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Dietary habits, eating practices and lifestyle pattern as predictors of increased waist circumference amongst University of Umm Al-Qura female students: A cross-sectional study (Obesity Associated Risk Factors)

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ABSTRACT

Objective: Waist circumference (WC) is considered one of the best indicators for assessing abdominal obesity. However, we designed this study to evaluate the association between dietary patterns, eating practices and lifestyle pattern among healthy young age females at Umm Al-Qura University, Makkah, Saudi Arabia, with increased WC. *Methods:* Healthy young adult female students were recruited in this cross-sectional study. Face-to-face interview of 1616 participants was performed with each applicant and a validated closed-questionnaire was used to determine the dietary habits, eating practices and lifestyle pattern. WC, weight, height, and BMI were measured by standard methods. *Results:* This study indicated that the mean BMI and WC for the whole sample were all within the normal level. The percentages of obese and overweight females were 10.9% and 18.1%, respectively. This study observed that no regular physical activity, skipping breakfast, consuming fried foods $\geq$ 5 times /week, and intake of processed meat for $\geq$ 5 times /week were the significantly related to increased adiposity. Additionally, drinking soft drinks $\geq$ 2 times /week was shown to be associated with 2- to 4-fold increase in the risk of adiposity when compared to participants who consumed soft drinks $\leq$1 time /week. *Conclusion:* Increasing the level of knowledge and awareness about the risk factors related to increased WC, such higher intake of some unhealthy foods and drinks and low physical activity, is very crucial to reduce the high prevalence of increased adiposity at this age group and decreasing the adverse health outcomes with age.

Keywords: Dietary Habits; Eating Practices; Lifestyle Pattern; Waist Circumference.

1. INTRODUCTION

It is now well recognized that obesity is an epidemic phenomenon that is tightly integrated in the global burden of total morbidity and mortality, implicated on all ages, both genders and individuals in both industrialized and unindustrialized nations (Jayanna et al., 2019). The World Health Organization (WHO) has described obesity as the leading metabolic disease in the 21st century, and the second most prominent cause of preventable death (after smoking), as a consequence of its causal interrelation to several fatal illnesses including heart disease, diabetes, dyslipidemia and certain cancers (Formiguera and Cantón, 2004).

Physiologically, obesity has been described as a chronic metabolic condition characterized by the excessive deposition of fat throughout the body over several years, as a result of chronic positive caloric balance beyond the limit of energy expenditure (Shaikh, 2018). In clinical settings, several methods have been developed to define obesity including waist circumference (WC), body mass index (BMI) and waist to hip ratio (WHR). Among these measures, BMI has been universally accepted as a standard index for defining the state and the degree of obesity, nonetheless an accurate estimation of body fat content was found hard to achieve using this approach (Sikaris, 2004). Accordingly, in 2008 the WHO expert consultation on obesity documented the significance of determining whole body fat content as a measure of obesity, particularly in the abdominal area (referred to as central or visceral obesity) (WHO, 2008). Therefore, the expert consultation emphasized the necessity for additional approaches to achieve the limitations of BMI, and to better recognize persons at increased risk of developing obesity-related complications. Accordingly, anthropometric measurements particularly WC and WHR were proposed as alternative methodologies for better identification of abdominal obesity. These measurements have also been reported in many follow up studies as stronger and more consistent independent risk factor than BMI in predicting those who are at risk of developing obesity-related comorbidities (WHO, 2008). However, WHO in the previous reported concluded that the best indicator for assessing abdominal obesity was WC rather than WHR and BMI.

However, the epidemic proportion of obesity over the past two decades has not been only demonstrated in high income and developed nations, but similarly in middle- and low-income countries, affecting both adults and children (Moradi-Lakeh et al., 2016). Whilst it is more prevalent in women than in men, it affects both sexes. In the Gulf Cooperation Council countries (GCC) particularly Kuwait, Saudi Arabia, Emirates and Qatar, the prevalence of obesity is even greater than either industrialized or western nations and low income agricultural developing countries. Published figures by the Lancet in 2014 revealed that approximately 70 to 75% of the adult in these countries are either overweight or obese (Ng et al., 2014).

