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Prevalence of Metabolic Syndrome and Its Components among Saudi Young Adults 18 - 30 Years of Age

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Abstract

Background: Metabolic syndrome (MS) is a cluster of established cardiovascular risk factors that collectively increase predisposition to major chronic diseases, including heart diseases and diabetes mellitus. Young adults can be affected by MS or any of its components which predispose them to its complications later in their life. Hence early detection of MS and its components can be of help in preventing or controlling its adverse consequences among young adults. **Materials and Methods:** A total of 1354 Saudis aged 18 - 30 was randomly selected from 20 regions in the Kingdom of Saudi Arabia (KSA). Anthropometrics were collected, and fasting blood samples were collected to ascertain fasting blood glucose and lipid profile. Components of full MS and its components according to the International Diabetes Federation (IDF) were used in this study. **Results:** Metabolic syndrome prevalence was 12% and was significantly higher among males, advancing age and government employees and unemployed subjects but not according to income or education levels MS was significantly higher among current smokers, subjects with low physical activity level, but not significant according to dietary habits in terms of combined fruits and vegetables consumption. Low levels of High Density Lipoprotein (HDL) were the most frequent component in both males and females. Both waist circumference (WC) and low levels of HDL were much higher among females. Significant predictors included male gender, advancing age, lower level of physical activity and current smoking. **Conclusion:** The prevalence of MS is 12% in young adults. Low HDL is the most prevalent component of MS in young adults and thus may also be the first detectable component of MS in many young adults. Early identification of MS components could lead to targeted interventions to prevent the development of the syndrome, and thus reduce cardiovascular disease risk in later life.

Keywords

Metabolic Syndrome, Young Adults, Saudi Arabia

1. Introduction

Metabolic Syndrome (MS) is morbidity asymptomatic initially with features of hypertension, dyslipidemia, obesity, insulin resistance and dysglycemia. The person is diagnosed as having MS depends on the definition used which usually includes at least three of the following five components: large waist circumference, elevated triglycerides, low HDL, raised blood pressure, and elevated fasting blood Glucose. Hence the prevalence of MS will depend on which of these components are used and other factors such as demographics, life style habits and other factors [1] [2] [3] [4]. Investigating MS and its components among young adults is a worthwhile project as even the presence of just a single component increases the risk of future MS and cardiovascular morbidity in young adults [5] [6]. Hence early detection of any component of MS will be very helpful in intervention strategies with significant public health benefit. Several studies were conducted worldwide addressing MS using recommended methodology the IDF definition of MS [2] [7].

2. Materials and Methods

This was a cross-sectional, community-based study that covered the entire population of KSA in 2005. The WHO STEP wise approach to surveillance (STEPS) of noncommunicable diseases (NCD) risk factors was the basis of the conduct of the survey and collection of the data [2] [8] [9]. The STEPS approach focuses on obtaining core data on the established risk factors that determine the major disease burden. The STEPS instrument covers three different levels of "steps" of risk factor assessment. They are: Questionnaire, Physical measurements and Biochemical measurements. The original survey covers all Saudi nationals aged 15 - 64 years from all the 20 health regions of the country made up the study population. Stratified cluster random sampling technique was used to recruit the subjects. Stratification was based on age (five 10-year age groups) and gender (male/female, two groups). All health regions of the country (20 regions) were covered. Based upon the proposed methodology of the WHO STEP wise approach, a sample size of 196 was calculated for each of these categories. A list of all primary health care centers (PHCCs) in each region was prepared; 10% of these PHCCs were randomly chosen and allocated a regional sample proportionate to the size of their catchment population in the sampled PHCCs. To identify the households, a map of the health center coverage area was used to select the houses. Each house was assigned a number, and a simple random draw was made. Data were collected using the WHO STEP wise approach, a tool used for epidemiologic studies to measure NCD in WHO-member countries [8] [9]. It covers three levels of risk factor assessment (steps) which include a questionnaire, physical (anthropometric) and biochemical measurements including fasting serum glucose, lipid profile (triglycerides (TGs), total, HDL-C and low-density lipoprotein (LD)), chronic diseases (noncommunicable e.g. hypertension, dyslipidemia, diabetes mellitus, etc.), and risk factors (e.g., obesity, smoking, physical activity, diet). The questionnaire was translated into Arabic by a team of physicians and then translated back to ensure its accuracy. The Arabic instrument was pretested and corrected before being tested on 51 eligible respondents to check the wording and the clarity of the questions. Necessary adjustments were made to the instrument in the light of the pretest. Data was collected by 54 male and 54 female data collectors working in teams. Each field team was made up of four persons: A male data collector, a female data collector, a driver, and a female assistant. The data collection teams were supervised by a hierarchy of a local supervisor, regional coordinators, and national coordinator. All individuals involved in data collection attended a comprehensive training workshop of interview techniques, data collection tools, practical applications, and field guidelines. Blood (5 ml) was collected, from the participants in the morning after an overnight fast. Sodium heparin was used as an anticoagulant, and the samples were centrifuged at 3000× g for 15 min at 20˚C to separate plasma. Aliquots were prepared for storage (−20˚C or −80˚C) until further analysis. Total cholesterol (TC), TGs, and glucose were measured with commercially available enzymatic colorimetric kits from QCA (Amposta, Spain). Seriscann normal (ref 994148) (QCA, Amposta, Spain) was used for quality control. Serum HDL levels were analyzed by an enzymatic method after precipitating serum reagents with phosphotungstic acid and magnesium. LDL-C was calculated according to the Friedewald formula (LDL-C = TC − HDL − [TG/5]). Height, weight, and waist and hip circumferences were measured using standard instruments, according to the STEP wise approach [8] [9] Body weight and height were measured without shoes, using electronic measuring scale. Body mass index (BMI) was calculated as weight in kilogram divided by height in m^2. WC was measured, in cm, midway between the lower costal margin and iliac crest during the end-expiratory phase. For the definition of MS, the IDF for MS was used in this study as follows [7]. Central obesity (defined as WC ≥ 94 cm for Europid men and ≥ 80 cm for Europid women, with ethnicity specific values for other groups). Plus, any two of the following four factors:

