Analysis of Libyan Family Pedigrees in Tripoli to Predict Obesity and Cardiometabolic Disorders in Adult

Mohamed A. Al-Griw *
Abdulhakem S. Elnefati *
Manal M. Emhaia *

Abstract:

Obesity is becoming increasingly more prevalent across multiple populations. Several studies reported a potential association between obesity and multiple pathological conditions. The aims of this study are to find out the prevalence of obesity among Libyan population at different age groups, and to evaluate the possible association between the parent's health status and their progeny's health status to predict adult obesity and cardiometabolic disorders such as diabetes mellitus and hypertension. A school-based cross-sectional study was carried out in Tripoli. A multistage stratified random sampling technique was used. The total sample included was 865 (460 males, 405 females) children (5-11years), adolescents (12-17years), and young adults (18-25years). The International Obesity Task Force (IOTF) reference standard was used to classify the participants as nonobese, overweight, and obese. The result showed that the overweight and obesity are progressively increased with age. Among both males and females, the highest prevalence of overweight was reported in Tripoli young adults, followed by adolescents, and children. As for obesity, Tripoli young adults also showed the highest prevalence of obesity for both males (29.5%) and females (33.6%). Obesity is 1.1 times more common among tested Libyan females than males. There is an urgent need to establish a plan of action to combat obesity in the Libyans. Cases of obesity are increasing in Libya and all over the

* Department of Zoology, Faculty of Science, University of Tripoli, Tripoli-Libya

world, with genetic and environmental factors playing a contributory role. With its known significant fatalities, obesity should draw the attention of the Libyan researchers and policy makers.

Key words: Obesity, body mass index, children, adolescents, young adults, risk analysis.

Introduction:

Obesity is a global epidemic resulting in major morbidity and premature death. It is defined as abnormal or excessive fat accumulation, which impairs health [1]. Body mass index (BMI; kg/m^2) is the most widely used diagnostic tool to identify nonobese, underweight, overweight, or obese individuals [1-2]. BMI is equal to body weight (kg) / height (m^2). The World Health Organization (WHO) defines overweight as BMI $\geq$ 25 kg/m^2, and obesity as BMI $\geq$ 30 kg/m^2 [3]. Central obesity refers to the accumulation of excess visceral fat, resulting in increased waist circumference. It is also defined as waist circumference >102 cm in males and > 88 cm in females [2] or as waist to hip ratio of > 0.9 cm for males and > 0.85 cm for females. Central obesity is strongly correlated with the risk of cardiometabolic disorders [2-4]. BMI is also accepted as the standard to diagnose overweight and obesity in children aged 2 years or more [4]. In children, overweight and obesity are defined as BMI $\geq$ 85th and $\geq$ 95th percentile, respectively, for age and sex [5]. The obesity is most commonly caused by excessive intake of dietary calories combined with lack of physical activity in genetically susceptible persons. In this study, we aimed to evaluate the possible correlation between obesity, using BMI as an indicator of weight status, and the presence of cardiometabolic disorders including cardiovascular disease, diabetes mellitus and hypertension as an indicator of health status.

Methods:

Study subjects:

This study was a school- and university-based study. The target populations were children in primary schools (5–11 years),

adolescents in secondary schools (12–17 years), and young adults in faculties at University of Tripoli (18–25 years). A multistage stratified random sampling procedure was used to select the subjects [6]. At the first stage, the city was divided into administrative regions, which varied from two to five regions, depending on the city's regions. Then, the schools were selected proportionally from each administrative region. The schools were grouped into boys and girls of secondary schools. Only governmental schools were included, due to the difficulty in obtaining permission from private schools and the lack of data regarding these schools. At the second stage, the faculties of the university were grouped to select subjects.

The total sample size in this study was 865 subjects (460 boys, 405 girls). The minimum sample size calculated as the sample size within ± 0.05 of the population proportion with a 95% confidence level. Therefore, the number of subjects selected varied, based on the number of students in each school or faculty and the number of selected schools and faculties, which in turn depended on the total population in the region/city.

