METABOLIC SYNDROME STATUS DEFINED BY THE INTERNATIONAL DIABETES FEDERATION AMONG A SAMPLE OF COLLEGE STUDENTS FROM PALESTINE

Akram M. H. Altaher*, Yasmeen S. Abu-Mustafa, Abeer R. Elujeili, Enas A. Almasry and Eman O. Almasry

**Corresponding Author: a.taher@cst.ps*

Department of Medical Sciences, University Collage of Science and Technology-Khanyounis, Gaza Strip, Palestine

Abstract

Introduction: Metabolic Syndrome (MetS) is a cluster of risk factors including central obesity, insulin resistance, dyslipidemia, and high blood pressure (BP). It viewed as the main risk factor for cardiovascular disease (CVD) and diabetes mellitus (DM). We aim to determine the prevalence of MetS among Palestinian college students using the definition proposed by the international diabetes federation (IDF). **Methods**: This study was a cross-sectional. A total of 100 male students and 100 age-matched female students were randomly selected. Personal, clinical, and lifestyle data of the students were gathered by questionnaire. Anthropometric and biochemical indices were measured. SPSS version 20 was used for data analysis. **Results**: Male students were more active in their lifestyle, more obese, hypertensive, hyperglycemia and hypertriglyceridemia than female students ($p \leq 0.05$). The most common MetS criteria among the students were low high density lipoprotein cholesterol (HDL-C) 31.0%, large waist circumference (WC) 14.0%, high Glucose 12.5%, high Triglycerides (TG) 8.5%, and high blood pressure (BP) 6.0%. MetS occurrence in the current study was 7.0% with 8% of women and 6% of men having MetS. Obese students had the greatest occurrence of high WC and elevated BP compared to those in other students ($p \leq 0.05$). Furthermore, obese students had a higher prevalence of MetS than found among other students. **Conclusion**: MetS is found among college students in Palestine. It also appears that obesity contributes to the high incidence of MetS. Early diagnosis and treatment of MetS risk factors and healthier lifestyle promotion lead to decrease the risk of MetS occurrence.

Keywords: Metabolic syndrome; IDF; College students; Palestine.

Introduction

MetS is known as a set of interrelated risk factors including fail to respond normally to the insulin by the cells, dyslipidemia, and high BP (Grundy et al., 2005). MetS is a major risk factor for many non-communicable diseases especially; cardiovascular diseases (CVD) and type 2 diabetes mellitus (T2DM) (Isomaa et al., 2017). CVD remains the first leading cause of death among Palestinians, accounting for 30.3% of deaths recorded in 2017 and is the 2nd major cause of young adults' death whose age in between 20 & 29. DM complications came in the fifth rank with a proportion of 9.0% (PMOH, 2017). Seven percentage of death around the word is due to MetS, the risk of CVD is increased by 34% and 16% for men and women, respectively due to MetS (Reaven, 2011). Little information is known about the frequency of MetS among the Arab population in the Middle East region. This is because few studies were concerned with this topic, but the available data suggest that it is an increasingly common problem. MetS originates from the diverse interaction of genetic predisposition and risk factors for lifestyle (Oh et al., 2012). Many studies suggested that the prevalence of MetS is directly correlated with Aging (Ford et al., 2004; Mattsson et al., 2007). In addition, other reports found gender differences according to MetS criteria (Huang et al., 2007; Fernandes, & Lofgren, 2011). One of the most frequently working definitions of MetS is that proposed by the International Diabetes Federation (IDF) (Altaher et al., 2018). According to the IDF, MetS is described as high WC presence plus two of the four risk causes for cardiac disease: high FBG, low HDL-C, high TG and high BP (De Marco et al., 2012). A previous study observed that the BP and low HDL cholesterol were the most morbid element of MetS with the percentages of 33% and 25% respectively (Reaven, 2011). University students undergrow of changes their habits on entering university, where they following a sedentary lifestyle and unhealthy dietary practices which leads to the arising of chronic disease risk factors (Smith, & Essop, 2009).