Etiologically, obesity is multifactorial disorder representing a complex interaction of numerous factors including environment, dietary behaviors, genetic susceptibility, race and ethnicity, physical activity, physiological, psychological, socioeconomic and cultural factors. Overall, the WHO consultation on obesity concluded that behavioral and environmental factors are the major determinants of the development of a global obesity epidemic during the last two decades (Abdul-Rasoul, 2012).

A recent study in Mecca City showed that central obesity in women increased remarkably at the age of 30 (Azzeh et al., 2017). It is noteworthy that studying the modifiable risk factors associated with increasing central obesity at a younger age should be an important issue in nations with high obesity prevalence. Furthermore, little is known about lifestyle factors, dietary habits and eating practices for young adult females in Mecca City. Therefore, this study is aiming to evaluate the lifestyle aspects, dietary patterns and eating practices among female students at Umm Al-Qura University (UQU) and their associations with increased WC.

2. SUBJECTS AND METHODS

Subject

This cross-sectional study was carried out at the female student's section at UQU Al-Abdiah campus, Mecca, Saudi Arabia between March 2016 to February 2017. A stratified random sampling procedure by department and class year was adopted. About 97% response rate was detected among female students.

The inclusion criteria for the participants were: asymptomatic healthy Saudi female university students aged 18-24 years. The exclusion criteria for the participants were: pregnant or breastfeeding, suffering from any chronic or metabolic diseases, showed any clinical abnormalities upon screening and worker. Informed consent was obtained from all participants at the onset of the study. Measurements and sampling were approved by the ethical committee of the Faculty of Applied Medical Sciences at UQU (approval number AMSEC-9-754-2016) following the Declaration of Helsinki rules.

Data collection

A study population of 1616 participants was eligible in this study. Face-to-face interview was performed with each applicant with the help of trained dietitian accompanied by a professor from Clinical Nutrition department, UQU. All participants' information was obtained from a closed-questionnaire including three sections; general characteristics, lifestyle habits and dietary habits and eating practices. The used questionnaire was mainly adopted from a previously validated questionnaire done by Al-Rethaiaa et al. (2010) among university students at Rass, Qassim University, KSA. Additionally, other questions related to intake of some unhealthy foods and drinks; processed meat, soft drink and energy drinks, in young Saudi adults were added from Moradi-Lakeh et al. (2016) paper. To fit the Saudi setting, one question about alcohol intake was not asked for students.

Prior to asking questions, recruited students were completely informed about the research to complete all questions successfully. After that, each barefooted participant stand up straightly on the Detecto physician's scale (Detecto, Webb City, Missouri, USA; available at the Faculty of Applied Medical Sciences, UQU), for measuring the weight and height, and BMI was calculated as kg/m^2. Body WC and HC were measured by measuring tape according to standard method described by Obeidat (2015), and WHR was calculated.

Statistical Analysis

Statistical tests were achieved by Statistical Package for Social Sciences software (SPSS; version 20, IBM, NY). Statistically significant results were set at $P<0.05$. Data were classified into two groups; continuous data that presented as means and standard deviation (mean ± SD), as well as discontinuous or ordinal data that presented as number and percentage. Because this is a questionnaire-based study, chi-squared test (x^2) was used to determine the significant difference. Odds ratio (OR) was obtained from Logistic Regression test and 95% confidence interval (95% CI) was also determined to find out the independent variables as predictors for increased adiposity as measured by WC. The WHO cutoff point for female's WC is 80 cm, and for WHR is 0.8.

3. RESULTS

Table 1 displays the characteristics of study sample. The mean age was 20.7±1.2 years. The mean BMI, WC, HC, and WHR were within the normal level. The distributions of the sample based on WC and BMI were illustrated in Figures 1 and 2, respectively. Overall, obese and overweight females were 10.9% and 18.1%, respectively, and the WC higher than the normal range was observed in 19.6%.

