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Modifiable cardiovascular risk factors among adults in Aleppo, Syria

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Abstract
Objectives This report provides the first comprehensive and standardized assessment of the distribution of cardiovascular disease (CVD) risk factors in Syria, where such data are still scarce.
Methods A population-based household survey was conducted in Aleppo (population >2.5 million), involving 1,168 subjects ≥25 years old (47.7% men; mean age 44.7 ± 12.7 years). Information about socio-demographics, personal behavior, and other CVD risk factors was collected. Anthropometric measurements and fasting blood samples were obtained.
Results The prevalence of clinical risk factors of CVD (ClinRFs) was 45.6% for hypertension, 43.2% for obesity, 21.9% for hypercholesterolemia and 15.6% for diabetes. The prevalence of behavioral risk factors (BehRFs) was 82.3% for physical inactivity, 39.0% for smoking, and 33.4% for unhealthy diet. All ClinRFs increased with age, while gender was associated only with obesity and smoking. Education was associated with obesity and diabetes ($P < 0.05$ for all).
Conclusions Adults in Syria have some of the world's highest prevalence of CVD risk factors. Unhealthy behaviors and social norms unfavorable to women may explain some of such risk profiles.

Keywords Cardiovascular risk factors · Adults · Smoking · Syria · Eastern Mediterranean

Introduction

Cardiovascular disease (CVD) is the primary cause of morbidity and mortality around the world, accounting for over 17 million deaths a year. Many studies indicate that most of the global CVD morbidity and mortality burden is in the developing countries, overtaking that of infectious diseases (World Health Organization 2003, 2008; Reddy 2002; Lopez et al. 2006). In a recent estimate of the World Health Organization (WHO), 7% of global CVD mortality was in the Eastern Mediterranean region (EMR), accounting for one-third of all deaths in this region (WHO 2008). In Syria, one of the low-middle income countries of the EMR (population ≈ 23,000,000), CVD affects 5.8% of adults over 18 years old (4.8% for heart disease and 1.0% for stroke) and is responsible for about a half of the overall mortality (Maziak et al. 2007). One of the remarkable patterns characterizing CVD morbidity/mortality in the EMR compared to developed societies is their earlier onset and male predominance casting a dreadful toll on the already strained economics of households and communities (Yusuf et al. 2001). In Syria for example, about half of the CVD deaths occur before the age of 65 years compared to only one-fifth occurring before the age of 70 years in developed countries (Maziak et al. 2007). Despite these alarming trends, reliable surveillance of CVD and its risk factors is absent in most counties of the EMR, including Syria. Knowledge of the type and the distribution of major CVD risk factors in the society is crucial to inform the planning of appropriate interventions and to prioritize the use of limited resources to target the

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most vulnerable groups to CVD in the society (WHO 2002; Fouad et al. 2006; Maziak et al. 2007). At the Syrian Center for Tobacco Studies (SCTS), we have started efforts to establish such surveillance including the use of objective assessment of CVD and its risk factors. This paper reports the results of the first comprehensive assessment of the distribution of CVD risk factors in Syria: obesity, diabetes mellitus, hypertension, hypercholesterolemia, smoking, low physical activity and unhealthy diet. It is based on data from the 2nd Aleppo Household Survey (AHS) conducted by SCTS in 2006 in Aleppo, the second city largest in Syria with a population of more than 2.5 million.

Methods

Study population and procedures

A detailed description of the 2nd AHS is reported elsewhere (Albache et al. 2010). Briefly, the 2nd AHS is a population-based, interviewer-administered survey performed in 2006 in Aleppo, Syria. Participants were adults ≥25 years of age, who resided in Aleppo, could understand the study procedures/measures, and provided informed consent to participate. A two-stage cluster sampling was used. First, 27 neighborhoods were randomly selected with probability proportional to size (PPS) from a list of 83 administrative residential neighborhoods listed in the Aleppo Municipality records, and next 1,268 households were randomly selected from the selected neighborhood with equal probability. Within each household, one of the adults aged ≥25 years was randomly selected. If the selected person was not available for the interview, a second interview was scheduled, and when this did not work or the selected person refused to participate in the study, an adjacent household was selected and so on. The survey was preceded by a media campaign involving local newspapers, radio, and television to inform the population about the upcoming study.

