

Review

Dietary transition and obesity in selected Arabic-speaking countries: a review of the current evidence

B.H. Aboul-Enein¹, J. Bernstein² and A.C. Neary³

التحول الغذائي والسمنة في بلدان متتقة ناطقة باللغة العربية: استعراض للأدلة الحالية

باسل أبو العينين، جرشو بيرنشتاين، أنجيلا نيري

الخلاصة: لقد أصبح تصاعد معدلات السمنة إحدى مشاكل الصحة العامة الكبيرة في إقليم الشرق الأوسط وشمال أفريقيا، وكان ذلك مرتبطاً بالتحويلات نحو نظام غذائي غربي. ولقد هدف هذا الاستعراض التكاملي إلى دراسة الاتجاهات والتحويلات الغذائية الحالية وارتباطها بالسمنة في البلدان الناطقة بالعربية في إقليم الشرق الأوسط وشمال أفريقيا. فجرى البحث في قواعد البيانات ذات الصلة عما أجري من دراسات في بلدان هذا الإقليم بين عامي 1998 و2014 لاستقصاء اتجاهات السمنة والتغيرات التي حدثت في أنماط النظم الغذائية على المستوى الإقليمي لدى جميع الفئات العمرية. فكانت هناك 39 مقالة تفي بمعايير الاشتمال. وقد أشارت جميع المقالات إلى حدوث انتشار للسمنة على نحو متزايد، وابتعاد عن الأنماط الغذائية التقليدية، فذكرت 51% منها حدوث تحول نحو نظام غذائي غربي، ووجدت نصفها أن النظام الغذائي الغربي قد ارتبط بزيادة السمنة. لقد بات من المبرر - ثقافياً - وضع استراتيجيات معنية بالتنقيف الصحي الغذائي وتعزيز الصحة لمواجهة كل من التحويلات الغذائية نحو النظام الغذائي الغربي والسمنة المتزايدة.

ABSTRACT Escalating obesity rates have become a significant public health problem in the Middle East and North Africa (MENA) region and have been associated with shifts towards a westernized diet. This integrative review aimed to examine the current dietary trends and transitions and their association with obesity in Arabic-speaking countries of the MENA region. Relevant databases were searched for studies in MENA countries between 1998 and 2014 that investigated obesity trends and changes in dietary patterns at the regional level in all age groups. A total of 39 articles fulfilled the inclusion criteria. All the articles noted that obesity was increasingly prevalent and that there was a significant dietary shift away from traditional dietary patterns; 51% reported a shift towards a westernized diet and half found that the western diet was correlated with increased obesity. Culturally relevant dietary health education and health promotion strategies are warranted to address both the dietary shifts towards the westernized diet and the increasing obesity.

Transition alimentaire et obésité dans une sélection de pays arabophones : examen des données actuelles

RÉSUMÉ L'augmentation rapide des taux d'obésité est devenue un problème de santé publique significatif dans la région du Moyen-Orient et de l'Afrique du Nord (MENA) et est associée à une occidentalisation des habitudes alimentaires. Le présent examen intégratif visait à étudier les tendances et les transitions alimentaires actuelles ainsi que leurs associations à l'obésité dans des pays arabophones de la région MENA. Des recherches ont été menées dans des bases de données pertinentes afin de trouver des études réalisées dans les pays de la région MENA entre 1998 et 2014 portant sur les tendances de l'obésité et les changements d'habitudes alimentaires parmi tous les groupes d'âge au niveau régional. Au total, 39 articles répondaient au critère d'inclusion. Tous les articles mentionnaient que l'obésité était de plus en plus prévalente et qu'un éloignement notable des habitudes alimentaires traditionnelles s'opérait. En effet, 51 % des articles rapportaient une occidentalisation de l'alimentation, et la moitié concluait qu'il y avait une corrélation entre l'alimentation occidentale et l'augmentation de l'obésité. Une éducation en santé alimentaire et des stratégies de promotion de la santé pertinentes d'un point de vue culturel sont requises pour s'attaquer à la question de l'occidentalisation des habitudes alimentaires et de l'augmentation de l'obésité.

¹School of Health Sciences, University of South Dakota, Vermillion, South Dakota, United States of America (Correspondence to: B.H. Aboul-Enein: Basil.AboulEnein@usd.edu; Basil.Aboul-Enein@lshsm.ac.uk). ²College of Graduate Health Studies, A.T. Still University of Health Sciences, Kirksville, Missouri, United States of America. ³Kinesiology, Health Science, and Athletics, Cuesta College, San Luis Obispo, California, United States of America.

