Worsening of the Cardiovascular Profile in a Developing Country

The Greater Beirut Area Cardiovascular Cohort

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ABSTRACT

Background: Lebanon has no established governmental noncommunicable diseases surveillance and monitoring system to permit reporting on noncommunicable diseases rates. The last World Health Organization-supported surveillance report showed worrying trends in cardiovascular disease (CVD) risk factors.

Objectives: A cardiovascular cohort was established to permit CVD outcomes studies in an urban sample in the Lebanese capital and the study in hand presents the baseline CVD risk factors of this cohort.

Methods: A cross-sectional study was carried out including 501 Lebanese adults (64.3% women) from the Greater Beirut area using random multistage probability sampling. Interviews, physical exams, and blood withdrawal were conducted to collect information on demographic and lifestyle factors, body mass index, blood pressure, fasting blood glucose, blood lipids, as well as history of coronary artery diseases, hypertension, diabetes mellitus type 2, dyslipidemia, and stroke. Means with SD for continuous variables and frequencies and percentages for categorical variables are reported.

Results: The prevalence CVD risk factors including obesity, smoking, diabetes mellitus type 2, hypertension, and dyslipidemia prevalence in the Greater Beirut area was higher than that reported for the general population. Important sex and age differences were also observed, whereby older participants and women had higher rates of obesity, diabetes mellitus type 2, and dyslipidemia and younger participants and men were engaged more in cigarette smoking and alcohol consumption. Interestingly, water pipe smoking was similarly prevalent among genders.

Conclusions: The overall prevalence of CVD risk factors in this urban population is higher than reported in the 2010 World Health Organization Stepwise Approach to Surveillance report on the Lebanese population, indicating that the urban population in the capital carries a higher burden of CVD risk. In addition, sex and age difference rates of CVD risk factors highlight the need for tailored public health measures to tackle the sex- and age-based CVD risk factors.

Lebanon is a Mediterranean, Middle Eastern country with 87% of its population living in urban areas. Similar to the region, it suffers from a high burden of noncommunicable diseases (NCD) whereby NCD account for 85% of the total annual deaths. Cardiovascular diseases (CVD) constitute 47% of the total annual deaths. According to the World Health Organization (WHO), the age-standardized death rates attributable to CVD have dropped by 30% in the last decade, which can be explained by the improvements in the health care system in the country [1]. Still, a recent cross-sectional study demonstrated that 13.4% of the Lebanese population aged ≥40 years suffer from coronary heart diseases (CHDs) [2]. The latter could be explained by a trend of escalating rates of CVD risk factors that was demonstrated in the 2008 WHO STEP-wise approach to Surveillance (STEPS).

The STEPS survey represents the latest population-wide comprehensive profile of CVD risk factors in Lebanon. The report was released in 2010 showing high levels of obesity, smoking, hypertension (HTN), and type 2 diabetes mellitus (T2D), with clear sex and age disparities [3]. In addition, few studies reported on individual CVD risk factors in Lebanon, including HTN [4], T2D [5], dyslipidemia [6], obesity [7-9], physical activity [10], and nutrition [11,12]. Since this report, and because Lebanon has no established governmental NCD surveillance and monitoring system to permit reporting on NCD rates, nongovernmental organizations including universities have

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TABLE 1. Associations among demographics, lifestyles, and sex

	All	Male	Female	p Value
Sample	501 (100)	179 (35.7)	322 (64.3)	
Demographic				
Age, yrs	45.4 ± 15.0	41.9 ± 16.4	47.3 ± 13.9	<0.0001
<40	181 (36.1)	84 (46.9)	97 (30.1)	<0.0001
40–60	238 (47.5)	66 (36.9)	172 (53.4)	
>60	82 (16.4)	29 (16.2)	53 (16.5)	
Lifestyle				
Smoking cigarettes				
Yes	216 (43.1)	96 (53.6)	120 (37.3)	<0.0001
Cigarettes/day	23.0 ± 15.2	26.5 ± 16.8	20.2 ± 13.3	0.009
Smoking water pipe				
Yes	142 (28.3)	49 (27.4)	93 (28.9)	0.72
Narguileh/day	1.4 ± 1.0	1.2 ± 1.0	1.5 ± 0.9	0.15
Alcohol				
Yes	95 (19.0)	74 (41.3)	21 (6.5)	<0.0001
Glasses/week	6.1 ± 9.7	6.6 ± 10.6	3.9 ± 3.9	0.32
Coffee				
Yes	403 (80.4)	137 (76.5)	266 (82.6)	0.10
Cups/day	3.5 ± 3.0	3.7 ± 3.4	3.4 ± 2.7	0.39
Physical activity				
None	79 (15.8)	32 (17.9)	47 (14.6)	0.33
Low intensity	239 (47.7)	83 (46.4)	156 (48.4)	0.88
Moderate intensity	156 (31.1)	58 (32.4)	98 (30.4)	
High intensity	106 (21.2)	38 (21.2)	68 (21.1)	
Total sitting time/day, min	291.9 ± 176.1	314.5 ± 186.7	279.2 ± 168.8	0.03

Values are n (%) or mean ± SD.

taken the initiative to assess population prevalence of NCD.