Table 1 Characteristics of study population (n=1616)

Parameter	Mean±SD
Age (year)	20.7±1.2
Wt (kg)	56.9±14

Ht (cm)	156.9±5.3
BMI (kg/m^2)	23.1±5.4
WC (cm)	72±10.8
HC (cm)	98.4±11.2
WHR	0.73±0.06

Abbreviations: Wt: weight, Ht: height, BMI: body mass index, WC: waist circumference, HC: hip circumference, WHR: waist to hip ratio

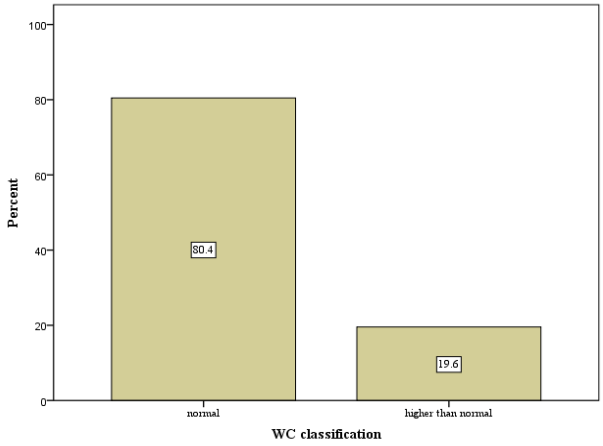

Figure 1 Frequency distribution of female students by their WC categories (normal and higher than normal)

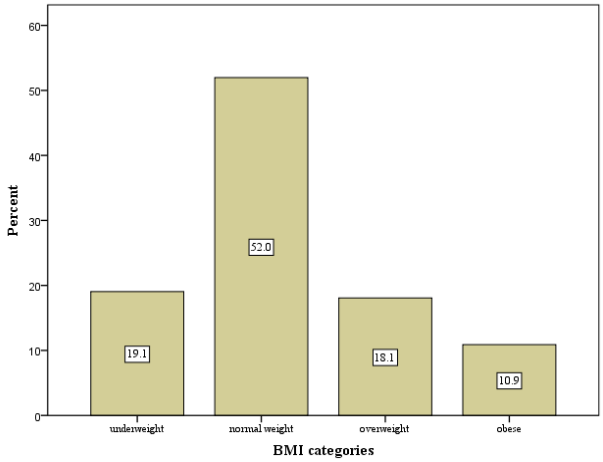

Figure 2 Frequency distribution of female students by their BMI categories (underweight, normal, overweight and obesity)

Total income and lifestyle habits as predictors for increased adiposity are observed in Table 2. Medium income of 4000-8000 SR (equals around 1070-2150 $), no regular physical activity, and no daily physical activity were the significant variables related to increased adiposity. Doing about half an hour physical activity was considered as a protective factor for increased adiposity.

Table 2 Total income and lifestyle habits as predictors for increased adiposity

Parameter	Frequency (%)		p-value (x^2)	OR (95% CI)
	Normal WC (n=1300)	Increased WC (n=316)		
Total income (SR)				
<4000	576 (44.3)	136 (43)	0.009 (11.6)	1.028 (0.736-1.436)
4000-8000	132 (10.2)	52 (16.5)		1.787 (1.157-2.759)*
8001-15000	292 (22.5)	56 (17.7)		1.02 (0.675-1.541)
>15000	300 (23.1)	72 (22.8)		1 (reference)

Regular physical activity				
Yes	824 (63.4)	180 (57)	0.021	1 (reference)
No	476 (36.6)	136 (43)	(4.5)	1.308 (1.019-1.679)*
Frequency of physical activity				
None	476 (36.6)	136 (43)		2.857 (1.652-4.943)**
Once a week	348 (26.8)	104 (32.9)	< 0.001	2.989 (1.709-5.225)**
2-4 times a week	316 (24.3)	60 (19)	(21.5)	1.899 (1.06-3.403)*
Daily	160 (12.3)	16 (5.1)		1 (reference)
Duration of physical activity				
None	476 (36.6)	136 (43)		1.026 (0.791-1.331)
< half an hour	264 (20.3)	24 (7.6)	< 0.001	0.326 (0.207-0.514)**
> half an hour	560 (43.1)	156 (49.4)	(28.1)	1 (reference)
Smoking history				
Current smoker	36 (2.8)	4 (1.3)	0.282	
Ex-smoker	20 (1.5)	4 (1.3)	(2.5)	NS
Never smoke	1244 (95.7)	308 (97.4)		

For OR, all variables were adjusted for each other. Additionally, the reference category is the normal WC group.
NS: not significant
* significant at $p<0.05$
** significant at $p<0.001$

Table 3 displays the dietary habits and eating practices as predictors for increased adiposity. The participants who did not regularly eat breakfast daily were more odds for having high adiposity than participants who daily consume breakfast. The participants who consumed fried foods > 5 times /week were about 3.6 higher risk of increased adiposity as compared with the lowest group of fried foods intake (<1 time /week). Additionally, soft drinks intake > 2 times /week increased the risk of adiposity for 2- to 4-fold when compared with participants who consumed soft drinks <1 time /week. Processed meat intake incremented the risk of adiposity by about 2 times for > 5 times /week group compared to <1 time /week group.

