Prevalence and Associated Factors of the Metabolic Syndrome Among a National Population Based Sample of 18-108 Year-olds in Iraq: Results of the 2015 Steps Survey

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Research

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Abstract

Background: This study aimed to assess the prevalence and associated factors of the metabolic syndrome (MetS) among 18-108 year-old persons in Iraq.

Method: Nationally representative cross-sectional data were analysed from 3,703 18-108 year old persons (32 years median age) that participated in the "2015 Iraq STEPS survey," with complete MetS measurements.

Results: Results indicate that 39.4% of 18-108 year-olds had MetS (harmonized definition), 39.8% among women and 39.0% among men, and the mean number of MetS components was 2.4 (SD=1.4), 2.4 (SD=1.4) among women and 1.5 (SD=1.4) among men. In adjusted logistic regression analysis, older age, current and past smoking and general overweight and obesity were associated with MetS. In addition, in unadjusted analysis, having lower education, ever alcohol use, and low physical activity were associated with MetS. In adjusted linear regression analysis, male sex, lower education, and obesity were associated with greater number of MetS components.

Conclusion: Two in five participants had MetS and several associated indicators were found which could be supportive in designing intervention activities.

Background

Non-communicable diseases (NCDs) are "estimated to account for 55% of all deaths in Iraq in 2016," which includes 27% cardiovascular diseases and 4% diabetes [1]. Compared with people without metabolic syndrome (MetS), individuals with MetS have a twofold higher risk for cardiovascular disease and fivefold higher risk for type 2 diabetes [2-4]. "A cluster of risk factors for cardiovascular disease and type 2 diabetes mellitus, which occur together more often than by chance alone, have become known as the metabolic syndrome." [5] "The risk factors include raised blood pressure, dyslipidaemia (raised triglycerides and lowered high-density lipoprotein cholesterol), raised fasting glucose, and central obesity." [5] Globally, it is estimated that "25% of the adult population can be characterized as having the MetS." [2,6] The prevalence of MetS is increasing in low- and middle-income countries with "improvement in economic situation, increasing urbanization, nutrition transition, and reduced physical activity." [7] In order to prevent and control MetS it is important that national population-based surveys are conducted periodically [8] There is a lack of national population-based data on the prevalence and associated factors of MetS in Iraq, an upper-middle income country in the Middle East.

In a cross-sectional study among adults recruited from different institutions (19-80 years) (N=566) in Erbil City, Northern Iraq, the prevalence of MetS (ATP IV criteria) was 30.6% [9], in an hospital out-patient sample (N=300) (30-75 years) in Baghdad in Iraq the prevalence of MetS (IDF criteria) was 42% [10], and among 320 hospital out-patients (25-85 years) in Baghdad in Iraq the prevalence of MetS (ATP III criteria) was 37.8% [11]. In national surveys in countries of the Eastern Mediterranean region, the national prevalence of MetS (NCEP-ATP III definition) in persons 35-74 years in 2004-2005 in Tunisia was

30.0% [12], in 2012 in Qatar (18-64 years) (IDF definition) 37% [13], in Iran (24-64 years) (IDF definition) in 2007 37.4% [14], and in 2005 in Saudi Arabia (15-64 years) (IDF definition) 28.3% [15]. In comparison, the prevalence of MetS in 2009 in China (18 years and older) (Revised NCEP ATP III definition) was 21.3% [16] and in 2015 in a low-income country Ethiopia (15-69 years) (IDF definition) 4.8% [17].

Factors that are associated with the prevalence of MetS include sociodemographic, health status and health risk behaviour related variables. Sociodemographic factors associated with MetS may include, female sex [18,19,20,21], older age [18,19,12,13,21], higher education [19], lower education [13,15], higher income [15], and urban residence [12,20,21]. Health status variables associated with MetS may include higher body mass index, general overweight or obesity [21,22] and abnormal waist to hip ratio [21,22]. Health risk behaviour variables associated with MetS may include physical inactivity [22,23], low leisure-time physical activity [24], sedentary behaviour [25], combined physical inactivity and inadequate fruit and vegetable intake [26], low intakes of fruits and dairy foods [27], and inadequate fruit and/or vegetable consumption [28-30]. In addition, frequent smoking [16], current smoking [31,32], and former smoking [33] was associated with a higher risk of MetS. Regarding alcohol use, some studies found that mild to moderate alcohol use decreased and heavy alcohol increased the risk of MetS [34,35], while other studies showed a positive association between current alcohol use and MetS [16]. The study using Iraq STEPS 2015 data aimed to assess the prevalence and associated factors of MetS among 18-108 year-old persons in Iraq.