Early identification of MetS components in young adulthood can lead to targeted interventions, thus lowering the risk of future development of diabetes and CVD among them. Palestine like many other countries around the world pays high attention concerning chronic diseases because of its role in the high rates of mortality and morbidity in addition to its adverse health effects on the individuals with the young age group. For that, it is very important to detect this silent syndrome early. Thus, the over the aim of this study was to identify the frequency of MetS criteria among Palestinian college students using the definition proposed by the IDF.

Methods

This study was conducted in between May and September 2016 and designed as cross-sectional style, the study samples were two hundred students (50.0% males and 50.0% females) selected by simple random sampling method from the sampling frame (student's lists at admission and registration department in the University College of Science and Technology - Khan Yunis Governorate). The calculated sample size was 138 students, and the Epi-Info program vr 7.2 was used to calculate the sample size at population number= 80000, 95.0 % confidence interval, 5.0% acceptable margin of error and 10 % expected prevalence of MetS based on previous study that carried out in Palestine (Altaher, et al., 2018). Both genders were aged at least 18 years old 18 and age-matched. All official approval letters to conduct the study were obtained. Consent forms which describe the study aim and significance were given for all study participants before data collection. Face to face questionnaires were used research team to collect the Personal data, clinical data and lifestyle status of the study population. The body height of the participants was measured in centimetre using stadiometer, and the weight in Kilogram using weighing scale. The BMI was calculated by dividing the weight (in kg) by the height square (in m). The BMI was classified according to WHO instructions (WHO, 2012).

The WC was measured according the WHO instructions at minimal inhalation narrow to 0.1 cm, in between the lowest rib and the superior edge of the iliac crest (WHO, 2012). According to American Heart Association; BP of the study participants is measured using mercury sphygmomanometer (Pickering et al., 2005). About 4 ml venous blood sample was withdrawn from the students in fasting status

(14-16 hours) in a tube without anticoagulation and the sera of students were isolated by centrifuge (Fuhua type) at 3000-4000 round/minute for ten minutes then stored at -18°C until analysed. By spectrophotomer (Stat Fax-1904 Plus, USA) and according to the beer's law; the levels of serum FBG, TC and TGs were measured using ElITech clinical kit, France (Trinder, 1969; Allain et al., 1974; Fossati, & Prencipe, 1982). The ElITech clinical kit, France was used to determine the HDL-C concentration based on precipitating method (Burstein, et al., 1970), while LDL-C was calculated using the formula of Friedewald: [LDL-C = TC – (HDL-C) – TG/5 (mg/dl)] (Friedewald et al., 1972). All lab tests were performed at the University College of Science and Technology-Khanyounis Clinical Chemistry Laboratory, Calculation of colorimetric tests for FBG, TC and TGs were performed by spectrophotomer (Stat Fax-1904 Plus, USA) according to beer's law. Version 20.0 of the SPSS system was used to analysis of data. Descriptive statistics, Chi-Square Test and t-Test were carried out at confidence intervals (CI) 95%. The P-value < 0.05 was considered as statistically significant.

Results

A total of 200 students (100 males Vs. 100 females) were included in this research. There was no statistically significant difference between the male group and females group according to the age in years (P=0.104) (Table 1). Most of the female group (52.0%) Vs. 5.0% of males group, their lifestyle was moderately. However, there was a statistical difference among the study subjects within related to the type of life style (P=0.000) (Table 1).

Table 2 demonstrates the MetS components and the differences in anthropometric, clinical and biochemical indices between males and females involved in the research. Males were more obese, hypertensive, hyperglycaemia and hypertriglyceridemia than females and these differences reach a statistical significance (p≤0.05) (Table 2). In the original sample, the most common MetS components were low HDL-C (31.0%), large WC (14.0%), high Glucose (12.5%), high TG (8.5%) and high BP (6.0%) (Table 3). It is also observed that the females group had higher WC as compared to males group (P=0.011) (Table 2). According to IDF definition, the prevalence of MetS in the total sample was 7.0% with 8% females and 6% of males having MetS (Figure 1). In addition, the prevalence of MetS was higher in women than in men (Figure 1). As show on the figure below, about 2.5 % of the total sample had at least one metabolic criteria, while 4.5% of them had at least two metabolic criteria (Figure 1).

The present findings indicated that only 12.5% (n=25) of the total sample were obese and 17.0% (n=35) of them were overweight, while 70.0% (n=140) of them were underweight and normal weight (Figure 2).