Except for blood analysis, the survey procedures and measurements were performed at home by trained mixed-gender teams of two interviewers. Prior to the survey, interviewers had 1 week of training at the SCTS on study protocol and procedures. The study questionnaire included questions about socio-demographics, personal and family history of diabetes, lifestyle-related risk factors, and the use of medications. Height was measured using a portable stadiometer and weight was measured with a digital scale equipped with high-precision strain-gauge sensor. Blood pressure (BP) was taken using a standard mercury sphygmomanometer after 5 min of rest in a sitting position. The mean value of three BP measurements was used in the analysis. Data were collected using notebook computers with a custom data entry program (Delphi programming language), including embedded features to limit missing, incorrect, or out of range entries. At the end of each household visit, the participant was invited to the SCTS laboratory within the next week to provide a morning blood sample after an overnight fast. Participants already diagnosed with diabetes were asked to stop hypoglycemic medications overnight before blood samples were obtained. Fasting venous blood was collected at the SCTS laboratory, and the plasma and serum samples were immediately separated and transported at 4°C to the Clinical Laboratory of the Aleppo School of Medicine for glucose and lipid profile testing. Samples were analyzed within 6 h of collection using an automated random access analyzer of clinical chemistry—turbidimetry (Biosystems A25, BioSystems, Barcelona, Spain). Participants with abnormal blood results were notified and assisted in seeking specialized consultation. Measurements, procedures, and outcome definitions were selected for the most part according to the European Health Risk Monitoring Project (EHRM) (Tolonen et al. 2002) and the WHO multinational MONItoring of trends and determinants in CArdiovascular disease project (MONICA) (WHO 1998). The study protocol and informed consent documents were approved by the Institutional Review Boards of the SCTS and the University of Memphis.

Study outcomes

The definitions of the study outcomes were based on standard criteria used in other studies to facilitate comparisons (Albache et al. 2010; Maziak et al. 2007). These are briefly described below.

Diabetes: individuals were considered to have Type 2 diabetes mellitus (T2DM) if they reported a history of physician-diagnosed T2DM, or had a fasting plasma glucose (FPG) level ≥126 mg/dL (World Health Organization/International Diabetes Federation 2006).

Hypertension: was defined as having either systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg, reported physician-diagnosed hypertension, or the use of antihypertensive drugs at the time of survey (National Institutes of Health/National Heart 2004).

Hypercholesterolemia: was defined as having a fasting total serum cholesterol ≥240 mg/dL, reported physician-diagnosed hypercholesterolemia, or the use of lipid-lowering drugs at the time of survey (NCEP/ATP 2002).

Obesity: was defined as body mass index (BMI) ≥30 (WHO 2002). BMI was calculated by dividing body weight in kilograms by the square of height in meters.

Smoking: was defined as self-reported past month cigarette or water pipe smoking.

Physical inactivity: was defined as reporting no regular physical activity (less than once a week of sport or brisk walking for at least 15 min) during leisure time (Albache et al. 2010).

Unhealthy diet: was defined as having the lower tertile for total score of two questions inquiring separately about the average days/week of consumption of fruits or vegetables categorized as <3, 3–6 or 7 days/week (coded as 1, 2, or 3, respectively; minimum score 2 and maximum 6).

Socioeconomic status (SES) score was calculated based on multiple indicators of education, household income and ownership, as well as employment status (Maziak et al. 2007). A combined 12-point SES score was then stratified into three categories based on the tertiles of score distribution as follows: low (0–5), middle (6–7), and high (8–12).

Statistical analysis

For clarity of presentation, the study outcomes are divided into two groups clinical risk factors (ClinRFs) including obesity, hypertension, hypercholesterolemia, and T2DM, and behavioral risk factors (BehRFs) including smoking, physical inactivity, and unhealthy diet. For all study outcomes, descriptive statistics were calculated for the overall study population according to the main socio-demographic characteristics (Table 1). Prevalence estimates of study outcomes and 95% confidence intervals (95% CI) of the point estimates were calculated based on sampling weights to correct for the complex study design and non-response according to the methods described in (Single 2000; Kalton 1983). Weighted estimates were used in all analyses including regression models. Bivariate analysis of the association of main study outcomes with socio-demographic indicators and the association of clinical risk factors (ClinRFs) with behavioral risk factors (BehRFs), as well as with obesity, was performed using chi-square test for trend (Tables 2, 3).

Binary logistic regression was used to assess predictors of ClinRFs among the study population (Table 4). Since clustering of ClinRFs is common leading to multiplication of risks, predictors of clustering of more than one ClinRF in an individual were studied using multinomial regression analysis (Table 5). All statistical analyses were performed with SAS version 8.02 (SAS Institute, Cary, NC, USA) and stata Version 10.0 (StataCorp LP, College Station, TX, USA).

Results

A total of 1,168 individuals (47.7% men; mean age 44.7 ± 12.8 years; age range 25–85) from 1,268 households agreed to participate and completed the study questionnaire (response rate = 92.1%). The characteristics of the study sample according to the studied parameters are shown in Table 1. Men reported greater SES score, employment rate, and education level than women ($P < 0.05$ for all).

