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Cardiovascular health among adults in Syria: a model from developing countries

Wasim Maziak^{a,b}, Samer Rastam^b, Fawaz Mzayek^c, Kenneth D Ward^{a,b}, Thomas Eissenberg^{d,b}, and Ulrich Keil^e

a Department of Health & Sport Sciences, and Center for Community Health, University of Memphis, Memphis, TN, USA

b Syrian Center for Tobacco Studies, Aleppo, Syria

c Department of Epidemiology, Tulane School of Public health and Tropical Medicine, New Orleans, USA

d Department of Psychology and Institute for Drug and Alcohol Studies, Virginia Commonwealth University, Richmond, Virginia, USA

e Institute of Epidemiology and Social Medicine, University of Muenster, Muenster, Germany

Abstract

Background—Despite the considerable mortality and morbidity associated with cardiovascular disease (CVD) many developing countries lack reliable surveillance of these ailments and their risk factors to guide intervention. This study aims to provide the first population-based estimates of CVD morbidity and mortality among adults in Aleppo-Syria and the distribution of their risk factors.

Methods—A cross-sectional survey of adults 18–65 years old residing in Aleppo-Syria was carried out in 2004 involving 2038 household representatives (45.2% men, mean age 35.3 years, response rate 86%). Main outcomes of interest were physician-diagnosed CVD (infarction, angina, failure, stroke) among survey participants, and past 5 year mortality due to CVD among their household members > 20 years of age (n=6252, 49.5% men). Measurement of blood pressure (BP), height and weight, and smoking history were obtained as well.

Findings—Prevalence of CVD was 4.8% for heart disease and 1.0% for stroke. CVD was responsible for 45.0% of overall mortality reported in the past 5 years, whereby 49% of CVD deaths occurred before the age of 65 year. Mean age of death was 62.6 years (63.6 years for HD and 61.4 years for stroke). Annual crude death rate due to CVD was 314 per 100,000 (95%CI: 215–414), of these 179 were due to heart disease, and 135 due to stroke. More men died from heart disease than women, while the opposite was true for stroke. Hypertension was detected in 40.6% (47.7% men, 34.9% women), obesity in 38.2% (28.8% men, 46.4% women), and smoking (cigarettes or waterpipe) in 38.7% (63.6% men, 19.2% women) of participants. Of those surveyed, 39.3% had 1 CVD risk factor, 27.4% had 2 risk factors, and 8.3% had 3 risk factors. Main predictors of clustering of risk factors were older age, male gender, and low education.

Conclusions—Syria is currently undergoing a stage, where morbidity and mortality from CVD are high but likely to increase based on the population's risk profile. CVD risk distribution in the

Correspondence Wasim Maziak, MD, PhD Associate Professor, University of Memphis 633 Normal Street Memphis, TN 38152 Phone: 901.678.5018 Fax: 901.678.1715 E mail: wmaziak@memphis.edu

Conflict of interest statement

We declare that we have no conflict of interest related to this study.

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Syrian society highlights the non-generalizability of CVD models from developed societies, and calls for local studies to inform effective interventions and policies.

Introduction

Cardiovascular disease (CVD) (coronary heart disease, stroke) is the leading cause of morbidity and mortality worldwide, and is increasing alarmingly in developing countries. Currently, CVD is responsible for about 30% of all deaths worldwide, and is projected to cause 24 million deaths by 2020 (1-3). While the developing world bears most of the burden of these deaths, there are still no signs of success in halting the CVD epidemic there (1-3). Moreover, deaths from CVD in developing countries occur at a younger age compared to developed ones, further hindering their social and economic development (4).

Four out of the 10 leading risk factors to health are related to CVD; hypertension, smoking, high cholesterol levels, and obesity (5). These risk factors explain at least 75% of new cases of coronary heart disease, reflecting in part a population shift in the energy intake-consumption balance (5,6). Cardiovascular risk factors tend to cluster together, leading to multiplication of risks, but also providing an opportunity to reduce multiple risk factors by addressing their common behavioral roots (7,8).