Table 4 illustrates the most common criteria of MetS in the original sample per BMI category. The obese group had the highest prevalence of elevated WC (15%) and elevated blood pressure (3.0%) as compared to those in other BMI categories (P=0.000 & 0.003 respectively) (Table 4).

The findings also show that 32.0% of obese subjects had at least three or more MetS requirements, much greater than those observed in the overweight or normal classifications (20.0 % and 3.6 % respectively) (Figure 3).

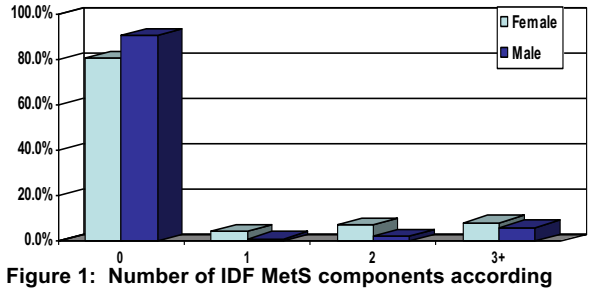

Figure 1: Number of IDF MetS components according to gender

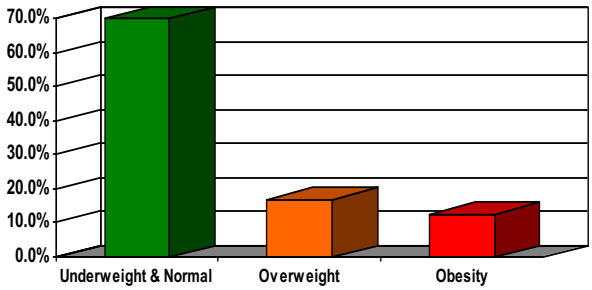

Figure 2: Percentage distribution of study participants by BMI

Table 1: Distribution of study participants by general characteristics

Variables	Males	Females	P Value
	N (%)	N (%)	
Age groups			
18 – 20 years	69 (69.0%)	57 (57.0%)	0.087
21 - 23 years	22 (22.0%)	29 (29.0%)	
≥ 24 years	9 (9.0%)	14 (14.0%)	
Address			
Rafah	18 (18.0%)	25 (25.0%)	0.115
Khanyounis	85 (82.0%)	71 (71.0%)	
Medial Camps	0 (0.0%)	4 (4.0%)	
Smoking status			
Smoker	0.0%	25.0%	**<0.001***
Non-Smoker	100.0%	75.0%	
Lifestyle			
Sedentary	20 (20.0%)	26 (26.0%)	**<0.001***
Moderately	5 (5.0%)	52 (52.0%)	
Vigorously	8 (8.0%)	13 (13.0%)	
Extremely	67 (67.0%)	9 (9.0%)	

*Significant level at P value <0.05

Table 2: Participants anthropometrical, clinical and biochemical description

Variable	Male group No.=100	Female group No.=100	Total No.=200	P- value
	Mean ±SD	Mean ±SD	Mean ±SD	
BMI (Kg/m^2)	23.94 ± 4.30	23.27 ± 4.30	23.15 ± 4.30	0.702
WC (cm)	80.67 ± 10.06	78.49 ± 11.33	79.58 ± 10.69	0.152
SBP (mm Hg)	122.70 ± 6.00	117.25 ± 4.68	119.98 ± 5.34	**<0.001***
DBP (mm Hg)	76.45 ± 7.01	74.90 ± 6.07	75.68 ± 6.54	0.096
TC (mg/dL**)**	131.04 ± 27.84	136.27 ± 39.12	133.65 ± 33.48	0.277
LDL-C (mg/dL)	67.31 ± 30.02	84.19 ± 40.47	75.75 ± 35.24	**0.001***
HDL-C (mg/dL)	44.44 ± 19.67	37.89 ± 22.23	41.16 ± 20.95	**0.028***
TGs (mg/dL)	99.58 ± 52.39	84.21 ± 39.08	91.89 ± 45.73	**0.020***
Glucose (mg/dL)	87.39 ± 11.84	83.12 ± 13.41	85.25 ± 12.62	**0.018***