Table 1 Basic characteristics of the study population in Aleppo, Syria 2006 ($n = 1,168$)

	Male *n* (%)	Female *n* (%)	Total *n* (%)
Age			
25–34	133 (23.9)	157 (25.7)	290 (24.8)
35–44	143 (25.7)	176 (28.8)	319 (27.3)
45–54	142 (25.5)	147 (24.1)	289 (24.7)
55+	139 (25)	131 (21.4)	270 (23.1)
Religion/ethnicity			
Arab-Muslim	521 (93.5)	570 (93.3)	1,091 (93.4)
Others	36 (06.5)	41 (06.7)	77 (06.6)
Education			
<6 years	127 (22.8)	224 (36.7)	351 (30.1)
6–11 years	256 (46)	253 (41.4)	509 (43.6)
≥12 years	174 (31.2)*	134 (21.9)	308 (26.4)
Employment			
No	116 (20.8)*	508 (83.1)	624 (53.4)
Yes	441 (79.2)	103 (16.9)	544 (46.6)
Socioeconomic status			
Low (0–5)	145 (0.26)	270 (44.2)	415 (35.5)
Middle (5–8)	190 (0.341)	179 (29.3)	369 (31.6)
High (8–12)	222 (39.9)*	162 (26.5)	384 (32.9)

* $P < 0.05$ according to chi-square test between genders

Prevalence and predictors of CVD risk factors

Clinical risk factors (ClinRFs)

Hypertension and obesity were the most common ClinRFs among the study population with a prevalence of 45.6 and 43.2%, respectively, followed by 21.9% for hypercholesterolemia and 15.6% for T2DM. The prevalence of ClinRFs increased significantly with age ($P < 0.05$ for all comparisons).Women had higher prevalence of obesity than men (51.8 vs. 34.4%; $P < 0.05$) (Table 2), and this difference increased with age, especially for groups of 45–54 and ≥55 years old ($P < 0.05$ for both) (Fig. 1). Unemployed individuals had a significantly higher prevalence of ClinRFs compared with the employed (20.7 vs. 9.8% for T2DM, 53.8 vs. 31.3% for obesity, 53.4 vs. 36.7% for hypertension, and 24.6 vs. 18.8% for hypercholesterolemia; $P < 0.05$ for all). Likewise, lower education levels significantly associated with increased prevalence rates of ClinRFs ($P < 0.05$ for all). However, SES score did not

Table 2 Prevalence of clinical cardiovascular risk factors according to studied characteristics among adults in Aleppo, Syria 2006 ($n = 1{,}168$)

	Clinical CVD risk factors			
	Obesity % (95% CI)	T2DM % (95% CI)	Hypertension % (95% CI)	Hypercholesterolemia % (95% CI)
Overall	43.2 (39.0–47.6)	15.6 (13.7–17.7)	45.6 (42.1–49.1)	21.9 (20.2–23.7)
Gender				
Male	34.4 (30.0–39.0)	15.6 (12.1–19.9)	47.2 (43.5–50.9)	21.7 (18.6–25.2)
Female	51.8 (44.8–58.8)*	15.6 (12.9–18.6)	44.0 (38.4–49.8)	22.1 (19.0–25.4)
Age				
25–34	22.5 (16.2–30.4)	1.6 (0.7–3.7)	22.3 (16.4–29.5)	6.8 (3.9–11.4)
35–44	46.1 (39.7–52.5)	5.7 (3.4–9.4)	32.0 (25.4–39.4)	21.3 (17.1–26.2)
45–54	64.1 (57.3–70.4)	26.1 (20.6–32.5)	63.5 (57.7–68.9)	36.4 (31.0–42.2)
55+	52.7 (46.0–59.3)*	36.9 (31.3–42.9)*	78.0 (73.0–82.3)*	32.2 (25.3–40.0)*
Religion/ethnicity				
Arab-Muslim	43.0 (38.5–47.7)	15.9 (14.0–17.8)	45.5 (41.9–49.3)	21.3 (19.5–23.1)
Others	46.9 (31.6–62.9)	10.1 (5.0–19.3)	46.4 (32.5–60.9)	34.9 (22.4–49.9)
Education				
<6 years	57.1 (50.0–63.9)	28.5 (23.7–33.8)	63.8 (56.6–70.5)	26.0 (22.6–29.8)
6–11 years	40.9 (34.8–47.3)	10.6 (7.6–14.5)	39.0 (33.6–44.7)	21.2 (17.7–25.3)
≥12 years	33.4 (27.8–39.6)*	11.1 (8.0–15.2)*	38.4 (31.7–45.6)*	19.0 (14.3–24.7)*
Employment				
No	53.8 (47.6–59.8)	20.7 (17.7–24.1)	53.4 (49.4–57.4)	24.6 (21.6–28.0)
Yes	31.3 (26.2–36.8)*	9.8 (7.6–12.5)*	36.7 (31.3–42.5)*	18.8 (16.6–21.4)*
Socioeconomic status				
Low (0–5)	48.3 (41.2–55.5)	19.8 (15.4–25.0)	49.0 (42.9–55.1)	20.7 (17.3–24.7)
Middle (5–8)	43.5 (36.7–50.5)	13.9 (9.8–19.5)	50.9 (45.3–56.5)	22.5 (18.3–27.2)
High (8–12)	37.1 (29.9–45.0)	12.4 (8.5–17.7)	36.3 (28.3–45.2)*	22.7 (18.0–28.2)

* $P < 0.05$ according to chi-square test for trend between categories of each predictor variable

show significant relationship with ClinRFs, except for hypertension (Table 2).