The GBACC (Greater Beirut Area Cardiovascular Cohort) is among these initiatives and is an urban sample representative of the Lebanese population residing in Beirut the capital of Lebanon [13]. The long-term goal of this cohort is to enable follow-up studies with outcomes data that address a current gap in the published reports. The study in hand describes the baseline CVD risk factors of this cohort in association with age and sex.

METHODS

This cross-sectional study among representative sample of the Lebanese population residing in Beirut, the capital of Lebanon, reports the epidemiology of CVD risk factors in the GBACC. The data collection took place at the American University of Beirut for a period of 5 months. The Institutional Review Board at the American University of Beirut provided approval to conduct the study (approval number IM.HT.03).

Study Population

The target population of our study was Lebanese adults, residing in Greater Beirut area and ages ≥18 years old. Pregnant women, mentally disabled people, and patients on dialysis were excluded from the sample.

Sampling Technique and Sample Size

Following the same methodology as the last WHO STEPS conducted in Lebanon [3], a representative sample of the Lebanese population in Beirut was selected randomly, based on a multistage probability sampling, where the strata would be the districts (the clusters) of Central Administrative Beirut. The second stage was selecting neighborhoods inside each selected area, and then selecting households based on a systematic random sample in each selected neighborhood and finally sampling a primary respondent within each household based on the most recent birthday.

If the selected respondent accepted to participate in the project, a written informed consent document was signed by the participants.

Data Collection

At the university, a detailed data collection form was completed for each subject, through interviews, physical exams, and blood withdrawal. In the current study, the relevant information assessing the cardiovascular profile and risk factors was retrieved from the original GBACC

TABLE 2. Associations among medical history, laboratory results, physical evaluation, and sex

	All	Male	Female	p Value
Sample, n	501	179	322	
Medical history				
Coronary artery disease				
Heart attack	22 (4.4)	7 (3.9)	15 (4.7)	0.70
Cardiac catheterization	45 (9.0)	19 (10.6)	26 (8.1)	0.34
Stent placement	10 (2.0)	6 (3.4)	4 (1.2)	0.18
Coronary heart bypass surgery	4 (0.8)	2 (1.1)	2 (0.6)	0.62
Family history of coronary artery diseases	190 (37.9%)	57 (31.8)	133 (41.3)	0.04
Hypertension				
Yes	182 (36.4)	68 (38.0)	114 (35.5)	0.58
T2D				
Existing T2D	64 (12.8)	19 (10.6)	45 (14.0)	0.28
Treated T2D (n = 64)	57 (89.1)	16 (84.2)	41 (91.1)	0.42
Treatment: lifestyle modifications (n = 64)	23 (35.9)	4 (21.1)	19 (42.2)	0.11
Treatment: drugs (n = 64)	57 (89.1)	16 (84.2)	41 (91.1)	0.42
No T2D	209 (41.7)	66 (36.9)	143 (44.4)	0.10
At risk of T2D	202 (40.3)	86 (48.0)	116 (36.0)	0.01
Probable T2D	90 (18.0)	27 (15.1)	63 (19.6)	0.21
Definite T2D	75 (15.0)	23 (12.8)	52 (16.1)	0.32
Dyslipidemia				
Existing dyslipidemia	120 (24.0)	34 (19.0)	86 (26.7)	0.05
Treated dyslipidemia (n = 120)	89 (74.2)	27 (79.4)	62 (72.1)	0.41
Treatment: lifestyle modifications (n = 120)	52 (43.3)	16 (47.1)	36 (41.9)	0.61
Treatment: drugs (n = 120)	64 (53.3)	15 (44.1)	49 (57.0)	0.20
Stroke	7 (1.4)	2 (1.1)	5 (1.6)	1.00
Laboratory tests				
Glucose, mg/dl	112.1 ± 43.4	111.3 ± 36.1	112.5 ± 47.0	0.77
Serum creatinine, mg/dl	0.8 ± 0.2	0.9 ± 0.2	0.7 ± 0.2	<0.0001
HBA_{1C}, %	5.9 ± 1.4	5.8 ± 1.3	6.0 ± 1.4	0.16
Cholesterol, mg/dl	186.0 ± 43.3	181.9 ± 46.2	188.3 ± 41.5	0.12
Triglyceride, mg/dl	141.5 ± 102.0	165.1 ± 137.9	128.4 ± 72.2	0.001
HDL, mg/dl	49.6 ± 14.8	43.3 ± 11.0	53.11 ± 15.5	<0.0001
LDL, mg/dl	108.8 ± 37.6	107.5 ± 40.8	109.6 ± 35.8	0.56
Physical evaluation				
BMI, kg/m^2	29.1 ± 5.8	28.0 ± 5.2	29.7 ± 6.0	0.001
<30	293 (58.5)	118 (65.9)	175 (54.3)	0.01
≥30	208 (41.5)	61 (34.1)	147 (45.7)	
Body fat	28.6 ± 11.5	24.3 ± 11.3	31.0 ± 10.9	<0.0001
Muscle mass	26.3 ± 6.4	32.9 ± 5.0	22.6 ± 3.3	<0.0001
Waist-to-hip ratio	1.0 ± 0.1	1.0 ± 0.1	1.0 ± 0.1	0.12
Waist circumference	95.8 ± 15.6	98.1 ± 13.4	94.6 ± 16.5	0.02
Heart rate	77.9 ± 10.3	78.1 ± 10.6	77.8 ± 10.1	0.71
Systolic blood pressure	121.9 ± 19.3	127.1 ± 18.9	119.0 ± 19.0	<0.0001
Diastolic blood pressure	75.3 ± 10.2	79.2 ± 9.8	73.2 ± 9.9	<0.0001