*Significant level at P value <0.05

Table 3: Percentage of IDF MetS criteria of the participants by gender

Variable	Male group No.=100	Female group No.=100	Total No.=200	P- value
	N (%)	N (%)	% of Total	
Low HDL-C	30 (30.0%)	33 (33.0%)	63 (31.0%)	0.648
High TGs	9 (9.0%)	8 (8.0%)	17 (8.5%)	0.800
High Glucose	14 (14.0%)	11 (11.0%)	25 (12.5%)	0.521
Large WC	9 (9.0%)	19 (19.0%)	28 (14.0%)	**0.011***
High BP	7 (7.0%)	5 (5.0%)	12 (6.0%)	0.552

*Significant level at P value <0.05

Table 4: Prevalence of IDF MetS criteria of the participants per BMI category

Variable	Underweight & Normal Weight	Overweight	Obesity	P- value
	% of Total	% of Total	% of Total	
Low HDL-C	20.0%	4.0%	5.5%	0.415
High TGs	4.5%	2.0%	2.0%	0.055
High Glucose	7.0%	2.0%	2.5%	0.336
Large WC	0.0%	10.0%	15.0%	**<0.001***
High BP	1.0%	2.0%	3.0%	**0.003***

*Significant level at P value <0.05

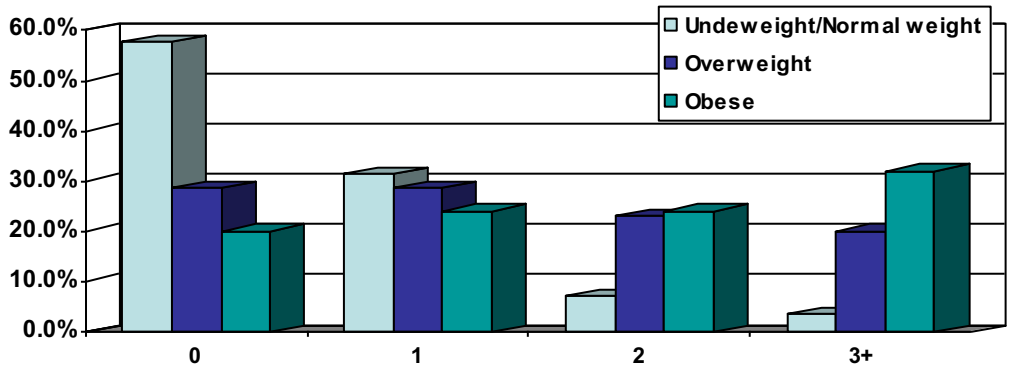

Figure 3: Number of IDF components according to BMI category

Discussion

As stated in the present findings, the most prevalent MetS criteria in the total sample were low HDL-C (31.0%), large WC (14.0%), high Glucose (12.5%), high TG (8.5%) and high BP (6.0%). In their research sample, a prevalence rate of 47.3% was recorded for low HDL-C (Dalleck, & Kjelland, 2012). Although, Ervin recorded that high WC and elevated BP as the most common MetS risk factors among adults with 20 years of age (Ervin, 2009). Furthermore, most studies in young adults have reported the greater occurrence of low HDL-C and elevated TG (Huang et al., 2007; Burke et al., 2009; Fernandes, & Lofgren, 2011; Dalleck, & Kjelland, 2012). It should be noted that the many past previous studies have also shown that racial variations in the WC cut points correspond to enhanced danger for Mets (Topè, & Rogers, 2013). In the line to the majority of previously reported studies, the current study also reports high occurrence rate (12.5%) for pre-diabetes (elevated blood glucose) among college students (Huang et al., 2007; Burke et al., 2009; Fernandes, & Lofgren, 2011; Dalleck, & Kjelland, 2012). In addition, as reported in the current study the prevalence of MetS components was (7.0%). However, the occurrence rate of MetS criteria in the total sample is considerably lower than the majority previously reported studies around the word (Topè, & Rogers, 2013; Al-Azzawi, 2018). This finding may be attributed to a good lifestyle and healthy dietary habits which were followed by the students in this study during their daily life which in turn lead to lowering the prevalence of MetS criteria among them. On the other hand, the finding of this study was in agreement with many published works that found a low prevalence of MetS components (less than 10.0%) among university students (Abolfotouh et al., 2012; Silva et al., 2014). The differences in the prevalence of MetS results among previously published report may be attributed to the diversity in the criteria that studied and in the cut-off points identified by the researchers.