Addressing the epidemic of CVD in developing countries requires acting on the root causes of its risk factors, an approach that is likely feasible across diverse socioeconomic settings (5, 7-10). However, many developing countries lack reliable surveillance data regarding the size, composition, and trends in CVD and their risk factors in their societies. Collecting these data is a crucial initial step for planning and monitoring the success of CVD intervention strategies (11). For example, the Eastern Mediterranean Region (EMR) is recognized as a hot spot for CVD, where projections of its burden exceed those of other regions, yet local data to inform health policy is inadequate (12-14). Specifically, as of 2005, the global cardiovascular InfoBase of WHO had no CVD related morbidity and mortality estimates for Syria (15). Therefore, establishing reliable surveillance for CVD and related risk factors seems an essential first step toward devising an action plan to curb the CVD epidemic in the EMR (16,17). This study, based on the Aleppo Household Survey (AHS) conducted in 2004 by the Syrian Center for Tobacco Studies (SCTS), aims to provide the first population estimates of CVD morbidity and mortality in Syria, as well as to characterize the population distribution of CVD and their determinants.

Methods

Population, sampling, procedures

AHS is a population-based survey conducted among a representative sample of households in Aleppo (2nd largest city in Syria with a population of $\approx 2,500,000$). AHS aims to characterize major health problems/risks among adults in Syria and is described in details elsewhere (18, 19). AHS employed stratified cluster sampling, whereby Aleppo was divided into two strata; formal and informal residential neighborhoods based on the official enumeration of the municipal registry. Informal neighborhoods represent about half of Aleppo's population and were characterized by residences that were built illegally or a land that was not designated for housing. From each stratum, residential neighborhoods were randomly selected with probability proportional to size (PPS). Within each neighborhood, households were selected with equal probability and an adult was randomly selected from each household, giving a total sample of 2038 household representatives age 18-65 years. Informed written consent was obtained from all participants prior to the survey.

Responses to questionnaire items were recorded by mixed gender interviewer teams using notebook computers. The questions used were based on instruments developed internationally (18,19). However, anticipating the literacy level and other issues related to our target population involving many low socio-economic communities, we opted for simple items and have conducted extensive formative work and piloting with members of the target population to better understand their health needs as well as tailor the study instrument and procedures (18-20). In addition to the questionnaire, all study participants underwent objective measurement of height using a sliding wall meter (Seca, Germany), body weight using digital scales (Camry, China, equipped with High Precision Strain-Gauge Sensor), and blood pressure (BP) using digital arm-cuff monitors (ALR K2, Japan, with ± 3 mmHg accuracy). Two seated BP measurements were made 5 minutes apart, and a third one was taken when the difference between the two was ≥ 10 mmHg for either systolic or diastolic values. The mean value of BP measurements was used in the analysis eventually.

Outcomes

The prevalence of CVD was assessed based on self-reported physician-diagnosed heart disease (angina, infarction, and heart failure), and stroke of any type (ischemic, hemorrhagic). Annual mortality estimates were calculated based on participant-reported deaths occurring in the past 5 years among their adult (≥ 20 years) household members. When such an event was reported, a verbal autopsy was performed by asking participants to name the main condition leading to that death from the following categories; heart disease, respiratory failure, stroke, cancer, TB, pneumonia, injury, and other. We also inquired about the smoking status of the diseased in the 5-year period prior to their death.

Hypertension was defined as having either systolic pressure >140 mmHg or diastolic pressure >90 mmHg or reported the use of anti-hypertensive drugs at the time of survey (21). Smoking was defined based on self-reported past month cigarette or waterpipe smoking. BMI was calculated by dividing weight in kg by the square of height in meters, and obesity was defined as having BMI ≥ 30 (22).

Explanatory variables

In addition to demographic variables used in the analysis (Table 1), scores for socioeconomic status (SES), vegetable and fruit consumption, and physical activity (PA) were derived from multiple inquiries, and were categorized for use in the analysis as outlined in Appendix 1.