Values are n (%) or mean ± SD, unless otherwise indicated.
BMI, body mass index; HBA_{1C}, glycosylated hemoglobin; HDL, high-density lipoprotein; LDL, low-density lipoprotein; T2D, type 2 diabetes mellitus.

database. Information included demographic and lifestyle factors, such as age, sex, smoking, alcohol and coffee consumption, and physical activity, were requested. Alcohol drinking was defined according to the Centers for Disease Control and Prevention definition of binge drinking [14]. Cigarette and water pipe smoking were measured sby number of cigarettes or water pipes per day. Coffee consumption was measured in number of cups per day and heavy coffee drinking was defined as >4 cups per day, approximately equivalent to 400 mg of caffeine. Physical activity was categorized into low-, moderate-, and high-intensity activity based on the International Physical

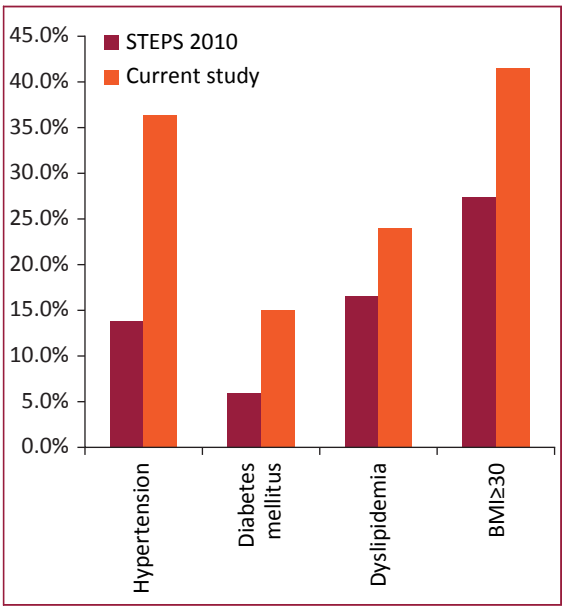

FIGURE 1. Comparison in findings related to medical history and physical evaluation for the overall groups between the latest World Health Organization STEP-wise approach to Surveillance (STEPS) report for Lebanon (2010) and the current study. BMI, body mass index.

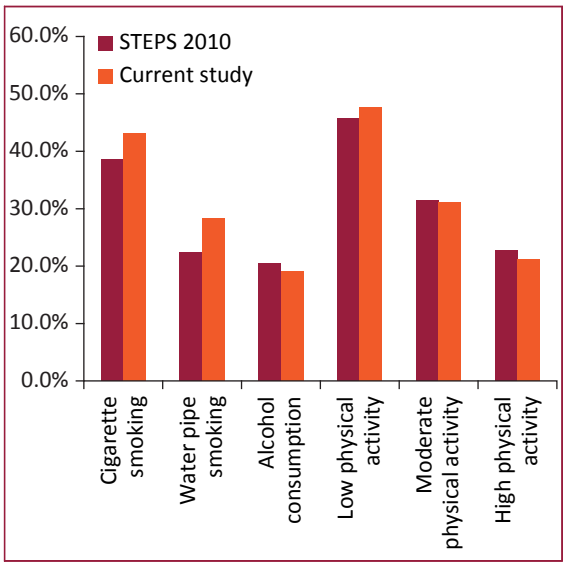

FIGURE 2. Comparison in findings related to lifestyle risk factors for the overall groups between the latest World Health Organization STEP-wise approach to Surveillance (STEPS) report for Lebanon (2010) and the current study.