In addition, the prevalence of MetS was higher in females than in males and this finding was in the line with many previously published studies (Topè, & Rogers, 2013; Al-Azzawi, 2018). The higher prevalence of MetS among females group may be due to the high tendency of females towered sedentary lifestyle, in addition to widen their WC as compared to males group. Furthermore, as mentioned, a total of 2.5% of the sample had at least one metabolic dysfunction, 4.5% of the sample had at least two metabolic criteria and this finding is less than thus reported by two studies reported previously (F de Freitas et al., 2013; Silva et al., 2014). Moreover, As we expected, the obese group had the highest occurrence of high WC and high BP as compared to those in the categories of underweight, normal and overweight, these findings were consistent with the study that conducted in 2013 which recorded that obese students had the greatest incidence high WC, low HDL-C, increased BP and increased fasting blood glucose compared to those in the categories of underweight, normal and overweight (Topè, & Rogers, 2013). In addition, Our results indicate that the BMI status of students plays an significant part in anticipating the likelihood of MetS since 32.0% of obese subjects had three or more MetS components, a much greater rate than that discovered among participants in the overweight or normal categories (20.0% and 3.6% respectively). Similar results nearly were reported by the work that conducted in 2013 where they observe that about 40% of obese students had three or more factors for MetS (Topè, & Rogers, 2013).

Conclusion

In summary, this is the first report on the prevalence of MetS defined by IDF definition in Gaza Strip, Palestine. The prevalence of MetS in the total sample was (7.0%) with (8%) females and (6%) males having MetS. Male students were more likely to be more obese, hypertensive, hyperglycaemia and hypertriglyceridemia than females ($p \leq 0.05$).
Obese students had the greatest occurrence of high WC and high BP as compared to those in students who were underweight, normal and overweight. However, prevention, early detection and early intervention programs need to be designed at universities to address MetS risk factors such as low HDL, high TGs and high WC, as well as focus on better management for pre-diabetic, diabetic and hypertensive students. In addition, Students should be regularly checked to detect MetS factors in advance, which in turn reduces the danger of CHD, HTN, and diabetes. Furthermore, Health program must be developed to encourage improve dietary habits, healthier lifestyle, promote exercise and discourage smoking among university and college students to reduce the likelihood of MetS development.

References

Abolfotouh, M. A., Al-Alwan, I. A., & Al-Rowaily, M. A. (2012). Prevalence of metabolic abnormalities and association with obesity among Saudi college students. *International journal of hypertension*, **2012**, 1-8.

Al-Azzawi, O. F. (2018). Metabolic Syndrome; Comparing the Results of Three Definition Criteria in an Iraqi Sample. *Al-Kindy College Medical Journal*, **14** (2), 7-12.

Allain, C. C., Poon, L. S., Chan, C. S., Richmond, W. F. P. C., & Fu, P. C. (1974). Enzymatic determination of total serum cholesterol. *Clinical chemistry*, **20** (4), 470-475.

Altaher, A. M., El Ujeili, A. R., Almasry, E. A., Almasry, E. O., & Abu Mustafa, Y. S. (2018). Prevalence of Metabolic Syndrome & its Components Among University Young Students in South of Gaza, Palestine. *IUG Journal of Natural Studies*, **26** (2), 10-26.

Burke, J. D., Reilly, R. A., Morrell, J. S., & Lofgren, I. E. (2009). The University of New Hampshire's young adult health risk screening initiative. *Journal of the American Dietetic Association*, **109** (10), 1751-1758.

Dalleck, LC. & Kjelland, EM. (2012) "The prevalence of Metabolic Syndrome and MetS risk factors in college-aged students". *Am J Hlth Prom*, **27** (1):37–42.

De Marco, M., de Simone, G., Izzo, R., Mancusi, C., Sforza, A., Giudice, R., ... & De Luca, N. (2012). Classes of antihypertensive medications and blood pressure control in relation to metabolic risk factors. *Journal of hypertension*, **30** (1), 188-193.