Introduction

Global obesity is a wide-reaching epidemic that continues to create public health challenges, particularly in developing countries (1). More than 1.9 billion adults, 18 years and older, are estimated to be overweight (body mass index [BMI] 25-29.9 kg/m²), representing 39% of the world adult population (38% of men and 40% of women). Of these overweight adults, over 600 million are obese (BMI 30-39.9 kg/m²). These are the 2014 figures from the World Health Organization (WHO) and are the most recent global data available (2).

In countries of the Middle East and North Africa (MENA), the prevalence of obesity has significantly increased over the last 3 decades (3) with subsequent increases in obesity-related comorbidities, including cardiovascular diseases, chronic respiratory diseases, diabetes, hypertension, metabolic syndrome and some types of cancer (1,3).

According to the WHO 2014 figures, the Eastern Mediterranean Region has the third highest mean BMI after North America and Europe (4). The highest levels of overweight and obesity are found in Egypt, Bahrain, Jordan, Kuwait, Saudi Arabia and the United Arab Emirates for adolescents and adults aged 15 years and older; the prevalence of overweight and obesity in these countries ranges from 74% to 86% in women and 69% to 77% in men (5).

The nutrition transition model, initially proposed by Popkin in 1993, has been defined as a rapid global change in food intake, sedentarianism, and their effects and health outcomes on diet-related diseases (6). The foremost health outcome of the nutrition transition is the increased prevalence of global obesity (7). The nutrition transition has been marked by a dietary shift in both consumption and energy expenditure as it relates to changes in demographic, epidemiological and socioeconomic

transitions, particularly in developing countries (8,9). The Westernized diet has been identified as the leading dietary component contributing to this overall global nutrition transition (6). It has been characterized as a simultaneous increase in the consumption of refined sugars, animal fat, salt and red meats, and a decrease in the consumption of dietary fibre, fruits, vegetables, unrefined whole grains and unsaturated fatty acids which predisposes populations of developed countries to chronic diseases (10).

While there have been dietary transitions across developing countries including in the MENA region, with an unfavourable dietary trend towards a Westernized diet (9,11,12), there have been insufficient attempts to provide an integrative review of the published literature on the current dietary trends and transitions and their association with the prevalence of obesity in the MENA region. At the same time, there has been notable growth in the number of studies on the growing obesity crisis facing the MENA region. Addressing dietary trends to help reduce obesity and obesity-related mortality and morbidity is currently an important topic on the world health agenda (6,13) and a crucial factor in establishing public health nutrition priorities and interventions. Therefore the purpose of this paper was to identify the present dietary trends and transitions associated with obesity in Arabic-speaking countries through an integrative review of the literature. Such a review could lead to a better understanding of the current status of obesity research in this region and the type of future research needed.

For the purposes of this study, Arabic-speaking countries of the MENA region were included, namely: Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates, Yemen and Palestine.

Methods

An integrative review of the literature was carried out using a combination of the following search terms: obesity; diet; nutrition; transition; trend; shift and Algeria; Bahrain; Egypt; Iraq; Jordan; Kuwait; Lebanon; Libya; Mauritania; Morocco; Oman; Qatar; Saudi Arabia; Sudan; Syria; Tunisia; United Arab Emirates; Yemen; Palestinian Territories. Articles pertaining to the general populations were selected. Nine academic electronic databases were searched: PubMed, Scopus, ProQuest, EBSCOhost, SpringerLink, ArticleFirst, Taylor & Francis, Wiley Online, and ScienceDirect. Academic databases were selected because of their academic rigor, aim, biomedical scope and accessibility. At the same time, references from retrieved articles were reviewed to identify additional relevant publications.

Inclusion/exclusion criteria

The search was limited to articles published between January 1998 and January 2015 and English language publications. Inclusion criteria for potential articles included cross-sectional studies, literature reviews, meta-analysis, policy reports, analysis, or position statements. To be considered a potential article that provided evidence to address this review, the article's aim and scope had to address the relationship between diet, transition and obesity within the specified search parameters stated above. Non-peer reviewed publications, dissertations and grey literature were excluded from this review. Articles were categorized by study design, age group, article focus (nutrition, obesity, or both), dietary shift findings, correlational findings and geographic location; all age group categories were reported using the publication authors' criteria.