Analysis

The survey sample was weighted to account for the complex sampling strategy (e.g. at the city, neighborhood, and household levels). Sampling weights were obtained according to the method described in (23) and reported by our group previously (24). Crude CVD prevalence and mortality rates with the 95% confidence intervals were estimated based on sampling weights using SAS PROC SURVEYMEANS procedure (Table 2). For the calculation of annual death rate among household members ≥ 20 years, the numerator consisted of the number of all reported CVD deaths of household members ≥ 20 years in the past 5 years, while the denominator consisted of the total number of persons ≥ 20 living in these households in the past 5 years plus all reported deaths. Since we did not inquire about the date of death, we assumed a mid point-occurrence (2.5 years) for reported fatalities in order to calculate their contribution to the person-years within the 5-year observation period. Age adjusted annual death rates for the age group 45-74 years ($n=1837$) were calculated according to the WHO standard world population assuming equal gender distribution (25) to allow for comparison with other populations (26).

Prevalence estimates were computed for major CVD risk factors (hypertension, obesity, smoking), and the chi-square test was used to determine demographic and socio-behavioral correlates of these risk factors (Table 3). Missing values for hypertension, obesity or smoking led to the exclusion of these cases from the analysis (total 74 excluded). Multinomial logistic regression analysis was performed to assess correlates of clustering of CVD risk factors with the 0 risk factor group being the reference. Independent variables entered in the model were; neighborhood (formal, informal), age, sex, religion, marital status, education, work status, SES score, physical activity score, and fruit-vegetable consumption score as shown in Table 3. All analyses were done using SAS (version 8.02)

Results

Full socio-demographic characteristics of the study sample are shown in Table 1. The study sample included 2038 household representatives (45.2% men, mean age $\pm$ SD 35.3 $\pm$ 12.1 years, age range 18-65 years, response rate 86%). Prevalence of CVD was 4.8% (95%CI 3.5-6.8) for heart disease, and 1.0% (95%CI 0.6-1.7) for stroke (Table 2). Mortality data were collected on all household members > 20 years (n=6252, 49.5% men), whereby 209 deaths were reported in the past 5 years. Of these deaths, 45.5% (95 cases) were due to CVD, making it the leading cause of mortality in our population. Annual crude death rate due to CVD was 314 per 100,000 (95%CI 215-414), while CVD age-adjusted mortality rate among 45-74 years was 740 per 100,000 (418 for men and 322 for women) (Table 2). Men in general suffered more heart disease mortality, while women suffered more from stroke mortality (Table 2). Mean age of death was 62.6 $\pm$ 15.1 years for CVD (63.6 $\pm$ 15 years for HD and 61.4 $\pm$ 15.3 years for stroke, $p>0.05$). Generally, smokers' mean age of death was 5 years lower (59.9 $\pm$ 15.0 years) than non-smokers' (65 $\pm$ 14.2 years), but the difference was not significant, as was the gender-based difference in mean age of HD or stroke, perhaps due to small sample size (Figure 1). About half of CVD deaths (49.0%) in our population occurred before the age of 65 years.

The prevalence of detected hypertension was 40.6%, compared to 11.8% who reported physician-diagnosed hypertension, and 8.6% who were taking antihypertensive treatment at the time of survey. The prevalence of obesity was 38.2%, and the prevalence of smoking (cigarettes or waterpipe) was 38.7%. In men, 51.4% were daily cigarette smokers who consumed on average 20.8 $\pm$ 14.0 cig/day. The distribution of these risk factors according to different socioeconomic and behavioral attributes studied is given in (Table 3). The prevalence of clustering of these risk factors was 39.3% for 1 risk factor, 27.4% for 2 risk factors, and 8.3% for 3 risk factors. Only 24.9% of adult participants had none of the three risk factors at the time of survey. According to multinomial logistic regression, older, men, less educated, and those with high consumption of fruits-vegetables were more likely to have clustering of CVD risk factors (Table 4).

Discussion

This study puts Syria on the map for the first time in terms of population-derived estimates of CVD burden and its risk factors in this society. This cross-sectional survey was conducted in Aleppo, which is the second largest city in Syria with population of $\approx$ 2,500,000. It shows that CVD/risks are the leading cause of morbidity and mortality in the society. The CVD profile in Aleppo is characterized by a predominance of heart disease compared to stroke, and greater morbidity and mortality from heart disease among men compared to women, while the opposite was noticed for stroke. Men, moreover, have worse CVD risk profile, except for obesity, which affected women more in the Syrian society. Cardiovascular risk factors did not show a clear relationship with socioeconomic status among the studied population, but people with low education had worse risk profiles compared to their counterparts. Smokers generally died about 5 years younger than non-smokers.