1) Raised TG level: ≥150 mg/dL (1.7 mmol/L),

2) Reduced HDL: <40 mg/dL (1.03 mmol/L) in males and <50 mg/dL (1.29 mmol/L) in females,

3) Raised blood pressure (BP): Systolic Blood Pressure (SBP) ≥ 130 or Diastolic Blood Pressure (DBP) ≥ 85 mm Hg,

4) Raised fasting plasma glucose ≥ 100 mg/Dl (5.6 mmol/L).

The case definition of MS was generated using statistical analysis system statistical package.

Questionnaires collected from the field were reviewed by the team leaders assigned to each team before submission to headquarters for data entry. A double entry of the questionnaires was done using Epi-Info 2000 software and EpiData software developed by the Menzes center for validation. After entry, the data, was cleaned. New variables were defined by adopting the standard STEPS variables (STEPS data management manual, draft version v1.5, October 2003). Collected data were cleaned, entered and statistically analyzed using SPSS for Windows, version 17.0 (Chicago, IL, USA). The data were given as mean and standard deviation for continuous variables and as frequencies (percentages) for categorical variables. Association between categorical variables was assessed using a Chi-square test. Differences between means were checked using t test or ANOVA or Manwhitnney or Kruskall tests as appropriate after checking for normality. Logistic regression analysis was used to identify predictors of MS and its individual components the level of significance was set at <0.05 throughout the study. Total counts may vary because of missing data from certain variables. The protocol and the survey instrument were approved by the ministry of health, center of biomedical ethics, and the appropriate authorities in KSA. The Institute Review Board (IRB) of King Fahad Medical City approved this study (IRB 19-090 dated 12 February 2019). Informed consent of all subjects was obtained. Participants were assured of confidentiality of data, and that they would be used only for the stated purpose of the survey. For this study only all young adults aged 18 - 30 years of age were selected from all subjects 15 - 64 years of age included in the survey.

3. Results

The young subjects aged 18 - 30 years were 1514 and 160 (10.6%) of them were excluded from final analysis due to missing data and there were no significant differences according to demographic characteristics between these 160 excluded subjects and the 1354 included subjects. Table 1 shows their demographic characteristics and prevalence of MS among the 1354 subjects included in the analysis. MS prevalence was 12% and was significantly higher among males, advancing age and government employees and unemployed subjects but not according to income or education levels.

Table 2 profiles MS according to some life style characteristics. Metabolic syndrome was significantly higher among current smokers, subjects with low physical activity level, but not significant according dietary habits in terms of combined fruits and vegetables consumption.

Table 3 depicts the frequency of each of the five components of MS among the study subjects. HDL was the most frequent component in both males and females. Both WC and low levels of HDL were much higher among females.

There were no significant differences in TGs, fasting blood glucose and hypertension according to demographic characteristics of subjects except age

Table 1. Metabolic syndrome according to demographic characteristics.