In multivariate logistic regression analysis, all the above associations were conserved for age and gender. However, the association with education was limited to obesity and diabetes, and the association with employment was limited to obesity. In addition, physical inactivity was associated only with obesity which, as expected, correlated with hypertension and hypercholesterolemia (Table 4).

Behavioral risk factors (BehRFs)

According to the study's definitions, the vast majority of study participants (82.3%) were physically inactive, whereas smoking was found among 39.0% (27.8% cigarettes, 4.5% water pipe, and 6.9% both).Unhealthy diet was found among 33.4% of participants. Smoking prevalence was higher in men than in women, with prevalence in men reaching 60.7% (43.5% cigarettes, 6.0% water pipe, and 11.3% both) compared to 17.8% among women (12.5% cigarettes, 2.9% water pipe and 2.4% both) ($P < 0.05$ for all) (Table 3). This gender difference in smoking tended to decrease with age (Fig. 1). Smoking showed reverse relationship with age where it decreased from 40% in the age group of 25–34 years to 28.3% in the age group of 55+ years. On the contrary, physical inactivity showed a positive relationship with age where it increased from 76.5% to 91.3% for the age groups of 25–34 and 55+ years, respectively ($P < 0.05$ for both comparisons). Unlike the ClinRFs, all the BehRFs were significantly related to the SES score, where physical inactivity and unhealthy diet were lower in the higher SES groups. The opposite was observed for smoking. Unemployed participants were less active (75.5 vs. 88.3%) and smoked less than the employed (56.5 vs. 23.5%; $P < 0.05$ for both comparisons). An inverse relationship was observed between education level and both unhealthy diet and physical inactivity (Table 3). The associations between BehRFs with age and gender, as well as between unhealthy diet and socioeconomic

Table 3 Prevalence of behavioral cardiovascular risk factors according to studied characteristics among adults in Aleppo, Syria 2006 ($n = 1{,}168$)

	Behavioral CVD risk factors		
	Smoking % (95% CI)	Physical inactivity % (95% CI)	Unhealthy diet % (95% CI)
Overall	39.0 (35.8–42.3)	82.3 (77.3–86.4)	33.4 (28.7–38.6)
Gender			
Male	60.7 (55.0–66.2)	80.2 (73.9–85.2)	32.2 (27.6–37.2)
Female	17.8 (14.5–21.7)*	84.4 (78.0–89.2)	34.6 (27.7–42.4)
Age			
25–34	40.0 (34.1–46.2)	76.5 (69.5–82.3)	31.4 (25.9–37.4)
35–44	49.2 (42.2–56.3)	79.9 (73.9–84.7)	29.7 (22.1–38.6)
45–54	37.1 (31.2–43.4)	84.2 (76.0–90.0)	37.1 (29.1–46.0)
55+	28.3 (22.2–35.3)*	91.3 (86.8–94.4)*	37.3 (28.7–46.9)
Religion/ethnicity			
Arab-Muslim	38.2 (35.2–41.3)	82.5 (77.5–86.6)	34.3 (29.5–39.5)
Others	54.7 (39.1–69.4)	77.8 (61.0–88.7)	15.9 (9.4–25.7)*
Education			
<6 years	33.5 (28.3–39.1)	89.2 (84.7–92.5)	49.1 (40.5–57.7)
6–11 years	44.6 (38.9–50.4)	85.0 (79.7–89.1)	34.4 (30.1–38.9)
≥12 years	35.1 (30.0–40.6)	71.0 (61.8–78.8)*	16.4 (12.6–21.1)*
Employment			
No	23.5 (19.1–28.5	88.3 (83.6 - 91.8	38.3 (30.9–46.4)
Yes	56.5 (48.1–64.5)*	75.5 (68.3–81.4)*	27.9 (22.5–34.0)
Socioeconomic status			
Low (0–5)	35.4 (29.6–41.6)	90.2 (85.7–93.4)	49.9 (43.0–56.8)
Middle (5–8)	39.4 (34.4–44.7)	83.6 (77.0–88.6)	30.5 (25.7–35.8)
High (8–12)	42.6 (36.8–48.7)*	71.9 (63.3–79.2)*	17.4 (14.0–21.5)*

* $P < 0.05$ according to chi-square test for trends between categories of each predictor variable

variables were maintained in the multivariate analysis (results not shown).

