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Prevalence, determinants and outcomes of general and abdominal obesity in medical students

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1. Introduction

The epidemic of overweight and obesity presents a major challenge to chronic disease prevention and health across the life course around the world (Hruby and Hu, 2015). They are increasing rapidly in both developed and developing countries (Bhurosy and Jeewon, 2014). They are associated with increased morbidity and rate of death, driven by comorbidities including metabolic disorder, increased cardiovascular risk, obstructive sleep apnea and certain types of cancer (Abdelaal et al., 2017). According to the WHO, worldwide obesity has nearly tripled since 1975 and accounted for more than 650 million in 2016 (WHO, 2017). Obesity can be noted as the initial wave of a defined group of noncommunicable diseases called “new world syndrome,” generating a huge socioeconomic and public health burden in low- and middle-income countries (WHO, 2000). Obesity occurs when energy intake exceeds its output for an extended period of time. This imbalance is fueled by economic growth, industrialization, mechanized transport, urbanization and a nutritional transition to processed foods which have led to sedentary life style and unhealthy eating pattern.

Apart from the general population, prevalence of overweight and obesity is also on the rise among health practitioners and medical students even at a higher rate than general population. It is alarming as they are important promoters and role models for maintaining a healthy lifestyle for the general population. Studies conducted in many countries on these population-group suggested that obesity is a challenging problem among medical students, while they are inquired to promote nutrition education in the community (Kumar and Ramiah, no date; Mogre et al., 2014; Khan et al., 2016; Sivashunmugam and Ansari, 2017). Ultimately, they are more prone to be overweight or obese and then at greater risk of chronic diseases. Current evidence indicates that better health practices among medical students, who, in the future, will be health educators are correlated with increased confidence and frequency of patient counseling regarding lifestyle and diet (Bergeron et al., 2017). In our country, there is a dearth of knowledge and limited data regarding overweight, obesity and lifestyle practices among medical students. Therefore, it would be worthwhile to provide base line information for health-care authorities to implement intervention program to prevent overweight and obesity. In light of this, our study aimed to estimate the magnitude of overweight, obesity and nutritional habits among medical students in South of Tunisia, to identify their risk factors and to assess their impact on mental health.

2. Materials and methods

2.1. Study design and sampling

We conducted a cross-sectional questionnaire survey among medical students at the Faculty of Medicine of Sfax University (FMSU) and the University Hospitals affiliated to the FMSU, Tunisia, on October 2017. In our Teaching Hospitals, medical cursus is divided into undergraduate medical studies, which included first-five academic years of basic and clinical studies and two years of ‘internship’, then students apply for postgraduate medical studies lasting 4–5 years, known as ‘residency’ in their chosen field of specialization. Eligible population of 1631 medical students who were attending FMSU during the study period were invited to take part in the survey. A brief history was taken regarding any endocrine disorder, medication, or relevant subjective signs and symptoms before choosing the respondent. Medical students suffering from metabolic disorders such as hypothyroidism, type 2 diabetes mellitus, and metabolic syndrome and those who are taking steroids and anti-obesity drugs were excluded. Participants who were pregnant or had recent child births and who had a recent history of fever, typhoid, diarrhea or any other medical condition in last two months which could have affected their body weight were also excluded from the study. There was no potential risk to participants as the study did not involve any intervention. The sample size was calculated based on the prevalence of 20% obesity amongst young Tunisians. The minimum sample size needed was 384 subjects. In order to have more credible results, we conducted a stratified random sampling of seven strata including 524 voluntary subjects, selected proportionally to each level of study.

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2.2. Data collection procedure

The investigation methods included a predesigned structured self-administered questionnaire administered to eligible participants and anthropometric measurements. All students were ensured about confidentiality and special attention was paid to verify that all respondents clearly understand the content and the objectives of the study. The questionnaires were administered and answered at the beginning of the course session for first-five academic years students and during training at the university hospitals for interns and residents.

2.3. Self-administered questionnaire

The first part of the questionnaire consisted of basic demographic data and social information like gender, age, marital status, current place of residence, financial situation of the family, perceived academic performance and health status. The second part of the questionnaire included information pertaining to life style items such as dietary habits, current physical activity levels (type and time spent), smoking status and alcohol consumption as well as intellectual, psychological and sleep disturbance. The respondents were also asked to grade their own stress on a scale of one to six. For the purpose of this study, a self-rated scale of 1–2 was considered as high level of stress, 3–4 as moderate-level and 5–6 as low level of stress.