Methods

Nationally representative cross-sectional data from the “2015 Iraq STEPS Survey” were analyzed [36]. The data and more detailed survey methods can be accessed; the overall response rate for STEP III was 93.5%, STEP II 98.6% and STEP I 98.8% [36,37]. Briefly, a “multi-stage cluster sampling was used with stratification to urban and rural areas. Primary sampling units (PSUs) (N=412) were the blocks, which consisted of 70 households or more before selection. One person from each household was randomly selected.” The “sample was weighted to be representative for Iraqi population.” [37].

Measures

Outcome variable: Metabolic syndrome

The harmonized definition of MetS was used, including three or more of any of the following five risk factors [5]: (1) “Elevated waist circumference (waist ≥ 97 cm in men, ≥ 99 cm in women) [38] [=High WC]; (2) Elevated blood pressure (systolic BP ≥ 130 or diastolic BP ≥ 85 mm Hg and/or on anti-hypertensive medication) [=High BP]; (3) Elevated fasting blood glucose (≥ 100 mg/dL and/or currently taking insulin or oral hypoglycemic drugs) [=High FBG]; (4) Elevated triglycerides (≥ 150 mg/dL and/or currently on medication for raised cholesterol) [=High TG]; (5) Reduced high-density lipoprotein (HDL) cholesterol (< 40 mg/dL in men; < 50 mg/dL in women and/or currently on medication for raised cholesterol) [Low HDL].”

Body Mass Index (measured $<18.5\text{kg/m}^2$ underweight, $18.5\text{--}24.4\text{kg/m}^2$ normal weight, $25\text{--}29.9\text{kg/m}^2$ overweight and $\geq 30\text{ kg/m}^2$ obesity); blood pressure (BP) measurements (average of the last two of three readings) were conducted with an electronic blood pressure monitor Spengler® ES 60; Blood samples were drawn (after 10-14 fasting) to determine levels of “fasting plasma glucose and fasting total cholesterol and lipid profile. The enzymatic method (Glucose Oxidase for fasting blood glucose and Cholesterol Oxidase for total cholesterol) was used.” [37]

Health risk behaviour variables included current and past smoking, past month passive smoking at home and/or at closed spaces at work, ever alcohol use, inadequate fruit and vegetable intake (<5 servings/day), and based on the “Global Physical Activity Questionnaire” low, moderate or high physical activity and sedentary behaviour (≥ 8 hours/day) [37].

Data analysis

Statistical analyses were done with “STATA software version 15.0 (Stata Corporation, College Station, Texas, USA),” taking into account the complex study design. The data were weighted “to make the sample representative of the target population in Iraq (by sex and by age groups: 18-39, 40-59, 60 and over).” [37] Chi-square tests were used to test for differences in proportions. Unadjusted and adjusted logistic regression was used to assess predictors of MetS and linear regression for the number of MetS components. Missing values were excluded from the statistical analysis. $P < 0.05$ was accepted as significant.

Results

Sample and MetS status characteristics

The sample comprised of 3,703 18-108 year old persons (32 years median age, 22 years interquartile range) with complete MetS measurements. More than one in five of the participants (59.5%) were female, 37.6% had more than primary education, and 75.9% lived in urban areas. More than one in ten participants (21.3%) reported current smoking, 7.3% past smoking, 60.3% past month passive smoking, 2.5% ever alcohol use, 79.5% inadequate fruit and vegetable intake, 52.3% low physical activity, 26.3% sedentary behaviour, and 34.0% obesity. The prevalence of MetS was 39.4%, 39.8% among women and 39.0% among men, and the mean number of MetS components was 2.4 (SD=1.4), 2.4 (SD=1.4) among women and 2.5 (SD=1.4) among men (see Table 1).

Associations with MetS

In adjusted logistic regression analysis, older age, current and past smoking and general overweight and obesity were associated with MetS. In addition, in unadjusted analysis, having lower education, ever alcohol use, and low physical activity were associated with MetS. In adjusted linear regression analysis, male sex, lower education, and obesity were associated with greater number of MetS components (see Table 2).