Characteristic	Number (%)	Subjects with Metabolic Syndrome	Subjects without Metabolic Syndrome	P Value
Gender	1354 (100)	1191 (88.0)	163 (12.0)	
Male	616 (45.5)	90 (14.6)	526 (85.4)	0.005
Female	738 (54.5)	73 (9.9)	665 (90.9)	
Age (years)	1354 (100)	1191 (88.0)	163 (12.0)	
18 - 22	499 (36.9)	45 (9.0)	454 (91.0)	
23 - 26	407 (30.1)	51 (12.5)	356 (87.5)	0.018
27 - 30	448 (33.1)	67 (15.0)	381 (85.0)	
Education	1352 (100)	163 (12.1)	1189 (87.9)	
Non	109 (8.1)	13 (11.9)	96 (88.1)	
Primary	260 (19.2)	32 (12.3)	228 (87.7)	
Intermediate	277 (20.5)	34 (12.3)	247 (87.7)	0.856
Secondary	409 (30.3)	52 (12.7)	357 (87.3)	
University	247 (18.6)	29 (11.7)	218 (88.3)	
Vocational	50 (3.7)	3 (6.0)	47 (94.0)	
Occupation	1553 (100)	163 (12.0)	1190 (88.0)	
Government Employee	327 (42.2)	58 (17.7)	269 (82.3)	
Non-Government Employee	113 (8.4)	7 (6.2)	106 (93.8)	
Student	363 (26.8)	26 (7.2)	337 (92.8)	0.001
Housewives	423 (31.3)	51 (12.1)	372 (87.9)	
Unemployed	127 (9.4)	21 (16.5)	106 (83.5)	
Monthly Income (Saudi Riyals)	1299 (100)			
<3000	375 (28.9)	40 (10.7)	335 (89.3)	
3000 - 6999	337 (25.9)	38 (11.3)	299 (88.7)	
7000 - 9999	418 (32.2)	59 (14.1)	359 (85.9)	0.559
10,000 - 14,999	111 (8.5)	16 (14.4)	95 (85.6)	
15,000+	58 (4.5)	7 (12.1)	51 (87.9)	

and gender for TGs and physical activity for fasting blood glucose. TGs were significantly more in males (24.1%) compared to females (17.3%) and in subjects 24 years of age with fasting blood glucose significantly higher among subjects with low physical activity level. Other results not depicted in tables revealed no significant differences in all these parameters according to education, occupation, income, smoking status and dietary habits concerning consumption of fruits and vegetables. Table 4 shows result of Logistic regression analysis for significant predictors of MS. All variables entered in bivariate analysis were entered in Logistic Regression Model. Significant predictors included male gender, advancing age, lower level of physical activity and current smoking as shown in Table 5.

Table 2. Metabolic syndrome according to some life style characteristics.

Characteristic	Number (%)	Metabolic Syndrome n (%)	No Metabolic Syndrome n (%)	P Value
Tobacco Smoking	1353 (100)	1190 (88.0)	163 (12.0)	
Current Smokers	164 (12.1)	34 (20.7)	130 (79.3)	
Ex-Smoker	30 (2.2)	1 (3.3)	29 (96.7)	0.001
Never Smoker	1159 (78.5)	128 (11.0)	1031 (89.0)	
Physical Activity Level	1318 (100)	1156 (87.7)	162 (12.3)	
High	237 (18.0)	19 (8.0)	218 (92.0)	0.005
Medium	214 (16.2)	18 (8.4)	196 (91.6)	
Low	867 (65.8)	125 (14.4)	742 (85.6)	
Fruits and Vegetables Serving per Day	1322 (100)	1146 (87.7)	161 (12.3)	
Below 5 Serving per Day	1259 (95.2)	158 (12.5)	1101 (87.5)	0.189
5 + Serving per Day	63 (4.8)	5 (7.9)	58 (92.1)	

Table 3. Frequency of metabolic syndrome components among the study subject (n = 1354).

MS Component	Number	Percentage
TGs > 1.7 mmol/L	276	20.4
Fasting Blood Glucose < 5.6 mmol/L	214	15.8
Hypertension SBP > 130 mmHg and/or DBP > 85 mmHg	267	19.7
WC		
Females > 80 centimeters (n = 738)	326	44.2
Male > 94 centimeters (n = 616)	115	18.7
HDL		
Males < 1.03 mmol/L (n = 616)	225	36.5
Females < 1.29 mmol/L (n = 738)	417	56.5

4. Discussion

About a quarter of the world population is estimated to have MS according to IDF with wide variations according to sociodemographic characteristics among the general population. Prevalence rates of MS among young adults using IDF definition ranged from 1.28% to over 23.0% in different communities [10]-[18]. The IDF estimates that ≈25% of the world's population has MS [3] although this estimate varies widely due to the age, ethnicity, and gender of the population studied [4]. Having a slightly raised value of a MS component at a younger age increases the future risk for MS later in life [5]. Therefore, it is important to establish the prevalence of MS components in young adults (18 - 30 years), as the presence of a MS component could represent a lifetime of increased

Table 4. Parameters of common cutoff points in males and females according to gender, age and physical activity level.