2.4. Anthropometric measurements

Height, weight and waist circumference of the students were measured by trained personnel according to the World Health Organization (WHO) guidelines (WHO, 2000). Height was measured in centimeters to the nearest 0.5 cm (cm) using a measuring scale equipped with a sliding head component marked on a vertical wall, with the subject standing in erect position without shoes or headgear with head in Frankfort plane, feet together, heels, buttocks and upper part of the back touching the scale. Waist circumference was measured in centimeter (cm) midway between the inferior angle of the ribs and the suprailiac crest. Abdominal obesity was determined as a waist circumference > 102 cm in men and > 88 cm in women according to the WHO cutoff points and risk of metabolic complications for waist circumference (WHO, 2008). Body weight was determined in Kilograms (Kg) using a calibrated digital balanced to the closest 0.1 kg with the subject standing evenly on both feet, wearing normal indoor clothing but without footwear, with emptied pockets, without shoes and before lunch. Prior to use, all scales were calibrated with a standard weight. Body mass index (BMI) was calculated using the formula weight (kg)/height (m^2). Weight and height were each measured three times and the average of each was taken to be used in the BMI calculation. The obtained results were interpreted according to the WHO current classification of body weight disorder in adults aged 18 years and above: Students with BMI < 18.5 kg/m^2 were considered as underweight, 18.5–24.9 kg/m^2 as normal, 25.0–29.9 kg/m^2 as overweight (pre-obese), and ≥30.0 kg/m^2 as obese ('WHO | Overweight and obesity', 2017).

2.5. Statistical analysis

Statistical analysis was performed using SPSS23. We used the test of Kolmogorov-Smirnov and Shapiro-Wilk to check the normality of quantitative variables. The results of quantitative variables were presented as mean ± standard deviation (SD) or median and interquartile range (IQR), those of qualitative variables as percentages. We used the T test in independent samples to compare two means. For categorical variables, we used the Chi-square test in independent samples. We performed multivariate analysis using a logistic binary regression [adjusted Odds Ratio (OR); $CI_{95\%}$ (Confidence Interval $_{95\%}$), p] in order to determine the independent factors associated with overweight and obesity, after adjusting on the confounding variables. *P* values lower than 0.05 were considered statistically significant.

Table 1
Socio-demographic characteristics of the participants.

Characteristics	Total N = 524	
Age (years) (Mean, SD)	22	3.4
Gender (N,%)		
Male	156	29.8
Female	368	70.2
Marital status (N,%)		
Single	465	88.7
Married	59	11.3
Financial situation of the family (N,%)		
Poor	2	0.4
Medium	500	95.4
Rich	22	4.2
Current place of the residence (N, %)		
With parents or tutors	357	68.1
Without parents (campus hostel, rental house)	167	31.9
Studies level		
First-five academic years	400	76.3
Internship	60	11.5
Residency	64	12.2
Perceived health status (N,%)		
Good	422	80.5
Poor/medium	102	19.5
Anthropometry		
BMI (Mean, SD) (Kg/m^2)	22.5	3.28
BMI categories		
Under-weight	43	8.2
Normal weight	366	69.9
Combined rate of overweight/obesity	115	21.9
Overweight	96	18.3
Obesity	19	3.6
Abdominal obesity (N,%)	117	22.3
Waist circumference (Mean, SD) (centimeter)	79.3	12.4

N: Number; BMI: Body Mass Index; SD: Standard Deviation.

3. Results

3.1. Socio-demographic characteristics of the students

From a total of 531 questionnaires distributed to eligible students, 524 completed questionnaires were returned, with a response rate of 98.6%. The mean age of the participants was 22 ± 3.4 years. There were 368 females (70.2%). The students were single in 465 cases (88.7%). We noted that 167 subjects lived without their parents (31.9%). The financial situation of the family was medium in 500 cases (95.4%). The perceived health status was good in 422 cases (80.5%). According to the study level, there were 400 students of first-five academic years (76.3%). The mean BMI of the students was 22.5 ± 3.28 kg/m^2. Among the 524 participants, 19 were obese (3.6%), 96 cases had overweight (18.3%) and 43 cases were underweight (8.2%). The rate of combined overweight and obesity (BMI ≥25 kg/m^2) was 21.9% (Table 1). The mean value of waist circumference 79.3 ± 12.4 cm. The prevalence of the abdominal obesity was 22.3%.