Overall, high WC was 43.8%, high BP 51.0%, high FBC 31.8%, high TG 35.4% and low HDL 54.5%. Low HDL was significantly higher in women than in men, and high TG was significantly higher among men than women, while high WC, high BP and high FBG did not differ significantly between the sexes. All five MetS components did not significantly differ by residence status. Between both sexes, all five MetS components significantly increased with age. Among men, high WC, high BP and high FBG increased with age, high TG increased from the 18-39 year-old age group to the 40-59 year-old age group and decreased among the 60 years and older age group. Low HDL did not significantly differ among age groups in men. Among men, high BP, high FBG, high TG and low HDL increased with age, while high WC increased from the 18-39 year-old age group to the 40 to 59 year-old age groups and slightly decreased among the 60 years and older age group (see Table 3).

Discussion

The investigation aimed to estimate the prevalence and correlates of MetS in a national population-based survey among 18-108 year-old persons in Iraq. The prevalence of MetS (harmonized definition) (39.4%) in 2015 seems higher than global estimates (25%) [2,6], and similar to different local studies in Iraq, in different institutions in Erbil City (30.6%, ATP IV criteria) [9], in an hospital out-patient sample (30-75 years) in Baghdad (42%, IDF criteria) [10], and among out-patients (25-85 years) in Baghdad (37.8%, ATP III criteria) [11], and probably similar to national estimates in 2004-2005 in Tunisia (30.0%, NCEP-ATPIII definition) [12], in 2012 in Qatar (37%, IDF definition) [13], in 2007 in Iran (24-64 years) (37.4%, IDF definition) [14], and higher than in 2005 in Saudi Arabia (28.3%, IDF definition) [15], in 2009 in China (21.3%, Revised NCEP ATPIII definition) [16], and in 2015 in Ethiopia (4.8%, IDF definition) [17]. The high prevalence of MetS in Iraq may be attributed to "improvement in economic situation, increasing urbanization, nutrition transition, and reduced physical activity." [7]

The study found that the most prevalent MetS components were low HDL, high BP, and high WC. Similar results were found in national surveys in Iran [14] and in Nepal [21]. In this study, we saw a decline of two MetS components (high WC among women and high TG among men) in persons 60 years and older. One possible explanation for this could be mortality prior to 60 years [18].

Consistent with former research [18,19,12,13,21], this investigation showed an association between older age and MetS. While several studies found a higher prevalence of MetS among women than men [18,19,20,21], this study did not show any significant sex differences. In fact, men seemed to have a greater number of MetS components than women in this study. Several studies showed an increased risk of MetS in people with lower education [13,15], which was confirmed in our study in unadjusted analysis and in adjusted analysis in terms of greater number of MetS components. Persons with lower education may have lesser knowledge on health risk behaviours that are implicated in the development of MetS [10]. While several previous research studies showed an association between urban residence and MetS [12,20,21], this survey did not find significant rural-urban differences. This could mean that MetS risk

behaviours (sedentary lifestyle, stress and diet changes) have penetrated rural areas as well as urban areas.

In agreement with previous research findings [21,22], this survey showed that having general overweight or obesity increased the odds for MetS. Consistent with previous studies [22-25], this investigation showed in unadjusted analysis an inverse association between high physical activity and MetS. Several studies and reviews [27-30], found a significant association between inadequate fruit and vegetable consumption and MetS, while this survey did not find any significant association between the two.

This study found in unadjusted analysis that ever alcohol use and in adjusted analysis that current and past smoking were associated with MetS. Regarding alcohol use, our findings confirm former research conducted in China [16]. Since the proportion of current alcohol users were too small in this study population, we are not able to distinguish heavy from moderate alcohol users. In terms of smoking, our findings are line with former research showing a positive association between active and past smoking and MetS [16,31-33]. In a recent review the following lifestyle changes are recommended to prevent and manage MetS: stop smoking, engage in physical activity (30–60 min of daily), moderate intake of red wine and beer, a healthy diet for weight loss and fruit and vegetable consumption as part of a healthy diet [39].

Study Limitations

The strength of the study was to cover a nationally representative adult sample in Iraq, but was limited because of its cross-sectional design as well as the self-report of the interview data. The variable on household income was not available on the publically available dataset and could therefore not be included in the analysis.

Conclusion

The 2015 Iraq STEPS survey found among a nationally representative population of adults that two in five participants had MetS. Several risk factors for MetS were identified, including older age, current and past smoking and general overweight and obesity, and in unadjusted analysis, having lower education, ever alcohol use, and low physical activity, which can facilitate in aiding interventions to prevent and control MetS in the general population in Iraq.

