016 *(2)*. Migration, which may follow natural or man-made disasters or national and international conflicts, is one of the important reasons why children work *(3–5)*. Poverty, poor schooling systems and low literacy rates, and large family size are also important causes of child labour *(6,7)*. Child labourers are estimated to contribute up to 10–20% of the family income in some low- and middle-income countries *(8)*.

Labour has a significant effect on the lives of the children, including on their lifestyle, health, education and future job prospects *(6,7)*. Adverse health effects of child labour include poor growth, malnutrition, skin diseases, musculoskeletal disorders, and behavioural and mental disorders which can lead to several chronic diseases *(9,10)*. The decreased food availability and variety, combined with occupational hazards, puts the physical health and nutritional status of child labourers at greater risk *(11,12)*. We postulated a theoretical framework of child labour and malnutrition (Figure 1). Poverty leads to food insecurity forcing the children to start work at an early age. The harsh working environment offers less food and variety in food (they generally do not get meals at work) leading to food inadequacy and consequently malnutrition and the other effects outlined above.

Pakistan is the world's fifth most populous country with an estimated population of 208 million people *(13)*. According to the latest ILO report, the global burden of child labour is declining; however, the number of children in child labour has steadily increased in Pakistan, from 3.3 million in 1996 to an estimated 12.5 million in 2012 *(14,15)*. In 2010–2011, many families migrated to the cities because of heavy floods that hit Pakistan. Migration is a push factor for child labour in the cities *(16)*. Information on the health status of child labourers is scarce in Pakistan. Therefore, we conducted a survey in the cities of the lower part of Sindh province to assess nutrition in child labourers including: food availability, food intake and nutritional status. We included child labourers in the agricultural sector, manufacturing industry, hotel

Figure 1 Child labour and malnutrition: a conceptual framework



and restaurant sector, domestic work and migrants. The migrant children only worked in the vegetable market.

Methods

Study design and setting

This analysis is part of a larger mixed-methods study designed to assess the health and social status of the child labourers in suburban areas of lower Sindh (Karachi, Hyderabad and Thatta districts), Pakistan. The study was conducted from May to November 2017. We report the results of the cross-sectional survey to assess the physical health, nutritional status and food insecurity of the child labourers.

We included children aged between 5 and 14 years who had been working for at least 9 months in the past year. Fourteen is the minimum legal age for work in Pakistan. We considered any sort of work – formal or informal, paid or unpaid, casual or regular, full time or part time, seasonal or year round, legal or illegal – as labour as per ILO convention 138 *(17)*.

The 1996 National Labour Survey of Pakistan identified that child labourers in Sindh were employed in: agricultural sector (46%), manufacturing industry (18%), hotels and restaurants (16%), domestic work (10%), transport sector (8%), and construction sector (2%) *(14)*. We therefore drew our sample proportionately according to the above working groups. However, the transport and construction sectors were not included as their representation was too small in the overall sample.

Children working in hotels, restaurants and domestic work were sampled from Karachi. Children working in the agricultural sector of Karachi, Thatta and Hyderabad districts were selected based on feasibility and ease of access. It is hard to reach child labourers in Pakistan because of gangs. We had links in these areas and hence knew people who connected us to the children and their community. Children for the manufacturing group were sampled from bangle and handicraft industries of Hyderabad, which is well known for using child labourers, and from children working in warehouses and the fishery industry in the outskirts of Karachi.

We considered migration as a critical factor aggravating child labour; however, migrants were not considered in National Labour Survey of Pakistan. Migrants in Karachi form well defined communities. We selected migrant children from settlements along the so-called super highway (a road in Karachi), which are the largest migrant areas of the city.

Sample size and sampling

The sample size was calculated assuming a proportion of stunting in child labourers of 26%, relative precision of 25% and 95% confidence level *(18)*. The minimum sample needed was 318 children after increasing based on a 10% refusal rate.

We used respondent-driven sampling, which is considered appropriate to sample hidden populations. Respondent-driven sampling is a form of snowball sampling but it is implemented in a way that uses mathematical modelling for the calculation of selection probabilities; thus qualifying as a probability sampling technique *(19)*. Since the group of migrant children was clustered in certain areas of Karachi, the initial children were selected based on convenience sampling. They were given coupons and a monetary incentive to recruit other children working in the same group. Each recruited child was also given coupons and a monetary incentive to continue the chain until the sample size was reached.

Data collection tool

We used a structured interview questionnaire to assess the food security (adapted and modified from National Health Interview Survey, 2016) and nutritional intake *(20)* (Appendix 1, Appendix 2). The tool used had been previously validated in Pakistan and had also been used in the National Nutrition Survey of Pakistan. Interviews were conducted by the research team, including a research associate, a resident medical officer and a volunteer med-

ical student. In addition, we measured the children's height and weight. Food security was defined as access by all people at all times to enough food for an active and healthy life *(20,21)*. The children were asked about their intake of the common food items in the past year (Appendix 1, Appendix 2), which was compared with the Malaysian dietary guidelines for children and adolescents for adequate and inadequate intake *(22)*. National level guidelines are not available for Pakistan and we selected the Malaysian guidelines because Malaysians' eating habits are similar to Pakistani people.

Statistical analysis

WHO Anthro plus was used to calculate the z-scores for height-for-age (stunting) and weight-for-height (wasting) to assess the nutritional status of children. Children having z-scores less than −2 were categorized as stunted (chronic malnutrition) or wasted (acute malnutrition). Proportions, frequencies and 95% confidence intervals (CI) were calculated. The Pearson chi-squared test and one-way analysis of variance (ANOVA) were used to determine the differences between the occupational groups in stunting, wasting and food security. Six questions were asked about food availability and a positive answer for just one question was considered as food insecurity (see Annex 1). Data were analysed using *SPSS*, version 23 and *Stata*, version 8.

Ethical considerations

The Ethical Review Committee of the Aga Khan University approved the study. Consent was taken from the children before the interview.

Results

In total, 634 children were included in our study: 184 from the agricultural sector, 120 from the manufacturing industry, 67 from hotels and restaurants, 63 domestic workers and 200 migrant child labourers. Almost a quarter of the children 148 (23.3%) were aged 5–9 years, while 486 (76.7%) were 10 years or older. Table 1 shows the socioeconomic and demographic characteristics of the children. The mean age and standard deviation (SD) of the children ranged from 10.2 (SD 2.2) years in the migrant children to 11.9 (SD 1.7) years in the children working in the manufacturing industry. Of the children in our study, 322 (50.8%) were boys: most of the children working in hotels and restaurants were boys (66, 98.5%), whereas most of the children in domestic work were girls (55, 87.3%). The rest of the occupational groups had more equal gender distribution. Overall, the children worked for an average of 6.12 (SD 0.98) days a week and 6.81 (SD 3.09) hours a day. The children earned a mean of 4462.7 Pakistan rupees (Rs) a month (US$ 1 = 104.8 Rs in 2017), with the migrant children earning the most (Rs 5688.5 a month, US$ 54.3) and the agricultural workers the least (Rs 3077.3 a month, US$ 29.4). A good proportion of children (45.1%) said that they had previously attended the

Table 1 Socioeconomic and demographic characteristics of child labourers (5–14 years), by occupational group

Characteristic	Total (*n* = 634)	Migrants (*n* = 200)[a]	Agriculture (*n* = 184)	Manufacturing industry (*n* = 120)	Hotels & restaurants (*n* = 67)	Domestic work (*n* = 63)
Age (years), mean (SD)	10.9 (2.06)	10.2 (2.2)	10.8 (1.8)	11.9 (1.7)	11.1 (1.8)	11.1 (1.9)
Sex, no. (%)						
Male	322 (50.8)	127 (63.5)	74 (40.2)	47 (39.2)	66 (98.5)	8 (12.7)
Female	312 (49.2)	73 (36.5)	110 (59.8)	73 (60.8)	1 (1.5)	55 (87.3)
Ethnicity, no. (%)	**(*n* = 434)**		**(*n* = 173)**			
Sindhi	225 (51.8)	–	161 (93.1)	29 (24.2)	17 (25.4)	18 (28.6)
Punjabi	122 (28.1)	–	0 (0.0)	57 (47.5)	34 (50.7)	31 (49.2)
Other	87 (20.0)	–	12 (6.9)	34 (28.3)	16 (23.9)	14 (22.2)
Income/month (Rs)[b], mean (SD)	4462.7 (3850.0)	5688.5 (4683.7)	3077.3 (2912.6)	5045.3 (4118.2)	4240.9 (2247.9)	3338.1 (2051.5)
Type of house[c], no. (%)						
Pakka	153 (24.1)	3 (1.5)	10 (5.4)	75 (62.5)	27 (40.3)	38 (60.3)
Semi-pakka	190 (30.0)	3 (1.5)	91 (49.5)	39 (32.5)	38 (56.7)	19 (30.2)
Kacha	291 (45.9)	194 (97.0)	83 (45.1)	6 (5.0)	2 (3.0)	6 (9.5)
No. people living in house, mean (SD)	8.28 (3.49)	9.1 (3.3)	7.5 (2.4)	8.5 (4.7)	7.9 (3.6)	7.6 (3.1)
Currently going to school, no. (%)	174 (27.4)	59 (29.5)	34 (18.5)	55 (45.8)	7 (10.4)	19 (30.2)
Ever attended school, no. (%)	286 (45.1)	95 (47.5	55 (29.9)	61 (50.8)	43 (64.2)	32 (50.8)

SD: standard deviation.
[a]*Migrant children worked in the vegetable markets.*
[b]*US$ 1 = 104.8 Pakistani rupees (Rs).*
[c]*Pakka is a house built of cement; kacha is made of mud; and semi-pakka has straw, mud, wood and bamboos and sometimes a tin roof but no cement is used.*
P < 0.01 for all the variables; Pearson chi-squared test and one-way ANOVA.

school for at least a month, but only 27.4% were currently going to school.

Overall, 15.5% (95% CI: 12.9–18.5) were stunted (chronic malnutrition) and 30.0% (95% CI: 26.5–33.6) were wasted (acute malnutrition) (Figure 2). The highest prevalence of stunting was in children working in agriculture (27.2%), and the lowest in the migrant child workers (9.0%). The prevalence of wasting was highest in the migrant children (35.0%) and lowest in children working in manufacturing (26.7%) (Figure 2). Stunting was significantly more common in girls (21%, 65/312) than boys (9.6%, 31/322; $P < 0.001$).

The mean number of meals a day eaten by the children was of 2.76 (SD 0.5). Just over half ate home-cooked food (55%) and drank tap water (54.9%). Most children working in the agricultural sector (53.8%) drank water from a borehole. Food insecurity was seen in 51.1% of the children, and was highest in the domestic workers (60.3%) and agricultural workers (59.8%) (Table 2).

Table 3 shows that adequacy of daily food intakes according to different food groups and age groups. Most of the children had an inadequate daily intake of all the food groups (fruits, vegetables, legumes, milk/dairy products and meat/ poultry).

About 21.5% of the children had skipped food for at least one day in the previous month and 24.0% said they had lost weight because of being unable to afford food. We estimated a high intake of tea and sweets (chocolate, toffee and cotton candy) in the children with a mean of 1.55 cups (SD 1.02) of tea day and 0.91 (IQR: 0.86) sweets a day.

Discussion

Our study findings show that 30.0% and 15.5% of the child labourers suffered from acute and chronic malnutrition, respectively. Stunting was significantly more common in girls than boys. About half the children (51.1%) were affected by food insecurity, and an alarming prevalence of food inadequacy was observed in the consumption of fruits, vegetables/potatoes, milk/dairy products, legume and meat/poultry. However, the estimates of malnutrition and food insecurity were no worse than the general population of Pakistan, which was 58% according to the national nutrition survey in 2011 *(23,24)*.

Few data are available on the nutritional status of child labourers in Pakistan. The Pakistan Demographic and Health Survey and the Multiple Indicator Cluster Survey (Sindh) offer nutritional estimates only for children under 5 years of age *(25,26)*. Thus, no national survey was available for comparison.

A study in Islamabad found that 20% and 12% of street children under 14 years were stunted and wasted respectively *(27)*. Street children are generally thought to have a greater risk of poorer health and violence and a very vulnerable group. While they were not included in our study, the nutritional status of our child labourers was worse, highlighting the high susceptibility of working children to malnutrition. Our estimates also correspond to national estimates of the World Food Programme in 2017 where 18% of the population of Pakistan faced severe shortage of food *(24)*. The culture and environment of Bangladesh is comparable to Pakistan and so are the estimates. A study in Dhaka, Bangladesh estimated that 15% and 26% of the child labourers in the city aged 5–17 years were wasted and stunted, respectively *(18)*. Our estimates of acute malnutrition (30% wasting) are similar to the estimates for child labourers working in

Figure 2 Nutritional status of the child labourers (5–14 years) in suburban areas of lower Sindh, by occupational group (n = 634)

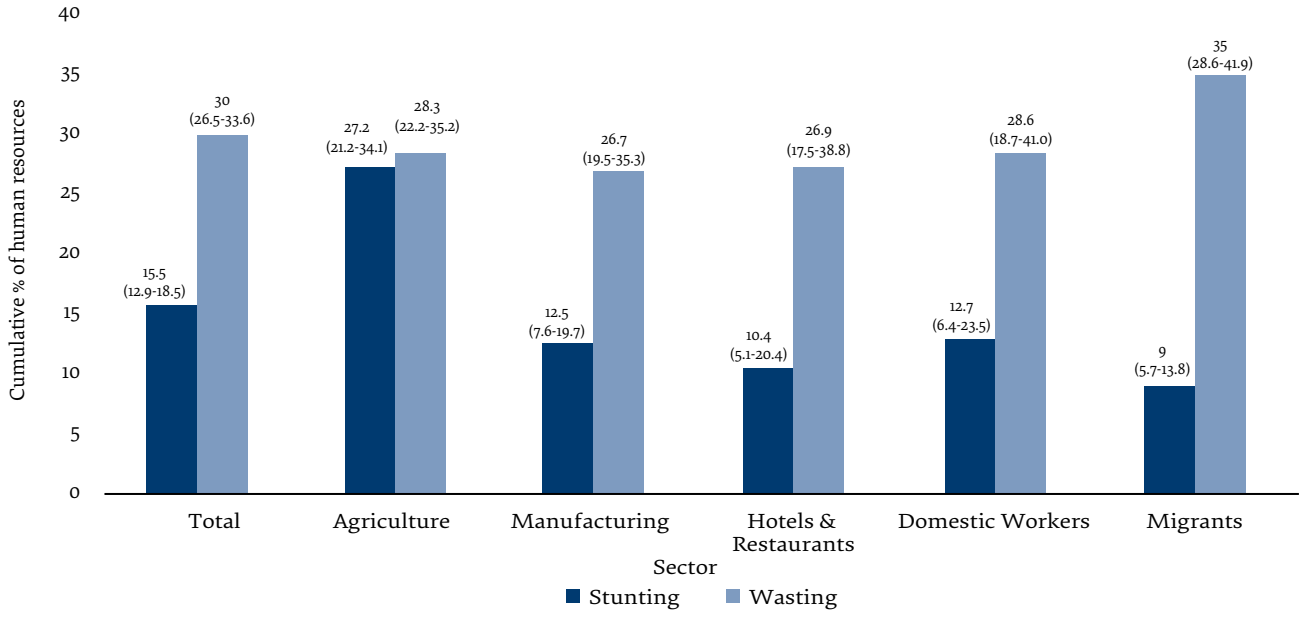


Table 2 Food and water intake in child labourers (5–14 years), by occupational group

Variable	Total (*n* = 634)	Migrants (*n* = 200)	Agriculture (*n* = 184)	Manufacturing industry (*n* = 120)	Hotels & restaurants (*n* = 67)	Domestic work (*n* = 63)
No. of meals/day, mean (SD)	2.76 (0.50)	2.91 (0.32)	2.45 (0.55)	2.87 (0.36)	2.91 (0.38)	2.87 (0.33)
Source of food, no. (%)						
Home only	349 (55.0)	108 (54.0)	101 (54.9)	98 (81.7)	7 (10.4)	35 (55.6)
Market/workplace and home	184 (29.0)	84 (42.0)	9 (4.9)	10 (8.3)	59 (88.1)	22 (34.9)
Does not eat at work	92 (14.5)	6 (3.0)	74 (40.2)	5 (4.2)	1 (1.5)	6 (9.5)
Other	9 (1.4)	2 (1.0)	0 (0.0)	7 (5.8)	0 (0.0)	0 (0.0)
Food insecurity, no. (%)						
No	310 (48.9)	106 (53.0)	74 (40.2)	69 (57.5)	36 (53.7)	25 (39.7)
Yes	324 (51.1)	94 (47.0)	110 (59.8)	51 (42.5)	31 (46.3)	38 (60.3)
Source of drinking water at work, no. (%)						
Tap water/pipe water	348 (54.9)	159 (79.5)	50 (27.2)	57 (47.5)	43 (64.2)	39 (61.9)
Borehole (hand pump/motor)	142 (22.4)	11 (5.5)	99 (53.8)	31 (25.8)	0 (0.0)	1 (1.6)
Well/pond/river/stream	39 (6.2)	7 (3.5)	32 (17.4)	0 (0.0)	0 (0.0)	0 (0.0)
Water filter (jerry can)	59 (9.3)	2 (1.0)	1 (0.5)	27 (22.5)	6 (9.0)	23 (36.5)
Water tanker	33 (5.2)	14 (7.0)	0 (0.0)	1 (0.8)	18 (26.9)	0 (0.0)
Don't know	13 (2.1)	7 (3.5)	2 (1.1)	4 (3.3)	0 (0.0)	0 (0.0)

SD: standard deviation.
P < 0.01 for all the variables; Pearson chi-squared test.

Philippines, where 38.3% (mean age 14.3 years, SD: 2.0) suffered from wasting *(28)*.

Our data show a high level of food insecurity (51.1%) which is in line with the National Nutrition Survey of Pakistan 2011, which reported that 58% of households were food insecure *(23)*. The World Food Programme also reported that 43% of the population was food insecure with 18% facing a severe shortage *(24)*. A high proportion of the children had food inadequacy in all the food groups. The intake of bread, rice, grains was not asked about in our study; we assumed their intake was high as these are the cheapest available staple foods. A reasonable intake of wheat and bread among the working children aged 8–18 years was also reported in a study in the Islamic Republic of Iran *(29)*.

Our results highlight the variation in the nutritional status of children working in the different occupational sectors. The highest prevalence of food insecurity was in children working in the agricultural sector (60%) which reflected the higher prevalence chronic malnutrition (27%) in these children. Although most of the children working in agriculture were working in the family business, they were at greater risk of food insecurity and deteriorating physical health compared with other groups. At the same time, 60% of children doing domestic work also had food insecurity but only 12.7% were stunted. The reasons for this difference in the prevalence of stunting with the same prevalence of food insecurity warrant investigation.

Interestingly, our estimates of food insecurity and nutritional status of the child labourers were not worse than the general population of Pakistan, although we thought they would be. This lack of difference is probably because many people in Pakistan are poor and hence cannot afford all the food they need. This might lead one to wonder if child labourers are better off compared with other children. We believe that the fact that the nutritional status of the child workers in our study was similar to the general population could also be attributed to the healthy worker effect; with more healthy children

Table 3 Adequacy of daily intake of different food groups of child labourers, by age group

Food group	Age (years)	
	5–9 (*n* = 148)	≥ 10 (*n* = 486)
	No. (%)	No. (%)
Fruit		
Adequate	2 (1.4)	18 (3.7)
Inadequate	146 (98.6)	468 (96.3)
Vegetables/potatoes		
Adequate	6 (4.1)	7 (1.4)
Inadequate	142 (95.9)	479 (98.6)
Legumes		
Adequate	38 (25.7)	87 (17.9)
Inadequate	110 (74.3)	399 (82.1)
Milk/dairy products		
Adequate	4 (2.7)	13 (2.7)
Inadequate	144 (97.3)	473 (97.3)
Meat/poultry		
Adequate	38 (25.7)	24 (4.9)
Inadequate	110 (74.3)	462 (95.1)

The mean intake was compared with the Malaysian dietary guidelines for children and adolescents (22). The guidelines are different for 5–9 year olds and those ≥ 10 years.

being selected for work and being able to continue to work. This could also be the reason of higher proportions of acute compared to chronic malnutrition in this group. The effect of work on the health of these children over time has is yet to be studied and we believe that they might be at risk of deteriorating health in future due to inadequate availability of food. In addition, there is a need to evaluate if previous interventions to help alleviate the situation of child labour in Pakistan have been effective.

To the best of our knowledge, this is the first study to assess the nutritional status of child labourers in different occupational sectors in Pakistan. One of the major strengths of our study was its sampling technique as respondent-driven sampling is considered a good strategy to sample hidden populations *(30)*. Migrants, who are generally neglected and not included among child labourers, were also included in our study. Moreover, the sample size was sufficient and validated tools followed by robust analysis were used to assess the outcomes. However, our study has some limitations. Although respondent-driven sampling is the accepted technique to sample the hidden populations, some of the children in our study might not have been labourers and were brought by other children because of the monetary incentive. Furthermore, our sample did not have sufficient power to detect statistically significant differences between the working groups. The National Labour Survey of Pakistan does not consider children working on the streets, in carpet industries or cottage industries in the estimated cohort so they were not included in our study. However, we believe that these are important groups of child labour missed in our study. Our study did not capture data of children who left work because of disability, illness or death. Lastly, we also cannot eliminate the possibility of recall bias and reporting bias while interviewing the participants.

Further studies are needed to evaluate child labour and nutrition and to develop strategies and policies to tackle child labour and associated health and well-being problems.

Acknowledgement

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Competing interests: None declared.

Appendix 1: Questionnaire to assess the food and water intake.

Ask the child if he/she eats the following. If the child says yes then ask him/her how many times a week he ate the following in the past 30 days.