Prevalence and predictors of clustering of CVD risk factors

Overall, 30.1% of participants had one ClinRF compared to 38.3% who had ≥2 ClinRFs. Half of the participants (49.5%) had multiple BehRFs, whereas 43.2% had only one BehRF. The multinomial regression analysis showed that clustering of ClinRFs was positively associated with age and inversely associated with education and employment (Table 5). Clustering of BehRFs was positively associated with gender and inversely associated with SES and education (data not shown). Interestingly, the relationship of age with clustering of ClinRFs depended on gender. As Fig. 2 shows, gender difference for ClinRFs clustering increased significantly with age (78.6 vs. 57.6%, for women and men of 55+ years, respectively; $P < 0.05$). On the other hand, the gender difference in the clustering of BehRFs decreased from 63.9 vs. 42.0% in men and women of age 25–34 years, respectively, $P < 0.05$) to become insignificant in the ≥55 years age group (Fig. 2).

Discussion

Hypertension, hypercholesterolemia, and smoking are the leading causes for CVD morbidity, and have been shown to explain about three-quarters of CVD (WHO 2002). Surveillance for CVD risk factors among different segments of the population is pivotal to design prevention strategies against the CVD epidemic. Unfortunately, most of the EMR countries still lack timely estimates of major CVD risk factors (Maziak 2009). In this report, we provide the first comprehensive assessment of the spread and distribution of CVD risk factors in Syria using standardized and objective methods. The results are useful for health planners to identify important CVD risk factors and groups at most risk in Syria. Additionally, and given the close cultural and social similarities among communities in the region, such information can be helpful for other Arab countries in the EMR.

This survey shows that CVD risk factors are widespread among adults in Syria, where the majority have one or more of the studied risk factors. Some of these risk factors reached dramatic levels such as physical inactivity, which is considered to be one of the most modifiable risk factors for cardiovascular morbidity and mortality (Prasad and Das

Table 4 Correlates of clinical cardiovascular risk factors among adults in Aleppo, Syria 2006 ($n = 1{,}168$)

	Obesity OR (95% CI)	T2DM OR (95% CI)	Hypertension OR (95% CI)	Hypercholesterolemia OR (95% CI)
Gender				
Male	Ref	Ref	Ref	Ref
Female	1.82 (1.21–2.74)*	0.95 (0.64–1.39)	0.80 (0.52–1.24)	1.13 (0.75–1.69)
Age				
25–34	Ref	Ref	Ref	Ref
35–44	3.65 (2.21–6.02)*	3.47 (1.30–9.23)*	1.39 (0.90–2.15)	3.35 (1.67–6.69)*
45–54	7.04 (3.64–13.60)*	17.55 (6.88–44.8)*	4.65 (2.95–7.31)*	6.96 (3.57–13.57)*
55+	3.34 (1.92–5.82)*	26.1 (9.96–68.1)*	8.59 (5.35–13.77)*	6.73 (3.73–12.15)*
Religion/ethnicity				
Arab-Muslim	Ref	Ref	Ref	Ref
Others	0.97 (0.39–2.40)	0.45 (0.16–1.26)	0.92 (0.47–1.77)	1.71 (0.91–3.21)
Education				
<6 years	Ref	Ref	Ref	Ref
6–11 years	0.73 (0.53–1.01)	0.66 (0.46–0.95)*	0.71 (0.41–1.23)	1.23 (0.76–2.00)
≥12 years	0.46 (0.30–0.69)*	0.58 (0.33–1.01)	0.72 (0.38–1.37)	0.78 (0.44–1.39)
Employment				
No	Ref	Ref	Ref	Ref
Yes	0.55 (0.36–0.84)*	0.84 (0.54–1.32)	0.86 (0.50–1.48)	0.88 (0.48–1.62)
Socio-economic status				
Low (0–5)	Ref	Ref	Ref	Ref
Middle (5–8)	1.24 (0.88–1.73)	0.81 (0.42–1.55)	1.40 (0.92–2.12)	1.21 (0.70–2.09)
High (8–12)	1.45 (0.97–2.16)	1.16 (0.72–1.88)	0.89 (0.41–1.93)	1.61 (0.71–3.66)
Physical inactivity				
No	Ref	Ref	Ref	Ref
Yes	1.80 (1.21–2.68)*	1.74 (0.99–3.07)	1.24 (0.88–1.77)	0.75 (0.40–1.42)
Smoking				
No	Ref	Ref	Ref	Ref
Yes	0.98 (0.77–1.24)	0.84 (0.46–1.54)	0.91 (0.64–1.31)	1.31 (0.78–2.21)
Unhealthy diet				
No	Ref	Ref	Ref	Ref
Yes	0.64 (0.–0.95)*	0.70 (0.48–1.03)	0.75 (0.57–0.98)*	0.72 (0.45–1.14)
Obesity				
No	–	Ref	Ref	Ref
Yes	–	1.34 (0.95–1.90)	1.96 (1.49–2.57)*	1.91 (1.33–2.74)*