The mortality toll from CVD in our population accounting for almost half (45%) of all deaths indicates the progress of the cardiovascular epidemic in Syria in comparison to other developing countries (averaging about 25% of all deaths) (27). In neighboring Jordan, CVD is currently responsible for about 35% of overall deaths (28). Compared to more developed countries, age-adjusted CVD mortality estimates of adults 45-74 years in Syria were higher than those reported in societies with notoriously high CVD burden. For example, stroke mortality rate among women in Syria (424 per 100,000) was higher than in the Ukraine (408 per 100,000) (26), signaling the gravity of this health problem among Syrian women. The predominance of CVD morbidity and mortality among men compared to women, with the exclusion of stroke, has been reported in other populations (3,26,28-31). Among Lebanese adults (> 50 years) for example, men have more than double the risk of dying from coronary heart disease compared to women, while women have about 60% increased risk of dying from stroke compared to men (30).

Observed patterns of CVD morbidity and mortality in Syria likely reflect unequal distributions of CVD risk factors. Heavy smoking, for example, is known to be a strong predictor of myocardial infarction mortality (32,33). In our population, men smoke more than women and are predominantly heavy smokers. Obesity on the other hand, is a known risk factor for stroke in women increasing its risk by 50% (34). As expected, age was a major determinant of CVD morbidity and mortality. However, about half of CVD mortality in our population occurred before the age of 65 years compared to only one fifth occurring before the age 70 years in developed countries (35). This is likely due to a combination of earlier onset and inadequate management.

Hypertension, smoking, and obesity were widely spread among adults in Aleppo, affecting about three quarters of adults in the studied population. Hypertension and smoking were more common among men, while obesity was more a problem of women, affecting almost half of them. Hypertension estimates were comparable to those reported from other Arab countries as well as from developed countries affecting about a third of adults (36-38). However, the fact that most hypertension cases in our population were not diagnosed or treated is alarming, and requires attention of health authorities to this major treatable CVD risk factor.

On the other hand, obesity among women has reached epidemic proportions surpassing those reported in other Arab countries, including the affluent societies of the Arabian Peninsula (37,39-43). To grasp the magnitude of this problem, suffice it to compare our findings (46.3% obesity among women) with estimates from other Mediterranean countries, which share many climatic and nutritional patterns with Syria such as Spain (15.2%), Greece (15%), and Turkey (29.4%) (44-46). On the other hand, obesity among women of Arab origin in the US is lower than that reported in Arab countries (47), indicating the importance of the local environments. Obesity among women in Syria is likely rooted in the social norms and gender roles of traditional Arab societies, whereby women are mainly looked at as child bearer-rearers. Confined to their homes, either due to societal traditions or their pressing household duties, women may have little chance for recreational or sport activities (48). Women in our study had generally lower level of reported physical activity than men (data not shown).

Smoking, traditionally a men's problem in Syria and other Arab societies (49), is gaining ground among women too; nearly a quarter of women currently smoke and 11.5% of them are daily smokers. Cigarette smoking among men has reached dramatic proportions, whereby 51.4% of men are daily cigarette smokers consuming on average more than one pack a day. These figures may help to explain the predominance of CVD morbidity and mortality among men, and point to the seriousness of this risk factor in Syria and similar societies in the EMR.