		0	1	2	3	4	5	6	7	
1	Do you eat daal/chole/lobia? (any beans or lentils)									
2	Do you eat vegetables? (Cooked or raw vegetables, except potatoes)									
3	Do you eat potatoes? (Cooked/fried/any form)									
4	Do you eat fruits?									
5	Do you eat eggs?									
6	Do you eat meat/chicken/fish? (Beef/mutton any animal meat)									
7	Do you take Milk/Yogurt/Lassi/Cheese? (Any form of milk)									
8	Do you eat butter/ghee/cream (balai)?									
9	Do you drink tea?									
10	Do you eat packed chips/slanty?									
11	Do you eat toffees/chocolates/cotton candy?									
12	Do you eat peanuts/almonds/seeds? (any seeds like watermelon/sunflower seeds or dry fruit)									
13	What is your main source of drinking water during working hours?	1. Tap water/pipe water 2. Boring (hand pump/motor) 3. Well 4. Pond/river/stream 5. Refused 6. Don't know 7. Others_____								
14	What is your main source of drinking water after working hours?	8. Tap water/pipe water 9. Boring(h and pump/motor) 10. Well 11. Pond/river/stream 12. Refused 13. Don't know 14. Others_____								
15	Do you purify water before drinking?	15. Yes 16. No								

Appendix 2

Q1: In the last 30 days, did you ever skip meals because there wasn't enough money for food?
Q2: In the last 30 days, how many days did this happen? *
Q3: In the last 30 days, did you ever eat less than you felt you should because there wasn't enough money for food?
Q4: In the last 30 days, did you lose weight because there wasn't enough money for food?
Q5: In the last 30 days, did you ever not eat for a whole day because there wasn't enough money for food?
Q6: In the last 30 days, how many days did this happen? *

*Greater or equal to 3 days was considered "yes"
A single "yes" answer was considered as "food insecurity"

Étude transversale de la malnutrition et de l'insécurité alimentaire chez les enfants travailleurs du Sindh (Pakistan)

Résumé

Contexte : Le travail des enfants est courant dans les pays à revenu faible et intermédiaire. Bien que le travail des enfants soit répandu au Pakistan, aucune donnée n'est disponible sur la santé des enfants travailleurs.

Objectifs : La présente étude avait pour objectif d'évaluer la sécurité alimentaire, les apports alimentaires et l'état nutritionnel d'enfants âgés de 5 à 14 ans et travaillant dans le bas Sindh (Pakistan).

Méthodes : Des enfants âgés de 5 à 14 ans travaillant dans les secteurs de l'agriculture, de l'industrie de transformation, des hôtels et restaurants et du travail domestique, ainsi que des enfants de migrants travaillant sur les marchés de légumes, ont été recrutés au moyen de la méthode d'échantillonnage déterminé selon les répondants. Des informations sociodémographiques et nutritionnelles ont été recueillies à l'aide d'un questionnaire d'entretien. La taille et le poids des enfants ont été mesurés enfin d'évaluer le retard de croissance (score z de la taille-pour-l'âge inférieur à –2) et l'émaciation (score z du poids-pour-l'âge inférieur à –2).

Résultats : Au total, 634 enfants travailleurs ont été inclus dans l'étude : 184 travaillaient dans l'agriculture, 120 dans l'industrie, 67 dans des hôtels et restaurants et 63 dans le travail domestique ; 200 étaient des enfants de migrants. Dans l'ensemble, un retard de croissance a été observé chez 15,5 % des enfants et une émaciation chez 30,0 % d'entre eux. La prévalence du retard de croissance était plus élevée chez les enfants travaillant dans l'agriculture (27,2 %), tandis que la prévalence de l'émaciation était plus élev ée chez les enfants de migrants (35,0 %). Près de la moitié des enfants (51,1 %) souffraient d'insécurité alimentaire. Les insuffisances alimentaires constatées concernaient principalement la consommation de légumes et de pommes de terre (98 % des enfants avaient des apports insuffisants), de légumineuses (97 %), de fruits (96 %), de viande et de volaille (95 %) et de lait et de produits laitiers (82 %).

Conclusion : L'état nutritionnel et l'insécurité alimentaire chez les enfants travailleurs au Pakistan sont comparables avec ceux de la population générale, ce qui souligne la gravité de la situation de ce pays en matière de sécurité alimentaire.

سوء التغذية وانعدام الأمن الغذائي في العمال الأطفال في السند، باكستان: دراسة مقطعية

ميشا إقبال، ظفار فاطمي، كوثر خان، يسرا جوماني، نيلما أمجد، أسعد نفيس

الخلاصة

الخلفية: يشيع عمل الأطفال في البلدان المنخفضة والمتوسطة الدخل. وعلى الرغم من انتشار عمل الأطفال في باكستان على نطاق واسع، إلا أنه لا توجد بيانات بشأن صحة العمال الأطفال.

الأهداف: هدفت هذه الدراسة إلى تقييم الأمن الغذائي، والمدخول الغذائي، والوضع التغذوي للعمال الأطفال الذين تتراوح أعمارهم بين 5–14 عاماً ويعملون في السند السفلي، باكستان.

طرق البحث: شملت الدراسة العمال الأطفال الذين تتراوح أعمارهم بين 5–14 عاماً الذين يعملون في الزراعة، والصناعات، والفنادق والمطاعم، والعمل المنزلي، والعمال الأطفال المهاجرين الذين يعملون في أسواق الخضروات، وذلك باستخدام أسلوب أخذ العينات من المستجيبين. وقد حُصل على البيانات الاجتماعية–السكانية والتغذوية باستخدام استبيان للأشخاص الذين جرت معهم المقابلة، وقيس طول الأطفال ووزنهم لتقييم التقزم (الطول–مقابل–الوزن –2 نقطة من الانحراف المعياري) والهزال (الوزن–مقابل–الطول –2 نقطة من الانحراف المعياري).

النتائج: بلغ مجموع العمال الأطفال 634 طفلاً، توزيعهم كالتالي: 184 في الزراعة، و120 في الصناعة، و67 في الفنادق والمطاعم، و63 في العمل المنزلي، و200 كانوا من العمال الأطفال المهاجرين. وبشكل عام، يعاني الأطفال من التقزم والهزال بنسبة 15.5٪ و30.0٪ على التوالي. وقد تركّز أعلى معدل لانتشار التقزم في الأطفال الذين يعملون في الزراعة (27.2 ٪)، بينما تركّز أعلى معدل لانتشار الهزال في العمال الأطفال المهاجرين (35.0 ٪). وكان نصف الأطفال تقريباً (51.1 ٪) يعاني من انعدام الأمن الغذائي. وتركز نقص التغذية أساساً في عدم استهلاك مدخول كاف من الفواكه (96 ٪)، والخضروات/ البطاطس (98٪)، والحليب/ منتجات الألبان (82 ٪)، والبقوليات (97 ٪)، واللحوم/ الدواجن (95 ٪).

الاستنتاجات: يتقارب الوضع التغذوي وانعدام الأمن الغذائي للعمال الأطفال في باكستان مع السكان عموماً، مما يلقي الضوء على خطورة الوضع في البلد في ما يتعلق بالأمن الغذائي.

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The epidemiology of cholera in the Islamic Republic of Iran, 1965–2014

Hossein Masoumi-Asl,[1,2] Goodarz Kolifarhood[3,4] and Mohammad Mehdi Gouya[1]

[1]Center for Communicable Diseases Control, Ministry of Health and Medical Education, Tehran, Islamic Republic of Iran (Correspondence to: Hossein Masoumi-Asl: dr_masoumiasl@yahoo.com). [2]Research Centre of Paediatric Infectious Diseases, Institute of Immunology and Infectious Diseases, Iran University of Medical Sciences, Tehran, Islamic Republic of Iran. [3]Student Research committee, School of Public Health; [4]Department of Epidemiology, School of Health and Safety, Shahid Beheshti University of Medical Sciences, Tehran, Islamic Republic of Iran.

Abstract

Background: Cholera is endemic in the Islamic Republic of Iran. According to surveillance system records and historical documents, cholera epidemics have led to thousands of deaths throughout the country in past centuries.

Aims: The aim of this study was an overview of cholera disease during the last 5 decades (1965–2014) and the epidemiological features of the most recent large-scale outbreaks.

Methods: In this descriptive study, cholera incidence data provided by the National Surveillance Database were extracted and significant fluctuating trends for 1965–2014 were tested using the Cochran–Armitage test. To identify the factors most associated with cholera incidence in the outbreaks, adjusted odds ratios were computed by ordinal logistic regression.

Results: Analysis of data has shown a tremendous decrease in incidence trends, from 19.7/100 000 to 0.01/100 000 over the 9 cholera epidemics that occurred at 5–6 year intervals during 1965–2014. Younger age groups (15–44 years) and inhabitants in urban areas have been more vulnerable to cholera in recent epidemics. The virulence of the pathogen and the case fatality rates have not changed during the last 3 epidemics.

Conclusion: The burden of cholera in terms of case load has dramatically reduced during 1965–2014. Furthermore, the epidemiological feature of cholera with regard to transmission route, domicile, age, immigration, mortality and antimicrobial resistance has changed considerably in recent epidemics. While the number of epidemic regions has diminished, some areas are still susceptible to cholera outbreaks.

Keywords: cholera, epidemiology, outbreaks, epidemics, Iran

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Introduction

Cholera is a severe and acute diarrhoeal disease. The etiologic agent, *Vibrio cholera*, was identified by Robert Koch in 1883 (*1*). The association of the disease with drinking water supplies contaminated with sewage was discovered during an 1854 cholera outbreak in London (*2*). If dehydration and electrolyte imbalance are properly compensated for, the prognosis of the disease will be favourable in most patients, otherwise it results in potentially high mortality rates (*3,4*). Environmental investigation of the pathogen and its interaction with susceptible hosts as well as other organisms makes the dynamics of cholera extremely complex (*5*). According to a World Health Organization (WHO) report in 2018, an estimated 95 000 people die due to cholera and 2.9 million are affected every year (*3*). Moreover, cholera epidemics have been recognized as a major health problem in recent decades, witness the large outbreaks in Haiti and the Dominican Republic in 2012 (*6,7*).

Emerging new pathogenic variants in many African and Asian countries, which have a mixture of phenotypic and genotypic traits of classical and El Tor biotypes, are enormous challenges in the global fight against cholera (*8*). The Islamic Republic of Iran, as a middle-income country, is experiencing case notification of cholera on a small scale annually. Although 90% of cholera cases have been reported from Afghanistan and Pakistan and a more recent epidemic in Yemen in 2017 (*9–11*), cholera is still considered an endemic disease in the Islamic Republic of Iran. The National Cholera Surveillance System is one of the oldest data collecting programmes in the country and was originally planned after the substantial El Tor cholera epidemic in 1965. According to surveillance system records and historical documents, cholera epidemics have claimed thousands of lives over the past centuries throughout the country (*12*).

However, the epidemiological features of cholera have changed dramatically in the Islamic Republic of Iran since 1965 and this study aimed to address the sociodemographic characteristics and their relationship with variations in transmission routes through the past 3 epidemics in 1998, 2005 and 2011.

Methods

Study setting and population characteristics

The Islamic Republic of Iran is located in the south-west region of Asia with an area landmass of 1 630 207 km² and a population of approximately 80 million. This country borders Turkey, Iraq, Azerbaijan, Armenia, Turkmenistan, Afghanistan and Pakistan, and is divided into 31 provinces. At the time of this study, urban inhabitants made up 69% of the population (*13*).

Cholera surveillance system

The Cholera Surveillance System is operated by the Iranian Department of Food and Waterborne Disease in the Center for Communicable Disease Control. Any suspicious case with mild to severe diarrhoea attending hospitals (public/private), clinics and health centres (urban/rural) are included in a free-of-charge stool culture screening programme. In addition, all travellers arriving inro the country from neighbouring endemic countries to the east and west (based on WHO reports) by land or sea are screened for cholera at border health posts, especially during July–December. Diagnostic as well as treatment centres are obliged to immediately notify the Department of Food and Waterborne Disease of any confirmed case of cholera based on laboratory certification via the district health centre.

All confirmed cases are cross-checked by stool culture and serotyping in national reference laboratories. As part of the National Cholera Surveillance System, the sensitivity of *V. cholerae* to antimicrobials should be assessed annually. Furthermore, a round of active case investigation is conducted by health staff among people who have had a history of close contact with index cases, after which records are entered into a national electronic database. These records comprise demographic characteristics, domicile, nationality, date of onset of signs and symptoms, date of diagnosis, date of entry to the Islamic Republic of Iran, questions about type and frequency of meals during the 5 days prior to diagnosis, and history of travelling outside the region.

Data source, statistical procedures

In this descriptive study, cholera incidence data provided by the National Surveillance Database during the last 5 decades (1965–2014), and coverage data on accessibility to safe drinking water based on the WHO definition of sanitation (*14*) in the Center for Communicable Disease Control were extracted for 1965–2014. The national census data for 6 periods over 1965–2011 were used to estimate incidence rates and consequential trends. For analysis of linear trend of cholera incidence rates, the Cochran–Armitage test for trend using *Winpepi* software was employed. Any unexpected increase/departure from a linear trend based on the Cochran–Armitage test in number of cases of cholera incidents over this period was considered an outbreak. Data on the past 3 outbreaks were disaggregated by province. To realize the most important determinants of cholera incidence in the outbreaks, adjusted odds ratios were computed by ordinal logistic regression using *STATA*, version 11. This method takes into account the effect of exposure(s) over the 3 levels of an ordered outcome (outbreaks in 1998, 2005 and 2011), and yields an OR summarizing effect(s) across given exposure levels. *P*-value ≤ 0.05 was considered significant.

Results

Analysis of cholera incidence during 1965–2014 revealed a tremendous decrease in incidence trends from 19.7/100 000 in 1965 to 0.01/100 000 in 2014 ($P = 0.0001$), with 9 epidemics having occurred at 5–6 year intervals (Figure 1). The highest incidence was in 1970 at 66.7/100 000 population.

Figure 1 Trend of cholera in the Islamic Republic of Iran 1965–2014 (linear refers to the incident trend of cholera cases)

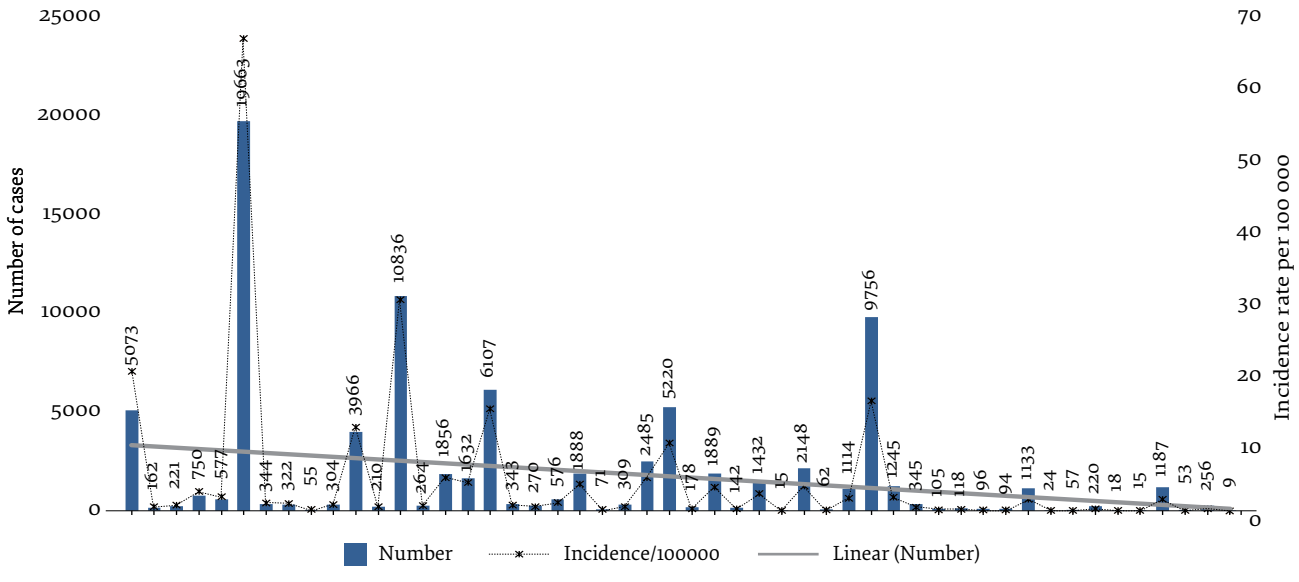


Figure 2 shows the frequency of cholera cases by province in the last 3 epidemics in the country: 21 provinces reported at least one outbreak during the period 1998–2014, and in the north and central plateau regions, 5 provinces experienced the last 3 outbreaks.

Figure 3 indicates coverage rate of accessibility to safe drinking water and sanitation in the past 4 decades. The number of households with access to safe drinking water and sanitation has increased dramatically, however the gradient of the slope for increasing accessibility to sanitation is dissimilar: and at least 20% of inhabitants in the south-east regions did not have access to sanitation by 2011.

The incidence rate of cholera in the country has fallen since the 1998 outbreak, primarily in the provinces in the northern and south-eastern parts of the country: Figure 4 shows the distribution by province over the last 3 outbreaks. While inaccessibility of safe drinking water was prominent in the 1998 outbreak, consumption of raw vegetables that were cultivated using sewage was the main route for cholera transmission in the northern region in 2005 and 2011. The main route for disease

Figure 2 Distribution of cholera cases in the provinces of the Islamic Republic of Iran in the last three cholera epidemics (1998, 2005, 2011)

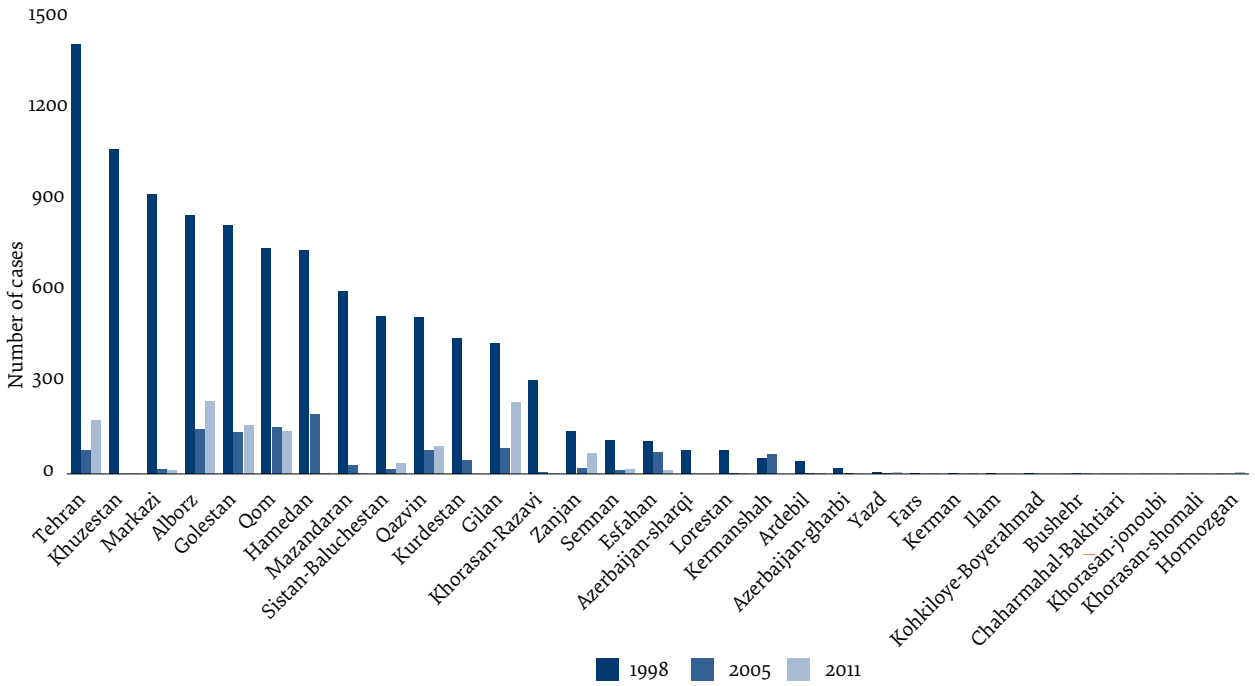


Figure 3 Accessibility to drinking water and sanitation in the Islamic Republic of Iran, 1976–2011

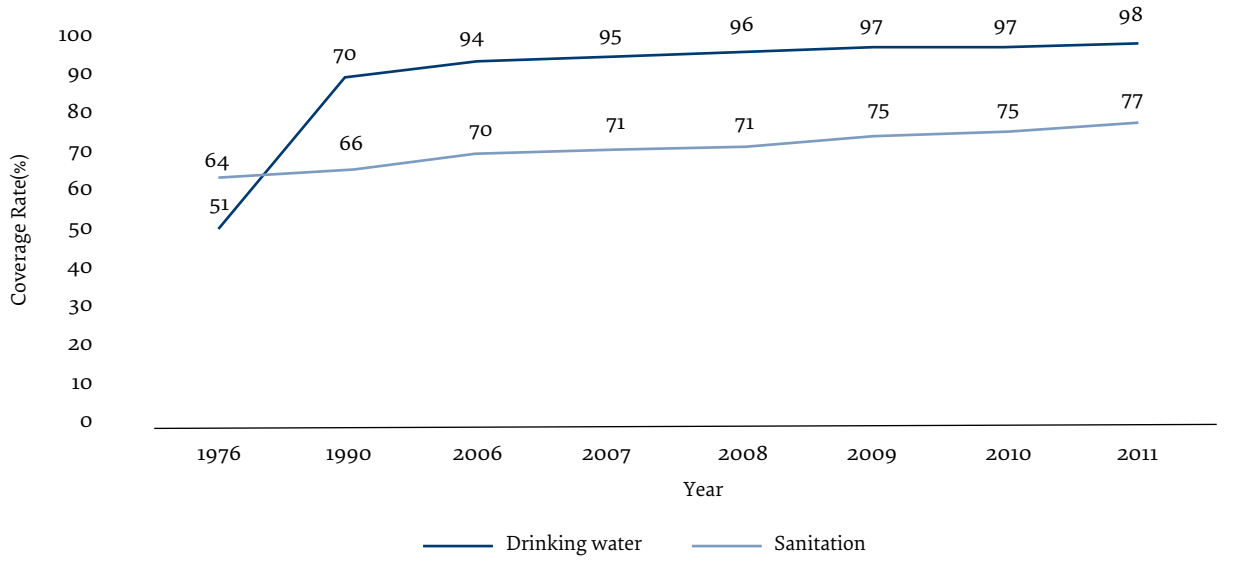
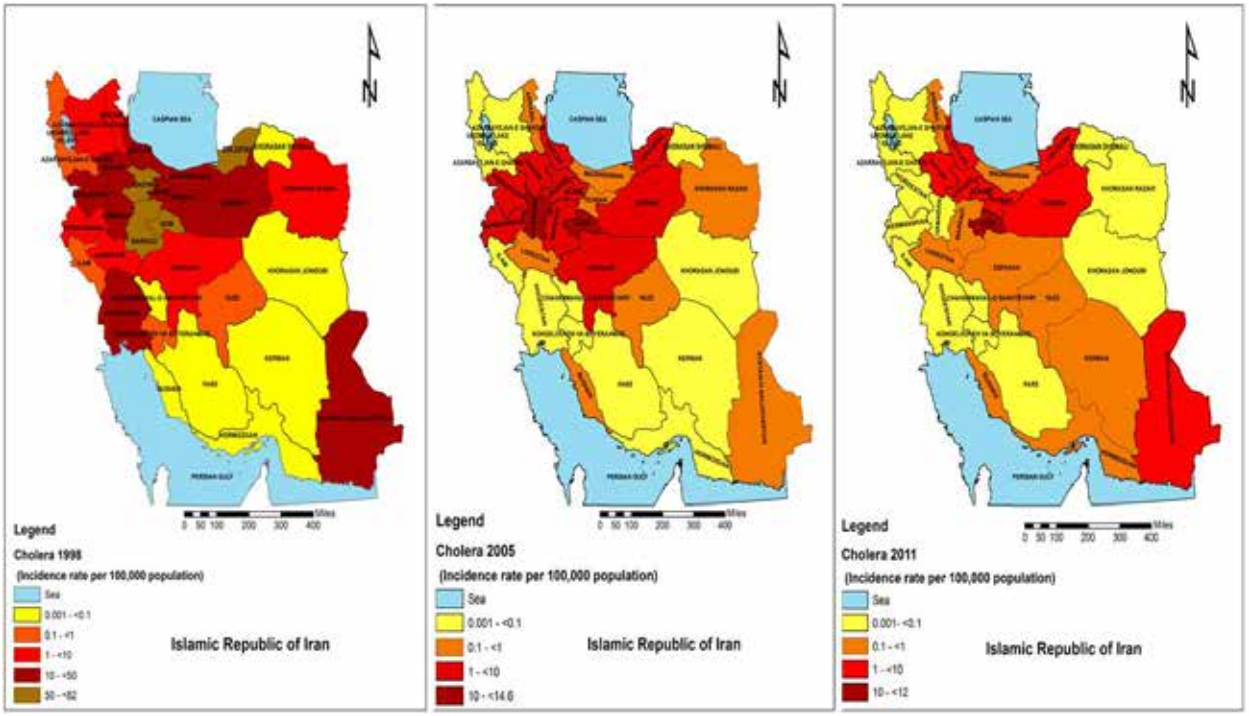


Figure 4 Map showing incidence rate of cholera in the last three cholera epidemics (1998, 2005, 2011) in the Islamic Republic of Iran



transmission in the south-eastern region in 2011 was the consumption of unsafe drinking water.

