Prevalence and predictors of non-fatal myocardial infarction in Jordan

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معدل انتشار احتشاء عضل القلب غير المميت ونُذُر وقوعه في الأردن

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الخلاصة: أجريت هذه الدراسة في أيار/مايو 2002 كجزء من المسح المستعرض المتعدد المراحل الذي قامت به الإدارة الأردنية للإحصاء حول البطالة والعمل؛ وذلك لقياس معدل انتشار الإبلاغ الذاتي عن احتشاء عضل القلب وترافقه بعوامل اختطار يمكن تصحيحها لدى الأردنيين ممن بلغوا سن الأربعين فأكثر. وقد شملت الدراسة 3083 مشتركاً، أُخبرَ 183 (5.9٪) منهم من قِبَل طبيب ما أنه مصاب باحتشاء عضل القلب. وقد اختلف معدل الانتشار باختلاف الجنس والعمر، فقد كان 128 من المصابين (69.9٪) من الرجال. وفي كل من الرجال والنساء كان الإبلاغ الذاتي عن ارتفاع ضغط الدم وفرط كوليستيرول الدم مترابطاً بشكل يُعتَدُّ به إحصائياً مع احتشاء عضل القلب، كما كان السكري من عوامل الاختطار التي يُعْتَدُّ بها إحصائياً لإصابة النساء باحتشاء عضل القلب. وكان هناك ترابط يُعْتَدُّ به إحصائياً بين التدخين الحالي وبين الإصابة باحتشاء عضل القلب، ولكن ليس للتدخين قبل الإصابة. ولم تكن التمارين الرياضية ولا منسب كتلة الجسم MI من النذر التي يُعْتَدُّ بها إحصائياً بوقوع احتشاء عضل القلب لدى أي من الذكور أو الإناث.

ABSTRACT This study in May 2002, part of the Jordan Department of Statistics national cross-sectional, multistage employment and unemployment survey, measured the prevalence of self-reported myocardial infarction (MI) and the association with modifiable risk factors among Jordanians aged 40+ years. Of 3083 participants, 183 (5.9%) had ever been told by a doctor that they had had a MI. The prevalence varied by age and sex; 128 (69.9%) of the cases were in men. Among males and females, self-reported hypertension and hypercholesterolaemia were significantly associated with MI and diabetes was a significant risk factor for women. There was a significant relationship between current smoking and MI but not with previous smoking. Exercise and body mass index were not statistically significant predictors of MI in both males and females.

Prévalence et facteurs prédictifs de l'infarctus du myocarde non mortel en Jordanie
RÉSUMÉ Cette étude, réalisée en mai 2002 dans le cadre de l'enquête nationale transversale à plusieurs degrés sur l'emploi et le chômage menée par le Département des Statistiques jordanien, a mesuré la prévalence de l'infarctus du myocarde (IDM) autodéclaré et son association à des facteurs de risque modifiables chez des sujets jordaniens âgés de 40 ans et plus. Sur 3083 participants, 183 (5,9 %) savaient, l'ayant appris d'un médecin, qu'ils avaient eu un IDM. La prévalence variait en fonction de l'âge et du sexe ; 128 (69,9 %) de ces cas étaient des hommes. Parmi les hommes et les femmes, l'hypertension et l'hypercholestérolémie autodéclarées étaient significativement associées à l'IDM et le diabète était un facteur de risque significatif chez les femmes. Il existait une relation significative entre le tabagisme au moment de l'étude et l'IDM, mais pas avec un tabagisme antérieur. L'exercice physique et l'indice de masse corporelle n'étaient pas des facteurs prédictifs d'IDM statistiquement significatifs chez les hommes et chez les femmes.

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Introduction

Cardiovascular disease (CVD) is considered the most common cause of death for both males and females worldwide [*1,2*]. Coronary artery disease (CAD) and stroke are the major contributors [*3*]. Myocardial infarction (MI) is the most common lethal manifestation of CAD [*4*].

Jordan, a middle-income country with an estimated population of 5 million [*5*], is experiencing an epidemiological transition where infectious diseases are declining and chronic diseases are becoming more predominant. At the same time, life expectancy continues to increase, reaching 71 years for females and 69 for males according to the latest estimates [*5*]. A sedentary lifestyle, high-fat diet and smoking are becoming more common.