Activity Questionnaire classification of physical activity levels [15]. Height, weight, and waist and hip circumference were taken by standard methods and calibrated equipment. Body mass index (BMI) was calculated [16]. Obesity was set at a cutoff of BMI $\geq$30 kg/m^2. Systolic and diastolic blood pressures were determined on 2 different occasions using a standard digital sphygmomanometer. Hypertensive individuals were defined as those with systolic blood pressure $\geq$140 mmHg and/or diastolic blood pressure $\geq$90 mmHg or those who are aware of being hypertensive [17].

Fasting serum glucose (FPG), cholesterol, triglycerides, high-density lipoprotein, low-density lipoprotein, and blood for glycosylated hemoglobin were measured by standard laboratory methods. Coronary artery diseases (CAD), HTN, T2D, dyslipidemia, and stroke were also self-reported. Respondents were asked whether a doctor ever told them that they currently have or had one of the cited diseases and whether they are treated for it. Subjects were also classified according to the American Diabetes Association criteria into 1 of 4 classes. Namely, having 1) definite T2D, if they had history of T2D and/or both FPG $\geq$126 mg/dl and glycosylated hemoglobin (HbA_{1C}) $\geq$6.5% (48 mmol/mol); 2) probable T2D, if they had history of T2D and/or either FPG $\geq$126 mg/dl or HbA_{1C} $\geq$6.5% (48 mmol/mol); 3) at risk for T2D or prediabetes, if they had no history of T2D and FPG between 100 and 125 mg/dl and/or HbA_{1C} between 5.8% and 6.49% (40 and 47 mmol/mol); and 4) no T2D or euglycemic, if they had no history of T2D and an FPG $<$100 and HbA_{1C} $<$5.8% (40 mmol/mol).

A subject was considered to have a family history of CAD when a first-degree male relative (e.g., father, brother) has experienced a heart attack before the age of 55 years or

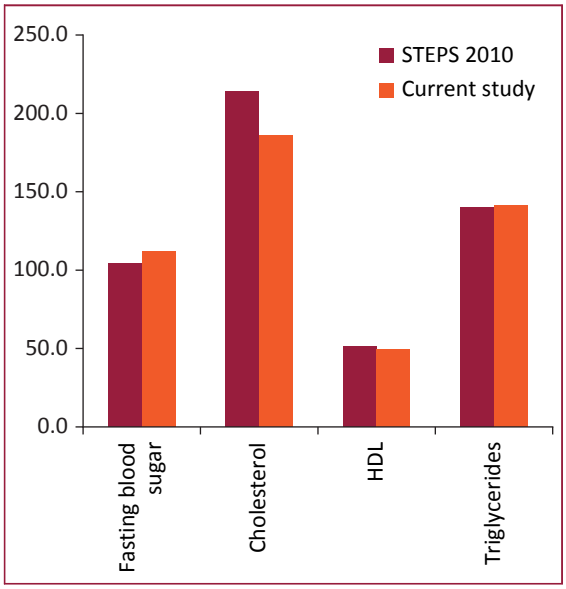

FIGURE 3. Comparison in findings related to laboratory results for the overall groups between the latest World Health Organization STEP-wise approach to Surveillance (STEPS) report for Lebanon (2010) and the current study. HDL, high-density lipoprotein.

if a first-degree female relative has suffered one before the age of 65 years.

Statistical Analyses

Data was entered into a database using SPSS 22 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive analyses were conducted to describe the cohort, where means with SD for continuous variables and frequencies and percentages for categorical variables were reported. Inferential statistics were carried out to assess the associations between different factors and sex and age groups using either the independent *t*-test or the chi-square test. Correlation analysis using Pearson correlation coefficient was performed between all continuous variables. A p value ≤ 0.05 was used to indicate significance in all cases.