Cholera transmission season in the Islamic Republic of Iran begins in July and extends to December (Table 1). Comparison of the most recent epidemic (2011) against the previous 2 (1998 and 2005) shows that the incidence decreased from July to December, and in 2005 and 2011 this reduction in incidence occurred earlier (July–October) compared with 1998. Generally, the number of cholera cases decreased in the older age groups in the last 2 epidemics (2005, 2011) compared with 1998. Comparison of urban and rural populations showed the likelihood of cholera had decreased in rural areas to 37%, and urban populations were more likely to be affected in the past 2 epidemics compared with 1998. Iranians made up the majority of cholera patients in all 3 epidemics. There was no change in the hospitalization rates in all 3 epidemics, and in accordance with this, the cholera case fatality rates did not change either. Although there has been a switching pattern between Inaba and Ogawa as the dominant serotypes during the last 3 epidemics, Ogawa was isolated more often in the most recent epidemic.

Discussion

Cholera incidence distribution during previous epidemics has been characteristically different over time. While the burden in terms of case load has been reduced in recent years and the number of epidemic regions has diminished, 5 provinces have been susceptible in all 3 epidemics. Evidence on the transmission mechanism in the past 3 epidemics has revealed different routes within and between affected regions: inaccessibility of safe drinking water in affected areas in 1998 and in the south-east region in 2011 was indicated as the main route of transmission, while consumption of raw vegetables contaminated by sewage in the northern region was more prominent in the 2005 and 2011 epidemics. Women, younger age groups and inhabitants in urban areas were more vulnerable to cholera disease in recent epidemics, nevertheless, the case fatality rate has not differed over the last 3 epidemics. However, the epidemiological features of the disease have changed considerably.

The most important change seen in the epidemiological features of cholera in the Islamic Republic of Iran is the transmission route. In low- and middle-income countries and in non-sanitary environments without access to potable water, the main route of cholera transmission was water. However, in 2 recent epidemics (2005, 2011), the pathogen was isolated from sewage, raw vegetables and human samples simultaneously (*15–17*). Moreover, laboratory findings with genotyping and molecular techniques showed clonal dissemination of a single strain of *V. cholerae* throughout the country in 2005 (*18*).

In addition to raw vegetables, having a meal outside the home was associated with cholera occurrence in a 2005 meta-analysis (*19*). The annual incidence rate of typhoid fever, a waterborne/foodborne disease having a common transmission mechanism (oral–faecal) with cholera, was dramatically reduced from 133.4 to 0.52 per 100 000 population in the country between 1965 and 2011 (*20*).

The second important change is related to domicile. This change in the cholera transmission mechanism

Table 1 Characteristics of the last three cholera epidemics (1998, 2005, 2011) in the Islamic Republic of Iran

Attribute	Year						Adjusted OR (95% CI)
	1998 (*n* = 9752)		2005 (*n* = 1133)		2011 (*n* = 1187)		
	No.	%	No.	%	No.	%	
Month							
July	209	2.14	38	3.35	58	4.88	Reference
August	1503	15.41	586	51.72	182	15.33	0.52 (0.49–0.55)
September	5562	57.03	349	30.08	913	76.92	
October	1321	13.54	125	11.03	32	2.69	
November	1038	10.64	31	2.73	2	0.18	
December	119	1.22	4	0.35	–	–	
Age (years)							
< 1	273	2.79	24	2.11	15	1.26	Reference
1–4	446	4.57	60	5.29	57	4.80	0.82 (0.81–0.84)
5–9	234	2.39	49	4.32	45	3.79	
10–14	254	2.60	49	4.32	60	5.05	
15–24	1102	11.30	310	27.36	242	20.38	
25–34	1122	11.50	275	24.27	268	22.57	
35–44	986	10.11	132	11.56	207	17.44	
45–54	1092	11.19	88	7.76	109	9.18	
55–64	1199	12.29	69	6.09	58	4.88	
≥ 64	3042	31.19	77	6.79	126	10.61	
Sex							
Male	5168	52.99	600	52.95	550	46.33	Reference
Female	4584	47.01	533	47.04	637	53.67	1.16 (1.06–1.27)
Domicile							
Urban area	6086	62.41	895	78.99	802	67.56	Reference
Rural area	3666	37.59	238	21.01	385	32.44	0.63 (0.56–0.69)
Nationality							
Iranian	9166	93.99	1102	97.27	1128	95.03	Reference
Afghan	507	5.19	26	2.29	54	4.54	0.68 (0.56–0.83)
Pakistani	79	0.82	5	0.44	5	0.43	
Severity							
Hospitalized	2555	26.19	227	20.04	386	32.52	Reference
Outpatient	7197	73.81	906	79.96	801	67.48	0.95 (0.85–1.48)
Serotype							
Inaba	92	0.94	1122	99.03	12	1.01	Reference
Ogawa	9603	98.47	11	0.97	1175	98.99	0.08 (0.07–0.09)
Hikojima	57	0.59	–	–	–	–	
Treatment outcome							
Cured	9642	98.88	1122	99.03	1175	98.99	Reference
Died	110	1.12	11	0.97	12	1.01	0.88 (0.56–1.38)

in recent years is likely due to a significant expansion in the urban populations following huge migrations of people seeking better job opportunities from the villages to the marginal areas of cities, where no facilities were planned (*13*). Furthermore, increasing accessibility of safe drinking water in rural areas along with improvements in socioeconomic conditions in general may explain the decreasing slope of incident trend in rural areas. However, as in other middle-income countries, there is an increasing trend towards having meals, especially fast food with salad, outside the home in urban areas, and this has played a significant role in the occurrence of diseases which have oral–faecal transmission routes in recent years compared with rural areas (*17,19*).

The third change is age distribution of the disease. Comparison of age groups the epidemics of 2005 and

2011 showed that older age groups were less affected than in 1998. A study on the effect of age on cholera morbidity in the Islamic Republic of Iran has indicated that partially acquired immunity in endemic areas acts as an important determinant of epidemics with 5–6 year intervals. Younger age groups with insufficient prior immunity against the cholera pathogen might be the outcome in recent epidemics (*21*).

The fourth change is the main challenge of controlling of cholera in the country in relation to illegal migration from neighbouring countries. Even though the role of foreign immigrants during the 3 epidemics we studied was not prominent, the number of cholera cases imported from outside Iranian borders is overrepresented in the interval years between epidemics. Accordingly, among 256 total confirmed cholera cases in the country during 2013, 211 (83%) were imported from Afghanistan (*22,23*). An evaluation of cholera outbreaks in the south-east region during 2010–2013 showed 63.3% of all cases were imported from Afghanistan (*24*).

The fifth notable change in cholera epidemiology is in mortality. There was no significant difference in mortality: the case fatality rate was around 1% throughout the 3 epidemics. There have been fewer deaths in recent epidemics, mainly due to recent improvements in case management and access to treatment services (*25*).

The main challenge for cholera disease control in the next decade will depend on the prevalence of antimicrobial resistance. According to the latest report on *V. cholerae* sensitivity to antimicrobials and its susceptibility testing on the 60 samples of *V. cholerae* serotype Inaba showed all isolates were resistant to nalidixic acid, tetracyclin, and trimethoprim sulfamethoxazole, with intermediate resistance to erythromycin, while they were sensitive to ciprofloxacin, cefixime and ampicillin (*22*). Furthermore, while all isolates were sensitive to tetracyclin, ciprofloxacin, and erythromycin in 2005 (*15*), in 2013 they were resistant to tetracyclin with intermediate resistance to erythromycin (*22*). In 2005, a study in Tehran showed that 86%, 84%, 84%, and 82% of the isolates were resistant to streptomycin, chloramphenicol, co-trimoxazole, and tetracycline, respectively. All of the isolates were susceptible to 3 antimicrobial agents, including ciprofloxacin, cefixime and ampicillin (*18*). In 2011, another Iranian study revealed that all of the isolates were susceptible to 3 antimicrobial agents, including ciprofloxacin, cefixime, and ampicillin, and the highest rate of resistance was seen to nalidixic acid (96.7 %) and co-trimoxazole (91.8 %) (*26*).

This is the first study in the Islamic Republic of Iran to use longitudinal data and describe the incidence trends of cholera disease over 5 decades (1965–2014), however there were some limitations in the study. Epidemiologic features and control of cholera disease based on related factors were investigated for the last 3 epidemics. While under-ascertainment of cholera cases due to mild or no symptoms of infections (90–95%) is common, under-reporting and variations in case definitions and methods of case finding in the communicable disease surveillance system in the country over 50 years should be indicated as the main limitation (*27,28*). However, in the case of cholera, under-ascertainment and under-reporting issues improved following intensified sensitivity of the communicable diseases surveillance system: it has been an urgent notifiable disease for at least 3 decades (*29,30*). Even though we analysed cholera outbreaks using logistic regression, it may be useful to consider time series analysis of the fluctuations of cholera incidence after adjustment for trend, periodicity and seasonality.

Conclusion

The burden of cholera disease in terms of case load has been reduced dramatically in the past 5 decades. Further, the epidemiological features of cholera in regard to transmission route, location, age, immigration, mortality and antimicrobial resistance have changed considerably in recent epidemics. While the number of epidemic regions has diminished, some areas throughout the country are still susceptible to outbreaks. Besides maintaining and strengthening the National Cholera Surveillance System, which focuses on changes in the epidemiologic features of cholera, well-designed control measures by community health authorities are recommended.

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Épidémiologie du choléra en République islamique d'Iran (1965-2014)

Résumé

Contexte : Le choléra est endémique en République islamique d'Iran. D'après les registres du système de surveillance et les documents publiés, les épidémies de choléra ont causé des milliers de décès à travers le pays au cours des siècles passés.

Objectifs : L'objectif de la présente étude était d'établir une vue d'ensemble de l'épidémiologie du choléra au cours des cinq dernières décennies (1965-2014) et des caractéristiques épidémiologiques des dernières grandes flambées épidémiques.

Méthodes : Dans cette étude descriptive, les données sur l'incidence du choléra fournies par la base de données nationale de surveillance ont été extraites et les tendances fluctuantes significatives pour 1965-2014 ont été évaluées au moyen du test de Cochran-Armitage. Pour identifier les facteurs les plus associés à l'incidence du choléra au cours des flambées épidémiques, des odds ratios ajustés ont été calculés par régression logistique ordinale.

Résultats : L'analyse des données a révélé une diminution considérable dans les tendances d'incidence de la maladie. En effet, l'incidence du choléra est passée de 19,7 pour 100 000 à 0,01 pour 100 000 au cours des neuf épidémies de choléra qui se sont produites à cinq ou six ans d'intervalle entre 1965 et 2014. Les groupes d'âge les plus jeunes (15-44 ans) et les habitants des zones urbaines ont été plus vulnérables au choléra lors des épidémies récentes. La virulence de l'agent pathogène et le taux de létalité n'ont pas changé au cours des trois dernières épidémies.

Conclusions : En termes de nombre de cas, le fardeau du choléra a diminué de manière manière considérable au cours de la période comprise entre 1965 et 2014. En outre, les caractéristiques épidémiologiques du choléra en ce qui concerne les voies de transmission, le domicile, l'âge, l'immigration, la mortalité et la résistance aux antimicrobiens ont notablement évolué au cours des dernières épidémies. Bien que le nombre de régions touchées par ces épidémies ait diminué, certaines zones sont toujours vulnérables aux flambées de choléra.

وبائيات الكوليرا في جمهورية إيران الإسلامية، 1965–2014

حسين معصومي اصل، غودارز كوليفرهود، محمد مهدي جويا

الخلاصة

الخلفية: تتوطن الكوليرا في جمهورية إيران الإسلامية. ووَفقاً لسجلات نظام الترصد والمستندات السابقة، فقد تسببت الكوليرا في آلاف الوفيات في جميع أنحاء إيران على مدار القرون الماضية.

الأهداف: يتمثل الهدف من هذه الدراسة في استعراض مرض الكوليرا على مدار العقود الخمسة الماضية (1965–2014) والخصائص الوبائية لآخر الفاشيات التي حدثت على نطاق واسع.

طرق البحث: في هذه الدراسة الوصفية، استُخرجت البيانات عن معدلات الإصابة بالكوليرا من قاعدة البيانات الوطنية لترصَّد الأمراض، كما فُحصت الاتجاهات المتذبذبة بصورة كبيرة في الفترة من 1965–2014 باستخدام اختبار كوكران–أرميتاج. وحُسبت نسب الأرجحية باستخدام الانحدار اللوجستي التتابعي لتحديد العوامل الأكثر ارتباطاً بحدوث الإصابة بالكوليرا أثناء الفاشيات.

النتائج: أظهر تحليل البيانات انخفاضاً هائلاً في الاتجاهات السائدة في الإصابة، حيث انخفضت النسبة من 19.7 لكل 100000 نسمة إلى 0.01 لكل 100000 نسمة خلال أوبئة الكوليرا التسعة التي حدثت على فترات تتراوح بين 5–6 سنوات خلال الفترة من 1965–2014. وكانت الفئات العمرية الأصغر سناً (15 – 44 عاماً) وسكان المناطق الحضرية أكثر عُرضة للإصابة بالكوليرا أثناء الأوبئة التي حدثت مؤخراً. ولم يحدث تغير في الشدّة الفيروسية لمُسببات مرض الكوليرا ومعدلات إماتة الحالات على مدار الأوبئة الثلاثة الأخيرة.

الاستنتاجات: انخفض عبء مرض الكوليرا بصورة كبيرة خلال الفترة من 1965–2014. وعلاوةً على ذلك، فقد شهدت الأوبئة التي حدثت مؤخراً تغيراً كبيراً في الخصائص الوبائية للكوليرا من حيث طريقة انتقال العدوى بها، وأماكن توطنها، وعُمر الأشخاص المُعرَّضين للإصابة بها، والهجرة، والوفيات، ومقاومة مضادات الميكروبات. وعلى الرغم من انخفاض عدد المناطق الوبائية، إلا أن بعض المناطق لا تزال عُرضة لحدوث فاشيات الكوليرا بها.

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Regional disparities in the distribution of Sudan's health resources

Mohamed Ismail[1]

[1]Institute of Public Administration, Riyadh, Saudi Arabia (Correspondence to: Mohamed Ismail: ismailm@ipa.edu.sa).

Abstract

Background: Equal distribution of health resources has been a core objective of both long- and medium-term strategic plans for the health sector in Sudan. However, the targets of these plans have not yet been achieved, resulting in weak performance of the whole health system. The unequal distribution of the health resources has resulted in significant regional disparities in provision of health care services.

Aims: This study aims to describe and analyse the inequality in geographic distribution of public sector's physical and human health resources in Sudan. In addition, the study also aims to measure the relations between density of health resources and health outcomes.

Methods: State-level data on health resources and health outcomes obtained from the Sudan Health Statistical Report of 2016 were used to calculate inequality indices, drawing Lorenz curves, and calculating Spearman's correlation analysis between health resource density and health-related outcomes.

Results: Our findings show that the distributions of health resources, based on population size, were highly unequal among the 18 states of Sudan.

Conclusion: There is a crucial need to improve health status in the relatively under-resourced states, particularly in Darfur, South Kordofan and Blue Nile states. Moreover, the government needs to use health resource allocation models that take into account the population size and health outcomes variables in each state in future health strategies.

Keywords: health resources, Gini coefficient, dissimilarity index, resource concentration index, Sudan

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Introduction

Background

Inequality of health resources is a worldwide phenomenon but it is more predominant in developing countries (*1*). Maldistribution of health resources has been one of the leading health care problems in many countries (*2*). Several studies have shown that inequitable geographical distribution of health resources is a major problem that hinders population access to health care services (*3–5*). Moreover, many studies show that there is a positive correlation between the availability of health resources and health outcomes represented by life expectancy and mortality rates (*6,7*). Therefore, equitable distribution of health resources in developing countries is of paramount importance, as many of these countries face severe shortages in physical and human resources to provide essential health care services (*8,9*).

In Sudan, inequitable regional distribution of wealth and resources has been the leading driver of political conflicts and violence since its independence in 1956 (*9–11*). Power sharing, equal distribution of national resources and provision of basic services to all citizens have been the main common goals for both political parties and armed movements (*11*). Many factors have cumulatively contributed to the inequality of resources in Sudan in the past decades. These factors include political, economic and administrative polices adopted by the successive national governments (*10*).

Nonetheless, the government of Sudan strives to provide equitable health care services to the whole population. The long-term strategic plan for health sector (2003–2027) aims to provide equitable, accessible, affordable, efficient and quality health care services (*12*). In line with the long-term plan objectives, the national health sector medium-term plan (2012–2016) also marks equity in access and utilization of health services (*13*). However, the targets of these plans have not been achieved (*14*). As a result, the distributions of health resources have been highly unequal, reflecting significant regional disparities in provision of health care services (*13–15*). For example, recent statistics show that the number of physicians per 100,000 population varied between 1.8 and 28.5 physicians across the Sudan's 18 administrative states in 2016 (*16*). The range is even wider for the nurse density rate, ranging from 6.6 to 90.2 nurses per 100 000 population (*16*).

Thus, it is immensely important to carry out research on the inequality of geographic distribution of health care resources in Sudan to enable the country to set strategies for improving population access to health care services.

Sudan's health status

The key national health indicators reveal that the overall Sudan's health status is low (*8,17*). Moreover, the point es-

timators of these indices disguise significant interstate and intrastate differences. There are marked disparities in the values of these indicators between the country's states. For example, the percent of the population with no access to health services ranged between 20 to 40% (*8*). This is mainly due to security concerns in conflict-affected states in Darfur, South Kordofan and Blue Nile, where most health care facilities are not accessible (*8*). About 45% of the population has no access to improved drinking water, particularly in the rural and conflict-affected areas, and more than 50% of selected essential medicines are not available (*17*). Moreover, the physician, nurse, and midwife densities are far below the minimum threshold of 230 doctors, nurses and midwives per 100 000 population that was recommended by WHO as necessary to deliver crucial maternal and child health services (*18*).

Despite the poor health status, the infant mortality rate (IMR) fell from 70 per 1000 live births in 2006 to 48 per 1000 live births in 2015, but still higher than the Millennium Development Goals (MDGs) target of 40 deaths per 1000 live births (*17,19*). Similarly, the under-5 years mortality rate (U5MR) also declined from 112.2 per 1000 live births in 2006 to 70 per 1000 live births in 2015, again still higher than the MDGs target of 53 deaths per 1000 live births in 2015 (*17,19*). Likewise, the maternal mortality rate (MMR) decreased from 509 per 100 000 live births in 2000 to 311 per 100 000 live births in 2015, still higher than the MDGs target of 134 deaths per 100 000 live births (*17,19*). The total life expectancy at birth also improved, from 58.0 years in 2007 to 63.7 years in 2015 (*17,19*).

This poor status of health is largely associated with low financial and human resources allocated to the health sector. In Sudan, the domestic general government health expenditure is extremely low, amounting to less than 2 % of the Gross Domestic Product (GDP) in 2015, far below the world level (*20*).The per capita government and private health expenditures in in 2015 were PPP US$ 86.3 and PPP US$ 185.4, respectively, which are also far below world level values (*20*).

Study objectives

Despite the unequal distribution of health care services and resources across Sudan's regions, up to now it seems that no study has been carried out on the geographic distribution of health resources. Therefore, this study aims to fill the existing research gap by analysing the level of inequality in geographic distribution of the public sector's health resources using 2016 data. In addition, the study also aims to measure the relationships between density of health human resources (physicians and nurse) and health outcomes.

Methods

Study variables and data sources

To measure the level of health resources distribution between states, 2 groups of variables were studied:

- health facilities, which includes hospitals, health units, health centres and beds;
- human resources, which includes specialist physicians, dentists, all physicians, nurses, public health officers, medical assistants, technicians, midwives, and health visitors.

The data for this study were obtained from the Sudan Health Statistical Report of 2016, published by the Federal Ministry of Health (*16*). The report provides detailed health statistics for the 18 states of Sudan for 2016.

Inequality indices

There are many indices for measuring inequality in the geographic distribution of health variables. The most common indices used in analysing inequality in the distribution of health resources include the Lorenz curve, the Gini coefficient, the weighted coefficient of variation and the dissimilarity index (*21–24*). In addition, the author has developed a resource concentration index to determine relatively under- and over-resourced regions/states.