To enssure the accuracy and consistency of the methodology (sampling procedure, measurements, and collection of the data), all participants completed the detailed questionnaire that included personal information about age, sex, geographical distribution, health status, family history, and other relevant information. Weight and height were taken using a standard procedure [6]. Weight was measured using calibrated portable scales. Height was measured to the nearest centimeter with the subject in full standing position, using a calibrated measuring rod. All anthropometric measurements were taken with minimal clothing and without shoes. Ethical authorization and approval were taken from the governmental institutes (generally the Ministry of Education). Each participant signed an informed consent statement by him / herself or by their parents.

Statistics:

All data were entered in an Excel file to carrying out the statistical analysis using the SPSS statistical package (version 20). The International Obesity Task Force (IOTF) reference standard was used to classify the children, adolescents, and young adults into three categories: nonobese, overweight, and obese [7]. Data for age, sex, weight, height and other anthropometric measurements were presented as mean ± SEM. Unpaired student t-test or one way ANOVA followed by Post-Tukey test, as appropriate was used to determine the differences in anthropometric measurements between categories, and between sexes.

Results:

Prevalence of obesity among Libyan children, adolescents, young adults:

To find out the prevalence of obesity among some Libyan age groups, the means of BMI (kg/m^2) was quantified and compared with general Libyan population (Figure1). Significant differences in age, between sexes and among age groups were revealed using one way ANOVA. The mean age is very close among the three age groups, ranging from 5.43 ± 1.54 years in children to 23.89 ± 1.72 years in young adults. The obesity progressively increased (P=0.032) with age (Figure1A). The percentages of overweight and obese patients were significantly increased (P=0.012) with age, from 12.7 ± 3.54% (overweight) and 4.2 ± 3.54% (obese) in those aged between 5 and 11 years to 46 ± 3.54% (overweight) and 46 ± 3.54% (obese) in those aged between 18 and 25 years (Figure1B). In general, children and adolescent of Libyan females were significantly ($P < 0.05$) heavier than males, but not in young adults with regard to BMI (kg/m^2) (Figure 1C). The highest mean weight among Libyan males was observed in adolescents (25 ± 2.54 %) and young adults (30 ± 1.93 %), which was similar to that observed in females (Figure 1D). However, the lowest mean weight for both males and females was observed in children 20 ± 1.47 % and 19 ± 1.28, respectively (Figure 1D).