Abbreviations

BP: Blood pressure; FBG: Fasting blood glucose; HDL: High-density lipoprotein cholesterol; MetS: Metabolic Syndrome; STEPS: **STEPwise** approach to surveillance; STATA: Statistics and data; TG: Triglycerides; WC: Waist circumference

Declarations

Ethics approval and consent to participate

Ethical approval for the study was obtained from the “Republic of Iraq Ministry of Health/Environment Public Health Directorate” and written informed consent was obtained from participants prior to the study [37].

Consent for publication

Not applicable.

Availability of data and materials

“The data for the current study are publicly available at the World Health Organization NCD Microdata Repository (URL: <https://extranet.who.int/ncdsmicrodata/index.php/catalog>).”

Competing interests

“The authors declare that they have no competing interests.”

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Authors' contributions

“All authors fulfil the criteria for authorship. SP and KP conceived and designed the research, performed statistical analysis, drafted the manuscript and made critical revision of the manuscript for key intellectual content. All authors read and approved the final version of the manuscript and have agreed to authorship and order of authorship for this manuscript.”

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“The data source, the World Health Organization NCD Microdata Repository (URL: <https://extranet.who.int/ncdsmicrodata/index.php/catalog>), is hereby acknowledged.”

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Tables

Table 1
Sample and metabolic syndrome (MetS) characteristics among adults in Iraq, 2015

Variable	Sample	MetS (≥ 3 components)	Number of MetS components
	N (%)	% (95% CI)	M (SD)
Socio-demographics			
All	3703	1726 (39.4)	2.42 (1.4)
Age (years)			
18-39	1777 (48.1)	479 (24.1)	1.82 (1.2)
40-59	1311 (35.5)	796 (62.9)	2.85 (1.3)
60-108	605 (16.4)	447 (72.3)	3.27 (1.2)
Gender			
Female	2204 (59.5)	1004 (39.8)	2.41 (1.4)
Male	1499 (40.5)	722 (39.0)	2.45 (1.4)
Education			
<Primary	1622 (37.8)	842 (46.2)	2.61 (1.4)
Primary	933 (24.6)	414 (39.9)	2.37 (1.3)
>Primary	1128 (37.6)	460 (32.1)	2.20 (1.4)
Residence			
Rural	801 (24.1)	366 (40.0)	2.39 (1.4)
Urban	2902 (75.9)	1360 (39.2)	2.43 (1.4)
Health variables			
Smoking status			
Never	2796 (71.4)	1249 (37.3)	2.36 (1.4)
Past	298 (7.3)	195 (60.3)	2.99 (1.3)
Current		282 (39.2)	2.42 (1.4)

	609 (21.3)		
Passive smoking			
No	1658 (39.7)	793 (41.6)	2.45 (1.4)
Yes	2038 (60.3)	932 (38.0)	2.41 (1.4)
Ever alcohol use			
No	3611 (97.5)	1668 (39.0)	2.41 (1.4)
Yes	90 (2.5)	58 (57.1)	2.84 (1.1)
Inadequate fruit and vegetable intake			
No	808 (20.5)	382 (37.2)	2.43 (1.4)
Yes	2879 (79.5)	1338 (40.00)	2.42 (1.4)
Physical activity			
Low	2065 (52.3)	1014 (42.5)	2.50 (1.4)
Moderate	856 (22.8)	412 (43.3)	2.47 (1.3)
High	779 (24.9)	300 (29.5)	2.17 (1.3)
Sedentary behaviour			
No	2617 (73.7)	1166 (38.1)	2.35 (1.3)
Yes	1045 (26.3)	545 (42.9)	2.61 (1.4)
Body mass index			
Underweight/Normal	949 (34.4)	177 (13.4)	1.54 (1.2)
Overweight	1200 (31.6)	533 (43.0)	2.37 (1.3)
Obesity	1541 (34.0)	1012 (62.4)	3.01 (1.2)

Table 2:

Table 2
Associations with metabolic syndrome (MetS)among adults in Iraq, 2015

Variable

MetS

Number of MetS components

Unadjusted OR (95% CI)

Adjusted OR (95% CI)

Adjusted Beta (95% CI)

Socio-demographics

Age (years)

18-39

40-59

60-108

1 (Reference)

5.34 (4.31, 6.62)***

8.22 (6.20, 10.98)***

1 (Reference)

3.40 (2.68, 4.31)***

6.69 (4.82, 9.29)***

Reference

0.82 (0.69 to 0.95)***

1.21 (1.06 to 1.37)***

Gender

Female

Male

1 (Reference)

0.97 (0.82, 1.14)