Because clustering of risk factors has a multiplicative effect on CVD morbidity and mortality (32,33), identification of groups with coexisting risk factors can help predict the course of CVD epidemic within the society as well as plan intervention strategies. In our population, only a quarter of adults were free from the assessed CVD risk factors at the time of survey, which is comparable to recent estimates from the United Arab Emirates (50). Expectedly, age and gender were the main determinants of CVD risk factors as well as their clustering, but what was particularly interesting in our results was the role of education. Low educated people in our population had the worst risk profile, mostly due to obesity and hypertension. But unlike patterns noticed in developed countries (15), higher socioeconomic status in our population was not associated with decreased probability of CVD risk factors. Education in our population therefore, seems to be influencing CVD risks through increased access to health information and adoption of healthy lifestyles rather than access to quality health care. Another sharp contrast with data from developed countries (51) is that increased consumption of fruits and vegetables was associated with a trend for increased CVD risk factors in our population. This paradox is likely rooted in the difference between the Syrian and similar Arab societies from industrialized ones. Fruits and vegetables can be widely affordable in Syria, while information about their beneficial effects on cardiovascular health is not widespread in the society. Frequent consumption of these food items in such setting therefore, may reflect more an indulging lifestyle rather than health-oriented behavior (52). This notion is supported by the high rate of obesity among those with high consumption of fruits/vegetables compared to others in our study. The value of fruit/vegetable consumption as a marker for cardiovascular health therefore, may depend on the level of information about cardiovascular health within the society.

Some limitations of this study involve the survey being conducted in one major urban center in Syria, which affects the generalizability of the results to the whole country. The cross sectional design of this study moreover, while optimal for the assessment of the spread of CVD and risk factors, is less though for the assessment of predictors of these health problems. However, given the lack of published standardized data about CVD and their risk factors in Syria and much of the Arab world, our study of a major urban center (Aleppo), including its large informal neighborhoods harboring much of rural immigrants (18,19), provides important insights about the morbidity and mortality of CVD and their risk factors in Syria. The use of self-reports to identify cases of CVD among participants and mortality cases among their households is another limitation of this study. However, because most CVD are symptomatic and deaths due to heart disease or stroke are likely to be recognized by attending physicians, we think that our estimates reflect to a good extent clinically relevant CVD morbidity and mortality in the studied population. Self-reporting also mandated that we applied common terms used by doctors in our population to describe CVD rather than standard definitions.

Applying population-based sampling and objective measures of risk factors, our data from Aleppo suggest that Syria is likely to be undergoing a dynamic stage, where morbidity and mortality from CVD are high but likely to increase further based on the population's risk factors profile. The study highlights the fact that the behavioral basis of CVD, in terms of over-nutrition/under-activity and smoking, are widespread within the Syrian society. Social traditions and gender roles moreover, may be predisposing women in particular to increased risk of obesity by restricting their recreational activities and physical exercise. The lack of a clear socioeconomic gradient in CVD risk factors suggests that the shift from CVD being the problem of the rich to it being the problem of the poor has not yet occurred in the Syrian society. Our data suggests that those with access to information may be able to modify their behavior to avoid CVD. While the debate of what are the optimal solutions to curb the CVD epidemic in developing countries continues (53), having reliable estimates of CVD and their risk factors in the population is the first essential step to being able to mount an adequate response to this escalating epidemic.

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Appendix 1

variables used to construct the socioeconomic status, fruit-vegetable consumption, and physical activity scores.

	value 0	value 1	value 2
Socioeconomic status score (0-12)			
Education	illiterate	≤ 9 years	> 9 years
Employment	unemployed, student	employed (manual, private, government), retired	employer, private business
Items ownership (phone, mobile phone, PC, AC, private car, TV, satellite dish)	≤2	3-4	> 4 or private car
Household members with paid job	0	1	> 1
Self reported monthly income	< 10,000 SL	10,000-20,000	> 20,000
Density index (household/rooms)	≥ 2.3	1.5-2.3	< 1.5
Fruit-vegetable consumption score (0-4)			
Frequency of vegetable intake/past month	Little (1-2 times/week)	Frequent, but less than daily	At least once daily
Frequency of fruit consumption/past month	Little (1-2 times/week)	Frequent, but less than daily	At least once daily
Physical activity score (0-4)			
Regular practice of sports	No	Yes (<3 times/week)	Yes (≥3 times/week)
Frequency of >10 minutes walk/past month	None or rarely	1-2 days/week	3 or more days/week

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* There was one case of mortality with no smoking records, so it was included in the total mean but not the smoking stats means

Figure 1.