Table 3 Dietary habits and eating practices as predictors for increased adiposity

Parameter	Frequency (%)		p-value (x^2)	OR (95% CI)
	Normal WC (n=1300)	Increased WC (n=316)		
Eating meals regularly				
Yes	1104 (84.9)	252 (79.7)	0.054	NS
No	196 (15.1)	64 (20.3)	(3.2)	
Frequency of eating breakfast				
Rarely	176 (13.5)	56 (17.7)		1.854 (1.044-3.294)*
1-2 times a week	348 (26.8)	96 (30.4)	0.012	1.838 (1.161-2.909)*
3-4 times a week	384 (29.5)	96 (30.4)	(11)	1.621 (1.073-2.448)*
Daily	392 (30.2)	68 (21.5)		1 (reference)
Number of meals (except snacks)				
1 time a day	436 (33.5)	92 (29.1)		
2 times a day	352 (27.1)	68 (21.5)	0.11	NS
3 times a day	252 (19.4)	80 (25.3)	(2.4)	
>4 times a day	260 (20)	76 (24.1)		
Vegetables (serving /d)				

>5	228 (17.5)	64 (20.3)	0.127	NS
2-4	868 (66.8)	192 (60.8)	(4.1)	
<1	204 (15.7)	60 (19)		
Fruits (serving /d)				
>5	392 (30.2)	100 (31.6)	0.724	NS
2-4	804 (61.8)	188 (59.5)	(0.646)	
<1	104 (8)	28 (8.9)		
Fried foods (times /week)				
>5	84 (6.5)	36 (11.4)	0.01	3.554 (1.649-7.662)*
2-4	1004 (77.2)	228 (72.2)	(9.2)	0.795 (0.507-1.246)
<1	212 (16.3)	52 (316)		1 (reference)
Having meals with family or friends				
Rarely	60 (4.6)	8 (2.5)		
1-2 times a week	230 (17.8)	48 (15.2)	0.181	NS
3-4 times a week	154 (11.8)	40 (12.7)	(3.4)	
Daily	856 (65.8)	220 (69.6)		
Type of food(s) for having a balanced nutrition				
Mainly meat	76 (5.8)	13 (4.1)		
Mainly vegetables	292 (22.5)	61 (19.3)		
Meat, vegetables and other variety of foods	840 (64.6)	220 (69.6)	0.147 (3.8)	NS
Others	92 (7.1)	22 (7)		
Soft drinks (times /week)				
>5	368 (28.3)	120 (38)	<0.001	4.033 (2.613-6.225)**
2-4	512 (39.4)	136 (43)	(23.9)	2.322 (1.607-3.354)**
<1	420 (32.3)	60 (19)		1 (reference)
Energy drinks (times /week)				
>5	96 (7.4)	24 (7.6)	0.163	NS
2-4	312 (24)	60 (19)	(3.6)	
<1	892 (68.6)	232 (73.4)		
Processed meat (times /week)				
>5	420 (32.3)	140 (44.3)	<0.001	1.934 (1.262-2.966)*
2-4	644 (49.5)	132 (41.8)	(16.4)	1.072 (0.708-1.622)
<1	236 (18.2)	44 (13.9)		1 (reference)

For OR, all variables were adjusted for each other. Additionally, the reference category is the normal WC group.
NS: not significant
* significant at $p<0.05$
** significant at $p<0.001$

4. DISCUSSION

Epidemiological studies regarding obesity cases among university students has been carried out rarely in spite of global increase of these cases and expanding knowledge about the importance of modifiable risk factors and the methods of detection. In this study, we prefer to determine the factors associated with increased WC because WC is the best indicator for assessing abdominal obesity rather than other practices; BMI and WHR (WHO, 2008). More than fifty percent of people in KSA are under 25 years and as much as