* $P < 0.05$ according to multivariate logistic regression

2009) together with hypertension, obesity, and smoking. Only about a fifth of our study participants were engaged in regular recreational physical activity, which was similar to figures reported from other countries in the EMR (e.g., only 19% of adults in Saudi Arabia were active on a regular basis (Musaiger 2004). Driven by lifestyle changes associated with urbanization and modernization, which lead to imbalance between food intake and physical activity, obesity is becoming more of a problem of developing rather than developed societies (Maziak et al. 2008). Based on recent results, women in Syria seem to be more affected by obesity compared to men, a finding that replicates similar patterns seen earlier in Syria as well as in other societies in the EMR (al-Shammari et al. 1994b; Fouad et al. 2006). Obesity prevalence among women in the Syrian society reached more than half of women (51.8%), but still higher prevalence has been reported, for example, in Saudi Arabia (70%) and Bahrain (79%) (Nishtar 2006). This occurs despite the similar physical activity and dietary patterns found among men and women in this study. However, men in traditional societies of the EMR are more likely to be working and are freer to engage in outdoor

Table 5 Correlates of clustering of clinical cardiovascular risk factors among adults in Aleppo, Syria 2006 (n = 1,168)

	One clinical risk factors OR (95% CI)	Two or more clinical risk factors OR (95% CI)
Gender		
Male	Ref	Ref
Female	0.94 (0.55–1.62)	1.25 (0.75–2.07)
Age		
25–34	Ref	Ref
35–44	2.06 (1.18–3.59)*	6.27 (3.79–10.4)*
45–54	3.88 (1.50–10.1)*	36.85 (17.5–77.7)*
55+	4.52 (1.83–11.2)*	37.20 (21.8–63.4)*
Religion/ethnicity		
Arab-Muslim	Ref	Ref
Others	1.81 (0.72–4.56)	1.12 (0.57–2.18)
Education		
<6 years	Ref	Ref
6–11 years	0.66 (0.33–1.29)	0.51 (0.30–0.85)*
≥12 years	0.77 (0.35–1.70)	0.26 (0.12–0.57)*
Employment		
No	Ref	Ref
Yes	0.66 (0.31–1.40)	0.41 (0.21–0.81)*
Socioeconomic status		
Low (0–5)	Ref	Ref
Middle (5–8)	1.24 (0.71–2.16)	1.46 (0.78–2.73)
High (8–12)	1.09 (0.53–2.23)	1.96 (0.86–4.47)
Physical inactivity		
No	Ref	Ref
Yes	1.47 (1.03–2.11)*	1.52 (0.86–2.71)
Smoking		
No	Ref	Ref
Yes	1.28 (0.79–2.08)	1.00 (0.65–1.56)
Unhealthy diet		
No	Ref	Ref
Yes	0.91 (0.62–1.32)	0.50 (0.31–0.82)*

* $P < 0.05$ according to multinomial logistic regression (no clinical risk factor as the reference category)

activities. This is supported by the fact that employment is inversely associated with obesity, even after adjustment for other factors that can influence this relation. On the other hand, women in traditional societies in the EMR are subjected to early arranged marriage, male dominance, and uncontrolled fertility (al-Shammari et al. 1994b; Fouad et al. 2006). For many women in the EMR, pre-prescribed roles and expectations as childbearers/housekeepers greatly limit their ability for recreational activities and self-care.

The impact of physical inactivity on other studied ClinRFs is mediated by the significant correlation between physical inactivity and obesity which, in turn, is associated with increased risk of hypertension and hypercholesterolemia among Syrian adults. Compared to other populations, our finding of hypertension prevalence of 45.6% is among the highest in the world. For example, in adults between 35 and 74 years, about 44.2% of Europeans, 27.8% of Americans (Wolf-Maier et al. 2003), and 27.2% of Chinese (Gu et al. 2002) have hypertension. Furthermore, this prevalence is almost twice as high as those reported in other societies in the EMR, e.g., 25% in Iran (Esteghamati et al. 2008) and 26.1% in Saudi Arabia (Al-Nozha et al. 2007).