Ervin, R. B. (2009). Prevalence of Metabolic Syndrome Among Adults 20 years of age and over, by sex, age, race and ethnicity, and body mass index; United States, 2003-2006.

F de Freitas Jr, R. W., M de Araújo, M. F., P Marinho, N. B., A de Vasconcelos, H. C., S Lima, A. C., R Pereira, D. C., ... & C Damasceno, M. M. (2013). Prevalence of the metabolic syndrome and its individual components in Brazilian college students. *Journal of clinical nursing*, **22** (9-10), 1291-1298.

Fernandes, J., & Lofgren, I. E. (2011). Prevalence of metabolic syndrome and individual criteria in college students. *Journal of American College Health*, **59** (4), 313-321.

Ford, E. S., Giles, W. H., & Mokdad, A. H. (2004). Increasing prevalence of the metabolic syndrome among US adults. *Diabetes care*, **27** (10), 2444-2449.

Fossati, P., & Prencipe, L. (1982). Serum triglycerides determined colorimetrically with an enzyme that produces hydrogen peroxide. *Clinical chemistry*, **28** (10), 2077-2080.

Friedewald, W.T., Levy R.I. & Fredrickson D.S. (1972): Estimation of the concentration of low-density lipoprotein cholesterol in plasma without use of the preparative ultracentrifuge. *Clinical Chemistry*, **18** (6) 499–502.

Grundy, S. M., Cleeman, J. I., Daniels, S. R., Donato, K. A., Eckel, R. H., Franklin, B. A., ... & Spertus, J. A. (2005). Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute scientific statement. *Circulation*, **112** (17), 2735-2752.

Huang, T. T. K., Shimel, A., Lee, R. E., Delancey, W., & Strother, M. L. (2007). Metabolic risks among college students: prevalence and gender differences. *Metabolic syndrome and related disorders*, **5** (4), 365-372.

Isomaa, B. O., Almgren, P., Tuomi, T., Forsén, B., Lahti, K., Nissén, M., ... & Groop, L. (2001). Cardiovascular morbidity and mortality associated with the metabolic syndrome. *Diabetes care*, **24** (4), 683-689.

Mattsson N, Ronnemaa T, Juonala M, Viikari JS, Raitakari OT. (2007). The prevalence of the metabolic syndrome in young adults. The Cardiovascular Risk in Young Finns Study. *J Intern Med*, **261**, 159–169.

Oh, J., Kim, J. Y., Park, S., Youn, J. C., Son, N. H., Shin, D. J., ... & Jang, Y. (2012). The relationship between insulin-like growth factor-1 and metabolic syndrome, independent of adiponectin. *Clinica Chimica Acta*, **413** (3-4), 506-510.

Palestinian Ministry of Health (PMOH), (2017). Palestine Health Information Center, Non-Communicable disease. Health Status in Palestine. (Accessed 10-5- 2019).

Pickering, T. G., Hall, J. E., Appel, L. J., Falkner, B. E., Graves, J., Hill, M. N., ... & Roccella, E. J. (2005). Recommendations for

blood pressure measurement in humans and experimental animals. *Circulation*, **111** (5), 697-716.

Reaven, G. M. (2011). The metabolic syndrome: time to get off the merry-go-round?. *Journal of internal medicine*, **269** (2), 127-136.

Silva, A. R. V. D., Sousa, L. S. N. D., Rocha, T. D. S., Cortez, R. M. A., Macêdo, L. G. D. N., & Almeida, P. C. D. (2014). Prevalence of metabolic components in university students. *Revista latino-americana de enfermagem*, **22** (6), 1041-1047.

Smith, C., & Essop, M. F. (2009). Gender differences in metabolic risk factor prevalence in a South African student population. *Cardiovascular journal of Africa*, **20** (3), 178.

Topè, A. M., & Rogers, P. F. (2013). Metabolic syndrome among students attending a historically black college: prevalence and gender differences. *Diabetology & metabolic syndrome*, **5** (1), 2.

Trinder, P. (1969). Determination of glucose in blood using glucose oxidase with an alternative oxygen acceptor. *Annals of clinical Biochemistry*, **6** (1), 24-27.

World Health Organization (2012): Obesity and overweight: *Fact sheet number 311.* Geneva. https://cutt.us/WHO2018**.** (accessed 22-8-2019).