—

Reference

0.23 (0.12 to 0.34)***

Education

<Primary

Primary

>Primary

1 (Reference)

0.77 (0.63, 0.95)*

0.55 (0.45, 0.68)***

1 (Reference)

1.03 (0.80, 1.34)

0.83 (0.64, 1.07)

Reference

-0.06 (-0.18 to 0.06)

-0.22 (-0.34 to -0.09)***

Residence

Rural

Urban

1 (Reference)

0.97 (0.74, 1.26)

—

Reference

-0.05 (-0.18 to 0.09)

Health variables

Smoking status

Never

Past

Current

1 (Reference)

2.55 (1.84, 3.54)***

1.08 (0.84, 1.39)

1 (Reference)

1.54 (1.00, 2.36)*

1.38 (1.01, 1.90)*

Reference

0.08 (-0.13 to 0.29)

0.03 (-0.13 to 0.19)

Passive smoking

No

Yes

1 (Reference)

0.86 (0.71, 1.04)

—

Reference

0.009 (-0.10 to 0.11)

Ever alcohol use

No

Yes

1 (Reference)

2.09 (1.23, 3.53)**

1 (Reference)

1.56 (0.77, 3.19)

Reference

0.13 (-0.16 to 0.43)

Inadequate fruit and vegetable intake

No

Yes

1 (Reference)

1.13 (0.89, 1.43)

—

Reference

0.01 (-0.11 to 0.13)

Physical activity

Low

Moderate

High

1 (Reference)

1.03 (0.83, 1.29)

0.57 (0.44, 0.73)***

1 (Reference)

1.07 (0.80, 1.44)

0.90 (0.66, 1.22)

Reference

0.04 (-0.09 to 0.17)

-0.12 (-0.26 to 0.03)

Sedentary behaviour

No

Yes

1 (Reference)

1.22 (0.98, 1.52)

—

Reference

-0.04 (-0.17 to 0.10)

Body mass index

Underweight/Normal

Overweight

Obesity

1 (Reference)

4.87 (3.67, 6.46)***

10.73 (8.21, 14.03)***

1 (Reference)

5.16 (3.07, 5.63)***

8.33 (6.27, 11.07)***

Reference

0.77 (0.64, 0.90)***

1.27 (1.13, 1.40)***

OR=Odds Ratio; CI=Confidence Interval; ***P<0.001, **P<0.01, *P<0.05

Table 3
Characteristics of components of metabolic syndrome among adults in Iraq, 2015

Variable	High WC	High BP	High FBG	High TG	Low HDL
	%	%	%	%	%
Total	43.8	51.0	31.8	35.4	54.5
<i>Sex</i>					
Female	43.1	48.8	32.1	32.0	64.9
Male	44.4	47.1	31.6	38.3	45.4
P-value	<0.375	0.060	0.994	0.002	<0.001
<i>Residence</i>					
Rural	44.4	53.1	28.6	33.1	57.5
Urban	43.7	50.1	32.6	36.1	53.5
P-value	0.990	0.645	0.217	0.334	0.450
<i>Age group all</i>					
18-39	30.2	35.5	23.6	27.4	51.3
40-59	67.1	73.1	43.6	48.1	58.8
60-108	67.3	88.5	51.9	51.5	62.5
P-value	<0.001	<0.001	<0.001	<0.001	<0.001
<i>Age group male</i>					
18-39	32.4	40.9	24.7	31.5	43.3
40-59	62.8	72.5	43.3	53.9	49.8
60-108	70.1	87.7	50.8	48.8	49.6
P-value	<0.001	<0.001	<0.001	<0.001	0.081
<i>Age group female</i>					
18-29	27.3	28.4	22.2	22.2	61.9
30-59	66.1	73.6	43.9	43.1	66.6
60-108	64.2	89.4	46.8	54.4	76.5
P-value	<0.001	<0.001	<0.001	<0.001	<0.001

High WC=Waist circumference (waist ≥ 89 cm in men, ≥ 91 cm in women); High BP=Blood pressure (systolic BP ≥ 130 or diastolic BP ≥ 85 mm Hg and or on anti-hypertensive medication); High FBG=Fasting blood glucose (≥ 100 mg/dL or on antidiabetic medication); High TG=Triglycerides

(≥ 150 mg/dL and/or on anti-cholesterol medication); Low HDL=High-density lipoprotein cholesterol
(< 40 mg/dL in men; < 50 mg/dL in women and/or on anti-cholesterol medication)