Weighted coefficient of variation

Like the ordinary coefficient of variation, weighted coefficient of variation (WCV) is a relative measure of dispersion. Taking the impact of population share in each state into account, the population WCV for a variable y (e.g. health resource), given a sampling weight hw and size variable hs (population size), is defined as (*24*):

$$WCV = \left[\frac{\frac{\sum_{i=1}^{n} w_i y_i^2}{\sum_{i=1}^{n} w_i} - \hat{\mu}^2}{\hat{\mu}^2} \right]^{\frac{1}{2}} \times 100$$

Where:

$$w_i = hw_i \times hs_i \quad \text{and} \quad \hat{\mu} = \frac{\sum_{i=1}^{n} w_i y_i}{\sum_{i=1}^{n} w_i}$$

High WCV values indicate a higher degree of health resource inequality and vice versa. As a relative measure of dispersion, WCV allows comparison of inequality levels for different health variables.

Gini coefficient

The Gini coefficient (GC) is widely used to assess the inequality distribution of health resources. For a sample of size n (e.g. number of regions), the GC for variable y (e.g. health resource) given a sampling weight hw and size variable hs (population size) is estimated as follows (*24*):

$$\hat{I} = 1 - \frac{\hat{\xi}}{\hat{\mu}}$$

Where:

$$\hat{\xi} = \sum_{i=1}^{n}\left[\frac{V_i^2 - V_{i+1}^2}{V_1^2}\right] y_i \; ; \; V_i = \sum_{k=i}^{n} w_k ; \; w_k = hw_k \times hs_k ; \text{ and } y_1 \geq y_2 \geq \ldots y_{n-1} \geq y_n$$

$$\hat{\mu} = \frac{\sum_{i=1}^{n} w_i y_i}{\sum_{i=1}^{n} w_i}$$

The coefficient value ranges between 0 and 1. Lower values indicate less inequality in the distribution of the resources, and higher values suggest greater inequality. A Gini coefficient < 0.2 indicates absolute equality, 0.2–0.3 low inequality, 0.3–0.4 medium inequality, 0.4–0.5 high inequality and > 0.5 represents extreme inequality (*25–27*).

Dissimilarity index

The dissimilarity index (DI), also known as the Hoover Index, measures the proportion of each health resource that would have to be redistributed in order to achieve even distribution of the health resource between states or regions. The index takes the following form (*28*):

$$H_j = \frac{1}{2} \sum_{i=1}^{n} \left| \frac{p_i}{P.} - \frac{y_{ij}}{y_{.j}} \right|$$

Where $\frac{P_i}{P.}$ is the percentage of the population in region i to the total population in the country, $\frac{y_{ij}}{y_{.j}}$ is the percent of resource j in region i to the total resource j in the country. The index value ranges between 0 and 1; smaller values indicate greater equity in resource allocation, and larger values show higher inequality in the distribution of the resource.

Lorenz curves

In addition to GC and DI indices, Lorenz curves (LCs) are widely used to represent graphically the distribution of health resources (*29,30*). The diagonal line in the LC represents perfect equality of the resource distribution among regions/states. The more the variable of interest curve deviates from the diagonal, the greater the degree of unequal distribution of the variable between regions/states.

Resource concentration index

To determine the resource concentration among the regions under study, the author developed the following formula:

$$RC_i = \frac{\left(y_{ij} / y_{.j}\right)}{\left(P_i / P.\right)}$$

The resource concentration index (RCI) determines the source of inequality with a value ≥ zero; ($RC_i \geq 0$). An index value = 1 indicates that the percentage of the health resource allocated to the state is exactly equal to the percentage of the population in the region; a value < 1 means that the region receives relatively fewer health resources compared to its population size, and a value > 1 shows that the region receives relatively higher health resources compared to its population size.

Data analysis

The *Distribution Analysis Stata Package* was used to calculate inequality indices (WCV and GC) and plot Lorenz curves for the health resources variables. Dissimilarity and resource concentration indices were calculated using *Excel*. Spearman's rho correlation was used to compute the correlation coefficients between density of health human resources (physicians and nurses) and health outcomes (IMR, U5MR, MMR, and life expectancy) using *SPSS* statistical package. For all the methods used for data analysis, the unit of analysis is the "state", as the health data were aggregated to state level in the Health Statistical Report of 2016.

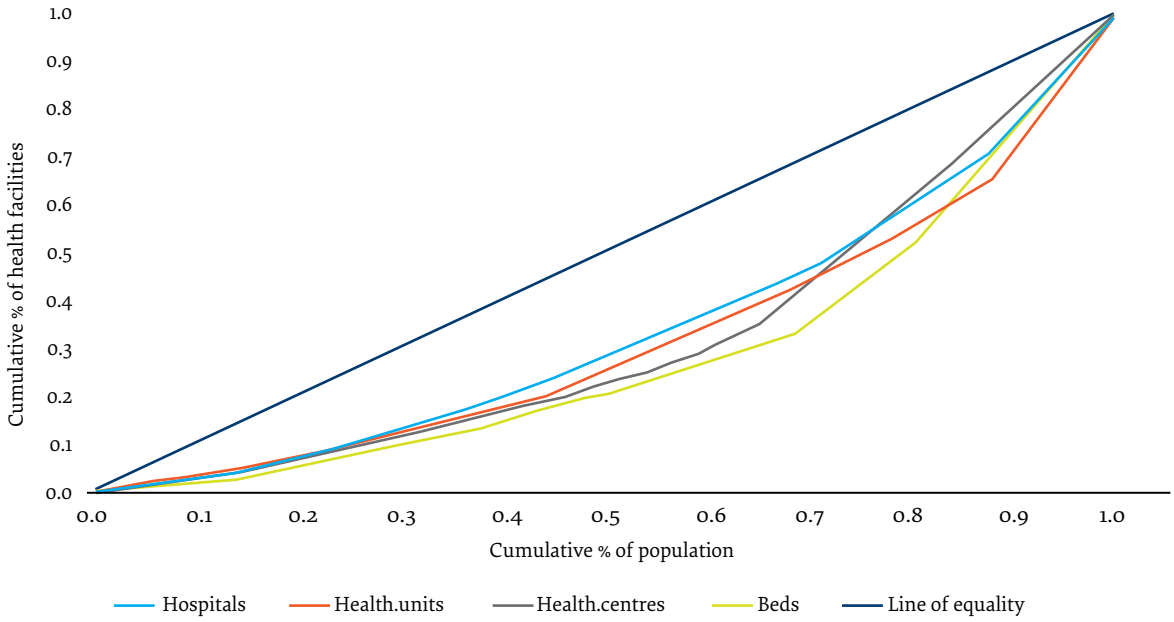
Results

Weighted coefficient of variation, Gini coefficient, and dissimilarity index

Table 1 shows the WCV and GC values for the health resources based on the population size, in addition to DI values. For health facilities, the WCV values show that hospitals beds is the most unequally distributed resource among the 18 states with a value of 82.9%, followed by health units, health centres and hospitals with respective WCV values of 76.6%, 66.0% and 62.8%. For human resources, the WCV values show that the most unequally distributed resources are dentists, specialists, total physicians, technicians and nurses, with extremely high WCV values of 145.0%, 129.4%, 124.6%, 113.9% and 95.9% respectively. The inequality distributions of the other human resources are relatively lower, with WCV values ranging between 33.1% for medical assistants and 75.4% for public health officers.

The GC values for the health facilities vary from 0.32 for hospitals to 0.43 for beds. Based on the GC interpretation, the inequality distribution of health facilities is medium except for beds, for which the inequality distribution level is high. The GC values for human resources vary considerably, ranging from 0.18 to 0.68. The GC values for specialists, dentists, total physicians and technicians vary range from 0.53 to 0.68, showing that the distributions of these resources exhibits extreme levels of inequality. The levels of inequality for nurses and public health officers are high, for midwives and health visitors medium, and for medical assistants very low.

Figure 1 Lorenz curve for Sudan's health facilities, 2016



The Lorenz curves depicted in Figure 1 show that distribution of health facilities is unequal, as all the curves were far from the line of equality. The distribution of beds was the worst, followed by health centres, health units and hospitals. For human resources, the geographical distribution is highly unequal, with distribution of specialists, total physicians and dentists worst (Figure 2).

The DI values for health facilities vary from 16.3% for beds to 27.6% for health units (Table 1). The DI values for human resources range from 17.8% for nurses to 44.2% for dentists. For example, according to the DI values, 44.2% of dentists in those states that have more dentists relative to their population size need to be transferred to states that have fewer dentists in order to achieve equal distribution across the states. The interpretation proceeds similarly for the other DI values.

Resource concentration indices

Tables 2 and 3 show the values of RCI for health facilities and human resources for the 18 states. Based on these values, the states that have more hospitals relative to their populations were Northern, River Nile, Red Sea,

Figure 2 Lorenz curve for Sudan's health human resources, 2016

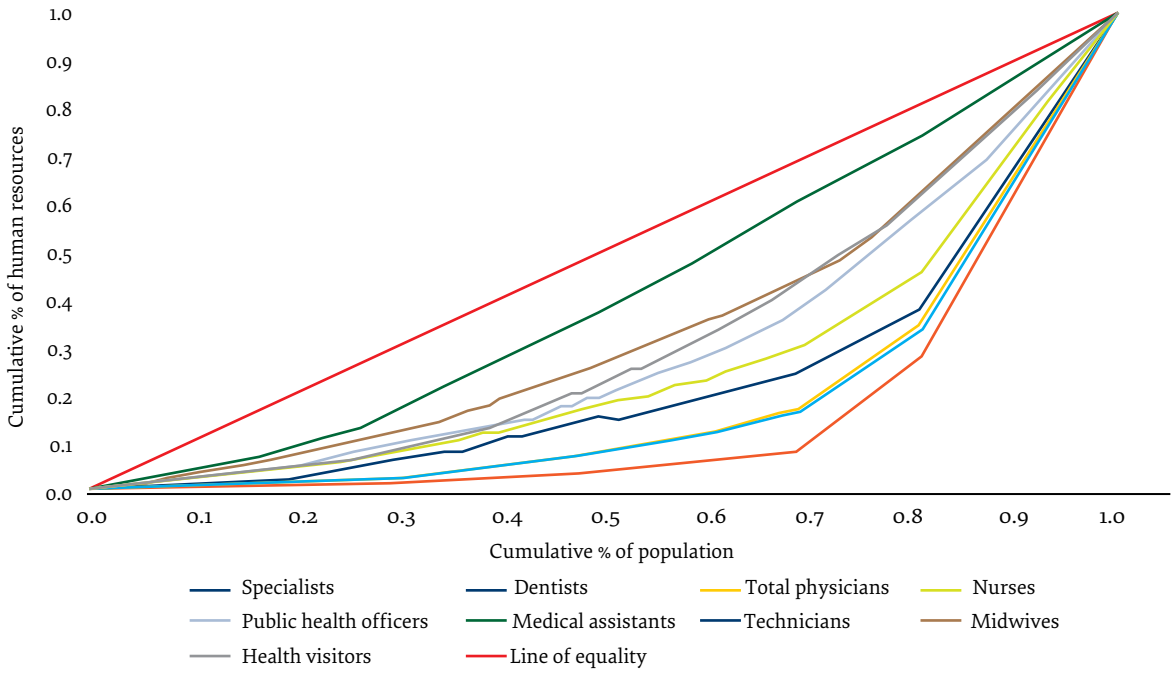


Table 1 Weighted coefficient of variation, Gini coefficient and dissimilarity index values for the distribution of the health facilities and human resources in Sudan, 2016

Variable	Weighted coefficient of variation (%)	Gini coefficient	Dissimilarity index (%)
Health facilities			
Hospitals	62.8	0.32	20.1
Health units	76.6	0.37	27.6
Health centres	66.0	0.36	18.1
Beds	82.9	0.43	16.3
Human resources			
Specialists	129.4	0.61	30.7
Dentists	145.0	0.68	44.2
Total physicians	124.6	0.60	29.3
Nurses	95.9	0.47	17.8
Public health officers	75.4	0.41	21.7
Medical assistants	33.1	0.18	21.4
Technicians	113.9	0.53	21.2
Midwives	60.3	0.33	25.6
Health visitors	65.5	0.37	25.6

Gezira and Sinnar. In contrast, Kassala, Khartoum, South Darfur, West Darfur and Eastern Darfur states have fewer hospitals relative to their populations. Regarding other health facilities, South Darfur, Eastern Darfur and Kassala states have the lowest RCI values, signifying the need of more health facilities in these states.

The RCI values for human resources show that number of physicians (specialists, dentists, total physicians) and nurses are relatively higher in Northern, River Nile, Khartoum and Gezira states, as RCI values are greater than one. Conversely, the RCI values for other states, particularly Darfur, Kordofan and Blue Nile states, are much lessr than one, indicating that these states have a relatively low number of physicians and nurses compared with their populations. For allied health personnel (public health officers, medical assistants, technicians, midwives, health visitors), the RCI values show that their distributions are irregular but generally have similar patterns to those of physicians.

Table 2 Resource concentration index values for health facilities in Sudan, 2016

State	Hospitals	Health units	Health centres	Beds
Northern	2.8	3.3	1.0	2.7
River Nile	1.6	0.8	3.5	2.0
Red Sea	1.6	1.4	1.0	1.2
Gadaerf	1.3	1.9	0.7	1.1
Kassala	0.7	0.5	0.9	0.7
Khartoum	0.5	0.3	0.7	1.2
Gezira	1.5	1.6	1.4	1.2
Sinnar	1.5	1.5	1.1	1.3
White Nile	1.1	1.3	1.0	0.8
Blue Nile	1.3	1.2	1.3	1.1
North Kordofan	1.1	1.3	1.5	0.9
South Kordofan	0.8	1.0	0.7	0.7
West Kordofan	0.9	0.9	1.1	0.9
North Darfur	1.0	0.6	0.7	0.6
South Darfur	0.4	0.2	0.4	0.4
West Darfur	0.5	0.7	1.0	0.6
Central Darfur	0.9	2.5	1.2	0.6
Eastern Darfur	0.4	1.0	0.6	0.3

Table 3 **Resource concentration index values for health facilities in Sudan, 2016**

State	Specialists	Dentists	Total physicians	Nurses	health officers	Medical assistants	Technicians	Midwives	Health visitors
Northern	1.1	1.1	1.5	2.2	1.0	4.0	1.6	1.2	0.5
River Nile	1.3	0.7	1.5	1.4	2.0	1.9	1.5	0.8	3.9
Red Sea	1.0	0.9	0.7	1.0	1.0	0.9	0.5	0.8	0.4
Gadaerf	0.7	0.2	0.7	1.1	1.9	0.7	1.1	0.8	0.6
Kassala	0.7	0.4	0.8	0.9	0.5	1.1	0.7	0.8	0.3
Khartoum	2.3	2.8	2.1	1.5	0.8	0.4	1.9	0.1	0.8
Gezira	1.5	1.9	1.4	1.1	1.7	0.6	1.0	1.0	0.9
Sinnar	0.8	0.6	1.0	1.5	0.9	2.2	1.1	1.0	0.4
White Nile	0.6	0.6	0.9	0.8	1.2	1.1	0.8	1.0	1.2
Blue Nile	0.3	0.4	0.9	1.4	0.4	1.3	0.8	1.7	2.9
North Kordofan	0.6	0.2	0.5	0.6	1.1	1.1	0.7	1.8	1.2
South Kordofan	0.2	0.1	0.3	0.6	1.4	1.2	0.3	1.1	1.7
West Kordofan	0.6	0.5	0.5	1.0	1.2	1.3	0.5	2.0	1.7
North Darfur	0.4	0.2	0.4	1.0	0.7	1.4	0.8	1.7	1.6
South Darfur	0.2	0.1	0.1	0.3	0.4	0.8	0.5	0.5	0.5
West Darfur	0.5	0.2	0.3	0.4	0.1	0.8	0.8	4.6	0.8
Central Darfur	0.3	0.3	0.2	0.2	0.1	0.4	0.1	1.9	0.5
Eastern Darfur	0.2	0.0	0.4	0.2	0.9	0.6	0.2	1.0	0.3

Why equality of health resources distribution matters?

To answer this point, correlation analysis using Spearman's rho correlation was performed to examine the relationship between density of human resources (physicians and nurses) and health outcomes, represented by IMR, U5MR, MMR and life expectancy.

The results of Spearman's correlation show there is a significant positive correlation between physician density and life expectancy ($P < 0.001$), revealing that the states with higher physician density have longer life expectancy (Table 4). The results also show that there are significant negative correlations between physician density and IMR, U5MR and MMR ($P < 0.05$ for all). This indicates that the states with higher physician density have lower IMR, U5MR and MMR. Moreover, there are significant negative correlations between nurse density and U5M and MMR at the 0.05 level of significance, indicating that states with a high density for nurses have lower U5M and MMR. However, there is no satisfactory evidence of a statistically significant relationship between nurse density and life expectancy and U5M ($P > 0.05$).

The overall results signify the importance of equal allocation of health human resources between the states in increasing access to health care services and enhancing health outcomes.

Discussion

Over the past few decades, the government of Sudan has adopted a number of policies and measures aimed at providing equitable, accessible and affordable quality health care services. Key policies and measures include interstate and intrastate redistribution of health human resources, improving working conditions, provision of financial incentives and overseas training for health workers in rural areas (*31*).

Despite the measures taken to improve health status and reduce health inequalities, the study results show

Table 4 **Spearman's correlations matrix between density of physicians and nurses, life expectancy, infant mortality rate (IMR), under-5 years mortality rate (U5MR) and maternal mortality rate (MMR) for the 18 states in Sudan, 2016**

Variable	Density of Physicians	Density of nurses	Life expectancy	IMR	U5MR
Density of nurses	0.847***				
Life expectancy	0.765***	0.522			
IMR	−0.658**	−0.572*	−0.449		
U5MR	−0.625*	−0.486	−0.645*	0.762***	
MMR	−0.732**	−0.646**	−0.687**	0.383	0.329

**P-value < 0.05, **P-value < 0.01, ***P-value < 0.001.*

that the distributions of health resources were highly asymmetric, demonstrating substantial disparities among Sudan's 18 states. Based on GC values, the inequalities in the distribution of health facilities ranged from moderate to high. Vis-à-vis human resources, the inequality was very high for physicians (specialists, dentists, total physicians) and varied from low to very high for allied health personnel. To achieve equal distribution of health resources among Sudan's states, the study results show that 16–28% of the health facilities and 18–44% of the human resources need redistribution between regions. Furthermore, the findings strongly confirm the importance of equal geographical distribution of human resources between the regions as there were significant positive relationships between density of human resources and health outcomes.

The unequal distribution of health resources is a part of the macro-level problem of uneven development and maldistribution of wealth in Sudan. Moreover, the problem of uneven development is the main cause of the current political conflict between the government and the armed movements in Darfur, Kordofan and Blue Nile states and the non-ruling political parties (*10*,*11*).

The results of this study are consistent with the findings of some studies carried out in other developing countries. For example, Rabbanikhah et al. found that the distribution of general practitioners among Iran's provinces during 2010–2016 were unequal (*2*): GC values ranged between 0.272 and 0.356. Geographic inequalities in the distribution of health care services and health outcomes were also reported in Ethiopia in 2011: GC values ranged from 0.047 for under-five deaths to 0.33 for skilled birth attendance (*32*). In China, Yang assessed the distribution of health resources during 2004–2009 and concluded that inequalities in health care were pervasive and favoured urban population (*33*). Regional inequalities in health care services and health outcomes have also been reported in Tunisia and Morocco (*34*,*35*).

However, the results of this study did not agree with some studies in other developing countries. For example, in Saudi Arabia, El-Farouk et al. found that health resources were equitably distributed among the administrative regions (36). Similarly, in Mongolia, Erdenee et al. found that the distributions of health care resources based on population in 2014 were adequate, but the distributions of these resources when based on geographic area were unequal (*37*). Additionally, research carried out by Wiseman et al. showed that the distribution of physicians based on population at the provincial level in Fiji in 2007 was relatively equal (*38*).

The results of the correlation analysis show that in general the Sudanese states with a greater density of human health resources have higher life expectancy and lower mortality rates, represented by the IMR, U5MR and MMR. These results are consistent with the results of a number of previous studies investigating the link between human resources for health and health outcomes (*39*,*40*). Moreover, a great deal of research has found that unequal distribution of health resources has negative effects on access to health care services and, hence, on health-related outcomes (*41*).

Limitations and future research

State-level data obtained from the annual health statistical report of 2016 were used to describe and analyse the regional differences in health resources in Sudan. It would be interesting to perform further analyses on the geographical distribution health resources within each state to compare inter and intra-state distribution.

Furthermore, the data used were also aggregated at the variables level. The annual health report lacks detailed information on health facilities such as rural and tertiary hospitals, which provide different levels of health care services. The availability of detailed data on health variables would improve the level analysis and the results.

Based on the study findings and data restrictions, further research considering inter-state distribution of health resources and disaggregated health variables is highly recommended.

Conclusion

There are distinct regional disparities in health resources in Sudan. Furthermore, it is also established that in the states with relatively better health resources, the populations have longer life expectancy and lower mortality rates. In contrast, the populations in relatively under-resourced states have shorter life expectancy and higher mortality rates.

Based on these findings, the need to address the problem of disproportionate distribution of health resources, particularly human resources, is immensely important. Therefore, we recommend the following:

- There is a crucial need to improve health status in the relatively under-resourced states, particularly Darfur, South Kordofan and Blue Nile states.
- In future health strategies, there is a need to use resource allocation models that take into account the population size and health outcome variables in each state.
- There is a need for the allocation of more funds for the health sector to implement equity-promoting strategies.
- Improving working conditions and offering greater incentives are important to attract, motivate and retain health workers in rural areas, particularly in Darfur and Kordofan states.

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Disparités régionales dans la répartition des ressources sanitaires du Soudan

Résumé

Contexte : La répartition égale des ressources sanitaires est un objectif central des plans stratégiques à long et moyen terme pour le secteur de la santé au Soudan. Cependant, les cibles de ces plans n'ont pas encore été atteintes, ce qui se traduit par une faible performance du système de santé dans son ensemble. La répartition inégale des ressources sanitaires a entraîné d'importantes disparités régionales en matière de prestation de services de santé.

Objectifs : La présente étude vise à décrire et à analyser l'inégalité dans la répartition géographique des ressources sanitaires physiques et humaines du secteur public au Soudan. En outre, l'étude vise également à mesurer les relations entre la densité des ressources de santé et les résultats sanitaires.