As in other developing countries in the Eastern Mediterranean Region (EMR) and elsewhere, [*1–3*], CVD is a major cause of death in Jordan, responsible for 35% of deaths [*6*]. Due to the tremendous impact of CVD on public health and the escalating cost of health care, strategies for prevention are becoming increasingly important and there is an urgent need to understand which risk factors to target in health prevention campaigns for MI.

In Jordan to our knowledge there have been a number of studies detailing the prevalence of risk factors for CVD but no studies looking at the importance of the association between each risk factor and nonfatal MI. Like other countries in the EMR, limited disease registries and low quality of records affect the availability of morbidity statistics in Jordan. Analysis of the data set we used for this study has shown the prevalence of different risk factors for noncommunicable diseases in Jordan and has already been published [*7*].

The aims of the present study were to examine the prevalence of self-reported nonfatal MI in Jordanian people aged 40 years and over; to determine the association between MI and various modifiable risk factors; and to determine if this association varies by sex.

Methods

Sample

The study was a cross-sectional survey of the Jordanian population at the national level. During the month of May 2002 the Ministry of Health, in cooperation with the Jordan Department of Statistics (the organization responsible of carrying out national surveys in Jordan), added 28 questions about behavioural risk factors of noncommunicable diseases to the Jordan Department of Statistics multistage employment and unemployment survey. This survey takes place quarterly and provides a comprehensive database on employment and unemployment in Jordan that serves researchers and policy-makers.

The sampling frame was representative nationally and stratified by region, governorate, major city, urban (localities with a population of 5000 or more) and rural areas. Within each stratum, sample blocks (a group of buildings that form a locality or part of it, with clear natural or man-made boundaries) were selected systematically with probability proportional to size. The sample households were selected using a systematic random procedure. The frame excluded persons living in remote areas, the majority of whom are nomads, and those living in collective dwellings (e.g. hotels, hospitals, work camps and prisons). In addition, the survey excluded the non-Jordanian population, because many non-

Jordanian workers live in small clusters and spend most of their time in work places; hence it is difficult to locate them during the daytime. From each sampled household, 1 respondent aged 18+ years was selected and interviewed directly. All reported estimates were weighted to account for the sample design and were further adjusted for the interview response rate.

The population localities in each of the 12 governorates were divided into urban and rural (except the 5 major cities, each of which formed an independent stratum), en-ding up with 29 strata. The sample size for the present survey consisted of 664 blocks, from each of which 15 households were selected using a systematic random procedure.

The results of the main fieldwork indicated that all of the 9960 sampled households were visited and 9541 interviews were successfully completed, i.e. 95.8% of the total sampled households. The main reasons for failure to complete the interview were: closed dwellings at the time of the visit (2.7%), and unavailability of an eligible respondent or refusal of the household to respond (0.6%). The response rate, based on dividing the number of completed interviews (i.e. excluding both the closed and vacant dwellings) by the number of expected completed interviews, was 99.0% and when excluding the vacant dwellings only, the response rate dropped to 96.3%.

Questionnaire

The questionnaire was designed and revised by technical staff. It was finalized on completion of the training programme. Before being fielded, the questionnaires were serially numbered at the national level. The questionnaire was divided into main topics, each containing a clear and consistent group of questions, and designed in a way that facilitated data entry and verification. Health-related questions focused on medical conditions: MI, bronchial asthma, diabetes, hypertension, hypercholesterolaemia and behaviours that related to noncommunicable diseases, e.g. obesity, smoking and physical inactivity.

Study variables

The data that were analysed for this project were from respondents aged 40+ years. Respondents were asked whether they were ever told by a health professional that they had had a MI, the main variable of interest.