3.2. Effects of socio-demographic characteristics, lifestyle behaviors, eating habits on BMI and waist circumference

Univariate analysis showed that socio-demographic factors associated with overweight or obesity in medical students were male gender ($p < 0.001$), being married ($p = 0.001$), living without their parents ($p = 0.034$) and the studies level ($p < 0.001$), notably internship and residency. These factors were also significantly associated with abdominal obesity. The frequency of abdominal obesity was statistically higher in rich families ($p = 0.036$). As to dietary habits, a daily

Table 2
Effects of socio-demographic characteristics, lifestyle behaviors and eating habits on BMI and waist circumference: results of univariate analysis.

Variables	Total	General overweight/ obesity	No general overweight/ obesity	p	Abdominal obesity	No abdominal obesity	p
Total		N = 115	N = 409		N = 117	N = 407	
Socio-demographic characteristics							
Gender (male)	156 (29.7)	50 (43.5)	106 (25.9)	***< 0.001***	19 (16.2)	137 (33.7)	***< 0.001***
Marital status (married)	59 (11.2)	23 (20)	36 (8.8)	***0.001***	28 (23.9)	31 (7.6)	***0.001***
Financial situation of the family (rich vs medium/poor)	22 (4.2)	8 (7)	14 (3.4)	0.09	9 (7.7)	13 (3.2)	***0.036***
Living without parents	115 (21.9)	46 (40)	69 (29.6)	***0.034***	46 (39.3)	121 (29.7)	***0.033***
Studies level							
First-five academic years	400 (76.3)	67 (58.3)	333 (81.4)	***< 0.001***	60 (51.3)	340 (83.5)	***< 0.001***
Internship	60 (11.4)	22 (19.1)	38 (9.3)		27 (23.1)	33 (8.1)	
residency	64 (12.2)	26 (22.6)	38 (9.3)		30 (25.6)	34 (8.4)	
Life style behaviors							
Smoking	53 (10.1)	16 (13.9)	37 (9)	0.12	13 (11.1)	40 (9.8)	0.68
Alcohol consumption	29 (5.5)	10 (8.7)	19 (4.6)	0.09	8 (6.8)	21 (5.2)	
Dietary habits							
Fresh vegetables consumption (1/day)	70 (13.3)	9 (7.6)	61 (14.8)	***0.018***	(8.4)	(12)	0.23
Fresh fruits consumption (1/day)	268 (51.1)	51 (44)	217 (53)	***0.042***	(44)	(53)	0.08
High-fiber cereals, whole-grain bread or rye consumption (1/day)	147 (28)	22 (18.6)	125 (30.4)	***0.006***	(18.7)	(29.9)	***0.009***
Physical activity							
Light exercise (light gardening, light housework, leisurely walking, volunteer work)							
4 times or more/week	71 (13.5)	8 (7)	63 (15.4)	***0.019***	6 (5.1)	65 (16)	***0.003***
< 4 times/week	453 (86.4)	107 (93)	346 (84.6)		111 (94.9)	342 (84)	
Moderate exercise (brisk walking, cycling, swimming, gardening, dancing							
4 times or more/week	42 (8)	3 (2.6)	39 (9.5)	***0.016***	4 (3.4)	38 (9.3)	***0.038***
< 4 times/week	482 (92)	112 (97.4)	370 (90.5)		113 (96.6)	369 (90.7)	
Vigorous exercise (lap swimming, aerobics, weight training, basketball, soccer)							
4 times or more/week	21 (4)	1 (0.9)	20 (4.9)	***0.035***	3 (2.6)	18 (4.4)	0.36
< 4 times/week	503 (96)	114 (99.1)	389 (95.1)		114 (97.4)	389 (95.6)	
Stress scale							
High	123 (23.4)	45 (39.1)	78 (19.1)	***< 0.001***	38 (32.5)	82 (20.1)	***0.004***
Moderate	308 (58.7)	63 (54.8)	245 (59.9)		68 (58.1)	240 (59)	
Low	93 (17.7)	7 (6.1)	86 (21)		11 (9.4)	82 (20.1)	