Méthodes : Les données sur les ressources sanitaires et les résultats sanitaires au niveau des États obtenues à partir du Rapport sur les statistiques sanitaires du Soudan de 2016 ont été utilisées pour calculer des indices d'inégalité, tracer des courbes de Lorenz et calculer l'analyse de corrélation de Spearman entre la densité des ressources sanitaires et les résultats sanitaires.

Résultats : Nos résultats montrent que la répartition des ressources sanitaires, basée sur la taille de la population, était très inégale entre les 18 États du Soudan.

Conclusion : Il faut absolument améliorer la situation sanitaire dans les États qui disposent de ressources relativement insuffisantes, en particulier dans les États du Darfour, du Kordofan du Sud et du Nil bleu. En outre, le gouvernement doit utiliser des modèles d'allocation des ressources sanitaires qui tiennent compte de la taille de la population et des variables des résultats sanitaires dans chaque État dans les stratégies futures de santé.

التفاوتات الإقليمية في توزيع الموارد الصحية في السودان

محمد إسماعيل

الخلاصة

الخلفية: ظل التوزيع المتكافئ للموارد الصحية هدفًا أساسيًا لكل من الخطط الاستراتيجية طويلة الأمد ومتوسطة الأمد للقطاع الصحي في السودان. غير أن أهداف هذه الخطط لم تتحقق، مما أدى إلى ضعف أداء النظام الصحي برمته. وقد أدى التوزيع غير المتكافئ للموارد الصحية إلى تفاوتات إقليمية كبيرة في توفير خدمات الرعاية الصحية.

الأهداف: هدفت هذه الدراسة إلى وصف عدم المساواة وتحليلها في التوزيع الجغرافي للموارد الصحية المادية والبشرية للقطاع العام في السودان. وبالإضافة إلى ذلك، كما هدفت الدراسة أيضًا إلى قياس العلاقات بين كثافة الموارد الصحية والنتائج الصحية.

طرق البحث: استخدمت البيانات على مستوى الدولة بشأن الموارد الصحية والمخرجات الصحية التي جمعت من التقرير الإحصائي للصحة السودانية لعام 2016 لحساب مؤشرات عدم المساواة، ورسم منحنيات لورينز، وحساب تحليل ارتباط سبيرمان بين كثافة الموارد الصحية والمخرجات ذات الصلة بالصحة.

النتائج: تبين النتائج التي توصلنا إليها أن توزيع الموارد الصحية، على أساس حجم السكان، كان غير متكافئ إلى حد كبير بين ولايات السودان البالغ عددها 18 ولاية.

الاستنتاجات: هناك حاجة ماسّة لتحسين الوضع الصحي في الولايات ذات الموارد المنخفضة نسبيًا، ولا سيّما في ولايات دارفور وجنوب كردفان والنيل الأزرق. وعلاوة على ذلك، تحتاج الحكومة إلى استخدام نماذج تخصيص الموارد الصحية التي تأخذ في الاعتبار حجم السكان ومتغيرات المخرجات الصحية لكل ولاية في الاستراتيجيات الصحية المستقبلية.

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Landscape analysis of family planning research, programmes and policies targeting young people in Jordan: stakeholder assessment and systematic review

Jewel Gausman,[1] Areej Othman,[2] Abeer Dababneh,[3] Iqbal Hamad,[4] Maysoon Dabobe,[4] Insaf Daas[3] and Ana Langer[1]

[1]Women and Health Initiative, Department of Global Health and Population, Harvard TH Chan School of Public Health, Boston (MA), United States of America. [2]Maternal and Child Health Nursing Department, School of Nursing, University of Jordan, Amman, Jordan. [3]Center for Women's Studies, University of Jordan, Amman, Jordan. [4]Jordanian Hashemite Fund for Human Development, Amman, Jordan. (Correspondence to: Jewel Gausman: jgausman@mail.harvard.edu).

Abstract

Background: Reaching married and unmarried young people in Jordan with family planning information and services is a priority, especially considering Jordan's large refugee populations. To date, dissemination of family planning research and programmatic experience targeting young people in Jordan has been limited.

Aims: This study aimed to provide in-depth information on family planning intervention programmes, research and policies in Jordan that focus on young people aged 10–24 years.

Methods: Data were gathered through a systematic review of peer-reviewed and grey literature related to reproductive health of young people, and focus groups discussions with stakeholders from 18 relevant governmental and nongovernmental organizations.

Results: The literature review included 37 documents produced since 2008, which provide information at the individual, family/community, service delivery and policy levels. Young people in Jordan have limited knowledge of family planning methods and where to obtain family planning services. Little information is available on the availability of family planning services for young people. Several policy documents discuss family planning and reproductive health of young people in Jordan. Focus group discussions identified opportunities to integrate services and strengthen the development of future policies.

Conclusions: The results of this study highlight key lessons learnt, opportunities for interventions and research gaps related to family planning among young people in Jordan. More attention should be paid to understanding and meeting the needs of Jordan's most vulnerable populations of young people, including urban refugees and married adolescents, especially as these populations continue to grow. Future programmes should build from past evidence and explore new areas and interventions.

Keywords: adolescents, youth, reproductive health, family planning services, Jordan

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Introduction

Preventing unintended pregnancy among young people is a global priority. Targeting young people in Jordan with family planning information and services is complicated by the conservative social context that prohibits sexual activity outside of marriage; however, many young women in Jordan remain at risk of early and unintended pregnancy *(1,2)*. While most sexual activity occurs within marriage, a study in Jordan found that 7% of university students reported premarital sexual activity, although data are limited *(3)*. In recent years, marriage of women younger than 18 years has increased in Jordan from 13.7% to 18.1% *(4)*. High pregnancy rates have been seen in married adolescents *(5)*, and sexual assault and rape are a concern, especially among refugees *(6)*.

The large influx of refugees in Jordan has stretched its limited health resources. Young people constitute large proportions of Jordan's refugee populations. About 30% of Jordan's population is non-Jordanian and includes populations from across the Middle East. Only 16% of the 1.2 million Syrian refugees in Jordan live in official camps *(7)*; those outside of camps are younger, poorer and less educated *(8)*. More than 2 million registered Palestinians and 66 000 to 150 000 Iraqi refugees live in Jordan *(9,10)*.

To date, there has been limited dissemination and collation of existing family planning research and programmatic experience among young people in Jordan between the ages of 10 and 24 years. Therefore, we aimed to (i): review and synthesize information from existing research and programmatic experiences that address family planning in young people in Jordan; (ii) examine which existing policies facilitate the provision of youth-friendly family planning services and which produce barriers, and; (iii) identify gaps in the research, policy

and programmatic environments that could strengthen the provision of youth-friendly family planning services in Jordan and increase family planning use among young people.

Our findings will serve as a resource for policy-makers and programme managers in Jordan and elsewhere in the Middle East in order to inform programme design and strategy development by documenting the current evidence base, past programmatic experiences, and existing policy environment, while identifying key gaps and opportunities.

Methods

We undertook a literature review of published and unpublished research, programmatic reports, and policy papers that address family planning in young people in Jordan, and conducted focus group discussions with key informants in the fields of research, policy and practice related to young people.

Systematic literature review

Academic and peer-reviewed documents were obtained through structured searches on PubMed®, JSTOR, Embase, MEDLINE®, Web of Science, CINAHL and Google Scholar. Our search terms included combinations of the following terms: family planning, reproductive health, birth spacing, contraceptive, fertility, unmet need and Jordan. We did not include terms related to youth because we wanted to find all studies that had our age range of interest regardless of whether the authors identified youth as a focus, given the sensitivity of the topic.

We accessed non-academic literature using four approaches: (i) searches of grey literature databases (OpenGrey, PopLine, USAID Development Experience Clearing House and Knowledge4Health), (ii) Internet searches, (iii) website review and (iv) consultation with experts. Hard-copy only documents were obtained by personal contact with organizations active in family planning in Jordan.

Documents were included if they focused on young people aged 10–24 years and on family planning, were published after 2008 in Arabic or English, and were conducted in Jordan. The year 2008 was selected as the cut-off to ensure current contextual relevance. Two researchers screened and reviewed each record for eligibility. Consensus was reached to identify a final list of relevant documents.

Focus group discussions

Four focus group discussions were conducted with key informants representing 18 organizations between August and September 2018. Key informants were identified through consultation with local experts and snowball sampling. Selection criteria for participation was based on an individual's expertise in the topic and/or experience working on family planning- or youth-related issues. The following organizations were represented: Ministry of Education, Ministry of Youth, National Council for Family Affairs, National Committee for Women's Affairs, Ministry of Health, Higher Population Council, Higher Health Council, United Nations High Commissioner for Refugees (UNHCR), United Nations Population Fund (UNFPA), United States Agency for International Development (USAID), Institute for Family Health, Royal Health Awareness Society, Jordanian Association for Family Planning and Protection, Jordanian Communication, Advocacy and Policy Project, Health Service Delivery Project, Women Helping Women, Jordan Hashemite Charity Organization, and National Women's Comprehensive Health Centre. Discussion centred on past programmatic experience, existing policies, barriers and challenges to providing services for young people, and recommendations to strengthen existing policies and programmes.

Data analysis

The social ecological model was used as a guiding framework for this analysis *(11)*. Data from the literature review were abstracted and synthesized as being either directly pertinent to youth, indirectly relevant to youth (i.e. youth were included as part of the overall study population, but not considered a specific target population), or applicable to the supportive environment, which included peers, family, school, community, and the service delivery, policy, and legal environments. For the analysis of qualitative data from the focus group discussions, the discussions were recorded, transcribed and thematically coded by two coders. Data were coded according to a priori themes based on the focus group discussion guide at the different levels of the ecological model (individual, family/community, service delivery and policy levels). The coders then inductively examined each level for emergent subthemes.

Ethical considerations

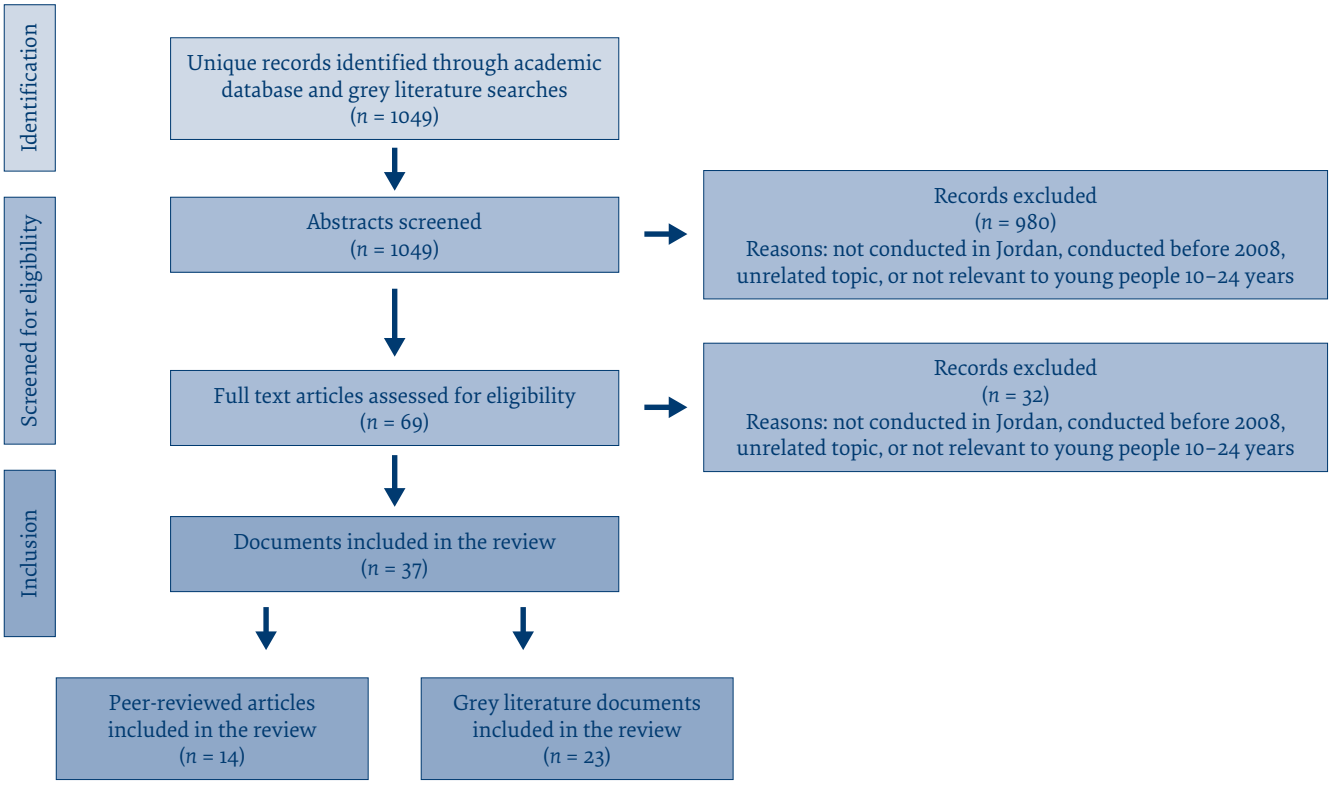
This study was approved by the institutional review boards of Harvard T.H. Chan School of Public Health (approval number: 18-0427) and University of Jordan School of Nursing.

Results

Literature review

We identified 1049 records, of which 37 documents were included as shown in the flow chart (Figure 1). Fourteen of the 37 documents were in peer-reviewed journals and 23 were retrieved from the grey literature (Table 1, available online at: ....). Fifteen documents specifically focused on young people, 16 included young people within the overall study population, programme or policy, and 15 documents targeted other levels of the ecological model in ways that were relevant to young people. Based on ecological level, the themes derived from the literature review include knowledge, attitudes and practices related to family planning in young people within a social context, the health service delivery environment and the policy landscape. Box 1 gives a summary of the key find-

Figure 1 Flow chart outlining the screening process to identify documents in peer-reviewed and grey literature on youth family planning and reproductive health in Jordan



ings and recommendations from the literature review to improve family planning programming targeting young people in Jordan.

Family planning: knowledge, attitudes and practices

Most of the research related to the family planning knowledge, attitudes and practices of young people in Jordan comes from secondary analysis of existing datasets (i.e. the Jordan Population and Family Health Surveys), relatively small project-based surveys and qualitative data from focus group discussions that are integrated in service delivery programmes. Few studies include unmarried young people and refugee young people outside of camps.

Jordanian, Syrian and Iraqi young people living in Jordan have limited knowledge of contraceptives *(5,18,48)*, especially younger adolescents. In one study, nearly half of the women aged 15–19 years and 15.9% of women between 20 and 24 years did not know if modern or traditional family planning methods, such as withdrawal or periodic abstinence, were more effective *(5)*. A study in Syrian refugees and two studies in Iraqi refugees found that knowledge of specific methods of family planning was almost non-existent among the young people in both populations *(2,18,48)*.

Misinformation and concerns over negative side-effects of using family planning are especially prominent among younger women. Married women between 15 and 24 years reported that concern about future fertility was one of the main reasons for not using a method *(5,21,42)*. Similar concerns have been found among young Iraqi and Syrian refugees in Jordan *(48,23)*.

Contraceptive use in young people in Jordan is low. Analysis of data from the 2012 Jordan Population and Family Health Survey found that 72.5% of married adolescents between 15 and 19 years were not using contraception *(21)*. Unmet need for family planning was high; of the 40% of married adolescent girls who did not want a child in the next 2 years, only 35.2% were using a contraceptive *(21)*. Pills and the lactational amenorrhoea method were the most commonly used modern methods among adolescent girls aged 15–19 years (11.4% and 4.1% of users, respectively). Half of all users in this age group were using a traditional method *(21)*. Use of family planning was lower in married adolescents than older young people; 18.3% of women between 15 and 19 years used contraception compared with 40.1% of women aged 20–24 years *(5)*. One study found that 6.5% of married Iraqi adolescents living in Amman between 15 and 24 years were using a method of contraception *(2)*. Many young people indicated that social pressure to begin childbearing immediately after marriage is one of their main reasons for not using family planning *(5,42)*.

Social expectations limit the role of men in family planning. One survey found that 70% of women aged

Table 1 Summary of peer-reviewed and grey literature published between 2008 and 2018 related to family planning among young people in Jordan

Authors	Year	Title	Ecological level of focus	Population and sample size	Study design/document description	Key results
Akour A, et al.*(12)*	2018	Impact of a pharmacist-provided information booklet on knowledge and attitudes towards oral contraception among Jordanian women: an interventional study	Youth; supportive environment	160 married women; 33 were 18–25 years	Design: randomized intervention study with pre and post measurements. Purpose: to assess the impact of a booklet on awareness and knowledge of oral contraceptive pills	Change in mean knowledge scores improved and was constant across all age groups
Organisation for Economic Co-operation and Development *(13)*	2018	Youth well-being policy review of Jordan	Youth; supportive environment	Not applicable	Design: Cross-sectoral policy analysis	• Reproductive health of young people has secondary position in the Government of Jordan's policy agenda. International organizations fill the gap • Current policies mention need to provide youth-friendly RH services, but no steps towards implementation have been defined • The National Reproductive Health/Family Planning Strategy (2013–2017) does not define young people as a population segment with specific needs, and focuses on three general priorities • Awareness-raising programmes do not target adolescents under 18 years because of cultural constraints
Clark CJ, et al. *(14)*	2017	The influence of family violence and child marriage on unmet need for FP in Jordan	Youth	Used Jordan Population and Family Health Survey. Included women 15–49 years stratified by marriage before 18 years or not. No age-disaggregated provided	Design: secondary analysis, observational study. Purpose: to examine the association between intimate partner violence, family violence and unmet need for FP	Women who were married between the ages of 15 and 18 years may be especially vulnerable to having unmet need for FP as women in this age group are less likely to use contraception, have lower autonomy and experience intimate partner violence.
Spindler E, et al. *(15)*	2017	Jordan's 2002 to 2012 fertility stall and parallel USAID investments in family planning: lessons from an assessment to guide future programming	Supportive environment	Used multiple data sources, including 30 project reports, 42 external studies and evaluations and 11 project briefs, as well as key informant interviews	Design: programme and policy review. Purpose: to examine the factors that contributed stalls in fertility and modern contraceptive use, the projects USAID supported and their impact, and programmatic insights gained to guide future programming	• No results specific to youth but extensive overview of policy and programmatic environment • Jordan's limited method mix, combined with strong sociocultural determinants around reproduction and fertility desires, have contributed to low contraceptive use in Jordan • Challenges to improved use of FP services include limited government investments in FP programmes, influential service provider behaviour and biases that limit informed choice and counselling, strong, pervasive social norms of family size and fertility, and limited availability of different contraceptive methods

Table 1 Summary of peer-reviewed and grey literature published between 2008 and 2018 related to family planning among young people in Jordan *(Continued)*

Authors	Year	Title	Ecological level of focus	Population and sample size	Study design/document description	Key results
Samari G *(6)*	2017	Syrian refugee women's health in Lebanon, Turkey, and Jordan and recommendations for improved practice	Youth; supportive environment	Not applicable	Design: Literature review focused on Syrian refugees and women's health between 2011 and 2016 (also included Turkey and Lebanon). Purpose: to examine Jordan's response to Syrian refugee women's health and provided recommendations	• Focused primarily on refugees in camps • Baseline results show that Syrians had more concerns about effectiveness of FP method and side-effects than Jordanians • Syrian women were displeased with the quality of RH care provided to them and the limited/overstretched services. • In camps, prostitution, rape and forced underage marriages were very common • In 2014, 11% of deliveries were in girls under 18 years. These girls were four times less likely to use FP • Cost was a barrier to refugee women seeking care outside of camps • Recommend including men in RH information • Need to integrate mental health services with RH services
Higher Population Council *(16)*	2016	Reproductive health services among Syrians	Youth; supportive environment	572 male and female Syrian refugees living outside of camps (including young people 12–24 years). Key informants from health services organizations	Design: cross-sectional survey and focus groups. Purpose: to measure satisfaction with health services	• Young people reported intermediate satisfaction with health services. They were most satisfied with pre-marital testing • Most of the women noted that the centres were located far from their residencies, were overcrowded, and lacked needed medical specialists in the areas served • Most of the young people of both sexes (aged 12–24 years) said that poor treatment by health care workers at the centres was an important disincentives to seeking this type of medical care • The need for identification cards was a significant barrier.
Jordan Communication Advocacy and Policy Activity *(17)*	2016	Family planning among Syrian refugees living in Jordan	Youth; supportive environment	Not applicable	Design: document review; secondary analysis of family planning knowledge data. Purpose: to describe family planning policies pertinent to and knowledge among Syrian refugees living in Jordan	• Provides detailed review of policy changes to government fee structures for Syrian refugees relevant to FP • Unmarried Syrian and Jordanian young people had very low levels of knowledge about modern contraceptive methods • Mainly focused on camps
Jordan Communication Advocacy and Policy Activity *(18)*	2016	Exploring gender norms and family planning in Jordan: a qualitative study	Youth	Four key target groups: married men (18–60 years); married women (18–49); and unmarried male and female youth (18–24) for a total of 408 participants in 42 focus group discussions. Key target groups further split into subgroups by nationality (Jordanian and Syrian)	Design: Focus group discussions. Purpose: to assess how gender roles and perceptions, in conjunction with religious and cultural norms, affect FP in terms of beliefs, attitudes and practices	• Unmarried male and female young people lacked sufficient knowledge and awareness of FP methods and said that they would benefit from FP educational programmes to help them make informed decisions on FP and method used

Table 1 Summary of peer-reviewed and grey literature published between 2008 and 2018 related to family planning among young people in Jordan *(Continued)*