Ethical Considerations

All procedures were done in a manner that ensures the confidentiality of the individuals and by Collaborative Institutional Training Initiative-certified workers. The patients signed the consent form after being briefed about the study aims and methods of implementation. None of the data collection measures bore any long-term hazards, and all blood withdrawal was done under sterile hygienic conditions. Furthermore, all data collected was stored in a manner that ensured no breach of participants' privacy.

RESULTS

A total of 501 participants (64.3% women) were included in this study. While almost one-half of the participants reported smoking cigarettes and the water pipe, the majority reported engaging in physical activity (Table 1). Although the prevalence of heart attack and stroke in the sample was low, the proportion of subjects with CVD risk factors was high, especially for HTN and a family history of CAD. The majority of subjects with T2D were treated. Still, a large proportion of the sample was at risk of T2D based on laboratory findings and over one-quarter were not treated for dyslipidemia (Table 2). Moreover, the prevalence of CVD risk factors including obesity, smoking, T2D, HTN, and dyslipidemia prevalence was higher than that reported in 2010 for the general population (Figures 1 to 3).

In comparison to men, women were as likely to smoke the water pipe, whereas men more commonly reported smoking cigarettes and drinking alcohol. Additionally, men spent more time sitting per day. There was no significant difference in doing physical activity, but physical activity was slightly higher for women (Table 1). Moreover, women were more likely to be obese and have dyslipidemia, whereas men were more likely to have higher systolic and diastolic blood pressures (Table 2). The middle-aged group (40 to 60 years) had the highest rate of cigarette smoking whereas the younger (<40 years) had the highest water pipe smoking and alcohol consumption rates, although the older (>60 years) drank the highest number of glasses of alcohol per week.

Three-quarters of the older group had HTN, in addition to having the highest BMI and total sitting time. More than one-third of the younger group was at risk of T2D, but the majority was engaged in physical activity (Tables 3 and 4).

To determine which variables are independently associated with HTN, dyslipidemia, and T2D, we performed a logistic regression analysis utilizing 1 model per outcome (Table 5). Increasing age, BMI, T2D, dyslipidemia, and triglyceridemia were independent predictors of HTN. Alcohol intake, high-density lipoprotein, and physical activity were protective against T2D, whereas HTN, dyslipidemia, and triglyceridemia were associated with increased T2D. On the other hand, increasing age, BMI, HTN, and triglyceridemia were found to be associated with dyslipidemia.

DISCUSSION

In this study, we assessed the association between various variables related to cardiovascular profile, risk factors, and the sex and age groups in a sample of 501 participants from Greater Beirut area. The CVD and stroke event rates were low and most of the participants engaged in physical activity. However, the rates of smoking, obesity, HTN, and T2D were high, with clear sex and age differences. Moreover, obesity, smoking, T2D, HTN, and dyslipidemia

TABLE 3. Associations among demographics, lifestyles, and age groups

	<40 yrs	40–60 yrs	>60 yrs	p Value
Sample, n	181	238	82	
Demographic				
Female	97 (53.6)	172 (72.3)	53 (64.6)	<0.0001
Lifestyle				
Smoking cigarettes				
Yes	71 (39.2)	121 (50.8)	24 (29.3)	0.001
Cigarettes/day	22.6 ± 16.1	23.1 ± 14.5	23.7 ± 16.6	0.95
Smoking water pipe				
Yes	84 (46.4)	51 (21.4)	7 (8.5)	<0.0001
Narguileh/day	1.6 ± 1.0	1.2 ± 0.9	1.4 ± 0.9	0.18
Alcohol				
Yes	58 (32.0)	25 (10.5)	12 (14.6)	<0.0001
Glasses/week	5.8 ± 10.5	6.5 ± 8.5	6.7 ± 8.7	0.94
Coffee				
Yes	123 (68.0)	216 (90.8)	64 (78.0)	<0.0001
Cups/day	2.9 ± 2.9	3.9 ± 3.1	3.1 ± 2.4	0.01
Physical activity				
None	26 (14.4)	36 (15.1)	17 (20.7)	0.39
Low intensity	73 (40.3)	119 (50.0)	47 (57.3)	0.06
Moderate intensity	61 (33.7)	71 (29.8)	24 (29.3)	
High intensity	47 (26.0)	48 (20.2)	11 (13.4)	
Sitting time/day, min	296.1 ± 182.7	280.2 ± 171.7	316.7 ± 172.7	0.25

Values are n (%) or mean ± SD, unless otherwise indicated.