Variable/Component	TGs	Elevated Fasting Blood Glucose	High Blood Pressure
Gender			
Males	24.1%	15.1	17.4
Females	17.3	16.3	19.5
P value	0.001	0.283	0.271
Age (years)			
18 - 23	17.5	14.7	18.8
24 - 29	23.3	15.8	16.6
30 - 35	20.0	21.6	28.0
P value	0.028	0.154	0.146
Physical Activity Level			
High	19.4	10.5	11.4
Medium	19.1	9.7	14.4
Low	21.3	18.0	20.3
P value	0.650	0.001	0.054

Table 5. Backward Wald logistic regression analysis for predictors of metabolic syndrome.

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
Predictors								Lower	Upper
Smoking		0.316	0.090	12.349	1	0.000	1.371	1.150	1.635
	Physical Activity	0.000	.000	4.102	1	0.043	1.000	1.000	1.001
	Total cholesterol	−0.162	0.092	3.079	1	0.079	0.851	0.710	1.019
	Weight for height ratio	−15.625	1.341	135.763	1	0.000	0.000	0.000	0.000
	Pulse pressure	−0.040	.010	14.903	1	0.000	0.960	0.941	0.980
	Constant	11.740	1.089	116.157	1	.000	125,484.987		

a. Variable(s) entered on step 1: c1, age, totsmoke, d1_day, d2_day, T_Activity, bmi, b8, edu_rev, work_rev, inome_rev, WHteatio, pulspressure.

cardiovascular disease risk. Moreover, the early identification of MS components could lead to targeted interventions to prevent the development of the syndrome, and thus reduce cardiovascular disease risk in later life. The results of this study revealed that MS affects 12% of young adults aged 18 - 30 years. Prevalence rates of MS among young adults using IDF [7] definition ranged from 1.28% in Romania [10], to 27% in Russia [11] with prevalence rates in between in many communities. These include prevalence rates of 3.6% in Turkey [12], 6.8% among young females in Emirates [13], 6.9% in Korea [14], 8.7% in India

[15], 12.2% in Brazil [16], 17% in Canada [17], 21.6% in USA [14] and 23.1% in South Africa [18]. Variations in prevalence rates can be expected and explained partly by differences in sociodemographic, geographic and life style characteristics. The risk factors and predictors of MS in this study included male gender, advancing age, smoking, and lower physical activity level. Male gender was a significant predictor of MS among young adults in the majority of studies in other communities [11] [19] [20] [21], Few studies reported that females are more affected than males [10] [12] while a study found no significant difference in MS among young adults according to gender [22]. The inconsistencies can be due to some confounding factors. Smoking and lower physical activity levels were significantly associated with higher prevalence of MS in this study in agreement with many studies worldwide [11] [21] [22] [23] [24]. Education, income and dietary habits were not significantly associated with MS among young Saudi adults in this study in disagreement with studies in other communities [17] [18] [25]. As for the prevalence of the different components of MS in this study lower levels of HDL was the most prevalent component, in both males and females in agreement with many studies worldwide, [10] [17] [19] [20] [22] [24] [26]. This finding raises the possibility that low HDL may be a key marker identifying early pathology associated with the development of MS Prevention of the development of the first MS component may have significant public health benefits as the presence of one component is predictive of the development of MS [6]. An increased waist circumference affected 44% of females in this study. A study reported that central obesity was the highest component of MS affecting 87.0% of all the metabolic syndrome subjects [26] [27]. Abdominal obesity was the most common component MS affecting young adults [10] [17] [19]. Significantly more females (51.9%) presented with increased WC than males (4.6%) [11] in accordance with findings of the present study. International studies reported that Atherogenic dyslipidemia defined as low HDL was the most prevalent MS component regardless of the criteria used (26.9% - 41.2%) followed by raised blood pressure (16.6% - 26.6%), abdominal obesity (6.8% - 23.6%), atherogenic dyslipidemia defined as raised triglycerides (8.6% - 15.6%), and raised fasting glucose (2.8% - 15.4%) [28].

5. Strengths and Limitations

Strengths:

This study, on a large sample of Saudi adults aged 18 - 30 years provides an analysis of correlates and determinants of MS and its individual components by examining the associations and predictors of MS and sociodemographic characteristics and life-style habits. Such information is hoped to be helpful in intervention strategies in this young productive sector of the community.

Limitations:

The study was cross-sectional in design and thus temporal direction of the relationships investigated is unclear. Given that lifestyle behaviors were self-reported, it is possible that some responses were influenced by social desirability, subjectivity and recall bias.

6. Conclusion

The prevalence of MS is 12% in young adults. Low HDL is the most prevalent component of MS in young adults and thus may also be the first detectable component of MS in many young adults. Exploring the importance and significance of low HDL in young adults may have considerable public health benefit as interventions aimed at improving low HDL cholesterol levels could reduce future incidence of MS and subsequent clinical disease. Waist circumference in females deserves similar consideration as it's widely prevalent. Early identification of MS components could lead to targeted interventions to prevent the development of the syndrome, and thus reduce cardiovascular disease risk in later life.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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