Authors	Year	Title	Ecological level of focus	Population and sample size	Study design/document description	Key results
Jordan Evidence-Based Medicine/Reproductive Health (JEBM/RH) Group *(19)*	2016	The best evidence on family planning methods and practices	Supportive environment	Not available	Purpose: to describe an intervention to improve evidence-based practices among FP providers	• Current barriers to uptake include lack of up-to-date information as well as a range of misconceptions by providers • These misconceptions are greatest for hormonal contraceptive methods which include oral contraceptive pills, injectable contraceptive and implants
West L, et al. *(20)*	2016	Factors in use of family planning services by Syrian women in a refugee camp in Jordan	Youth	16 married Syrian women in camps aged 18–35 years	Design: qualitative study using in-depth interviews. Purpose: to assess factors that influence use of FP services by women in camps	• Younger women reported wanting to have more children, thus not discussing FP • Cultural norms, such as concerns over fertility and pressure to begin childbearing immediately after marriage, limited FP uptake among younger participants • Mostly older women accessed FP services in camps; majority of participants did not access FP • Information on and awareness of FP was limited for all participants
World Health Organization *(21)*	2016	Adolescent contraceptive use: data from the Jordan population and family health survey, 2012	Youth	Used Jordan Population and Family Health Survey, 2012	Design: secondary analysis, observational study. Purpose: to examine contraceptive use among adolescents in Jordan	• High unmet need among married adolescents: 39.1% of married adolescent girls reported not wanting a child in the next 2 years, but only 35.2% were currently using any method to prevent pregnancy • The main reasons for not using a FP method include: breastfeeding (42.9%), fear of side-effects or health concerns (29.5%), menses had not returned after giving birth (26.7%) • Of all married adolescent girls 15–19 years, 72.5% were not using a method of contraception. • Pills and lactational amenorrhea were the most common modern methods used (11.4% and 4.1% of these adolescent girls, respectively). Use of the traditional method of withdrawal was high. • Most adolescent girls obtained FP services from the private sector (38%) or pharmacy (32%)
Jordan Communication Advocacy and Policy Activity *(5)*	2015	Knowledge attitudes and practices toward family planning and reproductive health among married women of reproductive age in selected districts in Jordan	Youth	408 male and female participants (Jordanian and Syrian); married women and men, and unmarried young people 18–24 years (108 females, 80 males)	Design: qualitative design using focus group discussions. Purpose: to explore how gender roles and perceptions in conjunction with religious and cultural norms, affect FP in terms of beliefs, attitudes and practices.	• Young people (especially unmarried) lacked knowledge and awareness of modern FP methods • Half of the unmarried Jordanian and Syrian male and female young people said that discussing FP was important between spouses • Male and female young people expressed a need for formal classes or training on FP

Table 1 Summary of peer-reviewed and grey literature published between 2008 and 2018 related to family planning among young people in Jordan *(Continued)*

Authors	Year	Title	Ecological level of focus	Population and sample size	Study design/document description	Key results
Underwood C, et al. *(22)*	2014	Friday sermons, family planning and gender equity attitudes and actions: evidence from Jordan	Youth; supportive environment	375 religious leaders and 857 mosque attendees. Sample of mosque attendees included young people 18–24 years. No age disaggregated data provided	Design: baseline/endline quasi-experimental (with control site) intervention study. Purpose: to assess the effects of a health communication programme targeting religious leaders	• Religious leaders had higher RH and FP knowledge after the intervention. • Mosque attendees who recalled a FP message were significantly more likely to take FP-related action (such as initiated use of or talked to a partner)
Krause S, et al. *(23)*	2013	Reproductive health services for Syrian refugees in Zaatri refugee camp and Irbid city Jordan: an evaluation of the Minimum Initial Service Package March 17-22 2013	Youth	11 key informant interviews with programme directors, coordinators and managers working in RH in response to Syrian refugees in Jordan. Health facility assessment included 5 health facilities in Zaatri camp, 1 hospital in Mafraq city and 7 facilities in Ibrid. Focus group discussions with women 18–24 years but no age-disaggregated sample size information was provided	Design: multimethod assessment with key informant interviews, facility assessments and focus group discussions. Purpose: to examine to what extent services with the minimal initial service package were in place for Syrian refugees living in Jordan in order to improve the emergency response and meet the RH needs of the refugees	• Refugee women and adolescent girls had a negative perception of clinical services • At Zaatri camp, all facilities were open and convenient for adolescent females. None of the 5 facilities visited provided RH outreach services. In Irbid, unmarried women or girls could attend most clinics, but they would not be provided with contraceptives • Of the 8 groups in Zaatri, women in only 3 knew of adolescent centres in the camp. Of the women that knew about centres, they were unclear as to whether the centres offered RH services. In Irbid, most women were not aware of any centres for adolescents. • Women were attracted to centres as they taught life skills and offered recreational activities in addition to giving RH lectures. • At Zaatri camp, male condoms were to be in stock but female condoms were not available. Women expressed concerns about asking for condoms. • In facilities in Irbid, condoms were not supplied to unmarried women in most clinics but men could buy condoms from pharmacies. Regardless of age, most participants knew you could find condoms at the pharmacy but the condoms were not usually free. One young women did not know what condoms were. • Health care services were perceived to be insufficient or of poor quality. Common problems included long wait lines, disrespect by health care providers and cost of transportation
Higher Population Council *(1)*	2013	National reproductive health/family planning strategy 2013–2017	Supportive environment	Not applicable	National policy document	• The strategy considers young people as key players in awareness, services and policies • Includes a review of ongoing projects and activities implemented by donor agencies • Includes reaching young people with FP information to change community norms through awareness-raising activities targeting schools, universities, mosques, churches, youth communities and local community leaders

Table 1 Summary of peer-reviewed and grey literature published between 2008 and 2018 related to family planning among young people in Jordan *(Continued)*

Authors	Year	Title	Ecological level of focus	Population and sample size	Study design/document description	Key results
Kamhawi S, et al. *(24)*	2013	Client-centered counseling improves client satisfaction with family planning visits: evidence from Irbid, Jordan	Youth	352 married/engaged women 15–49 years in Irbid	Design: FP client exit survey. Purpose: to examine whether client-centred counselling is associated with better client satisfaction	• No age disaggregated data • Client satisfaction was associated with use of the counselling protocol focused on client-centred counselling
O'Hara K, et al. *(25)*	2013	Experiences of intimate-partner violence and contraception use among ever-married women in Jordan	Youth	3434 women between 15 and 49 years	Design: cross-sectional study; secondary analysis of JPFS data. Purpose: to explore association between experiences of intimate partner violence and use of any form of contraception	• No age disaggregated data • Older women were more likely to use contraception that younger women • Women who reported severe physical violence were less likely to use contraception than women who did not experience such violence • Women who experienced sexual violence were more likely to use contraception
Underwood C, et al. *(26)*	2013	Religious leaders gain ground in the Jordanian family-planning movement	Supportive environment	136 religious leaders at baseline, 115 at endline	Design: baseline/endline intervention study with self-administered questionnaire. Purpose: to assess the effect of a training programme on knowledge of and attitudes to family welfare topics – specifically FP and RH	• Religious leaders had higher knowledge of the dangers of pregnancy in women under of 20 years • Religious leaders were more supportive of birth spacing messages for maternal health after the intervention
Cetorelli V, et al. *(27)*	2012	Is fertility stalling in Jordan?	Youth	Used Jordan Population and Family Health surveys from 1997 to 2009	Design: secondary analysis observational study. Purpose: to examine patterns in fertility from 1997 to 2009 and to review FP policy	• Percentage of women between 15 and 19 years who had never been married, and percentage of married women between 15 and 19 years using contraception increased between 1997 and 2009 • In 2009, 27% of married women 15–19 years and 43% of married women 20–24 year used contraceptives • Fertility peaked around 25–29 years

Table 1 Summary of peer-reviewed and grey literature published between 2008 and 2018 related to family planning among young people in Jordan *(Continued)*

Authors	Year	Title	Ecological level of focus	Population and sample size	Study design/document description	Key results
Hamza S *(28)*	2012	Long-acting hormonal contraceptives: without them, Jordan will not meet the population development goals	Supportive environment	Not available	Design: assessment of Ministry of Health service statistics. Purpose: to examine whether a team of stakeholders focused on expanding contraceptive implants increased availability at facilities	• Preliminary results suggest that contraceptive implants are available and in use by clients in 40% of hospitals and 10% of health centres. • Before the start of the programme, only 10% of hospitals and less than 4% of health centres provided contraceptive implants.
Jordan Health Communication Partnership *(29)*	2012	Evaluation of the Arab Women Speak Out (AWSO) Initiative – 2nd Tier (phase I) – in Irbid Governorate, Jordan, 2011	Youth	408 women, 20.8% between 15 and 24 years	Design: post-test, non-equivalent control group. Purpose: to increase information about FP through distribution of flash cards	• No age disaggregated data • 76% recalled messages related to women's role in making family-related decisions • 90% recalled messages about benefits of FP; 94% in treatment vs 74% in control group reported positive attitudes to modern contraceptives • 90% indicated that they would convey messages about delaying marriage until the age of 18 years for women for a happy, healthy life
Jordan Health Communication Partnership *(30)*	2012	Evaluation of the Arab Women Speak Out (AWSO) Initiative – 2nd Tier (Phase II) – in Irbid Governorate, Jordan, 2012	Youth	408 women, 26.5% between 15 and 24 years	Design: post-test, non-equivalent control group. Purpose: to increase information about FP through distribution of flash cards	• No age disaggregated data • 92% in treatment arm vs 74% in control arm reported positive attitudes to FP
Jordan Health Communication Partnership *(31)*	2012	Evaluation of the *hayati ahla* film in the Civil Status and Passports Department (CSPD) Offices Jordan – 2012	Youth	Visitors to the Civil Status and Passports Department, 3.8% under 20 years and 28.9% between 21 and 30 years	Design: post-test, intervention study. Purpose: to target new parents with information on FP and RH with a film	• No age disaggregated data • Small improvements in FP knowledge and attitudes • Most viewers thought that the video should be present in all offices of the Civil Status and Passports Department
Lilleston P *(32)*	2012	Planning for Life Phase 2: Evaluation Report	Youth	Out-of-school young people between 15 and 24 years (number not provided)	Design: pre- and post-intervention survey. Purpose: to integrate RH and FP into development programmes for young people	• The intervention significantly improved RH information and attitudes in participants • Implementing partner was surprised how receptive Jordanian young people were to the intervention

Table 1 Summary of peer-reviewed and grey literature published between 2008 and 2018 related to family planning among young people in Jordan *(Continued)*

Authors	Year	Title	Ecological level of focus	Population and sample size	Study design/document description	Key results
Shakhatreh F *(33)*	2012	Family planning in women of childbearing age in disadvantaged south Jordan	Youth; supportive environment	816 women 15–49 years	Design: randomized household survey. Purpose: to investigate current use of FP methods among Jordanian women, intention to use FP, faith in health services, and suggestions to improve health services	• No age disaggregated data presented • Main reasons for not currently using FP were: want more children, disapprove of the use of FP, refused by husband to use FP, and side-effects • Use of FP methods increased with increasing parity, level of education and age (until 40 years) • 26.8% of women had no faith in the Ministry of Health services. Bad doctor–patient communication was the main reason (47.3%) followed by lack of health care providers (10.9%) • Women suggested providing and training health care providers and improving doctor– patient communication
Connelly M *(2)*	2011	Baseline study: documenting knowledge attitudes and practices of Iraqi refugees and the status of family planning services in UNHCRs operations in Amman Jordan	Youth	Household survey: 407 households (14.8% of the respondents were between 15 and 19 years, 32.2% were between 20 and 29 years). Focus groups: Three groups of unmarried girls 15-–19 years, and three groups of unmarried boys 15–19 years	Design: mixed methods cross-sectional study; household survey and focus group discussions. Purpose: to document knowledge, beliefs, perceptions and practices of refugees related to FP services	• Very limited RH knowledge among adolescents 15–19 years, largely due to cultural norms that prohibit sex between unmarried people • Very few young people had heard of emergency contraception or female condoms. • Of the 407 households, 6.57% of women 15–24 years were using FP methods • Most common concern in women 15–24 years who wanted to limit or space births was related to fertility • Boys and girls 15–19 years would seek RH information from their parent first • Participants thought that sexual activity in adolescents was rare, but happened sometimes; sometimes sex was transactional in nature • An unmarried pregnant girl would bring shame on her family and would be at risk of honour killing or forced marriage
Jordan Health Communication Partnership *(34)*	2011	Evaluation of the consult and choose initiative in Zarqa Governorate, Jordan, 2011	Youth	6.7% of the sample were young people under 20 years and 44.7% were between 21 and 30 years	Design: post-test, exit survey. Purpose: to evaluate the effect of training programmes for health providers including posters, wall charts and client cue cards in maternal and child health centres	• No age disaggregated data • Most participants saw the poster, found it helpful and were satisfied with the intervention
Jordan Health Communication Partnership *(35)*	2011	Evaluation of the Arab Women Speak Out (AWSO) Initiative in Irbid Governorate, Jordan, 2011	Youth	472 women, 35.2% aged 18–29 years	Design: intervention study; pre-test/post-test non-equivalent control group. Purpose: to evaluate the effect of group discussion to discuss health-related needs	• No age disaggregated data • Participants had improved attitudes to birth spacing, longer pregnancy intervals, associating FP with birth spacing rather than birth control

Table 1 Summary of peer-reviewed and grey literature published between 2008 and 2018 related to family planning among young people in Jordan *(Continued)*

Authors	Year	Title	Ecological level of focus	Population and sample size	Study design/document description	Key results
Jordan Health Communication Partnership *(36)*	2011	Evaluation of the consult and choose initiative in Irbid Governorate, Jordan, 2011	Youth	472 men and women, 1.7% under 20 years and 52.9% between 18 and 29 years	Design: post-test exit survey. Purpose: to evaluate the effect of a provider training programme including posters, wall charts and client cue cards in maternal and child health centres	• No age disaggregated data • 80% of women who saw the video recalled messages about FP methods • The client counseling materials used as part of the were associated with patient satisfaction
Jordan Health Communication Partnership *(37)*	2011	Evaluation of the Arab Women Speak Out (AWSO) Initiative in Zarqa Governorate, Jordan, 2009–2010	Youth	919 men and women, 23.0% between 18 and 29 years	Design: Pre-test/post-test, non-equivalent control group. Purpose: to evaluate the effect of participatory exercise to discuss health-related needs	• Younger respondents were more likely to report positive attitudes to the use of FP in the future than older respondents
Jordan Health Communication Partnership *(38)*	2010	Evaluation of the "mabrouk II: you've become a mother and a father" initiative	Youth	1217 men and women, no age data provided	Design: post-test. Purpose: to evaluate the effect of FP material distributed to newlyweds at the Civil Status and Passport Department	• No age disaggregated data • Mean age of the women was 24.7 years • The material had a positive effect on knowledge of and attitudes to FP and birth spacing
Al-Awaki N *(39)*	2010	Private sector project for women's health evaluation report: evidence-based medicine (EBM) for family planning program	Supportive environment	180 private sector FP providers in Jordan	Design: pre- and post- intervention study. Purpose: to improve knowledge of, and attitudes and practices to combined oral contraceptives through evidence-based medicine round tables	• At baseline, correct knowledge and prescribing practices about combined oral contraceptives were poor • The intervention increased the per cent (from 78% to 92%) of providers willing to prescribe combined oral contraceptives to a newly-married 21-year-old who wished to delay childbirth • Female providers were more willing than male providers to prescribe combined oral contraceptives to a newly-married, young women who wished to delay childbirth
Khalaf I, et al. *(40)*	2010	Youth-friendly reproductive health services in Jordan from the perspective of the youth: a descriptive qualitative study	Youth; supportive environment	60 participants (27 males and 33 females) between 12 and 18 years	Design: qualitative study using focus group discussions. Purpose: to identify RH services that young people need, identify problems young people encounter when accessing RH services, and explore their perceptions of youth-friendly services	• Male and female participants were confused about what RH meant and could not identify key components • Most participants did not know that RH services were available • Participants wanted services but would be afraid to access them because of fears over acceptance by community members • Barriers to using services included problems in accessing services because of distance and poor organization of health services (crowded, dirty) • Participants reported poor treatment by providers at health services and poor quality of services; but participants said they had never used RH services • Participants wanted a health centre only for young people, with suitable hours, visual aids, and providers able to give correct information in creative ways and be respectful

Table 1 Summary of peer-reviewed and grey literature published between 2008 and 2018 related to family planning among young people in Jordan *(Concluded)*

Authors	Year	Title	Ecological level of focus	Population and sample size	Study design/document description	Key results
Abel E. *(41)*	2009	Jordan's reproductive health policy environment score: measuring the degree to which the policy environment in Jordan supports effective policies and programs for reproductive health	Youth; supportive environment	Used data from the policy environment score assessments in 1997, 2000 and 2008	Design: longitudinal descriptive study. Purpose: to measure the degree to which the policy environment supports RH	• The number of policy formulation, organization, and programme components increased greatly between 2000 and 2008 for adolescent FP and RH • Political support and resources for adolescent FP and RH declined considerably • The policy environment for adolescents is weak and has remained so since 2000
Health Communication Partnership *(42)*	2008	Motivating healthy timing and spacing of pregnancies – lessons from the field	Youth	12 focus group discussions with women and men of reproductive age who had at least one child under 5 years to understand social norms and perceived barriers to birth spacing	Design: qualitative study. Purpose: to understand how to motivate mothers and communities to adopt safe birth intervals	• No specific age disaggregated data presented • Childbearing was the main expectation for and by couples • FP was more problematic than birth spacing • Barriers to birth spacing include family and community pressure, desire for male heirs, woman's late age at marriage, and poor knowledge of contraception and fear of side-effects • Motivators for spacing births included high cost of living, desire to give attention to each child, mother and child health, and better quality of life for the couple • Respondents suggested entertainment education such as radio and television series, soap operas, testimonials, talk shows, and other entertainment formats to relay messages. Other suggestions concerned policies, educational role of health providers, and improving the quality of services
Jurdi P *(43)*	2008	Unintended pregnancies remain high in Jordan	Youth	Secondary analysis of the Jordan Population and Family Health Survey (2002) including married women 15–19 years and 20–24 years (sample size not provided)	Design: secondary analysis. Purpose: to describe fertility and unintended/mistimed pregnancy in the Jordan population	• 18% of pregnancies were unintended in women 15–19 years; 26% were unintended in women 20-24 years
Khalaf I, et al. *(44)*	2008	Jordanian women's experiences with the use of traditional family planning	Youth	Six focus groups with 51 women of childbearing age (18–44 years) in the northern, central and southern regions of Jordan	Design: qualitative study using focus group discussions. Purpose: to explore the issues and challenges related to the use of traditional FP methods	• No specific results from young people as no information on participants' age. • Pressure to get pregnant immediately after marriage

FP: family planning, RH reproductive health.

Box 1: Lessons learnt and opportunities for interventions to improve family planning in young people in Jordan

Individual level

- Young people in Jordan are interested in sexual and reproductive health topics and are willing to be active participants in research and programmes. As noted in one document detailing the implementation of a reproductive health intervention targeting young people in Jordan, "the taboo nature of reproductive health topics was a concern for the project partner, [but] facilitators and program staff were surprised by the enthusiasm with which youth received the information" *(32)*.
- Interventions that target young people before marriage, such as through premarital counselling, may help to shift attitudes towards family planning and male involvement *(18)*. A young, unmarried Jordanian man indicated, "Of course, family planning concerns both partners and attending workshops on that issue must be compulsory, just like the mandatory pre-marriage blood test" *(18)*. Targeted family planning education for young women and men in Syrian refugee camps could increase family planning uptake by alleviating cultural pressures regarding fertility *(20)*.

Family and community levels

- Create a more accepting community environment among parents, community leaders and religious leaders to shift social norms about family planning and encourage young people to seek reproductive health services. Young people regard parents as trustworthy sources of reproductive health information; however, they may not be adequately equipped to effectively fulfil this role. Furthermore, the social expectations related to fertility, gender norms, and contraceptive use for young people in Jordan are reinforced through families, peers and social structures within communities. Interventions designed to support parents as gatekeepers may also be useful across the Middle East in improving reproductive health outcomes in young people *(45)*.
- Entertainment-focused mass media may offer an effective platform through which to reach young people with information on family planning, especially birth spacing *(42)*. Young people recommend the use of social media along with formal classes on issues related to reproductive health *(18)*. Discussing birth spacing rather than family planning may be a more socially and culturally acceptable entry point with young people.
- Include men in sexual and reproductive health and rights information to encourage their positive and supportive participation in their partner's health.
- Ensure that youth-friendly sexual and reproductive health services are available in communities. These services should be private, confidential and offer high-quality services specifically for young people. Offering a range of integrated and gender-segregated services may increase the acceptability of such centres.

Policy level

- Improve laws and policies on early marriage. The intersection between gender-based violence, low family planning uptake and early pregnancy in married adolescents suggests the need to improve enforcement of laws against early marriage and empower girls at risk of early marriage *(14)*.
- Develop and approve a comprehensive sexual and reproductive health policy for young people *(17,46)* that includes measurable indicators to assess youth-friendly services and a robust monitoring and evaluation plan.
- Introduce mandatory comprehensive sexual education in schools, with a focus on puberty, gender-based violence, intimate relationships, family planning, and the importance of birth spacing and delayed first birth for women's health *(46,47)*.

15–19 years had not discussed family planning with their husband in the previous 6 months compared with 50.2% of women aged 20–24 years *(5)*. In addition, cultural values and shame limit the degree to which men participate in decisions on reproductive health *(18)*. Despite the restrictive gender norms, many unmarried Jordanian and Syrian young women want their partners involved in family planning, and some young men believe that discussing family planning between partners can strengthen marital relationships *(4,18,40)*.

Other women, television, community events and radio are common sources of family planning information for young Jordanian women *(5,40)*. While many adolescents use the Internet as a primary source of information, they do not think that online sources, including social media, are trustworthy *(5,40)*. Unmarried Iraqi boys and girls aged 15–19 years said they would first approach their mother (for girls) or father (for boys) if they had a question about their reproductive health before turning to other sources *(2)*.

In general, young people in Jordan have limited information on where to obtain family planning services and are concerned over the quality of care. According to data from the 2012 Jordan Population and Family Health Survey, most adolescent girls aged 15–19 years obtained family planning services from the private sector (38%) or pharmacy (32%) *(21)*. A study conducted in Jordanian adolescents aged 12–18 years found that most of them did not know where to obtain family planning services or they believed that such services were only available for pregnant women *(40)*. Syrian refugees living in camps also had limited knowledge about family planning services available for young people *(23)*. Young people expressed concerns over privacy and confidentiality because of strict social norms governing the sexual behaviour of adolescents. In Zaatri camp, young Syrian women spoke about embarrassment in asking for condoms and feared being overheard by men *(23)*. Jordanian young people are concerned about long waiting times, poorly staffed clinics and poor quality of care. They believe that providers do not take them seriously, do not know what information they need and view their questions as inappropriate *(40)*. A study that included urban Syrian refugees between 12 and 24 years found that poor treatment by health care workers was one of the biggest disincentives to seeking reproductive health services *(16)*.