Results

The search processes identified 26 728 citations. After abstract and full text screening, 39 studies were considered relevant and were included in the review (Table 1). Table 1 summarizes the characteristics and results of the 39 studies. Twenty-eight of the articles were published within the last 10 years. Twenty-four focused on obesity, 13 on nutrition and 2 on both. Eleven papers included children 18 years and younger, 16 included adults 18 years and older and 12 included data from all population groups age 5 years and older. Further reduction and stratification of age groups using individual author definitions would have produced categories too small and inconsistent for statistically significant analyses. The sample included 21 cross-sectional studies, 6 literature reviews, 6 reports, 5 analysis papers and 1 position statement.

All articles noted a significant shift away from traditional dietary practices for their respective regions and countries. Nineteen of the studies observed a dietary shift away from a traditional diet and towards a Westernized diet, while, 20 showed a dietary shift away from traditional dietary practice but not towards a Westernized diet.

In 25 studies there were correlations between obesity and poor nutrition, in 16 there was decreased physical activity, 14 compared urban versus rural setting and 8 reported anecdotal findings such as cultural norms and snacking or additional meals. Age presented as a significant correlational finding in terms of obesity and a shift to a Westernized diet. Nine of 11 articles investigating children reported obesity and 7 found a positive shift towards a Westernized diet; 5 of these studies reported positive a correlation between obesity and a Westernized diet (Table 2). Twelve of the 16 articles on adults included obesity with 8 reporting a Westernized diet shift; 5 showed a correlation between obesity and a Westernized diet (Table

2). Among 12 articles that included children and adults, 5 reported obesity and 4 reported a Westernized diet shift; 2 found a correlation between obesity and Westernized diet (Table 2). All 19 publications that noted both a dietary shift and a Westernized diet shift found a positive correlation between the two.

Discussion

A large majority of articles focused on obesity as a static condition and not a causation or result. While 13 articles mentioned nutrition as a significant contributor, most focused on obesity as the primary issue. To describe incidence and prevalence of obesity in place of nutritional trends with strong correlations to obesity is somewhat out of date. As a result, our study could not assess nutrition as preventive or protective factors for overweight and obesity. Nutritional content represents a single element within a dietary shift; preparation and cooking methods, caloric intake, meal frequency, and portion size are variables not specifically or individually considered when discussing dietary shift.

Some recent articles highlight the current alarming levels of obesity and predictions for obesity in Arabic-speaking countries (14–16) and continue to indicate an unfavourable dietary trend towards a Westernized diet in the MENA (17,18). The Westernized diet was identified as a significant contributor to obesity in half of the articles included. In articles that identified a general dietary shift, correlations were noted between a Westernized diet and incidence and prevalence of obesity in the MENA region. The link between shifts from traditional regional dietary patterns towards a Westernized diet is remarkable within this sample of peer-reviewed articles. For example, Lebanon has experienced a transition from a typically Mediterranean style of diet towards convenience foods, particularly among young adults and adolescents

(19). A cross-sectional survey (20) in Morocco indicated that adherence to a Mediterranean diet has decreased with dietary patterns transitioning towards a Westernized diet pattern. Another cross-sectional study in Kuwait indicated that the Kuwaiti population was experiencing a dietary transition, evidenced by a high consumption of calorically dense foods that are low in total dietary fibre and micronutrient density (21). Recent studies indicate that consumption of fruits and vegetables among the Saudi population continues to fall below the WHO dietary recommendations (22,23). Within the context of these results there was a consistent relationship between a Westernized diet and overweight and obesity. These studies continue to support an urgent need to increase culturally congruent nutrition awareness for healthy food choices. Additionally, age also presented as a potentially significant factor for tailored nutrition interventions and further research.

The current trends in the United States reveal how the Westernized diet contributes to incidence and prevalence rates for overweight and obesity. Future research into dietary shifts in the MENA region associated with overweight and obesity could include predictive analysis that incorporates similar variables from developed countries where the Westernized diet is prevalent (e.g. United States, Northern Europe).