14% of Saudi population is between 15-24 years old (Shaikh, 2018). The occurrence of chronic, non-communicable illnesses worldwide is rising at an alarming proportion. It knows nowadays that factors related to excessive body weight are key factors in developing non-communicable diseases (Jayanna et al., 2019) and have become a crucial public health concern in all countries either developed or developing countries (Goyal et al., 2010). It was estimated in 2016 that around 650 million of young people aged 18 years and older were obese and that young people with overweight were more than 1.9 billion (WHO, 2016). In our study, among young female students aged around twenty years old, the prevalence of obesity was 10.9% while the prevalence of overweight was 18.1%. Our study was in accordance with two surveys conducted in KSA. The first cross-sectional survey was conducted by Hamam et al. (2017) who found that the prevalence of overweight was 25.9% while 10.9% was obese. Moreover, in the second cross-sectional national multistage survey performed in 13 regions of KSA on persons aged > 15 years, the study results revealed that the prevalence of obesity and overweight among female participants were 13.9% and 23.4%, respectively (Moradi-Lakeh et al., 2016). In contrast, in another two studies, the results of the incidence of overweight and obesity were either lower or higher than our study. In a research that was carried by Yahia et al. (2008) to assess the prevalence of obesity and overweight in a representative sample of university students in Beirut, the results indicated that 3.2% and 13.6% were the prevalence percentages of obese and overweight participants, respectively. On the opposite, the overall prevalence of overweight was 35.7% for female University students (Nmor et al., 2013). However, different countries showed different rates of overweight or obesity which could be related to diverse lifestyle habits and eating patterns. Planning and implementing intervention programs and policies that are oriented toward preventing the incidence of new cases of obesity is very important that will limit or even prevent the expansion of such health problem.

It was shown in our study that family income of 4000-8000 SR was significantly associated with increased WC with [OR =1.787; CI: (1.157-2.759)]. At this range of income, the adiposity rate may increase as a result of limited healthy eating options could be obtained. This outcome is not in line with previous research carried by Hamam et al. (2014) in which body weight was not significantly affected by family income; that overweight and obesity among students of high-income families and low-income families were 38.2% and 42.1%, respectively.

Physical activity also was studied as a major factor in our study to show its association with overweight and obesity. It was indicated in our study that no regular physical activity and no daily physical activity were significantly associated with increased WC (P = 0.021, and 0.001, respectively) and consequently increased adiposity. Results of our current study were contradicted with a study carried among Ajman University student to find out the proportion of students with obesity (Ahmed et al., 2015). In this aforementioned study, the association between different categories of BMI and the level of physical activity was statistically insignificant. Nonetheless, prevalence of overweight and obesity among physically active participants were 20.4% which was lower than those who were not physically active (32.1%). On the opposite, our study was consistent with another study conducted by Labban (2014) on Syrian University student to find out the association between the prevalence of both obesity and overweight and the physical activity. Labban (2014) indicated that the prevalence of overweight/obesity among students, obviously among females, was inversely associated with physical activity. Definitely, physical activity has an important role in reducing adiposity, but type and duration of it will consider critical factors.

Series of studies among university students had been conducted across the globe to investigate the association between the prevalence of both obesity and overweight and different eating behaviors and habits (Pe´russe-Lachance, 2010). Nutritional assessment for young people is the ideal method to measure their dietary habits and patterns. Generally speaking, the diet which contains high quality and appropriate quantity has a good impact on health status and consequently, any deviation from the appropriate levels may cause the incidence of new cases with underweight or overweight. Unhealthy diet that lose the principle of balance in energy and nutrients content in the diet will result in higher and new cases that suffer from obesity or overweight (Rebato et al., 2001). Our study revealed that participants who did not eat breakfast on a daily basis were more odds for having increased WC than participants who daily consume breakfast and the association was highly significant. This result was not in accordance with two previous studies. Al-Rethaiaa et al. (2010) who conducted a study among college students in KSA to find out association between obesity and eating habits and found that the association between frequency eating of breakfast and obesity was not significant. Moreover, typical results were found through the study conducted by Yahia et al. (2008). Our study revealed that participants who consumed fried foods > 5 times /week were about 3.6 higher risk of increased WC as compared with the lowest group of fried foods intake (<1 time /week). This result was also contradicted with the two studies of Al-Rethaiaa et al. (2010) and Yahia et al. (2008) that both indicated that there was no significant association between frequency of eating fried foods and the risk of overweight or obesity. In addition to previous results, it was indicated in our study that female students who consumed soft drinks intake > 5 times /week and (2-4) times/week have an increased the risk of adiposity [OR=4.033; CI :(2.613-6.225) and OR=2.322 (1.607-3.354), respectively] compared with participants who consumed soft drinks <1 time /week. Two meta-analyses