The main predictors explored for MI were sociodemographic, health-related and behavioural risk factors. The sociodemographic variables were age, sex, region, urban/rural, educational level and marital status. Age and educational level (years of education) were continuous variables. The health-related variables, in addition to a subjective health evaluation, were self-reported hypertension, hypercholesterolaemia and diabetes mellitus. These 3 variables were based on whether or not the subject was told by a health professional about the presence of any of these risk factors. Gestational diabetes was excluded from the analysis. The behavioural risk factors were smoking, obesity and physical activity. Smokers were asked whether they smoked every day, some days, or not all. Those who smoked every day were asked "on average when you were smoking in the last 30 days, how many cigarettes did you smoke every day?" Smokers were classified as ever smokers (i.e. ever smoked $\geq$ 100 cigarettes during their life time) or nonsmokers (i.e. never smoked 100 cigarettes during their lifetime). For further analysis, the number of smoked cigarettes per day was transformed into number of packets per day (20 cigarettes per packet). Questions on self-reported height

and weight were included, and body mass index (BMI) (ratio of weight in kilograms to height in metres squared [kg/m^2]) was calculated. Overweight was classified as BMI 25.0–29.9 kg/m^2 and obesity as BMI ≥ 30 kg/m^2 [*7*]. Interviewees were asked whether they engaged in weekly moderate physical activity. Moderate activity was defined as any activity that caused light sweating and small increases in heart rate or breathing for 30 minutes [*7*].

Statistical analysis

All analyses were performed using *STATA-7* software. Unadjusted and adjusted odds ratios (OR) were calculated, with 95% confidence intervals for the adjusted OR (95% CI), to assess the likelihood of MI across variables related to sociodemographic, health and behavioural risk factors. Adjusted ORs were calculated using logistic regression analysis to determine the net effect of each of the different variables on the outcome variable (MI). Logistic regression analyses were also done for both males and females.

Ethical issues

The data are being used with the consent of the Director of the Health Disease Control and Prevention Unit at the Jordanian Ministry of Health.

Results

The study included 3083 participants aged 40+ years, of whom 183 (5.9%) had been ever told by a doctor that they had a MI. This paper investigates the prevalence of MI among respondents and studies its relationship with sociodemographic, behavioural and health-related characteristics both at the bivariate and multivariate levels.

Bivariate results

Sociodemographic associations

Table 1 shows the different sociodemographic, behavioural and health-related variables according to MI status. The prevalence of MI was markedly different by sex; 128 (69.9%) cases were in men compared with 55 (30.1%) in women (OR = 2.30, 95% CI: 1.65–3.15; $P < 0.0001$).

The mean age of the participants without MI was 53.3 [standard deviation (SD) 11.3] years, while for MI cases the mean was 60.3 (SD 11.0) years. However, the mean age of male cases was 59.0 (SD 11.4) years and that of female cases was 63.3 (SD 9.4) years. Without stratifying by sex, age increased the risk of having a MI; with each increase of 10 years in age, the odds of having MI among cases ratio becomes 1.63.

The distribution of MI cases across marital status showed that 86.9% of the cases were married compared with 85.1% of the non-cases. Marital status was not significantly associated with MI.

The geographical distribution of the cases showed that just over half the cases lived in the middle region of the country compared to approximately 48% of non-cases. In addition, approximately three-quarters of the cases lived in urban areas, regardless of the region. The region of residence and the rural–urban distribution were not significantly associated with MI.

Only 52 (28.4%) cases out of 183 reported their family level of income. The majority of cases and non-cases (44.0% and 40.5%) had a family income of 100–199 Jordanian dinars (JD) per month. Level of income was not significantly associated with MI.

Years of education was a significant protective predictor of MI (OR = 0.95, 95% CI: 0.91–0.99; $P = 0.037$). As the number of years of education increased, the odds of having MI decreased. With each increase

Table 1 **Sociodemographic, behavioural and health-related factors by self-reported myocardial infarction status**