TABLE 4. Associations among medical history, laboratory results, physical evaluation, and age groups

Variables	<40 yrs	40–60 yrs	>60 yrs	p Value
Sample, n	181	238	82	
Medical history				
Coronary artery disease				
Heart attack	2 (1.1)	11 (4.6)	9 (11.0)	0.001
Cardiac catheterization	2 (1.1)	19 (8.0)	24 (29.3%)	<0.0001
Stent placement	0 (0.0)	6 (2.5)	4 (4.9%)	0.02
Coronary heart bypass surgery	1 (0.6)	2 (0.8)	1 (1.2)	0.85
Family history of coronary artery diseases	73 (40.3)	90 (37.8)	27 (32.9)	0.52
Hypertension				
Yes	30 (16.7)	93 (39.1)	59 (72.0)	<0.0001
T2D				
Existing T2D	4 (2.2)	37 (15.5)	23 (28.0)	<0.0001
Treated T2D (n = 64)	4 (100.0)	32 (86.5)	21 (91.3)	0.65
Treatment: lifestyle modifications (n = 64)	1 (25.0)	10 (27.0)	12 (52.2)	0.13
Treatment: drugs (n = 64)	4 (100.0)	32 (86.5)	21 (91.3)	0.65
No T2D	113 (62.4)	84 (35.3)	12 (14.6)	<0.0001
At risk of T2D	63 (34.8)	100 (42.0)	39 (47.6)	0.11
Probable T2D	5 (2.8)	54 (22.7)	31 (37.8)	<0.0001
Definite T2D	4 (2.2)	47 (19.7)	24 (29.3)	<0.0001
Dyslipidemia				
Existing dyslipidemia	7 (3.9)	78 (32.8)	35 (42.7)	<0.0001
Measured cholesterol	60 (33.1)	151 (63.4)	57 (69.5)	<0.0001
Treated dyslipidemia (n = 120)	4 (57.1)	58 (74.4)	27 (77.1)	0.54
Treatment: lifestyle modifications (n = 120)	2 (28.6)	39 (50.0)	11 (31.4)	0.13
Treatment: drugs (n = 120)	2 (28.6)	38 (48.7)	24 (68.6)	0.06
Stroke	1 (0.6)	3 (1.3)	3 (3.7)	0.13
Laboratory tests				
Glucose, mg/dl	98.5 ± 24.8	114.8 ± 41.7	133.8 ± 65.3	<0.0001
Serum creatinine, mg/dl	0.8 ± 0.2	0.7 ± 0.2	0.8 ± 0.3	0.001
HBA_{1C}, %	5.4 ± 0.7	6.1 ± 1.4	6.7 ± 1.9	<0.0001
Cholesterol, mg/dl	172.0 ± 36.6	193.6 ± 43.5	195.3 ± 48.5	<0.0001
Triglyceride, mg/dl	128.5 ± 83.9	145.2 ± 80.5	159.4 ± 169.9	0.06
HDL, mg/dl	48.9 ± 14.5	50.3 ± 14.6	49.1 ± 16.1	0.62
LDL, mg/dl	97.9 ± 31.0	114.9 ± 38.7	115.5 ± 42.3	<0.0001
Physical evaluation				
BMI, kg/m^2	27.1 ± 5.6	30.2 ± 5.9	30.2 ± 4.6	0.001
<30	135 (74.6)	124 (52.1)	34 (41.5)	<0.0001
≥30	46 (25.4)	114 (47.9)	48 (58.5)	
Body fat	24.8 ± 11.7	30.8 ± 11.5	30.9 ± 8.5	<0.0001
Muscle mass	27.9 ± 6.8	25.8 ± 6.1	24.1 ± 5.5	<0.0001
Waist-to-hip ratio	1.0 ± 0.1	1.0 ± 0.1	1.0 ± 0.1	<0.0001
Waist circumference	89.6 ± 13.0	98.9 ± 17.0	100.9 ± 11.3	<0.0001
Heart rate	78.8 ± 11.0	77.4 ± 10.1	77.4 ± 9.0	0.32
Systolic blood pressure	116.3 ± 15.4	121.1 ± 18.5	136.8 ± 22.0	<0.0001
Diastolic blood pressure	73.9 ± 9.6	75.4 ± 10.7	78.2 ± 9.5	0.007

Values are n (%) or mean ± SD, unless otherwise indicated.
Abbreviations as in Table 2.

prevalence rates were found to be higher than those reported in the WHO STEPS report in 2010 for the Lebanese population. The assessed outcomes in our cohort show an increasing rate of CVD risk factors comparable to other reports from Lebanon and the Middle East region.