Mean age of death for household members diseased in the 5 years prior to the survey according to their smoking status during the 5 years leading to their death.

variables used to construct the socioeconomic status, fruit-vegetable consumption, and physical activity scores.

	value 0	value 1	value 2
Socioeconomic status score (0-12)			
Education	illiterate	≤ 9 years	> 9 years
Employment	unemployed, student	employed (manual, private, government), retired	employer, private business
Items ownership (phone, mobile phone, PC, AC, private car, TV, satellite dish)	≤2	3-4	> 4 or private car
Household members with paid job	0	1	> 1
Self reported monthly income	< 10,000 SL	10,000-20,000	> 20,000
Density index (household/rooms)	≥ 2.3	1.5-2.3	< 1.5
Fruit-vegetable consumption score (0-4)			
Frequency of vegetable intake/past month	Little (1-2 times/week)	Frequent, but less than daily	At least once daily
Frequency of fruit consumption/past month	Little (1-2 times/week)	Frequent, but less than daily	At least once daily
Physical activity score (0-4)			
Regular practice of sports	No	Yes (<3 times/week)	Yes (≥3 times/week)
Frequency of >10 minutes walk/past month	None or rarely	1-2 days/week	3 or more days/week

Table 1

Basic description of the study's sample (n=2038)

		N (%)
Neighborhood	Non-formal	1021 (50.1)
	Formal	1017 (49.9)
Age		
	18-29 years	736 (36.1)
	30-45 years	874 (42.9)
	46-65 years	428 (21.0)
Sex		
	Men	921 (45.2)
	Women	1117 (54.9)
Religion		
	Muslim	1938 (95.3)
	Non-Muslim	95 (4.7)
Marital status		
	Single, divorced, widowed	494 (24.2)
	Married	1544 (75.8)
Education		
	≤9 years	1556 (76.3)
	≥9 years	482 (23.7)
Work status		
	Student	119 (5.8)
	Employed	938 (46.0)
	House-person, retired	981 (48.1)
Socioeconomic status (SES score)		
	Low	791 (38.8)
	Middle	710 (34.8)
	High	537 (26.3)

Table 2

Crude and age-adjusted morbidity and mortality rates due to CVD among adults in Aleppo, Syria

<i>Morbidity estimates</i> [*] (N=2038)	Men % (95% CI)	Women % (95% CI)	Total % (95% CI)
Prevalence			
Heart disease (n=96)	6.2 (3.6-10.5)	3.7 (2.5-5.5)	4.8 (3.5-6.8)
Stroke (n=22)	0.9 (0.5-1.7)	1.0 (0.5-2.1)	1.0 (0.6-1.7%)
All (n=108)	6.5 (3.9-10.7)	4.6 (3.3-6.5)	5.4 (4.0-7.3)
<i>Mortality estimates</i> ^{**} (N=6252)	per 100,000 (95% CI)	per 100,000 (95% CI)	per 100,000 (95% CI)
Crude rates			
Heart disease (n=53)	215 (107-323)	144 (28-261)	179 (96-262)
Stroke (n=42)	115 (58-172)	155 (48-262)	135 (74-197)
All (n=95)	330 (207-453)	299 (148-450)	314 (215-414)
Age-adjusted rates [†] (45-74 years) (N=1837)			
Heart disease	433 (193-672)	398 (10-805)	418 (164-673)
Stroke	246 (78-414)	424 (19-829)	322 (130-514)
All	679 (392-966)	822 (254-1390)	740 (430-1051)

* based on participants' self-report of physician-diagnosed condition

** based on participants' self-report of deaths among their household members ≥ 20 years in the previous 5 years

[†] adjusted for the WHO world population as a standard and assuming equal gender distribution

Table 3

Prevalence of major CVD risk factors according to different demographic and socioeconomic parameters among adults in Aleppo, Syria (n=2038)