BMI: Body Mass Index; WC; Waist circumference; N: Number.
*General overweight/obesity: BMI ≥ 25 kg/m^2; ** Abdominal obesity: WC ≥ 88 cm in women and ≥ 102 cm in men, no abdominal obesity: WC < 88 cm in women and < 102 cm in men.

consumption of high-fiber cereals and whole-grain bread or rye was significantly associated with lower risk of both overweight/obesity and abdominal obesity, while a daily fresh fruits and vegetables consumption were significantly less frequent in overweight/obese students only. With regard to alcohol consumption and smoking, no significant association with overweight/obesity was noted. Engagement in physical activity 4 times or more per week decreased the risk of both general and abdominal obesity: A light and a moderate exercise were statistically less frequent in obese and overweight students (p = 0.019 and 0.016, respectively) and in those with abdominal obesity (p = 0.003 and p = 0.038, respectively). Similarly, a vigorous exercise was significantly associated with lower risk of overweight/obesity (p = 0.035). A high emotional stress was also significantly associated with both overweight/obesity and abdominal obesity (p < 0.001 and p = 0.004, respectively) (Table 2).

In multivariate analysis performing logistic regression, males gender (Ad OR = 3.2; CI 95% = [1.96–5.2]; p < 0.001), internship (Ad OR = 2; CI95% = [1.1–3.9]; p = 0.031) and residency (Ad OR = 3.2; CI 95% = [1.7–6]; p < 0.001) levels, as well as moderate (Ad OR = 3.4, CI95% = [1.4–8.3]; p = 0.006) and high (Ad OR = 6.7, CI95% = [2.6–16.9]; p < 0.001) stress scale were independent risk factors of overweight/obesity. However, daily fresh vegetables (Ad OR = 0.4, CI95% = [0.2–0.8]; p = 0.014) and high-fiber cereals whole-grain bread or rye (Ad OR = 0.5, CI95% = [0.28–0.83]; p = 0.008) consumption, regular physical activity (4 times or more per week) including light exercise (Ad OR = 0.37, CI95% = [0.16–0.86]; p = 0.021), moderate (Ad OR = 0.24, CI95% = [0.06–0.89]; p = 0.033) and vigorous exercise (Ad OR = 0.091, CI95% = [0.01–0.74]; p = 0.025) were independent protective factors of overweight/obesity (Table 3).

With regard to abdominal obesity, male gender, (Ad OR = 3.1, CI95% = [1.7–5.5]; p < 0.001), coming from a rich family (Ad OR = 3.22, CI95% = [1.2–9]; p = 0.022), internship (Ad OR = 4.1, CI95% = [2.2–7.65]; p < 0.001), residency levels (Ad OR = 5, CI95% = [2.7–9.2]; p < 0.001) and high stress scale (Ad OR = 2.8, CI95% = [1.2–6.2]; p = 0.01) were independently associated with higher risk of abdominal obesity. Daily high-fiber cereals, whole-grain bread or rye consumption (Ad OR = 0.5, CI95% = [0.29–0.83]; p = 0.008) and practicing light exercise 4 times or more per week (Ad OR = 0.37, CI95% = [0.15–0.9]; p = 0.036) were independent protective factors of abdominal obesity (Table 3).

3.3. Impact of obesity on intellectual abilities, sleep disturbance and psychological disorder

Obese and overweight students were significantly less able to concentrate (p = 0.024), but more living under stress (p = 0.023), feeling unhappy and depressed (p = 0.016) as well as losing confidence (p < 0.001) than normal and underweight students. Moreover, they had lost much sleep (p = 0.024) and were unable to enjoy normal activities (p = 0.03) (Table 4).

4. Discussion

The present study aimed to determine nutritional habits, healthy lifestyle behaviors and overweight/obesity prevalence rates among medical students in South of Tunisia. To the best of our knowledge and

Table 3
Effects of socio-demographic characteristics, lifestyle behaviors and eating habits on BMI and waist circumference: results of multivariate analysis.