Variable	Myocardial infarction[a]				OR (95% CI)	*P*-value
	Yes (*n* = 183)		No (*n* = 2900)			
	No.	%[b]	No.	%[b]		
Sex						
Female	55	30.1	1435	49.5	1	
Male	128	69.9	1465	50.5	2.30 (1.65–3.15)	< 0.0001
Mean (SD) age (years)	60.3 (11.0)		53.3 (11.3)		1.05 (1.03–1.06)	< 0.0001
Marital status						
Unmarried	24	13.1	432	14.9	1	
Married	159	86.9	2468	85.1	1.16 (0.75–1.80)	0.511
Region						
North	53	29.0	850	29.3	1	
Middle	92	50.3	1387	47.8	1.06 (0.75–1.51)	0.728
South	38	20.7	663	22.9	0.92 (0.60–1.41)	0.700
Urban–rural						
Rural	44	24.0	804	27.7	1	
Urban	139	76.0	2096	72.3	1.20 (0.86–1.71)	0.280
Mean (SD) length of education (years)	8.82 (4.12)		9.69 (4.34)		0.95 (0.91–0.99)	0.037
Income						
< 100 JD	7	13.5	94	9.6	1	
100–199 JD	22	44.0	398	40.5	0.74 (0.31–1.79)	0.507
200–299 JD	12	23.1	290	29.5	0.56 (0.21–1.45)	0.231
≥ 300 JD	11	21.1	200	20.4	0.73 (0.28–1.96)	0.537
Smoking						
No	105	57.4	1565	54.0	1	
Yes	78	42.6	1333	46.0	0.87 (0.64–1.20)	0.375
Exercise						
No	131	71.6	1679	58.2	1	
Yes	52	28.4	1279	41.8	0.55 (0.40–0.77)	< 0.0001
Mean (SD) BMI (kg/m²)	27.10 (4.59)		27.80 (4.81)		1.03 (0.99–1.07)	0.084
Hypertension						
No	43	25.9	1525	66.4	1	
Yes	123	74.1	770	33.6	5.70 (3.96–8.10)	< 0.0001
Diabetes						
No	117	63.9	2501	86.5	1	
Yes	66	36.1	391	13.5	3.60 (2.62–4.96)	< 0.0001
Cholesterol						
No	39	41.9	490	71.2	1	
Yes	54	58.1	198	28.8	3.40 (2.19–5.34)	< 0.0001

[a] *Data missing for some variables.*
[b] *Except where indicated.*
SD = standard deviation; OR = odds ratio; CI = confidence interval; BMI = body mass index.

of 10 years in education the odds ratio of having MI became 0.6.

Behavioural characteristics

After calculating the BMI according to the self-reported weight and height, the proportion of overweight people in the sample was 31%. The mean BMI was 27.3 (SD 4.7) kg/m^2 and 28.4 (SD 5.2) kg/m^2 for males and females respectively. BMI was not statistically significantly correlated with MI (OR = 1.03, 95% CI: 0.99–1.07; $P = 0.084$).

The proportion of MI cases who were smokers (ever smoked < 100 cigarettes versus ≥ 100 cigarettes) was 42.6%. This variable was not significantly associated with MI (OR = 0.87, 95% CI: 0.64–1.20; $P = 0.375$). However, if we considered the current smoking status based on the number of packets smoked, we found that the number of cigarettes smoked daily was significantly related to MI ($P < 0.0001$). With increasing number of packets, the association with MI increased. People who smoked < 1 packet were 1.4 times more likely to be have MI compared with nonsmokers. Those who smoked 1–2 packets were 1.7 times more likely to have MI than nonsmokers. A smoker of > 2 packets was 4.5 times more likely to be associated with MI compared with nonsmokers. It is worth noting that more than three-quarters of those who were current smokers were males.

Out of all the MI cases, 52 (28.4%) did at least 20 minutes of moderate physical activity in any day of the week and 131 (71.6%) did not exercise. Three-quarters of those who exercised were males (39 cases) and one-quarter (13 cases) were females. Physical activity was significantly negatively associated with MI ($P < 0.0001$). Those who did moderate exercise were 45% less likely to be associated with MI compared to those who did not (OR = 0.55, 95% CI: 0.40–0.77) ($P < 0.0001$).

Health-related characteristics

Out of all 183 MI cases, 144 (78.7%) had their blood pressure checked within the previous 6 months, irrespective of whether they were hypertensive or not (data not shown). Out of the 166 MI cases who knew their hypertension status, 123 (74.1%) reported that a health professional had told them that they had high blood pressure, and 108 (65.1%) had been told more than once that they had hypertension. Of the 123 patients who had been told they had hypertension and who reported MI, 108 (87.8%) were taking antihypertensive medication (data not shown). Participants who reported being told that they had hypertension were 5.7 times more likely to have had a MI than those who were not told this (OR = 5.70, 95% CI: 3.96–8.10; $P < 0.0001$). Among MI patients who had high blood pressure, participants who took antihypertensive medication were 71% less likely (OR = 0.29, 95% CI: 0.13–0.53; $P < 0.0001$) to have MI compared to those who were not taking medication (data not shown).