The articles included covered publications from 1998 to 2014 but the majority of articles were published in the last 10 years which may signify an increase in research on obesity in the MENA region. A historical review of the literature that predates electronic journals would likely reveal other relevant articles and could provide more historical insight into the trends in obesity and diet. Understanding the potential effects of a westernized diet with regard to overweight and obesity and utilizing the online publishing on investigational studies in the MENA region could

Table 1 Summary of literature search

Study (Year) (reference)	Study design	Age group ^a (years)	Nutrition (N) or Obesity (O) or Both (B)	Western diet (Yes/No)	Region/Country/Territory
Kilpi et al. (2014) (15)	Literature review	15+	O	Y	Bahrain, Egypt, Iran, Jordan, Kuwait, Lebanon, Oman, Saudi Arabia, Turkey
Tayyem et al. (2014) (34)	Cross-sectional	14-18	O	Y	Jordan
Ng et al. (2014) (35)	Literature review	Children & adults	O	N	MENA region
Al Nohair (2014) (16)	Report	18+	O	Y	Bahrain, Kuwait, Qatar, Oman, Saudi Arabia, Lebanon, UAE
Regaieg et al. (2014) (36)	Cross-sectional	9-12	O	N	Tunisia
Musaiger et al. (2014) (37)	Cross-sectional	15-18	O	Y	Bahrain
Al-Quwaidhi et al. (2014) (38)	Analysis	25-64	O	Y	Saudi Arabia
Zaghloul et al. (2013) (21)	Cross-sectional	Children & adults	N	Y	Kuwait
Boutayeb et al. (2013) (39)	Literature review	18+	O	N	Eastern Mediterranean Region
Musaiger et al. (2013) (17)	Cross-sectional	15-18	N	Y	Algeria, Jordan, Kuwait, Libya, Palestine, Syrian Arab Republic, UAE
Musaiger et al. (2013) (40)	Cross-sectional	5-18	O	N	Kuwait, Libya, Palestine, Syrian Arab Republic, UAE
El Rhazi et al. (2012) (20)	Cross-sectional	18+	N	Y	Morocco
Ramdani et al. (2012) (41)	Cross-sectional	40+	O	N	Morocco
Golzarand et al. (2012) (11)	Analysis	Children & adults	N	Y	MENA region
Elmehdawi & Albarsha (2012) (42)	Report	18+	O	Y	Libya
Nagwa et al. (2011) (43)	Cross-sectional	10-18	O	Y	Sudan
Ng et al. (2011) (44)	Cross-sectional	Children & adults	N	N	UAE
Badran & Laher (2011) (14)	Report	5-18	O	Y	MENA region
Musaiger (2011) (45)	Literature review	Children & adults	O	Y	Eastern Mediterranean Region
Al-Hazzaa et al. (2011) (18)	Cross-sectional	14-19	N	Y	Saudi Arabia
Saker et al. (2011) (46)	Cross-sectional	6-8	O	N	Algeria
Musaiger et al. (2011) (47)	Position Statement	Children & adults	O	Y	MENA region
Musaiger et al. (2011) (48)	Literature review	Children & adults	N	N	MENA region
Ng et al. (2011) (49)	Literature review	Children & adults	O	N	Bahrain, Kuwait, Qatar, Oman, Saudi Arabia, UAE
Yahia et al. (2008) (19)	Cross-sectional	18-24	B	Y	Lebanon
Zindah et al. (2008) (50)	Cross-sectional	18+	O	N	Jordan
Fouad et al. (2006) (57)	Cross-sectional	18+	O	N	Syrian Arab Republic
Al-Kandari (2006) (52)	Cross-sectional	20+	O	N	Kuwait
Lafta & Kadhim (2005) (53)	Cross-sectional	7-13	O	N	Iraq
Al-Lawati & Jousilahti (2004) (54)	Cross-sectional	18+	O	Y	Oman

Table 1 Summary of literature search (Concluded)

Study (Year) (reference)	Study design	Age group ^a (years)	Nutrition (N) or Obesity (O) or Both (B)	Western diet (Yes/No)	Region/Country/Territory
Abdul-Rahim et al. (2003) (55)	Cross-sectional	30+	O	N	Palestine
Galal (2003) (56)	Analysis	Children & adults	N	N	MENA region
Musaiger (2002) (57)	Report	18+	N	Y	MENA region
Benjelloun (2002) (58)	Analysis	Children & adults	N	N	Morocco
Galal (2002) (59)	Analysis	Children & adults	N	N	Egypt
Mokhtar et al. (2001) (60)	Cross-sectional	Children & adults	B	N	Tunisia, Morocco
Ba (2000) (67)	Cross-sectional	18+	O	N	Mauritania
Musaiger (1998) (62)	Report	18+	N	Y	Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, UAE
Miladi & Musaiger (1998) (63)	Report	18+	N	N	MENA region

^aChildren and adults refers to studies that included population-level review data.