Variables	Overweight/obesity (BMI ≥ 25 kg/m2)		Abdominal obesity	
	Ad OR (CI 95%)	p	Ad OR (CI 95%)	p
Gender (male)	3.2 [1.96–5.2]	< ***0.001***	3.1 [1.7–5.5]	< ***0.001***
Financial situation of the family				
Medium/poor	–	-	1	-
Rich	–	-	3.22 [1.2–9]	***0.022***
Studies level				
First-five academic years	1	< ***0.001***		
Internship	2 [1.1–3.9]	***0.031***	4.1 [2.2–7.65]	< ***0.001***
residency	3.2 [1.7–6]	< ***0.001***	5 [2.7–9.2]	< ***0.001***
Dietary habits				
Daily fresh vegetables consumption	0.4 [0.2–0.8]	***0.014***		
Daily high-fiber cereals, whole-grain bread or rye consumption	0.5 [0.28–0.83]	***0.008***	2 [1.2–3.4]	***0.008***
Physical activity				
Light exercise (light gardening, light housework, leisurely walking, volunteer work)				
< 4 times/week	1	-	1	-
4 times or more/week	0.37 [0.16–0.86]	***0.021***	0.37 [0.15–0.9]	***0.036***
Moderate exercise (brisk walking, cycling, swimming, gardening, dancing				
< 4 times/week	1	-	-	-
4 times or more/week	0.24 [0.06–0.89]	***0.033***	-	-
Vigorous exercise (lap swimming, aerobics, weight training, basketball, soccer)				
< 4 times/week	1	-	-	-
4 times or more/week	0.091 [0.01–0.74]	***0.025***	-	-
Stress scale				
Low	1	< ***0.001***	1	***0.037***
Moderate	3.4 [1.4–8.3]	***0.006***	1.9 [0.9–4]	0.065
High	6.7 [2.6–16.9]	< ***0.001***	2.8 [1.2–6.2]	***0.01***

BMI: Body Mass Index; WC; Waist circumference; Ad OR: Adjusted Odds Ratio.

according to the literature review, this is the first study on both obesity and nutritional habits in health sciences students residing in this region. Our study brings to light the magnitude of general and abdominal obesity among medical students and their potential risk factors in a developing country undergoing a nutritional transition. Results of this study emphasized the need for adopting a health policy to control the rising prevalence of obesity in young adults and to establish targeted programs to help curb this massive burden.

The prevalence of the combined rate of overweight and obesity (21.9%) as well as abdominal obesity (22.3%) was at an alarming rate, representing a challenging threat for the future doctors. This clearly showed a tendency towards a high weight disorder among medical students rather than towards the low weight disorders. These results also correlated with previous researches carried out in Pakistan (approximately 21%) (Khan et al., 2016), from 22 to 25% in Malaysia (Sivashunmugam and Ansari, 2017) and 31.1% in Saudi Arabia (Mehmood et al., 2016). Other studies conducted in Ghana (Mogre et al., 2014) and Nigeria (Onyechi and Okolo, 2009) revealed that the prevalence of general overweight was 9.3% and 27%, respectively. This variation in body weight prevalence worldwide could be related to environmental and genetic factors. Males were significantly more exposed to general overweight and obesity as well as central obesity, which may result from nutritional habits in our region and physical activity level of the students. These findings concurred with previous studies, reporting that 30–35% of males and 14–16% of females had BMI $\geq 25.0\ kg/m^2$ (Habibe et al., 2013; Khan et al., 2016), and that central obesity was statistically associated with male gender (Khan et al., 2016). This might be explained by the fact that a slim body size is widely idealized as a result of westernization in the Arabic countries, notably for females, while males desired to have a larger size, with developed muscles, bringing them closer to the ideal. Contrarily, other study showed that female medical students were more overweight and obese than their male counterparts (Nisar et al., 2009; Sivashunmugam and Ansari, 2017).