discussed the association between the intake of soft drinks and obesity. The first meta-analysis conducted by Vartanian et al. (2007) they study the correlation in 11 cross-sectional studies between body mass index and the intake of soft drinks and the results revealed that the significant correlation were shown just in 2 of these studies. In the second meta-analysis consisted of 14 prospective and 5 experimental studies, it was reported by Olsen and Heitmann (2009) that three out of five of experimental studies shown positive associations between body fat and consumption of soft drinks and that most of the prospective studies indicated typical positive assassination. Finally, a previous study indicated proportional correlation between higher body weights and the intakes of meat (Bes-Rastrollo et al., 2006). However, another study indicated the magnificent role of meat in providing body with the feel of satiety in addition to its role in appropriate energy production (Paddon-Jones et al., 2008). Moreover, an intervention study revealed that there was a significant association between high protein diet and the loss of body weight (Layman et al., 2009). As shown in these three previous studies, the relation between the prevalence of obesity and meat intake was not consistent with our results that in our study it was shown that processed meat intake for > 5 times/week was significantly associated with increased WC and adiposity [OR=1.934; CI: (1.262-2.966)]. The results of our study were in accordance with a meta-analysis and systematic review conducted by Rouhani et al. (2014) They found positive association between prevalence of obesity and the consumption amount of red and processed meats with (OR: 1.37; 95% CI: 1.14–1.64). Moreover, Rouhani and his colleagues found that higher BMI and WC values were positively correlated with higher amounts of intake of red and processed meat.

5. CONCLUSION

In conclusion, factors associated with increased WC in female university students were medium income, no regular or no daily physical activity, skipping breakfast, consuming fried foods > 5 times /week, consuming soft drinks > 2 times /week, processed meat intake >5 times/week. National campaigns should be implemented to increase awareness about risk factors associated with increased WC and adiposity to diminish the high prevalence of overweight and obesity and the adverse health consequences related to high adiposity.

Conflict of interest

The authors have no conflict of interest to declare.

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Authors' contributions

Both authors are equally contributed in this work.

REFERENCE

1. Abdul-Rasoul MM. Obesity in children and adolescents in Gulf countries: Facts and solutions. Avances en Diabetología. 2012; 28(3):64-69.
2. Ahmed EA, Ahmed AA, Huque MS, Abdul-hameed A, Khan I, Muttappallymyalil J. Obesity among University Students: A cross-sectional Study in Ajman, UAE. Gulf Med J. 2015; 4(S2):14-S23.
3. Al-Rethaiaa AS, Fahmy AE, Al-Shwaiyat NM. Obesity and eating habits among college students in Saudi Arabia: a cross sectional study. Nutr J. 2010; 19(9):39.
4. Azzeh FS, Bukhari HM, Header EA, Ghabashi MA, Al-Mashi SS, Noorwali NM. Trends in overweight or obesity and other anthropometric indices in adults aged 18-60 years in western Saudi Arabia. Ann Saudi Med. 2017; 37(2):106-113.
5. Bes-Rastrollo M, Sánchez-Villegas A, Gómez-Gracia E, Martínez JA, Pajares RM, Martínez-González MA. Predictors of weight gain in a Mediterranean cohort: the Seguimiento Universidad de Navarra Study. Am J Clin Nutr. 2006; 83:362-70.
6. Formiguera X, Cantón A. Obesity: epidemiology and clinical aspects. Best Pract Res Clin Gastroenterol. 2004; 18(6):1125-1146.
7. Goyal RK, Shah VN, Saboo BD, Phatak SR, Shah NN. Gohel MC. et al. Prevalence of Overweight and Obesity in Indian Adolescent School Going Children: Its Relationship with Socioeconomic Status and Associated Lifestyle Factors. JAPI. 2010; 58:151-58.