All papers/studies reported a dietary shift away from traditional dietary practices and a correlation between the dietary shift and overweight/obesity.

MENA = Middle East and North Africa; UAE = United Arab Emirates.

expand on the results of this study. Finally, given that the time frame studied represents less than a single generation, retrospective longitudinal studies are warranted.

The recent peer-reviewed studies offer insight into the increase of obesity in the MENA region. The studies identified acknowledge that obesity is increasingly prevalent and problematic among MENA countries. There is a need add to obesity-related research in Arab countries where correlational factors are identified and prevention is discussed (24).

This review was limited to 9 electronic biomedical databases, additional databases could have added to the study in both complexity and sample size. Additionally, age groups described within individual articles overlapped; some child groups included ages 5 to 18 years while others used more narrow definitions. None of the age subgroups identified by individual sample publications occurred with enough frequency and consistency to allow for statistical analysis. Ideally, the research sample would include carefully defined groups for children, adolescents, young adults, adults,

and ageing adults, with consistent agreement, to reduce variance within groups. In addition, only sources published or made available in English were used for this study. Arabic, French and other language searches were excluded and therefore some relevant literature might have been missed.

Conclusion

Given that this study looked at obesity and not prevention, further effort needs to be made by Arabic-speaking

Table 2 Number of studies showing obesity prevalence and dietary shift in different age groups

Age group ^a	Obesity prevalent with dietary shift	Westernized diet shift	Significant correlation	Region/Country/Territory with significant correlation
Children (n = 11)	9	7	5	Bahrain, Egypt, Islamic Republic of Iran, Jordan, Kuwait, Lebanon, Oman, Saudi Arabia, Sudan and Turkey
Adults (n = 16)	12	8	5	Bahrain, Kuwait, Qatar, Oman, Saudi Arabia, Lebanon, Libya, and United Arab Emirates
Children and adults (n = 12)	5	4	2	Middle East and North Africa region

^aChildren = 5-18 years; adults = 18 years and older, children and adults include all age ranges.

countries to reduce obesity with special consideration given to preventive proposals and dietary interventions. A potential next phase is to concentrate research efforts on developing public health dietary strategies, interventions, and guidelines that are both age- and culturally-relevant to this region. A recently published recommendation by Musaiger offered a unique culturally compatible dietary guideline, the Arab Food Dome, designed for Arab countries with food groups common to the Mediterranean diet and specific to the MENA region (25,26). Similar to the Arab Food Dome, the Saudi Ministry of Health has published dietary guidelines, the Healthy Food Palm, based on the US Food and Drug Administration

dietary guidelines for Americans but applicable for the Saudi population (27). The WHO Regional Office published a new dietary guideline and recommendations for an overall healthy pattern of eating that can be adopted among Arab countries (28). It is compatible with the various cultures and eating patterns within the populations of the region and is based on the availability of local foods traditionally consumed.

Traditionally, the Mediterranean region has protected against overweight, obesity and their co-morbidities by its well documented and culture-specific dietary patterns (29–31). However, as developing countries shift from traditional dietary patterns to adopt Westernized diet patterns, public

health professionals, nutritionists and dietitians and health educators should expect some predictable outcomes (32). Preventing these shifts is unlikely (9,10,33) and acknowledging the potential and expected outcomes should be a priority. The Healthy Food Palm Guide, The Arab Food Dome, dietary guidelines of the WHO Regional Office, education on preparation of traditional healthy foods and eating habits, public health promotion of indigenous foods and culturally relevant dietary habits are important therefore to help reduce the risk of obesity within Arabic-speaking populations.