Factors associated with overweight and obesity have been widely described in order to dress preventive interventions accordingly. In this population-group, obesity can arise in early years due to the altered lifestyle of families with enhanced purchasing power, elevated hours of inactivity because of heavy workload and addictive behaviors, which have substituted outdoor physical exercise. Several socio-demographic factors, diet and lifestyle are possibly the major contributors to weight problems and varies with different socio-economic status. The economic growth and prosperity of Tunisia over the last two decades, simultaneously to the influence of the western world has brought pronounced changes in the lifestyle of the people and led to an increased consumption of fast foods and sugar-dense drinks. Being married was significantly associated with both general and abdominal obesity. A previous research showed that living without a partner, either being divorced or never married, was associated with lower body weight (Teachman, 2016). In this same perspective, it has been reported that having a spouse become obese nearly doubles one's risk of becoming obese (Cobb et al., 2016). A previous study showed that the risk of obesity was two times higher among young adults of high socio-economic class compared with middle and low socioeconomic status group (Mehta et al., 2016). These findings were in line with our results. This might be attributed to their food habits such as frequent fast food and outside food and because of their sedentary lifestyle such as watching TV, playing computer game and lack of regular walking. Students coming from rich families have easier access to shopping malls, supermarkets, which continually advertise unhealthy food and high-calorie products. Another important finding was that according to the study level, residents and interns were more likely to have high weight disorders. Possible explanation for this is that these periods are highly stressful in the medical cursus, where students experienced the highest degree of pressure, since they are facing medical liability at an

Table 4
Impact of obesity on intellectual, psychological and sleep disturbance.

Variables	(BMI ≥ 25 kg/m^2) (N,%)	(BMI < 25 kg/m^2) (N,%)	p
Able to concentrate	155 (37.9)	57 (49.6)	***0.024***
Lost much sleep	44 (38.3)	113 (27.6)	***0.028***
Living under stress	83 (72.2)	248 (60.6)	***0.023***
Feeling unhappy and depressed	66 (57.4)	183 (44.7)	***0.016***
Losing confidence	52 (45.2)	84 (20.5)	< ***0.001***
Unable to enjoy normal activities	62 (53.9)	157 (38.4)	***0.003***
Playing useful part	89 (77.4)	337 (82.4)	0.22
Could not overcome difficulties	45 (39.1)	155 (37.9)	0.84

N: Number; BMI: Body Mass Index; %: Percentage.

early age. In our study, living without their parents was associated with overweight and obesity. Similarly, it has been reported that living alone at dormitory was associated with obesity (OR = 1.7) (Habibe et al., 2013). Two points must be enlightened: Firstly, the type of food available in a college cafeteria or outside market may be mainly junk food and snacks or may have a higher fat content than home-made food. Secondly, greater financial autonomy as compared to their earlier years after leaving their parental homes and socio-cultural adjustment problems may explain in part their tendency to high caloric food.

Initiation of unhealthy diet in medical students has been reported in several studies in literature. Students with central obesity had a significantly greater total daily caloric intake (Khan et al., 2016). Frequently eating between meals (Patel et al., 2016), snacks between breakfast and lunch (Mahmood et al., 2013), rare frequency of fresh fruits-vegetables consumption (Habibe et al., 2013), long daily sleeping duration (Habibe et al., 2013), frequent consumption of sweets/pastries in the past week (Nisar et al., 2009) and eating while watching TV (Aldossari and Al-Zahrani, 2017) were significantly associated with higher risk of obesity and overweight in medical students. These findings were in accordance with our study, suggesting that a healthy diet was independently associated with lower risk of both abdominal and general obesity. Eating habits among medical students may be ascribed to peer pressure, mental stress and performance anxiety in a competitive academic environment. It is worthy to note that the food choices are influenced by the media advertisement. Television has changed a great deal in the past two decades and had a potential effect on directing attention of youth to caloric and fatty food.