Box 2: Summary of important research gaps related to family planning for young people in Jordan

- Up to 2012, the Jordan Population and Family Health surveys only administered the women's questionnaire to ever-married women (51). To date, there are no nationally representative data on the sexual and reproductive health-related practices, needs and outcomes in never-married women, which is particularly important to understanding the needs of young people.
- No studies were found that focused on family planning or reproductive health issues in Palestinian refugees.
- Most studies in Syrian refugees focused on camp settings. Few data are available on Syrian refugees (especially Syrian young people) living outside of camps and those living in urban settings.
- Very few data were available on the attitudes of service providers to delivering family planning or reproductive health services to young people. Such data would help to better target training for service providers to improve their interaction with young people, dispel myths and misinformation providers may have, and improve the quality of care.
- Parents represent an important opportunity for interventions to improve reproductive health among young people in Jordan. No data were found on parents' concerns about family planning or reproductive health among young people, which could support future intervention design.
- More research should be conducted on ways to make young people's interactions with health facilities more youth-friendly.
- Young men and boys are an important population to engage in research on family planning.

Health service delivery environment

Little information is available on the availability of family planning services for young people. While a few facility-based assessments included data on aspects of service delivery pertinent to young people, this research did not have a specific focus on service delivery to young people. The Ministry of Health is piloting youth-oriented services in some women and child health centres, but implementation is not systematic, and the criteria for youth-friendly are still undefined *(13)*. Reproductive health services provided in schools are limited to medical examinations, referrals and awareness-raising campaigns *(13)*. Results from a health facility assessment in Zaatri and Irbid camps found that in Zaatri camp, health facilities were open and services were said to be available to adolescent females, while in Irbid, unmarried women could attend clinics but they would not be provided with contraceptives *(23)*.

A few studies have assessed the quality of family planning services offered to young people in Jordan. An evaluation of family planning counselling at selected public and private clinics noted that many government-run facilities lacked private rooms to offer confidential services *(49)*. Other studies found widespread misconceptions among health professionals about the side-effects of family planning methods used by young people *(50)*. A study of private-sector providers in Jordan found that poor knowledge about the use of combined oral contraceptives by young people negatively influenced prescribing practices, especially among male providers *(39)*.

Policy landscape

Several policy documents discussed family planning and reproductive health of young people in Jordan. The national reproductive health policy refers to young people as a cross-cutting priority and seeks to raise young people's awareness of services and policies on reproductive health *(1)*; however, the policy lacks specific indicators and age-disaggregated data *(13)*. The national youth strategy from 2005 to 2009 focused on improving reproductive health services for young people, especially through information dissemination, premarital medical examination and the provision of youth-friendly services *(47)*. A more recent youth strategy has not been approved, but is currently under development for 2018–2025 *(13)*. A 2008 assessment that focused on the reproductive health policy environment in Jordan highlighted concerns about: legal and regulatory restrictions on what family planning services can be provided to young people; inadequate provider training on how to counsel youth; limited availability of family planning methods; and lack of routine research and data pertaining to young people *(41)*.

Many of the same policy constraints affecting Jordanian young people also apply to young refugees; however, some issues are unique to refugees. A study in 2016 among Syrian refugees in urban areas found that young people between 12 and 24 years reported that a requirement to have an identification card substantially limited their ability to access reproductive health services *(16)* because most Syrian refugees are still unregistered in Jordan. Syrian refugees are also required to have a health services card to access services at Ministry of Health facilities. In late 2015, the Ministry of Health reduced the fee to obtain a health services card for registered Syrian refugees over 12 years from 30 to 5 Jordanian dinars (equivalent to about US$ 42 and US$ 7, respectively) *(17)*. Recent changes in the policy on out-of-pocket payments for health services by refugees have led to confusion and reduced service utilization. Before 2014, registered Syrian refugees were provided with free primary health care at Ministry of Health facilities, including family planning; however, a policy change required that Syrians pay the same rates as uninsured Jordanians. Although family planning services are exempted from charge for uninsured Jordanians, the policy is inconsistently applied to Syrian refugees *(17)*.

Focus group discussions

Analysis of the focus group discussions revealed three key themes: (i) a lack of youth-friendly services increases barriers to health services at the individual level, (ii) integration of services may improve social acceptability of family planning services and (iii) policy changes to make

services more accessible for youth as well as the consistent implementation of policies are needed.

Theme 1: lack of youth-friendly services

During focus group discussions, stakeholders emphasized that family planning for young people is a priority, especially to support married adolescents in delaying and spacing births. Stakeholders also agreed that the existing environment for delivery of reproductive health services is not adequately youth-friendly. A participant from a nongovernmental organization indicated that in recent years there had been a shift away from the provision of youth-friendly services and identifying young people as specific target population for reproductive health services at the policy level: "Ten years ago, there was a 'youth sector' that is not there anymore, and part of its [role] was to train health workers in providing youth friendly services." A Jordanian government official mentioned that the lack of a youth-friendly environment for delivery of services led to low utilization of health services by young people: "When youth want to go to health centres to acquire information related to reproductive health, they shy away from asking due to the fact that we don't have a friendly environment [for youth] within health centres, this could be a priority... for youth to feel more comfortable". Another Jordanian government official mentioned that the existing environment for delivery of services created even greater challenges for young men who wanted to obtain reproductive health services: "Even though female youth are shy to go...we only see female youth attending maternity and family planning centres. Male youth are even less willing to attend these centres".

Theme 2: integration of services

Several participants mentioned that the strong donor-driven emphasis on family planning had caused communities to equate family planning with a foreign agenda. For example, a representative from a United Nations agency mentioned that, "Unfortunately, when we say family planning they attack us on religious basis and say that there are external agendas being forced upon us". Another participant representing an international donor agency added that, "[family planning programmes] first appeared under the name of birth limitation, and due to social and cultural customs, they have been doubted, refused, and looked at as foreign policies". Participants suggested that beginning with less controversial reproductive health topics, such as women's perinatal physical and mental health, before including more sensitive topics such as family planning, may be a better strategy than focusing on family planning alone, especially to build acceptance of programmes targeting younger adolescents. However, a government representative mentioned, "we [should] start with 15 years olds about sexual education, psychological health, family planning, looking after women's health even before marriage, and the same for males... It all must be in line with each other; you cannot focus on one topic and skip the other because people will attack the project... especially in rural areas"

In order to make family planning services more acceptable to communities, several participants described past success in integrating family planning into other programmes targeting young people. A participant from a local nongovernmental organization indicated that including reproductive health information into a life-skills programme made parents more supportive of the content: "We were afraid that parents wouldn't allow their kids to come. Actually, it was the opposite. Parents were happy that someone was telling the truth to their children". Participants also emphasized the importance of compulsory sexual education at the university level and integrating family planning into premarital counselling and preconception care; however, one nongovernmental organization participant mentioned that, "it's [not] a very optimistic environment for sex education, and focusing on extracurricular activities may be a better strategy to reach more young people before compulsory programmes can be established". Efforts to engage parents and build their capacity in discussing reproductive health information with their children was also discussed as a priority, given the cultural importance of parent–child relationships. A nongovernmental organization participant mentioned that, "mothers avoid answering their children's questions as children or teenagers," and there was agreement by participants that engaging adult figures in reproductive health topics was critical to overcoming the shame associated with reproductive health. As a representative from the Ministry of Youth said, "we need to build the capacity of parents, schools, teachers, and counsellors".

Theme 3: policy change and consistent implementation

Stakeholders identified several policy-related challenges that make access to family planning services more difficult for young people. A government official mentioned that, "there are laws and regulations...that forbid young people between the ages of 10 to 24 from accessing such information and services if not accompanied by a parent". Furthermore, participants from nongovernmental organization indicted that an existing policy that prohibits pregnant women from accessing reproductive services without a marriage licence is problematic for women married outside the formal legal system. This situation is most common among refugees and adolescent girls, and results in these women becoming pregnant at an early age and not receiving adequate maternal care. In addition, the confusion over the fee structure for reproductive health services at government facilities for Syrian refugees was identified as an important barrier. In addition, focus group participants indicated that there was currently an ongoing debate over another policy change to the fees charged for Syrian refugees accessing health services in the public sector.

Several policy-related opportunities to make services more youth-friendly were identified by focus group participants. One participant indicated that while the new reproductive health policy for young people is believed to include criteria for youth-friendly services, it had not yet been adopted. Furthermore, a national-level monitoring and evaluation plan needs to be implemented at the

same time to ensure that the services are being offered according to agreed standards and that their delivery is sustained. A participant from the government mentioned that while the recently-drafted, youth-friendly service guidelines are expected to be adopted, "Until now, we don't have any national standards related to a youth-friendly health environment...and we need support from a strong national body... to sustain [them]". Participants also emphasized the need for a strong, government-wide body to coordinate activities related to young people across sectors to ensure a unified approach and to maximize impact. While participants praised current efforts to build a platform to document, collect and disseminate past experiences and evidence from research and programmes that target young people in Jordan, they indicated that such efforts were still just starting.

Discussion

The purpose of our review was to consolidate and synthesize the results and lessons learnt from research, programmes and policies targeting family planning in young people in Jordan at different ecological levels (individual, family/community, service delivery and policy levels). Our results highlight several key lessons learnt and opportunities for interventions on family planning for young people in Jordan at the individual, service delivery and policy levels. In addition, we identified several important research gaps on family planning in young people in Jordan that, if filled, could improve future, evidence-based interventions. A summary of these gaps is given in Box 2.

The results of our literature review and focus group discussions emphasize that young people in Jordan face many barriers to accessing reproductive health and family planning information and services. At the individual level, despite ongoing efforts, misinformation about family planning is widespread among young people and utilization of family planning services remains low. Furthermore, young people do not trust existing sources of information. The conservative social environment tends to cause young people to feel ashamed of accessing information related to reproductive health or family planning, so they have few resources they can rely on. To date, both programming and research focused on the unique needs of young people in Jordan have been limited. In particular, little information on the sexual behaviour of unmarried young people, especially young men, means that they are often overlooked in family planning programmes and policies, as the results of our literature review and focus group discussions indicate. As most existing research is based on relatively small sample sizes, larger studies that focus specifically on the reproductive health needs and behaviour of young people, including unmarried young people are needed to improve the evidence base on the family planning and reproductive health services needed by young people in Jordan. With changing demographics and normative shifts, more young people may engage in premarital sexual activity in the future, thus emphasizing the need for research on the reproductive health needs and behaviour of young people. Recent trends in other Arab countries suggest that increases in the age of marriage may be coupled with increases in premarital sexual activity, although data are limited *(52)*. Increased attention should be also paid to understanding and meeting the needs of Jordan's most vulnerable young populations, including urban refugees and married adolescents, especially as these populations continue to grow. Research focused on these populations may be of regional significance and help other countries with large refugee populations to better serve young people.

At the service delivery level, data from the focus group discussions emphasized the need for reproductive health and family planning services to be more youth-friendly. However, the literature review provided very limited information on how young people interact with the service delivery environment, and few specific initiatives to address the needs of young people exist. Both the literature review and the focus group discussions highlighted that the gender-related social norms that limit male involvement in reproductive health and family planning issues, and the fact that reproductive health and family planning services are typically provided at maternity and family planning centres, combine to exclude young men from using such services. As suggested in the focus group discussions, in order to ensure that any expanded implementation of youth-friendly services adequately meets the needs of young people, more research is needed to: understand how young people themselves envision a youth-friendly service delivery environment; identify gaps in current services and how they are organized; and explore supply-side barriers to providing high-quality services for young people.

At the policy level, our results highlight the need for improved policies to better support the consistent provision of good-quality youth-friendly reproductive health and family planning services. Often, not only is there inconsistency in what reproductive health and family planning services are available to young people and under what conditions, but consistent awareness is lacking of what policies exist for young people. This is because our focus group participants were inconsistent in the policies that they described pertaining to parental permission and marriage requirements, and such policies were not discussed in the literature. Such inconsistency may contribute to the low rates of utilization of reproductive health and family planning services by young people in an environment where they are already apprehensive about seeking care. Changes in policy that affect service availability for Syrian refugees discussed in the literature and in the focus group discussions may be particularly hard on already vulnerable populations of married adolescents, especially as this population is thought to have the highest rate of child marriage.

To better support policies, improved monitoring and evaluation of services offered at facilities is needed

to ensure consistent implementation of standards. In addition, a more robust, nationwide, data collection platform is needed that includes age-disaggregated indicators relevant to the specific reproductive health needs of young people. The ongoing development of a national reproductive health strategy for young people signals important progress; however, the exclusion of the sexual and reproductive health of young people from previous national policy documents appears to reflect Jordan's conservative cultural climate, and work in this area will likely continue to be contentious.

The results of our review should be considered in light of a few limitations. While every attempt was made to be exhaustive in the literature review, some studies or documents may have been unintentionally excluded in the analysis because they did not appear in the search results, or did not appear to have a youth-specific focus. This may be especially true with the grey literature search, as many organizations' reports are unpublished. Furthermore, while the participants included in the focus group discussions represented a wide range of stakeholders, not all organizations were represented. Furthermore, as participants were representing their organizations, discussions may have been constrained as they may not have wanted to appear too critical of governmental policy or their organization's challenges. Nevertheless, the participants openly discussed critical areas for improvement within policies and programmes, which may indicate the reliability of the data. We were not able to draw any conclusions about differences in trends according to stakeholder type.

Our study provides a consolidated picture of the state of research, programmes and policies targeting family planning in Jordan for young people between 10 and 24 years since 2008. Future programmes should build on past evidence in order scale up promising interventions while exploring new areas for research and programmes based on local needs. Results from our study may be applicable across the Middle East, as many other countries are dealing with similar populations because of displacement, a conservative programmatic environment and policy-related challenges.

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Analyse globale de la recherche, des programmes et des politiques de planification familiale ciblant les jeunes en Jordanie : évaluation des parties prenantes et revue systématique

Résumé

Contexte : Atteindre les jeunes mariés et non mariés en Jordanie en leur fournissant des informations et des services de planification familiale est une priorité, compte tenu notamment des importantes populations de réfugiés en Jordanie. À ce jour, la diffusion de la recherche en planification familiale et de l'expérience programmatique ciblant les jeunes en Jordanie a été limitée.

Objectifs : La présente étude avait pour objectif de fournir des informations approfondies sur les programmes, la recherche et les politiques d'intervention en matière de planification familiale en Jordanie, centrés sur les jeunes âgés de 10 à 24 ans.

Méthodes : Les données ont été recueillies par le biais des éléments suivants : un examen systématique de la littérature grise et examinée par des pairs concernant la santé génésique des jeunes ; et des discussions thématiques de groupe avec des parties prenantes de 18 organisations gouvernementales et non gouvernementales concernées.

Résultats : L'examen de la littérature comprenait 37 documents produits depuis 2008, qui fournissent de l'information aux niveaux individuel, familial et communautaire, au sujet de la prestation des services et des politiques. Les jeunes Jordaniens ont une connaissance limitée des méthodes de planification familiale et des lieux où obtenir des services de planification familiale. On dispose de peu d'informations sur la disponibilité des services de planification familiale pour les jeunes. Plusieurs documents politiques examinent la planification familiale et de la santé génésique des jeunes en Jordanie. Les discussions thématiques de groupe ont permis de cerner les possibilités d'intégrer les services et de renforcer l'élaboration des politiques futures.

Conclusions : Les résultats de la présente étude mettent en évidence les principaux enseignements tirés, les possibilités d'interventions et les lacunes de la recherche liés à la planification familiale chez les jeunes en Jordanie. Il convient d'accorder davantage d'attention à la compréhension et à la satisfaction des besoins des populations de jeunes les plus vulnérables de Jordanie, y compris les réfugiés urbains et les adolescents mariés, en particulier à mesure que ces populations continuent à croître. Les programmes futurs devront s'appuyer sur les données du passé et explorer de nouveaux domaines et interventions.

تحليل المشهد الواقعي لبحوث تنظيم الأسرة وبرامجه وسياساته التي تستهدف الشباب في الأردن: تقييم أصحاب المصلحة والاستعراض المنهجي

جويل جوسمان، أريج عثمان، عبير دبابنة، إقبال حمد، ميسون دبوب، إنصاف دعاس، أنا لانجر

الخلاصة

الخلفية: يعد الوصول إلى الشباب المتزوجين وغير المتزوجين في الأردن من خلال المعلومات والخدمات المتعلقة بتنظيم الأسرة أولوية، لا سيّما بالنظر إلى العدد الكبير من اللاجئين في الأردن. وحتى الآن، كان نشر البحوث المتعلقة بتنظيم الأسرة والخبرة البرنامجية التي تستهدف الشباب في الأردن محدودًا.

الأهداف: هدفت هذه الدراسة إلى توفير معلومات متعمقة حول برامج التدخل في مجال تنظيم الأسرة والبحوث والسياسات في الأردن التي تركز على الشباب الذين تتراوح أعمارهم بين ١٠ و ٢٤ سنة.

طرق البحث: جمعت البيانات من خلال ما يلي: استعراض منهجي للمؤلفات التي يراجعها الأقران والأدبيات غير الرسمية المتعلقة بالصحة الإنجابية للشباب؛ ومناقشات مجموعات التركيز مع أصحاب المصلحة من ١٨ منظمة حكومية وغير حكومية ذات صلة.

النتائج: شمل استعراض المؤلفات ٣٧ وثيقة صدرت منذ عام ٢٠٠٨، وهي تقدم معلومات على مستوى الفرد والأسرة/ والمجتمع المحلي وعلى مستوى تقديم الخدمات والسياسات. وكان الشباب في الأردن لديهم معرفة محدودة بأساليب تنظيم الأسرة وأين يحصلون على خدمات تنظيم الأسرة. ولا تتوفر سوى معلومات قليلة عن توافر خدمات تنظيم الأسرة للشباب. وناقشت العديد من الوثائق السياسية موضوع الأسرة والصحة الإنجابية للشباب في الأردن. وحددت مناقشات مجموعات التركيز الفرص المتاحة لإدماج الخدمات وتعزيز وضع السياسات في المستقبل.

الاستنتاجات: تبرز نتائج هذه الدراسة الدروس الرئيسية المستفادة، وفرص التدخل والثغرات البحثية المتعلقة بتنظيم الأسرة بين الشباب في الأردن. وينبغي إيلاء المزيد من الاهتمام لفهم الاحتياجات وتلبيتها للسكان الأشد ضعفاً من فئة الشباب في الأردن، بما في ذلك اللاجئون الحضريون والمراهقون المتزوجون، لا سيّما مع استمرار نمو هؤلاء السكان. وينبغي أن تستند البرامج المقبلة إلى الأدلة السابقة وأن تستكشف مجالات وتدخلات جديدة.

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Mobile-aided diagnosis systems are the future of health care

Donia Ben Hassen[1]

[1]Higher School of Digital Economy, University of Manouba, Tunisia (Correspondence to: D. Ben Hassen: donia.ben.hassen@esen.tn)

Abstract

Technology has been a driving force in changing the routine duties of physicians. Advances in mobile technologies have given rise to a new term: mHealth (mobile Health). mHealth devices generate big data and integration of mHealth and big data into existing eHealth services, and the continued growth in coverage of mobile cellular networks are new opportunities. This paper provides an overview on mHealth growth and the benefits of its combination with big data analysis for various purposes of health care. We outline our proposed framework for mobile-aided diagnostic systems. We also discuss the opportunities and challenges of mHealth in aiding diagnosis through mobile technologies.

Keywords: big data, health care, mHealth, mobile-aided diagnostic systems

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Introduction

Several terms such as telemedicine, telehealth, eHealth (electronic health) have been used to refer to the use of information technology to support health service delivery and health systems. Transition of these terms to a new term mHealth (mobile health) has become evident in the literature due to the unprecedented spread of mobile technologies as well as advances in their innovative application. As reported by the World Health Organization, mobile health (mHealth) is a subset of eHealth and is defined as the use of mobile wireless technologies for health. More recently, the term digital health was introduced as a broad umbrella term encompassing eHealth (which includes mHealth), as well as emerging areas, such as the use of advanced computing sciences in big data, genomics and artificial intelligence (*1*). The greater personal access to smartphones worldwide was the motivation behind the development of the mHealth field. This new field has emerged in recent years and offers the ability of remote individuals to participate in health care, which may not have been possible in the past.

The most common application of mHealth is the use of mobile phones and communication devices to educate consumers about preventive healthcare services. However, mHealth is also used for chronic disease management and to aid diagnosis of complex diseases (*2*). Hence, mHealth devices generate a large amount of data and in order to obtain the maximum benefit from mHealth data, emerging big data technologies can be used. Analysis of big data in aggregate form at different stages has potential in various purposes.

This paper is organized as follows: after commenting on the benefits of using mHealth in decision-making, we describe the contribution of mobile health and big data in various aspects of healthcare services. We then presents computerized schemes for our proposed system, and finally, we discuss the opportunities and challenges, as well as the directions for future research in this field.

mHealth overview

From text reminders to virtual clinic visits, the proliferation of mobile health apps has greatly improved patient outcomes as well as the overall quality of healthcare provided (*3*). Tens of thousands of mobile health apps are now available for downloading from online stores. These apps enable clinicians to save time by allowing them to access patient information more efficiently (*4*). Besides, they allows patients particularly with chronic diseases to prevent complications and obtain alarms in abnormal situations that can be viewed by doctors in real time (*5*). A recent report by the Mobile Health Market notes that 80% of physicians use smartphones and medical apps as healthcare tools and innovative platforms for doctor/patient interaction (*6*).

Smartphones are the most commonly used mobile devices in our daily life. They are the most prominent platforms for mHealth applications. mHealth apps can perform a variety of functions related to self-monitoring such as weight management, activity levels and smoking cessation by tracking personal data including daily calorie intake, heart rate, glucose level and even brain activity. Thus, healthcare providers can keep patients under continuous observation and detect the symptoms at an early stage to treat them more effectively.

Therefore, many studies have evaluated the effect of mobile health apps on the experience of patients and physicians. mHealth is already being applied and tested in diverse health contexts, such as Parkinson's disease and maternal and child health (*7*), and diabetes is the most investigated condition (*8*,*9*). The popularity of mobile health for management of diabetes is growing. The Community Preventive Services Task Force

recommends the use of diabetes self-management mobile apps in healthcare systems (*10*). There is a general overview of various applications of mHealth for diabetes care, for example, to obtain monitoring data and measuring glycaemic management outcomes (*5*). Most evidence on mHealth for diabetes relies on advanced features of smartphones that can improve diabetes self-management. Another key development of mobile apps is notifying parents of the condition of their children with diabetes as well as child–parent communication.