The CVD event rate in our study is low and comparable to that reported among asymptomatic users of a primary health care network in Lebanon [18]. It is lower, though, than that reported by Zeidan et al. [2], where it was demonstrated that 13.4% of the Lebanese population

ages ≥40 years suffer from CHD. CHD was defined in that study as self-reported previous myocardial infarction, having had percutaneous coronary intervention, or coronary artery bypass graft [2]. Although the CHD definition used is similar to our study, our cohort includes adults 18 years and older, possibly reducing the prevalence in our cohort. On the other hand, according to the 2014 WHO NCD country profiles, death rates attributable to CVD rates in neighboring countries such as Syria (28%), Jordan (35%), and Iraq (33%) are lower than that of Lebanon (47%).

In our study, more than one-third of the participants reported or were found to have HTN, which is more than double of what was reported in the WHO STEPS survey [3]. The latter is a simple, standardized method for collecting, analyzing, and disseminating data in WHO member countries by using the same standardized questions and protocols, for monitoring within-country trends. In the WHO STEPS study, HTN was based on self-reporting while in our study in addition to self-reporting, we measured blood pressure on 2 different occasions. This difference could have led to identifying a group of HTN individuals who were not aware of the diagnosis in our study and therefore partly explain the higher prevalence of HTN in our study. This finding needs to be further explored given the importance of screening for HTN so proper therapy can be initiated. Another explanation for this elevated HTN rate could be that our study included individuals from an urban area, whereas the WHO STEPS study was from both urban and rural areas, and data from other countries suggests that, compared with rural areas, urban areas have higher prevalence of HTN [19]. In another report in 2011, the WHO reported 39% of individuals among the general population to have HTN, which is closer to the number we are reporting [1]. This provides further confirmation that overall the prevalence of HTN is increasing in Lebanon. In the region, countries such as Jordan have lower HTN rates of 28.8%. In an attempt to combat this alarming trend, earlier efforts to work on national salt intake reduction identified levels and sources of salt intake in the Lebanese [20]. This, however, did not translate into concrete steps in terms of health policy changes yet. The barriers preventing reaching these changes must be understood to permit heath policy changes that can curb this concerning increase in HTN.

Because of its adverse effects on cardiovascular structure and function, obesity has a major impact on CVD, such as heart failure, coronary heart disease, sudden cardiac death, and atrial fibrillation, and obesity is associated with reduced overall survival [21]. Studies on adult men and women in Lebanon showed that obesity prevalence rates have increased during the past decade from 17% in 1997 to 27.4% in 2010 [3,22]. The prevalence of obesity in our cohort was the highest among women (45.7%) and older participants (58.5%) and is overall (41.5%) higher than that reported by the STEPS survey. This is double the estimate in the 2008 WHO country NCD profile (27.4%), but with similar sex differences. Regional neighbors have similar obesity rates, such as Syria (27%) or even higher such as Jordan (30%). Tackling this increasing rate of obesity is a heated subject currently in Lebanon and worldwide. Recent data suggest that surgical interventions to treat obesity could reduce all-cause mortality and may have favorable long-term CVD outcomes, although more data are needed to confirm the latter [23]. Moreover, data is now emerging suggesting that there is a cost for delaying access to surgery [24]. Accordingly, it is not surprising that in the Middle East region and Lebanon, the number of bariatric surgical interventions is on the rise [25]. However, these surgeries are not without complications [26] and are also costly [24]. More importantly, a recent bariatric

TABLE 5. Logistic regression analysis to determine the predictors of hypertension, T2D, and dyslipidemia in the cohort

Predictors	OR (95% CI)	p Value
Hypertension		
Age, yrs		
40–60	1.82 (1.06–3.11)	0.03
>60	8.09 (4.05–16.16)	<0.0001
BMI ≥30 kg/m^2	1.97 (1.27–3.06)	0.003
T2D	2.70 (1.45–5.03)	0.002
Dyslipidemia	2.28 (1.36–3.83)	0.002
Triglyceridemia	1.05 (1.02–1.08)	0.002
T2D		
Alcohol	0.25 (0.09–0.64)	0.004
Physical activity	0.50 (0.25–0.99)	0.05
Hypertension	3.79 (2.08–6.92)	<0.0001
Dyslipidemia	2.61 (1.47–4.65)	0.001
Triglyceridemia	1.04 (1.01–1.08)	0.01
HDL	0.98 (0.95–1.00)	0.05
Dyslipidemia		
Age, yrs		
40-60	10.78 (4.57–25.42)	<0.0001
>60	12.36 (4.75–32.15)	<0.0001
BMI ≥30	1.70 (1.05–2.75)	0.32
Hypertension	2.51 (1.52–4.16)	<0.0001
Triglyceridemia	1.07 (1.04–1.10)	<0.0001

Variables entered into the model:

Hypertension outcome:

Age (reference: <40 yrs), sex (reference: male), smoking (reference: no), alcohol (reference: no), coffee (reference: no), physical activity (reference: none), BMI (reference: <30 kg/m^2), serum creatinine, cholesterol, triglycerides (per unit increase of 10), HDL, LDL, T2D (reference: no), dyslipidemia (reference: no).