8. Hamam FA, Eldalo AS, Alnofeie AA, Alghamdi WY, Almutairi SS, Badyan FS. The association of eating habits and lifestyle with overweight and obesity among health sciences students in Taif University, KSA. J Taibah Univ Med Sci. 2017; 12(3):249-260.
9. Jayanna K, Swaroop N, Kar A, Ramanaik S, Pati M, Pujar A, et al. Designing a comprehensive Non-Communicable Diseases (NCD) programme for hypertension and diabetes at primary health care level: evidence and experience from urban Karnataka, South India. BMC Public Health. 2019; 19:409.
10. Labban, L. The association between physical activity, overweight and obesity among Syrian University students. Saudi J. Sports Med. 2014; 14(2):121-127.
11. Layman DK, Evans EM, Erickson D, Seyler J, Weber J, Bagshaw D. et al. A moderate-protein diet produces sustained weight loss and long-term changes in body composition and blood lipids in obese adults. J Nutr. 2009; 139:514-21.
12. Moradi-Lakeh M, El Bcheraoui C, Tuffaha M, Daoud F, Al Saeedi M, Basulaiman M. et al. The health of Saudi youths: current challenges and future opportunities. BMC Fam Pract. 2016; 5(17):26.
13. Ng MT, Fleming M, Robinson B, Thomson N, Graetz C, Margono L, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2014;384(9945):766-781.
14. Nmor J, Nwaka KH, Nmor JC. Eating Behaviors of University Students in Southern Nigeria: An Evaluation of Sex Differences. Sci J Public Health. 2013; 2(1):23-37.
15. Obeidat AA, Ahmad MN, Haddad FH, Azzeh FS. Evaluation of several anthropometric indices of obesity as predictors of metabolic syndrome in Jordanian adults. Nutr Hosp. 2015; 32(2):667-677.
16. Olsen NJ, Heitmann BL. Intake of calorically sweetened beverages and obesity. Obes Rev. 2009; 10:68-75.
17. Paddon-Jones D, Westman E, Mattes RD, Wolfe RR, Astrup A, Westerterp-Plantenga M. Protein, weight management, and satiety. Am J Clin Nutr. 2008; 87:1558S-61S.
18. Pe´russe-Lachance E, Tremblay A, Drapeau V. Lifestyle factors and other health measures in a Canadian university community. Appl Physiol Nutr Metab. 2010; 35(4):498e506.
19. Rebato E, Rosique J, Vinagre A. Nutritional status by socioeconomic level in an urban sample from Bilbao (Basque Country). Am J Hum Biol. 2001; 13: 668-78.
20. Rouhani MH, Salehi-Abargouei A, Surkan PJ, Azadbakht L. Is there a relationship between red or processed meat intake and obesity? A systematic review and meta-analysis of observational studies. Obes Rev. 2014; 15 (9):740-8.
21. Shaikh Z. A comparative study on the Demographic Indicators of the Kingdom of Saudi Arabia, Ministry of Health. Int. J. Multidiscip. 2018; 3(6):167-171.
22. Sikaris KA. (2004). The clinical biochemistry of obesity. Clin Biochem Rev. 2004; 25(3): 165-181.
23. Vartanian LR, Schwartz MB, Brownell KD. Effects of soft drink consumption on nutrition and health: a systematic review and meta-analysis. Am J Public Health. 2007; 97:667-75.
24. WHO. Obesity and overweight; 2016. Available from: https://www.who.int/news-room/fact-sheets/detail/obesity-and overweight. [Last accesed on 2017 Jan 21].
25. WHO. Waist circumference and waist–hip ratio. Report of a WHO expert consultation, Geneva, 8-11 December 2008; 2008. Available from: https://www.who.int/nutrition/publications/obesity/WHO_report_waistcircumference_and_waisthip_ratio/en/. [Last accesed on 2016 Mar 14].
26. Yahia N, Achkar A, Abdallah A, Rizk S. Eating habits and obesity among Lebanese university students. Nutr J. 2008; 30(7):32.