A total of 66 MI cases reported they had diabetes, defined as ever having been told by a health professional or a laboratory technician that they had high blood glucose. Self-reported diabetes was significantly associated with having had a MI, with a 3.6-fold increased risk (OR = 3.60, 95% CI: 2.62–4.96; $P < 0.0001$). Of the diabetes cases, 60 people (91.9%) had checked their glucose level. Out of all MI cases, 117 (63.9%) had never been told by a health professional that they had diabetes, of which 85 (72.6%) were males (data not shown). Among MI patients, female diabetics were 3.4 times more likely to have MI compared

with diabetic males (OR = 3.4, 95% CI: 2.58–4.83; $P < 0.0001$).

There were 54 MI cases who reported they had high cholesterol, defined as ever having been told by a health professional or a laboratory technician that they had high blood cholesterol. Self-reported hypercholesterolaemia was significantly associated with MI, with a 3.4-fold increased risk (OR = 3.40, 95% CI: 2.19–5.34; $P < 0.0001$). Of the 183 MI cases, 80 (43.7%) had had their blood cholesterol level checked within the previous year, irrespective of whether they had high blood cholesterol. Of the 96 MI cases who had their blood cholesterol checked, 54 (58.1%) had been told they had high cholesterol.

Multivariate results

Table 2 shows the results of logistic regression analysis of the associations between MI and sociodemographic, behavioural and health-related variables for the overall sample. Although BMI and previous history of smoking were not statistically significant predictors of MI, they were included in the multivariate model in order to control for their effects on the other predictors. The logistic regression results showed that years of education, self-reported hypertension diagnosis and self-reported hypercholesterolaemia diagnosis were significantly associated with MI. On the other hand, self-reported diabetes diagnosis, BMI, smoking and physical exercise were not.

The interaction between sex and age was significant ($P = 0.041$) and hence stratification by sex was done for further analysis. For males, the logistic regression results showed that length of education, self-reported hypertension and self-reported hypercholesterolaemia were statistically significant, while age, self-reported diabetes, smoking, BMI and exercise were not (Table 3). However, the results of logistic regression among females showed that age and education and self-reported hypertension, hypercholesterolaemia and diabetes were statistically significant variables (Table 4).

Discriminant analysis for the overall model showed that the sensitivity and specificity were 76.4% and 75.8% respectively, using the cut-off point 0.066. The area under the receiver operating characteristic (ROC) curve of the model

Table 2 **Logistic regression of the associations between self-reported myocardial infarction and sociodemographic, behavioral, and health-related variables**

Variable	Adjusted OR (95%CI)	*P*-value
Sex		
Female	1	
Male	0.002 (0.010–0.128)	0.011
Age	1.02 (0.98–1.06)	0.242
Length of education	0.88 (0.84–0.98)	< 0.0001
Smoking		
No	1	
Yes	0.70 (0.97–1.09)	0.225
Exercise		
No	1	
Yes	0.73 (0.40–0.77)	0.268
BMI	0.98 (0.99–1.07)	0.554
Hypertension		
No	1	
Yes	2.80 (1.86–7.21)	< 0.0001
Diabetes		
No	1	
Yes	2.4 (0.65–1.65)	0.887
Cholesterol		
No	1	
Yes	4.50 (0.28–0.64)	< 0.0001
*Age*Sex*	1.13 (1.06–1.18)	0.041

SD = standard deviation; OR = odds ratio; CI = confidence interval; BMI = body mass index.

was 83.0% (Table 5). For the male model, using the cut-off point 0.076, sensitivity and specificity were 72.1% and 77.8% respectively; the area under the ROC curve was 82.0%. For the female model, sensitivity and specificity were 76.0% and 80.0% respectively using the cut-off point of 0.056 (Table 5).

Discussion

Pooled data from different studies suggest that about 4% of men and 2% of women have had a MI at some time in their lives [*8*]. Age and sex have been demonstrated to be associated with the risk of MI risk factors [*8*] and males are more likely to suffer from MI than females [*9*]. Many hypotheses have been proposed to explain this finding but the underlying reasons are still controversial [*10*]. Biological, social, and behavioural determinants could partially explain this sex difference [*11–13*]. Many studies have shown that MI and its complications occur about 10 years later in females than males [*14,15*].