T2D outcome:

Age (reference: <40 yrs), sex (reference: male), smoking (reference: no), alcohol (reference: no), coffee (reference: no), physical activity (reference: none), BMI (reference: <30 kg/m^2), serum creatinine, cholesterol, triglycerides (per unit increase of 10), HDL, LDL, dyslipidemia (reference: no), hypertension (reference: no).

Dyslipidemia outcome:

Age (reference: <40 yrs), sex (reference: male), smoking (reference: no), alcohol (reference: no), coffee (reference: no), physical activity (reference: none), BMI (reference: <30 kg/m^2), serum creatinine, cholesterol, triglycerides (per unit increase of 10), HDL, LDL, T2D (reference: no), hypertension (reference: no).

CI, confidence interval; OR, odds ratio; other abbreviations as in Table 2.

surgery practice analysis in the region showed that there was significant variability in the practices with suboptimal adherence to guidelines [27]. This in turn can potentially translate into more downstream problems. Thus, there is a pressing need to invest at the level of preventing obesity. Nongovernmental organization–based initiatives have launched nutrition awareness campaigns in Lebanon to promote healthy eating practices among school children [20,28]. However, more is definitely needed and a governmental/WHO concerted effort might be more effective. Importantly, the fact that obesity and dyslipidemia are more prevalent among women highlights the need to understand why is this so and consider developing women-targeted interventions.

As many as 30% of all CHD deaths in the United States each year are attributable to cigarette smoking, with the risk being strongly dose-related [5,29]. Cigarette and water pipe smoking are the most prevalent risk factors in our study, whereby almost one-half (43.1%) of the participants smoked cigarettes, the majority being 40- to 60-year-old participants (50.8%) and men (53.6%). The 2011 WHO estimate reported that men engaged more often than women in cigarette smoking. Lebanon had also higher rates of smoking than Jordan (27.1%) or Iraq (13.7%). Water pipe smoking has also been associated directly with CAD and acute cardiovascular effects [30,31]. Much less data exist on the prevalence of water pipe smoking. In the WHO STEPS survey, they reported that around 22.4% for the general population smoked water pipes, which suggests an increasing prevalence in our cohort (28.3%). On another note, in contrast to cigarette smoking, which is more prevalent among men, water pipe smoking is equally prevalent among men and women. This suggests that when it comes to water pipe smoking, efforts need to similarly target both sexes. Furthermore, our study highlights that those who were <40 years of age had the highest rates of water pipe smoking or cigarette smoking. Knowing how difficult it is to quit smoking, particularly, once initiated at an early age [32], we hypothesize that the spread of this habit within this age category is a poor marker of how things will evolve. Although tobacco control measures have already been researched in our population [33], and a policy banning smoking in public places has been passed in Lebanon, implementation of this policy has been quite challenging. The numbers we are presenting here seem to suggest that at best there has been no reduction in the prevalence of smoking despite all these efforts. This is a call to revisit this policy to make it more effective with more emphasis on the younger age categories.

The current study had several strengths that included clear inclusion and exclusion criteria and acceptable sample size. Although multistage random sampling was used to select the sample, there might have been some selection bias, where older and sicker patients, as well those of lower socioeconomic status were overestimated. Such a selection bias might limit the generalizability of the results to the whole population. Even though the sampling was done only in Greater Beirut area, >50% of the population resides there. In the STEPS study, however, the percentage of respondents from Beirut was around 11%, which should be taken into consideration when making conclusions when comparing both cohorts. Moreover, the male-to-female ratio was almost 1:1 in the STEPS cohort whereas in our cohort in was close to 2:1. This skewed ratio does not come as a surprise. Although the male-to-female birth rate in Lebanon is reported to be close to 1, the male-to-female ratio of emigration is 2:1, and nearly 45% of families surveyed in Lebanon had 1 family member abroad [34]. Thus it is our opinion that a 2:1 female-to-male ratio in our study may not be far off from the reality.

CONCLUSIONS

With the high prevalence of all risk factors related to CVD, public health policies are a pressing need. New developments and patient approaches recognize the wider societal issues that influence the lifestyle choices people make. Effective future approaches should take this into consideration and probably take advantage of technological innovations and build on these developments to offer even greater choice in accessing preventative services.

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