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References

- Boutayeb A. The double burden of communicable and non-communicable diseases in developing countries. *Trans R Soc Trop Med Hyg.* 2006 Mar;100(3):191–9. PMID:16274715
- Obesity and overweight. WHO Fact sheet, Updated June 2016 (<http://www.who.int/mediacentre/factsheets/fs311/en/>, accessed 2 October 2016)
- Rahim HF, Sibai A, Khader Y, Hwalla N, Fadhil I, Alsiyabi H, et al. Non-communicable diseases in the Arab world. *Lancet.* 2014 Jan 25;383(9914):356–67. PMID:24452044
- Global Health Observatory data repository. Mean body mass index trends (age-standardized estimate). Data by WHO region [webpage] (<http://apps.who.int/gho/data/view.main.REGION12461?lang=en>, accessed 12 September 2016).
- World Health Organization. Eastern Mediterranean Regional Office. Obesity. (<http://www.emro.who.int/health-topics/obesity/>, accessed 30 September, 2016).
- Popkin BM. Nutritional Patterns and Transitions. *Popul Dev Rev.* 1993;19(1):138–57 (https://www.jstor.org/stable/2938388?seq=1#page_scan_tab_contents, accessed 2 October 2016).
- Caballero B, Popkin BM. The nutrition transition: Diet and disease in the developing world. San Diego (CA): Academic Press; 2002.
- Popkin BM, Adair LS, Ng SW. Global nutrition transition and the pandemic of obesity in developing countries. *Nutr Rev.* 2012 Jan;70(1):3–21. PMID:22221213
- Popkin BM, Slining MM. New dynamics in global obesity facing low- and middle-income countries. *Obes Rev.* 2013 Nov;14 Suppl 2:11–20. PMID:24102717
- Cordain L, Eaton SB, Sebastian A, Mann N, Lindeberg S, Watkins BA, et al. Origins and evolution of the Western diet: health implications for the 21st century. *Am J Clin Nutr.* 2005 Feb;81(2):341–54. PMID:15699220
- Golzarand M, Mirmiran P, Jessri M, Toolabi K, Mojarrad M, Azizi F. Dietary trends in the Middle East and North Africa: an ecological study (1961 to 2007). *Public Health Nutr.* 2012 Oct;15(10):1835–44. PMID:22317906
- Nasreddine L, Mehio-Sibai A, Mrayati M, Adra N, Hwalla N. Adolescent obesity in Syria: prevalence and associated factors. *Child Care Health Dev.* 2010 May;36(3):404–13. PMID:19961497
- World Health Organization. Global strategy on diet, physical activity and health. (<http://www.who.int/dietphysicalactivity/en/>, accessed 30 September, 2016).
- Badran M, Laher I. Obesity in Arabic-speaking countries. *J Obes.* 2011;2011: 686430. PMID:22175002
- Kilpi F, Webber L, Musaiger A, Aitsi-Selmi A, Marsh T, Rteveladze K, et al. Alarming predictions for obesity and non-communicable diseases in the Middle East. *Public Health Nutr.* 2014 May;17(5):1078–86. PMID:23642403
- Al Nohair S. Obesity in gulf countries. *Int J Health Sci (Qassim).* 2014 Jan;8(1):79–83. PMID:24899882
- Musaiger AO, Al-Mannai M, Tayyem R, et al. Perceived barriers to healthy eating and physical activity among adolescents in seven Arab countries: a cross-cultural study. *Scientific World Journal.* 2013;2013:1–11.
- Al-Hazzaa HM, Abahussain NA, Al-Sobayel HI, Qahwaji DM, Musaiger AO. Physical activity, sedentary behaviors and dietary habits among Saudi adolescents relative to age, gender and region. *Int J Behav Nutr Phys Act.* 2011 12 21;8(140):140. PMID:22188825
- Yahia N, Achkar A, Abdallah A, Rizk S. Eating habits and obesity among Lebanese university students. *Nutr J.* 2008 10 30;7:32. PMID:18973661
- El Rhazi K, Nejari C, Romaguera D, Feart C, Obtel M, Zidouh A, et al. Adherence to a Mediterranean diet in Morocco and its correlates: cross-sectional analysis of a sample of the adult Moroccan population. *BMC Public Health.* 2012 05 11;12:345. PMID:22578133
- Zaghloul S, Al-Hooti SN, Al-Hamad N, Al-Zenki S, Alomirah H, Alayan I, et al. Evidence for nutrition transition in Kuwait: over-consumption of macronutrients and obesity. *Public Health Nutr.* 2013 Apr;16(4):596–607. PMID:22974508