There is a causal relationship between hypertension and CVD with a relative risk of 3–4 for systolic hypertension [*16*]. The relative risk decreases to 2 with a 20% reduction in blood pressure [*17*]. Prior analysis of our data set showed that the prevalence of hypertension among Jordanians is 22.2% [*7*]. A high proportion

Table 3 **Logistic regression among males for the associations between self-reported myocardial infraction status and sociodemographic, behavioural and health related variables**

Variable	Adjusted OR (95% CI)	*P*-value
Age	1.02 (0.99–1.05)	0.207
Length of education	0.87 (0.81–0.94)	< 0.0001
Smoking		
No	1	
Yes	0.65 (0.34–1.20)	0.185
Exercise		
No	1	
Yes	0.69 (0.38–1.20)	0.216
BMI	1.04 (0.93–1.08)	0.925
Hypertension		
No	1	
Yes	3.30 (1.80–5.90)	< 0.0001
Diabetes		
No	1	
Yes	1.60 (0.47–1.59)	0.639
Cholesterol		
No	1	
Yes	3.90 (2.27–6.71)	< 0.0001

OR = odds ratio; CI = confidence interval; BMI = body mass index.

Table 4 **Logistic regression among females for the associations between self-reported myocardial infarction and sociodemographic, behavioural and health-related variables**

Variable	Adjusted OR (95% CI)	*P*-value
Age	1.15 (1.03–1.28)	0.011
Length of education	0.79 (0.63–0.98)	0.030
Smoking		
No	1	
Yes	6.90 (0.48–97.9)	0.154
Exercise		
No	1	
Yes	0.56 (0.25–9.40)	0.645
BMI	0.82 (0.66–1.13)	0.070
Hypertension		
No	1	
Yes	3.70 (2.13–6.20)	< 0.0001
Diabetes		
No	1	
Yes	5.70 (0.03–0.98)	0.047
Cholesterol		
No	1	
Yes	21.0 (3.6–123.7)	0.010

OR = odds ratio; CI = confidence interval; BMI = body mass index.

Table 5 **Discriminant analysis for the overall, female and male models for self-reported myocardial infarction**

Variable	Overall model		Male model		Female model	
Cut-off point	0.066	0.500	0.076	0.500	0.056	0.500
Sensitivity (%)	76.4	5.2	72.1	4.9	76.0	1.0
Specificity (%)	75.8	99.5	77.8	98.8	80.0	99.0
ROC curve area	83.0		82.0		86.0	

ROC = receiver operating characteristic.

of MI cases in our study (around 79%) had checked their blood pressure within the previous 6 months. In addition, the high percentage (around 88%) of hypertensive patients who were taking medication are less likely to develop complications due to hypertension control. It should be noted that screening for hypertension is obligatory in health facilities in Jordan; each patient who visits a health facility should have his/her blood pressure measured, irrespective of the reason of visit. Moreover, we have to take into consideration the high coverage rate of public health insurance that supplies patients with medication almost free of charge.

Our study showed a significant relation between self-reported diagnosis of high cholesterol and MI. A causal relationship between diet and blood cholesterol level and CVD has been demonstrated. The relative risk of high cholesterol for ischaemic heart disease is 2.5–3.5, satisfying most criteria for causation. A 10% reduction of blood cholesterol produces a 20%–30% decline in CHD deaths. In addition every 1% reduction in mean LDL cholesterol level has a 1%–2% reduction in CHD morbidity and mortality [*18*]. In Jordan the prevalence of hypercholesterolaemia as reported by the prior analysis of the data collected in this survey is 20.9% [*7*].

A self-reported diagnosis of diabetes was not a risk factor for MI in our regression analysis. The prevalence of diabetes is increasing as a result of sedentary lifestyles and increasing prevalence of obesity. Furthermore, this study agrees with numerous studies that have shown that MI is more common among diabetic people than non-diabetics [*19–21*]. A self-reported study among elderly Mexicans has shown that 15.2% of MI cases were diabetic patients [*22*]. Diabetes is a gradual process and patients go through different phases without expressing any symptoms, and cross-sectional studies severely underestimate the number of diabetic patients. Its worth noting that silent (painless) MI is much more prevalent among diabetic patients [*23,24*].