Hypercholesterolemia was found in approximately one-fifth of Syrian adults, which is similar to what has been reported from Saudi Arabia (al-Shammari et al. 1994a) and Iran (Fazizi et al. 2004), and is at the lower end of prevalence estimates reported from European populations (Tolonen et al. 2005). As for diabetes, the prevalence of T2DM reported in this study (15.6% rising to 36.9% in older groups) is among the highest in the EMR (Motlagh et al. 2009) and in the world (International Diabetes Federation 2006). In addition, most T2DM, hypertension, and hypercholesterolemia cases found in our study were not diagnosed or treated (data not shown).

Interestingly, and unlike patterns seen in developed societies (Maziak et al. 2007), unhealthy diet—characterized by low fruit/vegetable consumption—was not related to obesity in our population. It is likely that in societies where health information about the benefits of diets rich in fruits and vegetables is not widespread, the level of consumption may reflect access, affordability, and perhaps food indulgence rather than health-driven behavior. This is why unhealthy diet in our study, based on low levels of fruits and vegetables consumption, and perhaps low consumption of other food items, showed an inverse relation with obesity, as well as with other ClinRFs. Accordingly, future studies of dietary habits in the EMR should involve a more comprehensive assessment of various food items, including calories, saturated fats, trans fats, salt, and refined sugars.

One-third of adults in our population smoked cigarettes and/or water pipe, which is high even when compared with other countries in the EMR known to have notorious smoking levels (Motlagh et al. 2009). Our findings of much higher prevalence of smoking among men than women agree with other reports from the region (Motlagh et al. 2009). Actually, the true picture of smoking habit among women may be underestimated. Given the social structure of the EMR, women may refrain from reporting smoking as freely as men, especially if they were asked in the presence of other family members. However, smoking among adults in Syria is more of a male problem. The fact that more than 60% of men smoke reflects a major failure in tobacco control policies in Syria, a country that has ratified the

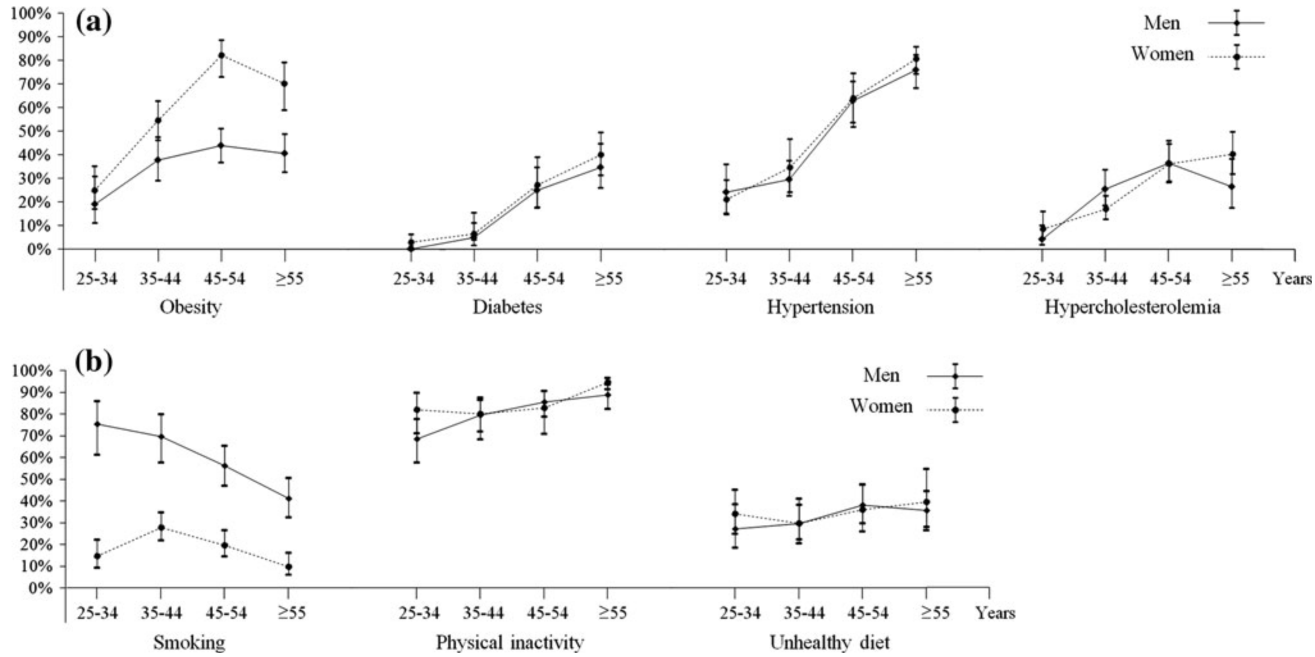

Fig. 1 Prevalence of clinical (**a**) and behavioral (**b**) cardiovascular risk factors stratified by age and gender among adults in Aleppo, Syria 2006 ($n = 1{,}168$). *ClinRFs* clinical cardiovascular risk factors (obesity, type 2 diabetes mellitus, hypertension, and hypercholesterolemia). *BehRFs* behavioral cardiovascular risk factors (smoking, inactivity, and unhealthy diet)