Reduction in physical activities leads to increase in prevalence of overweight and obesity and consequently the rise in noncommunicable diseases. According to Carlson, low levels of physical activity have become a major concern on public health (Carlson et al., 2014). Several previous studies were conducted to evaluate the physical activity and fitness status of university students. In fact, lack of exercise can cause an increase in body weight and higher amount of activity is necessary for the maintenance of body weight. In our study, taking part in light, moderate or vigorous exercise regularly (more than 4 times per week) were independently associated with lower risk of overweight and obesity. Likewise, Patel P showed that frequency of going to gym was significantly associated with obesity (Patel et al., 2016). Khan ZN reported that the physical activity was very low in medical students and most of them neither played sports in college nor did regular walk or jogging (Khan et al., 2016). Indeed, technological advances, cars, elevators, escalators, remotes as well as the development of video games, computers and internet, especially if it used for non-educational purposes, have led to a decrease in level of physical activity and then promoted sedentary lifestyle. Therefore, improved nutrition and increased physical activity achieved through intensive lifestyle counseling and health education would be interestingly helpful in order to avoid severe obesity outcomes, such as high plasma lipids rate, blood pressure, and plasma glucose as well as cardiovascular diseases mortality and diabetes (Li et al., 2014). Furthermore, recent studies have shown that physicians and medical students who adopt healthy lifestyle behaviors are more confident about their skills. In terns, patients are more likely to follow medical advice about lifestyle modifications, as evidenced by physician's body weight.

Stress-induced eating may be one factor contributing to the development of obesity. We found that perceived high stress scale in medical students was an independent risk factor of high weight disorders. In fact, the environment of studying medicine is very stressful. Stressful conditions can influence eating patterns in humans and appears to alter overall food intake, resulting in under-or overeating (Bakr et al., 2002). Chronic life stresses may be causally linked to weight gain and seem to be associated with a greater preference for energy- and nutrient-dense foods, namely those that are high in sugar and fat (Gupta et al., 2009). Otherwise, other factors may also interfere in the stress level of medical students, such as heavy workload, pair problems and medical responsibility, which should be also taken into consideration.

In literature, several works demonstrated that obese and overweight students had more sleep disturbance as well as psychological and sleep disorders. Sleep disturbance has significantly affected the weight gain in Saudi medical students (Alodhayani et al., 2017) and exerts a modulating effect on glucose metabolism and then on diabetes as well as obesity. A recent systematic review showed a negative relationship in youth between obesity and various aspects of neurocognitive functioning, such as executive functioning, attention, visuo-spatial performance (Liang et al., 2014). Several evidence-based studies have shown that obese teens have a higher incidence of mental health problems such as depression, anxiety and poor self-esteem than nonobese (Melnyk et al., 2006). Previous American studies highlighted the possibility of a biological link between overweight, obesity, and depression, with obesity seen as an inflammatory state, which is perceived as a stressful live event in which the brain responds in a similar way as it responds to a medical illness, leading to elevated pro-inflammatory cytokines (Nemiary et al., 2012). These results were enlightened in our study but remain hypothetic since the cross-sectional study design can only estimate the prevalence and associated factors of a condition or disease, unless we can assure temporality. Another limitation of the cross-sectional studies is the seasonal bias or a stressful period which may affect the students' nutritional habits and then their size. Although this study presented a regional approach of obesity issue in South of Tunisia and could not be generalized to the whole country, it highlighted the magnitude of this problem among medical students. Further national and multi-center research would be of a great benefit in order to better estimate this problem among Tunisian medical students.

5. Conclusion

Our study provided an insight into the burden of overweight, obesity and abdominal obesity, assessed their potential risk factors and highlighted their impact on mental health in medical students of Southern Tunisia. An alarming prevalence of high body weight problems was associated with a high rate of unhealthy lifestyle. Therefore, there is an urgent need to encourage inculcating physical exercise in the daily activity of medical students and to implement health awareness plans including nutrition and lifestyle education in their curriculum. A multifaceted intervention involving students, their families and university administration is recommended in order to tackle high rates of overweight and obesity and to prevent their potential consequences. So that, physicians of tomorrow would be able to practice a healthy diet and to be role models for the general society.

Conflicts of interest

None.

Authors' contribution

Houda Ben Ayed, Mariem Ben Hmida, Maroua Trigui, Mondher Kassis, Jihène Jedidi and Maissa Ben Jemaa: Substantial contribution to conception and design of the study, to data acquisition, or to data analysis and interpretation.

Houda Ben Ayed, Maroua Trigui, Maissa Ben Jemaa, wrote the article and/or revised the article for important intellectual content.

Houda Ben Ayed, Raouf Karray, Yosra Mejdoub, Mondher Kassis, Habib Feki, Sourour Yaich and Jamel Damak read and approved the final version of the submitted manuscript.

All Authors revised the manuscript and gave their contribution to improve the paper.

All authors read and approved the final manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.obmed.2018.12.007.

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