22. El Bcheraoui C, Basulaiman M, AlMazroa MA, Tuffaha M, Daoud F, Wilson S, et al. Fruit and vegetable consumption among adults in Saudi Arabia, 2013. *Nutr Diet Suppl.* 2015;7:41-9.
23. Alsunni AA, Badar A. Fruit and vegetable consumption and its determinants among Saudi university students. *J Taibah Univ Med Sci.* 2015;10(2):201-7.
24. Sweileh WM, Zyoud SH, Al-Jabi SW, Sawalha AF. Quantity and quality of obesity-related research in Arab countries: assessment and comparative analysis. *Health Res Policy Syst.* 2014 07 08;12:33. PMID:25005130
25. Musaiger AO; Arab Centers for Nutrition. The Food Dome: dietary guidelines for Arab countries. *Nutr Hosp.* 2012 Jan-Feb;27(1):109-15. PMID:22566309
26. Musaiger AO, Takruri HR, Hassan AS, Abu-Tarboush H. Food-based dietary guidelines for the Arab Gulf countries. *J Nutr Metab.* 2012;2012:905303. PMID:22347625
27. Saudi Ministry of Health General Directorate of Nutrition. Dietary Guidelines for Saudis - The Healthy Food Palm. 2012; (<http://www.moh.gov.sa/en/depts/Nutrition/Pages/Palm-food.aspx>, accessed 2 October 2016)
28. Promoting a healthy diet for the WHO Eastern Mediterranean Region: User-friendly guide. Cairo: WHO Regional Office for the Eastern Mediterranean 2012 (http://www.who.int/nutrition/publications/nutrientrequirements/healthydiet-guide2012_emro/en/, accessed 30 September, 2016).
29. Vasto S, Barera A, Rizzo C, Di Carlo M, Caruso C, Panotopoulos G. Mediterranean diet and longevity: an example of nutraceuticals? *Curr Vasc Pharmacol.* 2014;12(5):735-8. PMID:24350926
30. Vasto S, Scapagnini G, Rizzo C, Monastero R, Marchese A, Caruso C. Mediterranean diet and longevity in Sicily: survey in a Sicani Mountains population. *Rejuvenation Res.* 2012 Apr;15(2):184-8. PMID:22533429
31. Vasto S, Buscemi S, Barera A, Di Carlo M, Accardi G, Caruso C. Mediterranean diet and healthy ageing: a Sicilian perspective. *Gerontology.* 2014;60(6):508-18. PMID:25170545
32. Danaei G, Singh GM, Paciorek CJ, Lin JK, Cowan MJ, Finucane MM, et al. The global cardiovascular risk transition: associations of four metabolic risk factors with national income, urbanization, and Western diet in 1980 and 2008. *Circulation.* 2013;127(14):1493-502, 502e 1-8. PMID:23481623
33. Popkin BM. Global changes in diet and activity patterns as drivers of the nutrition transition. *Nestle Nutr Workshop Ser Pediatr Program.* 2009;63:1-10; discussion 10-4, 259-68. PMID:19346763
34. Tayyem RF, Al-Hazzaa HM, Abu-Mweis SS, Bawadi HA, Qatatsheh A, Musaiger AO. Association of lifestyle factors with obesity indices among adolescents in Amman, Jordan. *Malays J Nutr.* 2014;20(1):51-62.
35. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet.* 2014 Aug 30;384(9945):766-81. PMID:24880830
36. Regaieg S, Charfi N, Trabelsi L, Kamoun M, Feki H, Yaich S, et al. [Prevalence and risk factors of overweight and obesity in a population of school children in urban areas Sfax, Tunisia]. *Pan Afr Med J.* 2014 01 25;17:57. PMID:25018807
37. Musaiger AO, Al-Roomi K, Bader Z. Social, dietary and lifestyle factors associated with obesity among Bahraini adolescents. *Appetite.* 2014 Feb;73:197-204. PMID:24231426
38. Al-Quwaidhi AJ, Pearce MS, Critchley JA, Sobngwi E, O'Flaherty M. Trends and future projections of the prevalence of adult obesity in Saudi Arabia, 1992-2022. *East Mediterr Health J.* 2014 10 20;20(10):589-95. PMID:25356689
39. Boutayeb A, Boutayeb S, Boutayeb W. Multi-morbidity of noncommunicable diseases and equity in WHO Eastern Mediterranean countries. *Int J Equity Health.* 2013 08 20;12:60. PMID:23961989
40. Musaiger AO, Al-Mannai M, Al-Lalla O, Saghir S, Halahleh I, Benhamed MM, et al. Obesity among adolescents in five Arab countries; relative to gender and age. *Nutr Hosp.* 2013 11 01;28(6):1922-5. PMID:24506370