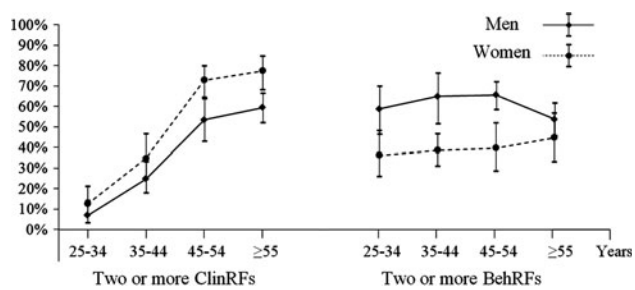

Fig. 2 Prevalence of cardiovascular risk factor clustering stratified by age and gender among adults in Aleppo, Syria 2006 ($n = 1168$). *ClinRFs* clinical cardiovascular risk factors (obesity, type 2 diabetes mellitus, hypertension, and hypercholesterolemia). *BehRFs* behavioral cardiovascular risk factors (smoking, inactivity, and unhealthy diet)

Framework Convention on Tobacco Control (FCTC). According to the FCTC, countries should implement and enforce several key tobacco control policies that focus on reducing the demand and supply sides for tobacco products (WHO/FCTC 2011). While Syria has recently implemented progressive tobacco control policies such as clean indoor air policies, lack of enforcement, existing loopholes, and failure to formulate a comprehensive tobacco control program remains the rule.

As is expected, all ClinRFs increased with age, whereas BehRFs showed variable age-related trends (smoking decreased with age, while physical inactivity tended to increase). Gender-based differences are most notable for obesity and smoking, whereby men smoke more (60.7%) while women suffer more from obesity (51.8%). In addition, gender is found to be an important modifying factor for the age-related patterns of CVD risk factors. For example, the gender difference in the clustering (≥2) of ClinRFs increased with age, while the opposite was noticed for the clustering of BehRFs, which starts higher in young men but becomes similar to women in older adults of the studied population (Fig. 2). Part of the gender/age effect on clustering of ClinRFs is likely due to obesity and its pronounced influence on other ClinRFs, while smoking may be implicated in the age–gender effect on BehRFs. The reduction in smoking prevalence with age may reflect both changes in health-related behaviors after smoking-related illness and/or early mortality due to smoking. Evidence suggests that smokers in Syria die on average 5 years younger than their nonsmoking counterparts (Maziak et al. 2007).

Socioeconomic factors are also strongly associated with CVD risk factors in the study population. Generally speaking, the socioeconomic distribution of CVD risk factors seen in this study is different from patterns reported in developed countries (WHO 2010). For example in our study, people with high SES have no better profile of ClinRFs. However, combining several indicators of SES in one measure, as we did in this study, can hide some of the underlying dynamics of the role of individual components of SES. For example, better education is consistently associated with better clinical and behavioral risk profile in our population. This finding agrees with those reported from other developing countries (Sugathan et al. 2008; Woo et al. 1999; Al-Mahroos et al. 2000) and can provide an opportunity to reduce CVD risks in the society. Education in this population may influence CVD risks favorably through increased access to health information and adoption of healthy lifestyles.

A limitation of the study is its reliance on estimates derived from a cross-sectional survey. Cross-sectional design is good for generating hypotheses based on observed associations, but cannot establish causal relationships. However, all factors studied in the survey were established CVD risk factors in the literature. Another limitation is that this survey was conducted in one city, in Syria, which can affect the generalizability of the results to the whole country. However, Aleppo is the second major city in Syria accounting for about a fifth of the urban population in the country, and can be considered representative of urban adults in Syria. Also, some of the outcomes of the study are not based on comprehensive assessment of the studied behaviors, such as physical activity and diet. More detailed assessments of patterns of physical activity (recreational and work related) and diet (quantitative assessment of major food items) are needed to make more accurate inferences about the role of these behaviors on CVD risks in the Syrian population. Finally, laboratory measurements were missed for 362 subjects, which caused underestimation of the prevalence of T2DM and hypercholesterolemia given that many of these conditions were diagnosed for the first time in this study. Nevertheless, and given the lack of published standardized data about CVD risk factors in Syria and other EMR countries, this study provides a unique contribution about epidemiological patterns of CVD risk factors among adults in Syria and can be helpful to other Arab societies of the EMR.

In summary, the alarming profile of CVD risk factors in the Syrian society calls for urgent and concerted efforts that focus on early detection and treatment, as well as primary prevention through effective policies, including national educational programs about the adverse effects of CVD risk factors and associated behaviors on the health and well-being of the individual.

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