Our study showed a significant relationship between years of education and self-reported MI in the regression analysis. The most common measures that have been used to evaluate socioeconomic status are level of income, occupation and level of education; however, these measures are difficult to standardize in developing countries, particularly for females [*25*]. Education is more strongly associated with CAD than any other indicator of socioeconomic status [*26*]. Although there has been a sharp increase in the level of

education in Jordan in recent decades, education status was relatively low 5 to 6 decades ago. In addition, no information could be derived from the level of income variable since 66.5% (2049 of 3082) of the information was missing. No statistical test is robust enough to compensate for this shortcoming. The reason behind the incompleteness of the data may well be the reluctance of Jordanians to answer a question that relates to dignity and social standing.

Using a classification based on current smoking status, our study found a relationship between current smoking and self-reported MI. Cigarette smoking has been identified as the single most important source of preventable morbidity and premature mortality [*27*]. In Jordan, 29.8% of the population are defined as current smokers, of whom 8.3% are females [*7*]. Results of a large case–control study showed the adjusted odds ratio for MI in smokers in the Middle East region was 2.27 (95% CI 2.11–2.44) [*28*]. Other data have shown, however, that there is no safe limit for smoking, since smoking as few as 5 cigarettes a day increases the likelihood of a MI [*29*]. In contrast, our study did not find a relationship between previous history of smoking and MI. This could be due to people misclassifying themselves because of the specific number of cigarettes (100) in the question asked. Also, recall bias could be a factor. Some differences exist in the patterns of smoking between women and men, for example women tend to smoke fewer cigarettes than males and for a shorter duration [*30*]. Furthermore, the difference could be partially explained by reporting bias, since smoking among females is generally considered socially unacceptable in Jordan.

BMI was not a significant risk factor for MI in our regression analysis. However, our questionnaire asked about height and weight at the present time, and many people lose weight after being diagnosed with a MI. Some studies in industrialized countries have shown differences between measured and self-reported BMI [*31*]. In addition, self-reported height is a controversial measure [*32*]. From the EMR, particularly in Lebanon, a study has shown a bigger difference in self-reported height than studies in the industrialized world [*33*]. Furthermore, many people in Jordan do not have regular medical checkups and there are often no height and weight measures in our health facilities. As a result of rapid modernization and urbanization, a new lifestyle has emerged in Jordan, characterized by physical inactivity. The percentage of those who exercise among MI cases is low (27%) [*7*]. This low prevalence of physical activity is particularly important since it negatively impacts the health status and also increases the economic burden for society [*34*]. It is worth mentioning that the majority of MI patients who exercised (75%) were males. This low prevalence of Jordanian women who exercise is most likely due to cultural norms that restrict women's outdoor physical activities. The lack of facilities where people can exercise should also be taken into consideration.

Strengths and limitations

Although our study is based on self-reported variables, the self-report approach has been demonstrated to provide reasonable information on sociodemographic and health-related problems including MI [*35,36*]. Results from a study of 107 patients aged $\geq$ 65 years showed that agreement between self-reported results compared to medical records for the diagnosis of MI was 94% with a kappa statistic of 0.7 [*35*].

To our knowledge, this is the first study in Jordan that assessed the relationship

between the prevalence of different risk factors and MI morbidity. Our study was population-based which allowed us to represent all localities and subgroups among the Jordanian population. Moreover, the questionnaire had different aspects which permitted us to explore the relationship of demographic, socioeconomic, behavioural and medical aspects. The relatively large sample size of the study provided the high power and precision of estimates. The high response rate (96.3%) is also considered a major strength of our study.

We are also aware of some other limitations. In general, surveys explore prevalence rates of diseases rather than incidence. Such an approach leads to under-reporting of the magnitude of the outcome of the study. In our study, this effect could be explained by 2 factors; first, there may be subclinical cases of MI which were not reported, and secondly, the severe cases of MI may have already led to death. Since our data were collected directly from respondents, without confirmation of any diagnosis from health care providers, misclassification of MI status may have occurred [*37*].

Recommendations

This study was the first step in establishing MI morbidity information in a community-based survey in Jordan. Since this survey will be conducted continuously we recommend monitoring the prevalence of nonfatal MI, the mortality and morbidity trends of MI among the Jordanian population, and the changes in the prevalence of the behavioural risk factors and their effects on the prevalence of MI. Furthermore, like many other countries in the EMR, Jordan suffers from underutilization of data sets. Therefore maximizing the usefulness of the data by secondary analysis is the strategy to follow.

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