	Hypertension % (n)	Smoking % (n)	Obesity % (n)
Total	40.6 (747)	38.7 (898)	38.2 (778)
Neighborhood			
Non-formal	40.1 (390)	37.6 (429)	37.0 (377)
Formal	41.0 (357)	39.5 (469)	39.9 (401)
Age			
18-29 years	26.8 (176)	35.7 (278)	15.8 (119)
30-45 years	36.7 (304)	43.2 (445)	44.7 (392)*
46-65 years	66.3(267)	37.3 (175)	63.2(267)
Sex			
Men	47.4 (400)	63.6 (613)	28.8 (261)
Women	34.9(347)*	19.2(285)*	46.4(517)*
Religion			
Muslims	41.2 (711)	38.2 (844)	38.7 (743)
Non-Muslim	28.8 (33)*	48.7 (51)*	34.6 (33)
Marital status			
Married	43.8 (591)	42.3 (719)	44.5 (679)
Single, divorced, widowed	34.1 (156)	31.2(179)*	20.5 (99)*
Education			
≤9 yrs	42.1 (589)	40.1 (703)	41.3 (617)*
>9 yrs	36.5 (158)	34.7 (195)	28.8(161)
Work status			
Student	18.5 (31)	20.6 (35)	10.2 (13)
Employed	45.2 (379)	58.9 (583)	30.2 (277)
House-person, retired	39.9 (337)*	22.5 (280)*	50.3 (488)*
Socioeconomic status (SES score)			
Low	44.8 (295)	27.7 (269)	46.3 (358)
Middle	36.7 (260)	39.3 (353)	33.8 (240)
High	41.3 (192)	47.8(276)*	34.3(180)*
Fruit-vegetable consumption score			
Low	37.0 (162)	38.7 (205)	28.5 (144)
Middle	40.6 (371)	37.2 (424)	39.9 (367)
High	43.0 (214)	40.7 (269)	41.6 (267)
Physical activity score			
Low	39.6 (256)	32.8 (288)	40.6 (306)
Middle	43.1 (403)	40.8 (475)	38.9 (392)
High	33.7 (88)	48.1 (135)	30.9 (80)

* $p < 0.05$ according to χ^2 test

Table 4
Correlates of clustering of CVD risk factors among adults in Aleppo, Syria (n=1958).

	Single risk factor OR (95% CI)	Two risk factors OR (95% CI)	Three risk factors OR (95% CI)
Neighborhoods			
Non-formal	0.84 (0.64-1.11)	1.10 (0.80-1.50)	0.92 (0.60-1.43)
Formal	Ref	Ref	Ref
Age	1.06 (1.04-1.07)*	1.11 (1.10-1.13)*	1.11 (1.09-1.13)*
Sex			
Men	3.13 (2.13-4.60)*	3.79 (2.44-5.90)*	6.78 (3.58-12.9)*
Women	Ref	Ref	Ref
Religion			
Muslims	0.92 (0.50-1.69)	0.93 (0.49-1.83)	0.88 (0.35-2.22)
Non-Muslim	Ref	Ref	Ref
Marital status			
Single, divorced, widowed	0.93 (0.68-1.28)	0.96 (0.66-1.40)	0.62 (0.33-1.14)
Married	Ref	Ref	Ref
Education			
≤9 yrs	1.83 (1.26-2.65)*	1.83 (1.20-2.78)*	2.01 (1.14-3.55)*
>9 yrs	Ref	Ref	Ref
Work status			
Student	0.74 (0.40-1.40)	1.24 (0.57-2.66)	0.37 (0.07-1.94)
Employed	1.03 (0.67-1.58)	0.76 (0.47-1.23)	0.57 (0.29-1.12)
House-person, retired	Ref	Ref	Ref
Socioeconomic status (SES score)			
Low	1.06 (0.70-1.61)	1.01 (0.63-1.62)	0.81 (0.42-1.57)
Middle	0.93 (0.65-1.33)	0.85 (0.57-1.28)	1.02 (0.59-1.75)
High	Ref	Ref	Ref
Fruit-vegetable consumption score			
Low	0.89 (0.63-1.26)	0.72 (0.48-1.08)	0.44 (0.24-0.80)*
Middle	0.93 (0.69-1.25)	0.86 (0.61-1.21)	0.79 (0.50-1.24)
High	Ref	Ref	Ref
Physical activity score			
Low	0.84 (0.56-1.28)	1.04 (0.64-1.69)	0.71 (0.37-1.33)
Middle	0.73 (0.49-1.08)	0.96 (0.61-1.53)	0.30-0.97)*
High	Ref	Ref	Ref

* $P < 0.05$ according to multinomial logistic regression with all listed variables included in the model for each OR