41. Ramdani N, Vanderpas J, Boutayeb A, Meziane A, Hassani B, Zoheir J, et al. Diabetes and obesity in the eastern Morocco. *Mediterranean Journal of Nutrition and Metabolism.* 2012;5(2):149-55.
42. Elmehdawi RR, Albarsha AM. Obesity in Libya: a review. *Libyan J Med.* 2012;7:7. PMID:22899968
43. Nagwa MA, Elhussein AM, Azza M, Abdulhadi NH. Alarming high prevalence of overweight/obesity among Sudanese children. *Eur J Clin Nutr.* 2011 Mar;65(3):409-11. PMID:21063434
44. Ng SW, Zaghoul S, Ali H, Harrison G, Yeatts K, El Sadig M, et al. Nutrition transition in the United Arab Emirates. *Eur J Clin Nutr.* 2011 Dec;65(12):1328-37. PMID:21772317
45. Musaiger AO. Overweight and obesity in Eastern Mediterranean Region: prevalence and possible causes. *J Obes.* 2011;2011:407237. PMID:21941635
46. Saker M, Merzouk H, Merzouk SA, Ahmed SB, Narce M. Predictive Factors of Obesity and their Relationships to Dietary Intake in Schoolchildren in Western Algeria. *Maedica (Buchar).* 2011 Apr;6(2):90-9. PMID:22205890
47. Musaiger AO, Al Hazzaa HM, Al-Qahtani A, Elati J, Ramadan J, Aboulella NA, et al. Strategy to combat obesity and to promote physical activity in Arab countries. *Diabetes Metab Syndr Obes.* 2011;4:89-97. PMID:21660292
48. Musaiger AO, Hassan AS, Obeid O. The paradox of nutrition-related diseases in the Arab countries: the need for action. *Int J Environ Res Public Health.* 2011 Sep;8(9):3637-71. PMID:22016708
49. Ng SW, Zaghoul S, Ali HI, Harrison G, Popkin BM. The prevalence and trends of overweight, obesity and nutrition-related non-communicable diseases in the Arabian Gulf States. *Obes Rev.* 2011 Jan;12(1):1-13. PMID:20546144
50. Zindah M, Belbeisi A, Walke H, Mokdad AH. Obesity and diabetes in Jordan: findings from the behavioral risk factor surveillance system, 2004. *Prev Chronic Dis.* 2008 Jan;5(1):A17. PMID:18082006
51. Fouad M, Rastam S, Ward K, Maziak W. Prevalence of obesity and its associated factors in Aleppo, Syria. *Prev Control.* 2006 Jun;2(2):85-94. PMID:18040524
52. Al-Kandari YY. Prevalence of obesity in Kuwait and its relation to sociocultural variables. *Obes Rev.* 2006 May;7(2):147-54. PMID:16629871
53. Lafta RK, Kadhim MJ. Childhood obesity in Iraq: prevalence and possible risk factors. *Ann Saudi Med.* 2005 Sep-Oct;25(5):389-93. PMID:16270761
54. Al-Lawati JA, Jousilahti PJ. Prevalence and 10-year secular trend of obesity in Oman. *Saudi Med J.* 2004 Mar;25(3):346-51. PMID:15048174
55. Abdul-Rahim HF, Holmboe-Ottesen G, Stene LCM, Husseini A, Giacaman R, Jervell J, et al. Obesity in a rural and an urban Palestinian West Bank population. *Int J Obes Relat Metab Disord.* 2003 Jan;27(1):140-6. PMID:12532166
56. Galal O. Nutrition-related health patterns in the Middle East. *Asia Pac J Clin Nutr.* 2003;12(3):337-43. PMID:14505998
57. Musaiger AO. Diet and prevention of coronary heart disease in the Arab Middle East countries. *Med Princ Pract.* 2002;11 Suppl 2:9-16. PMID:12444306

58. Benjelloun S. Nutrition transition in Morocco. *Public Health Nutr.* 2002;5(1 A):135-40. PMID:12027276
59. Galal OM. The nutrition transition in Egypt: Obesity, undernutrition and the food consumption context. *Public Health Nutr.* 2002;5(1 A):141-8. PMID:12027277
60. Mokhtar N, Elati J, Chabir R, Bour A, Elkari K, Schlossman NP, et al. Diet culture and obesity in northern Africa. *J Nutr.* 2001 Mar;131(3):887S-92S. PMID:11238780
61. Ba ML. Obésité en Mauritanie: aspects épidémiologiques [Obesity in Mauritania: epidemiologic aspects]. *Tunis Med.* 2000 Nov;78(11):671-6. PMID:11155392
62. Musaiger AO. Change in dietary habits, lifestyle and trend in diseases in the GCC countries. *Bahrain Med Bull.* 1998;20(3):87-90.
63. Miladi SS, Musaiger AO. Food consumption patterns and nutrition situation in the Arab countries. *Bahrain Med Bull.* 1998;20(3):83-6.