Mobile health studies are not restricted to those cited above. They are growing exponentially, dealing with many areas and intersecting with others. This exponential growth has greatly affected health care and has outpaced the science (*11*). Table 1 shows a selection of studies illustrating the potential of applying mHealth.

mHealth and big data technologies

The health domain generates large amounts of quantitative (e.g., laboratory tests and images) and qualitative (e.g., electronic health records and clinical notes) data that are utilized in diagnosis and treatment. Notably, the field of medical image storage and analysis has grown exponentially, with an increase in data set sizes. Physicians are asked, in their daily work, to examine hundreds of computed tomography (CT), magnetic resonance, positron emission tomography or X-ray images and to diagnose complex diseases. This large volume of data is exploited for decision-making purposes. Indeed, medical images are not simple data, and they are usually overloaded with heterogeneous data from different sources. For these reasons, there are many isolated databases of semistructured and unstructured valuable data in health care.

Mobile technologies enable clinicians to collect all this health data easily, by smart applications, smart devices, and Internet of Things sensors, from a diverse set of sources. The term Internet of Things refers to the connection of physical objects to the Internet (*16*). However, it is difficult to process these data using traditional database management tools, especially data that do not have a common structure. With the help of mobile devices that continuously produce large amounts of structured and unstructured data, mHealth data have turned into big data. mHealth has the potential to store and process efficiently big data that are increasing exponentially in quantity over time, from a large number of usually disparate data sources. Currently, big data technologies are increasingly being used to solve the problems of data storage and management for biomedical and healthcare informatics research (*17*). Hence, with the ability to deal with large volumes, big data hold the promise of storage of medical images and offer the analytical tools to investigate them. There are 5 unique characteristics of big data that distinguish them from ordinary data: volume, velocity, variety, veracity and value (*18*). Volume refers to the size of data, which is clearly the most important characteristic of the big data. Velocity refers to the speed of the data that need to be processed in real time. Variety refers to the distinct types of data. Veracity is related to the quality of the collected data. Finally, value reflects the benefits of big data analytics. Big data can often produce an extensive amount of health statistics that are discussed in the context of improving medical care and preventing disease (*19*). Moreover, big data can transform mHealth data into meaningful information and could benefit clinicians and patients through knowledge read on a mobile platform.

So, mHealth integrates mobile computing, medical sensors and portable devices in order to promote the development of emerging systems and applications for health care. To obtain the optimum benefits of mHealth, it needs to work with big data as an integrated tool. The mHealth apps based on big data are a fast-growing field, with many new studies published in recent years, such as the successful application in which the authors have proposed a learning scheme for patients' activity recognition (*20*). The mutual relation between mHealth and big data makes it easier to study and monitor

Table 1 Examples of studies illustrating the potential of mHealth

Area	Sample	Methods	Data type	Refs
Skin cancer care	228 participants aged 50–64 years at high risk of melanoma	Mobile dermascopes	Questionnaire Preteledermoscopy and skin self-photographs	(*12*)
Tuberculosis diagnostics	4701 images (4248 with manifestations) from Peru	Mobile computing and deep learning	Image capturing and transmission by mobile device. Annotated X-ray. Images and data analytics	(*13*)
Multimedia mHealth application	Users of hyperbaric oxygen therapy chamber	Virtual reality	3D stereoscopic virtual reality glasses and immersive perception	(*14*)
Internet of Things	23 patients	Wearable devices and mobile apps to monitor oxygen saturation and heart rate	An alarm was sent to clinicians in the event of oxygen saturation below 90%, heart rate above 140 or below 60 bpm	(*15*)

patients' health status and has the potential to achieve higher quality care at lower costs and with better overall outcomes (*21*).

New horizons of mobile-aided diagnostic systems

The uncertain nature of the diagnosis of many diseases makes diagnostic decisions difficult. Several emerging technologies are involved in the diagnostic process, such as telemedicine. The use of mHealth in diagnosis is a recent phenomenon. Studies have shown that mHealth can improve decision-making opportunities (*22*). mHealth plays key roles in various aspects of the diagnostic process. One recent study has proposed that mHealth technology can be integrated into medical decision-making for patients with advanced knee arthritis (*23*).

Other recent studies have begun talking about mobile-aided diagnostic systems such as an android smartphone app (*24*) that detects the optic nerve head in retinal fundus images in order to identify diabetic retinopathy as well as other abnormalities in eye examinations. Association of a mobile application and a computer-aided diagnostic system has been proposed for diagnosis of skin nodules (*25*).

Despite the continuous development of mobile platforms in terms of processing power, storage capacity and captured image quality, current mHealth technologies were developed for simple measurements and do not have the capabilities to address the challenges of diagnosis of complex diseases such as breast cancer and cardiovascular disease.

The main objective of our research is to design a secure, simple to use, efficient and intelligent mobile-aided diagnostic big data system. As shown in Figure 1, our proposed system utilizes traditional client–server architecture, which includes a client using a smartphone and a server (cloud computing service). The client and server communicate via a cellular network. Wearable and sensor technologies are key to development of our mHealth project. Wearable systems are intended to facilitate data collection, and they offer an additional source of patient data that may improve clinicians' ability to diagnose certain conditions. Additionally, with the rapid development of wireless communication and sensor technologies, mobile phones and tablets have increasingly stronger computing and sensing capacities (*26*).

Figure 1 Graphic presentation of our proposed framework for a mobile-aided diagnostic system

Thanks to the use of wearable sensors, it is possible to collect and analyse the data coming from these devices to monitor patients' health status, such as heart rate and blood pressure. Currently, this feature allows acquisition of vital data but it does not process the other medical data to diagnosis serious diseases. We intend to connect with sensors different medical modalities, such as imaging, cell-based assays and even electronic records. This will generate a large amount of significant data. To handle the large volume of data and achieve ease of use, cloud computing technology is the solution. In fact, the development of cloud computing has been of paramount importance to big data and will play a major role in our proposed infrastructure that can be used for various purposes like construction of an electronic archive.

Additionally, the use of this system can influence positively communication and relationships between patients and providers, facilitating relationship-centred health care (*27*). The clinician–patient relationship is an important determinant of quality health care (*28*). The mHealth revolution has a positive impact on how doctors/nurses interact with patients. In the future, face-to-face healthcare provider/patient contacts will become less common and exchanges between consumers and providers will increasingly be mediated by smartphones.

Our proposed infrastructure will forever change the way providers and consumers interact. It will mediate almost all information and will be the source of almost everything that doctors and other clinicians will learn about their patients. Patient information will be accessible to all providers anywhere and anytime and this access of course will be limited to only those clinicians to whom the patient grants access. Patients will have electronic access to almost as much information about their condition and the medical evidence base as their healthcare providers have. Finally, it is essential that clinicians and researchers understand how to adopt and adapt this transformation of the healthcare systems of the future.

Ethical and interoperability issues

Information about individuals can be collected without the people even noticing. Health data are sensitive, and their granularity presents significant challenges to anonymizing personal information, and this exposes consumers to privacy and data security risks (*29*). The

ethical requirement is to keep sensitive and identifiable information confidential. With the growth mHealth technologies, healthcare professionals have encountered an emerging new set of ethical issues relating to privacy (*30*). The classical medical ethics principles of autonomy, beneficence, nonmaleficence and justice can be used to address ethical dimensions of mHealth application design. User autonomy is the issue of trust to the service that is offered and its provider. Beneficence obligates the healthcare professional to promote good and provide assistance to others. Nonmaleficence is the principle that one should do no harm. Justice requires that all people be treated fairly and equally (*30*). Health technology should be safe and secure and its applications should not violate privacy and trust. Therefore, protection of patient data has always been a principal concern within the eHealth field. The evolution of technology to mobile health platforms has made the issue more complex. Certainly the use of mobile devices has raised new concerns for data privacy and security. With many things being connected, new security and privacy problems arise, for example, confidentiality, authenticity and integrity of data sensed and exchanged.

Problems of data security in mHealth have been tackled by numerous researchers. Many studies have used standards to ensure the security and privacy of their mobile apps, such as an app that utilizes data encrypted using Secure Shell (*31*). However, the lack of specific strategies and mechanisms to ensure adequate security and privacy to maximize the full capabilities of mobile devices presents a significant barrier to care. The interoperability problem, in a Wi-Fi-based environment, could be solved through many traditional methods such as a Wi-Fi/Bluetooth gateway or by using Web services. The health data are transmitted in plain text using the JSON format, which represents a security weakness because it allows eavesdropping during the connection.

Discussion and conclusion

mHealth combined with big data is fast becoming a new prospect in the world of health and has potential benefits. This new field refers to electronic health data so large and complex that they are difficult to manage with traditional software and computing algorithms. With more computing power and high-quality imaging, it will be beneficial if doctors receive on their smartphones patient files, CT scans and blood test results. Furthermore, intelligent mobile apps can help with diagnosis. This revolution in mobile-aided diagnostic systems will offer opportunities to manage complex diseases and save time and money. Mobile-aided diagnostic systems are predicted to influence profoundly the future of health care. Although these systems are opening a new generation of innovation applications, several challenges exist.

We think that the main challenge in developing mHealth technologies for complex diseases is the medical infrastructure, especially in low-resource countries. Another challenge is to bring this innovation to clinics and introduce the new equipment to medical staff.

Furthermore, there is a need to improve its usability and security. The impact of mHealth on the work of nurses and physicians must be also analysed. By giving doctors real-time statistics, mobile-aided diagnostic systems could improve population health and reduce healthcare costs. Mobile-aided diagnostic systems have a potentially role to play in preventing disease. They can allow the discovery of relationships between disease and lifestyle or the environment. This helps people to successfully modify their risk behaviours.

Finally, creative use of mHealth, such as mobile-aided diagnostic systems, has the potential to reduce the cost of health care and improve well-being in numerous ways. These applications are making health services more efficient and sustainable, but rigorous research is needed to examine the potential, as well as the challenges, of utilizing mobile technologies to improve health outcomes.

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Les systèmes de diagnostic assistés par téléphone portable : l'avenir des soins de santé

Résumé

La technologie est génératrice de changements dans les tâches courantes des médecins. Les progrès en matière de technologies mobiles ont donné naissance à un nouveau terme : la santé mobile. Les dispositifs de santé mobile génèrent des mégadonnées (« big data ») ; l'intégration de la santé mobile et des mégadonnées dans les services déjà existants de cybersanté, ainsi que le développement constant de la couverture par les réseaux de téléphonie mobile, ouvrent de nouvelles perspectives. Le présent article fournit une vue d'ensemble du développement de la santé mobile et des avantages de son association avec l'analyse des mégadonnées pour de nombreuses applications des soins de santé. Nous présentons une proposition de cadre pour les systèmes de diagnostic assistés par téléphone portable. Nous examinons également les perspectives et les enjeux de la santé mobile en matière d'aide au diagnostic par les technologies mobiles.

نُظم التشخيص باستخدام الأجهزة المحمولة: مستقبل الرعاية الصحية

دنيا بن حسن

الخلاصة

ظلت التكنولوجيا تُمثل القوة الدافعة في تغيير طبيعة المهام الروتينية للأطباء. وقد ساهم التقدم في تكنولوجيا الأجهزة المحمولة في ظهور مصطلح جديد، ألا وهو mHealth أو استخدام تكنولوجيا الأجهزة المحمولة في مجال الصحة. ويساعد استخدام تكنولوجيا الأجهزة المحمولة في مجال الصحة في توليد بيانات ضخمة ودمجها في خدمات الصحة الإلكترونية الموجودة، كما يمثل استمرار نمو التغطية بشبكات الهاتف المحمول فرصاً جديدة. وتستعرض هذه الورقة نمو استخدام تكنولوجيا الأجهزة المحمولة في مجال الصحة وفوائد الجمع بين ذلك وتحليل البيانات الضخمة لأغراض متعددة خاصة بالرعاية الصحية. كما نطرح من خلالها إطار العمل المُقترَح لنُظم التشخيص باستخدام الأجهزة المحمولة. ونناقش أيضاً الفرص والتحديات الماثلة أمام استخدام تكنولوجيا الأجهزة المحمولة في مجال الصحة للمساعدة في التشخيص.

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Meeting of the Eastern Mediterranean Regional Technical Advisory Group (RTAG) on immunization[1]

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Introduction

The COVID-19 pandemic has created unprecedented challenges for immunization programmes in the Eastern Mediterranean Region. In order to assess the impact of COVID-19 and scrutinize the current status of immunization goals in the Region, the World Health Organization Regional Office for the Eastern Mediterranean (WHO/EMRO), Cairo, Egypt, held a meeting of the Regional Technical Advisory Group (RTAG) on immunization during 13–14 April 2020 (*1*). The meeting was conducted virtually (due to the COVID-19 pandemic situation).

The objectives of the meeting were to:

- review regional progress, challenges and constraints facing the achievement of the goals of the Eastern Mediterranean Vaccine Action Plan (EMVAP) and provide advice on the way forward;
- brief RTAG members on the progress in verification of elimination of measles and rubella and hepatitis B control in the Region;
- review the standard operating procedures (SOPs) of the RTAG; and
- discuss the impact of the COVID-19 pandemic on immunization programmes in the Region and measures to mitigate it.

Summary of discussions

The current COVID-19 pandemic may result in a substantial negative impact on immunization programmes in the Region. Initial information from many countries indicates postponement of vaccination campaigns and underutilization of routine immunization services. An accumulation of susceptible populations may have serious consequences for vaccine-preventable diseases (VPD) morbidity and mortality. Regional routine vaccination coverage has increased in recent years despite the challenges facing the Region. However, around 3 million infants – almost 1 in 5 – still miss receiving their basic vaccines (*2*).

Commendable progress has taken place towards measles and rubella elimination in the Region, with half of its countries having either achieved elimination or progressed well towards it. However, the occurrence of measles outbreaks in several countries and the failure of five countries to achieve maternal and neonatal tetanus (MNT) elimination are persistent problems.

Several outbreaks of VPDs have occurred recently in the Region, mainly affecting countries with low routine coverage. Improving immunization coverage, introducing booster doses and improving regional and national capacity for early detection and rapid response are required.

While commendable efforts to improve immunization data quality are ongoing in several countries, the current overall situation of immunization data quality hampers optimal decision-making. However, remarkable progress has taken place in establishing processes for verification of elimination and control goals at the regional level.

Recommendations

To WHO

- Promoting the use of absolute numbers of unvaccinated children along with vaccination coverage to monitor programme performance, especially in countries with high numbers of unvaccinated children.
- Support countries of the Region in submitting high quality applications to GAVI to introduce second doses of measles and rubella vaccines.
- Responding to the demand of populations and decision-makers for a vaccine against COVID-19, as an opportunity to promote the unique importance of vaccination, as most cost-effective tool to prevent and control disease outbreaks, epidemics and pandemics.
- Finalizing, printing and disseminating the regional guide for verification of the hepatitis B reduction target and conducting briefing sessions for countries on the verification process, as soon as possible.
- Ensuring continued support to the Expanded Programme on Immunization (EPI) to streamline the sources and flow of immunization data in order to ensure the coherence and standardization of immunization data reporting.

To Member States

- Ensuring that countries of the Region document the impact of the COVID-19 pandemic on national immunization programmes and monitor vaccine availability.

[1] This report is based on the Summary Report on the Meeting of the Eastern Mediterranean Regional Technical Advisory Group (RTAG) on immunization, 13–14 April 2020, virtual meeting.

- Monitoring susceptibility to measles and closing the immunity gap among all population groups, including refugees, immigrants, health-care workers and other high-risk groups.
- Ensuring that countries make plans for catch-up vaccination of missed children, using appropriate strategies, as soon as possible, when the COVID-19 pandemic situation allows.
- Involving the national immunization technical advisory group (NITAG), relevant partners and stakeholders in decision-making on the implementation of immunization activities during the COVID-19 pandemic.
- Designing appropriate strategies for the integrated delivery of essential services during the COVID-19 pandemic where possible, and in the post-pandemic period.
- Ensuring that countries of the Region maintain high-quality VPD surveillance and alert functions to safeguard the early detection of VPD outbreaks and timely response to them.
- Encouraging countries of the Region to regularly share their subnational immunization data to ensure identification of missed children and achieve national and regional immunization goals.

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Dr Mohammad Haytham Al-Khayat (1937-2020)

It is with great sorrow that that we extend our condolences on the sad demise of Dr Mohammad Haytham Al-Khayat. Born in 1937, Dr Al-Khayat joined the World Health Organization (WHO) in 1983 and became the Deputy Regional Director for the Eastern Mediterranean Region from 1991 to 1999, and remained the Regional Director's Senior Adviser until 2012. He was also a member of several institutions and bodies where he generously contributed to promoting the public health agenda and raising a variety of health issues in many forums.

Dr Al-Khayat worked tirelessly to serve the Region and its people, with particular attention to those in war and emergency situations. He spared no effort to achieve WHO's goals established by its early founders and assumed a prominent scientific position regionally and globally.

A speaker of five languages, Dr Al-Khayat authored many books in both Arabic and English. His publications – particularly the *Unified Medical Dictionary* and the series *The Right Path to Health* issued by WHO – have been an asset to many public health scholars and students across the Region.

Dr Al-Khayat was a member of most (if not all) Arabic Language Academies in the Region, where he provided valuable services in the fields of language and terminology. He was also a member of several scientific councils, and his life is noted for its dedicated service to public health in the Region and the importance of equality of access to health for all.

رثاء الدكتور محمد هيثم الخياط (١٩٣٧ – ٢٠٢٠)

نعزيكم وأنفسنا في وفاة العلّامة الدكتور محمد هيثم الخياط الذي التحق بمنظمة الصحة العالمية في عام ١٩٨٣، وشغل منصب نائب المدير الإقليمي من عام ١٩٩١ إلى عام ١٩٩٩، ثم منصب كبير مستشاري المدير الإقليمي حتى عام ٢٠١٢. وكان عضواً في كثير من المؤسسات والهيئات مساهماً في دفع أجندة الصحة وقضاياها المختلفة قدماً في مختلف المحافل.

لقد خدم رحمه الله الإقليم وسكانه بلا كلل ولا ملل، وأولى اهتماماً خاصاً طوال مدة عمله في المنظمة لخدمة سكان الإقليم ممن يعانون من ويلات الحروب والطوارئ التي ألمت بكثير من أرجاء الإقليم. ولم يَأْلُ رحمه الله أي جهد في سبيل تحقيق مرامي منظمة الصحة العالمية التي أرساها المؤسسون الأوائل لها. فتبوأ مكانةً علميةً مرموقةً، ليس على مستوى الإقليم فحسب، وإنما على الصعيد العالمي كذلك.

وكان رحمه الله يتحدث خمس لغات، وكان واسع الاطلاع، وله كثير من المؤلفات باللغتين العربية والإنجليزية، أفادت الكثير من طلاب العلوم الصحية في الإقليم، ومنها «المعجم الطبي الموحد» باللغتين العربية والإنجليزية، و«سلسلة الهدي الصحي» التي أصدرتها منظمة الصحة العالمية وكان لها كبير الأثر في ترسيخ مفاهيم الصحة في الإقليم.

وكان رحمه الله عضواً في معظم إن لم يكن جميع – مجامع اللغة العربية في الإقليم، فخدم من خلالها علوم اللغة والمصطلحات خدمات جليلة، وكان أيضاً عضواً في المجامع العلمية الإقليمية.

إن مناقب الدكتور محمد هيثم الخياط لا تُحصى، فقد وهب حياته لخدمة قضايا الصحة في الإقليم، ووقف مدافعاً بصلابة عن الحق في الصحة للجميع على قدم المساواة.

رحم الله الفقيد رحمةً واسعةً وتغمَّده بواسع مغفرته.

Dr Ramez Khairi Mahaini (1959-2020)

It is with great sadness that we announce the loss of our dear colleague Dr Ramez Khairi Mahaini, who passed away on 30 August 2020 in Cairo, Egypt, leaving behind a great legacy with the World Health Organization Regional Office for the Eastern Mediterranean (WHO/EMRO).

Dr Mahaini had dedicated 25 years of his life to the betterment of the lives of women and children in the Eastern Mediterranean Region. He originally joined WHO/EMRO in Alexandria, Egypt, in 1994, and had recently served as Coordinator of Maternal and Child health, Regional Advisor of Reproductive and Maternal Health, and was the focal point for the health of older persons for the Region.

Dr Mahaini was the embodiment of dedication and professionalism in the service of WHO's mission and vision, and a great source of support for all his colleagues in WHO Headquarters, Regional and Country Offices. His kindness and thoughtfulness extended to all staff members and he will always be remembered as a resourceful mentor, trustworthy colleague and dear friend. In his private life, Dr Mahaini was also known for his love of poetry and nature. Dr Mahaini is succeeded by his wife and two sons.

رثاء الدكتور رامز خيري مهايني (١٩٥٩–٢٠٢٠)

انتقل إلى رحمة الله زميلنا العزيز الدكتور رامز خيري مهايني، الذي وافته المنية في ٣٠ أغسطس / آب ٢٠٢٠ في القاهرة، مصر، مُخلفاً وراءه إرثاً عظيماً لدى المكتب الإقليمي لمنظمة الصحة العالمية لشرق المتوسط.

وقد كرس الدكتور مهايني ٢٥ عاماً من حياته لتحسين حياة النساء والأطفال في إقليم شرق المتوسط. وكان قد التحق بالمكتب الإقليمي لشرق المتوسط في الإسكندرية، مصر في عام ١٩٩٤، وعمل مؤخراً منسقاً لشؤون صحة الأمهات والأطفال، ومستشاراً إقليمياً للصحة الإنجابية وصحة الأمهات، كما كان مسؤول الاتصال المعني بصحة كبار السن في الإقليم.

ومثّل الدكتور مهايني تجسيداً حقيقياً للتفاني والمهنية في خدمة مهمة منظمة الصحة العالمية ورؤيتها، كما كان مصدراً لدعم جميع زملائه بشكل كبير في المقر الرئيسي للمنظمة، والمكتب الإقليمي، والمكاتب القُطرية. وقد امتدت معاملته الكريمة إلى جميع الزملاء والموظفين، وسيتذكره الجميع دوماً باعتباره معلماً بارعاً وزميلاً جديراً بالثقة وصديقاً عزيزاً. وعُرف الدكتور مهايني في حياته الخاصة بحبه للشعر والطبيعة.

رحم الله الدكتور مهايني وأدخله فسيح جناته.

Correspondence

Editor-in-chief

Eastern Mediterranean Health Journal
WHO Regional Office for the Eastern Mediterranean
P.O. Box 7608
Nasr City, Cairo 11371
Egypt
Tel: (+202) 2276 5000
Fax: (+202) 2670 2492/(+202) 2670 2494
Email: emrgoemhj@who.int

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