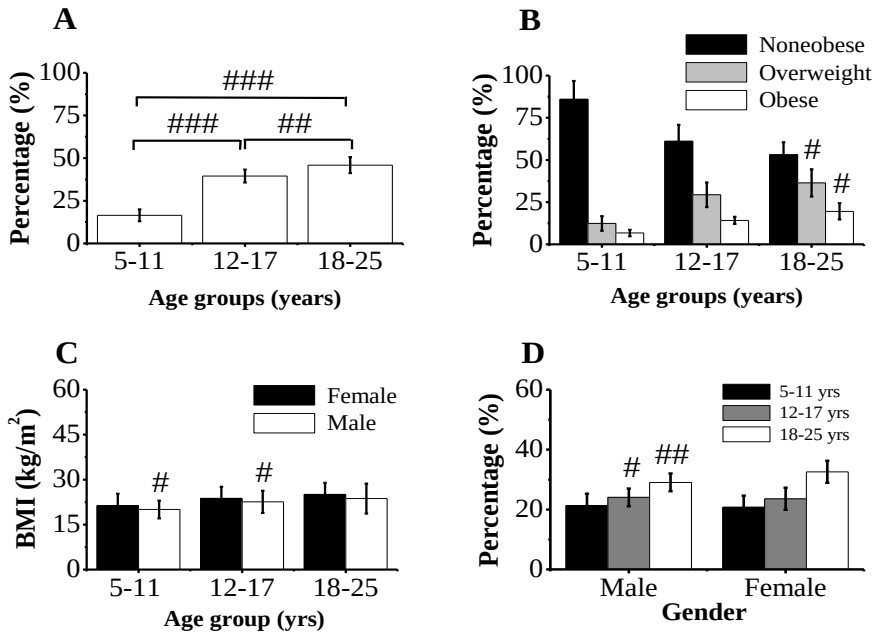

Figure 1. Comparison in prevalence of the obesity among some Libyans in Tripoli at age groups. (A) The percentage obese children, adolescent and young adults. (B) The percentage nonobese, overweight and obese. (C) Quantification of the BMI among Libyan males and females. (D) The percentage of nonobese, overweight and obese males and females. Data are represented as mean ± SEM. # versus nonobese. #$P < 0.05$, ##$P < 0.01$, ###$P < 0.001$. One-way ANOVA followed by Post-Tukey test.

Correlation between the weight status and lifestyle:

To find out the contributing factors that might play a role in the prevalence of the obesity, we studied the possible correlation of lifestyle (physical activity and diet quantity)

with the weight status of the Libyans at different age groups. Statistical analysis showed that there was a positive relation between the weight status and physical activity among Libyans at most studied age groups (Figure 2). Correlation was more prevalent among Libyans who aged between 18-25 years (P = 0.013, Figure 2C) than those aged between 12-17 years (P = 0.04,

Figure 2B), but not younger (5-11 years) (P = 0.08, Figure 2A). Our results also showed that physical activity had effect on the weight status of both sexes (Table 1); however, the obesity was almost two times more common among Libyan females than males with regard to getting sufficient physical activity.

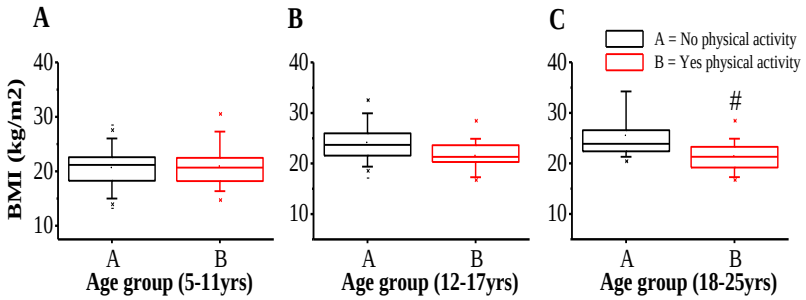

Figure 2. Correlation between the weight status and physical activity among Libyans at different age groups. Data are represented as mean ± SEM. #P < 0.05. Independent 2-tailed student's t-test.

Table 1. Correlation between the weight status and physical activity among Libyan males and females at different age groups. #P < 0.05.

Obesity (BMI ≥ 25)						
	Males			Females		
	No		Yes	No		Yes
Age (y)	n = 110	BMI	n = 130	n = 195	BMI	n = 133
		Kg/m^2			Kg/m^2	
5-11	23.7 ± 0.4		22.4 ± 0.2#	20.1 ± 0.6		20.6 ± 0.2
12-17	25.4 ± 0.7		23.1 ± 0.5#	22.4 ± 0.8		22.7 ± 0.4
18-25	26.4 ± 0.9		24.3 ± 0.5#	23.9 ± 0.7		23.6 ± 0.6

Next, we have studied the effect of diet quantity (number of meals per day) on the weight status of Libyans at some age groups. Interestingly, our results showed that the diet quantity (eating 3-4 meals per day) was not significantly contributed to the increase of susceptibility in getting weight at most ages (table 2); except for those females aged between 18-25 years (P = 0.03, table 2). Of the 130 young adult who were questioned about their

subjective opinions on the causes of their obesity, 75 individuals replied that they enjoyed eating and that they considered this aspect as a contributing factor. Otherwise, no clear pattern emerged. Thus, some participants stated that study stress or frustrating experiences repeatedly led to overeating and thus contributed to their obesity. Only 55 individuals stated they currently controlled their weight; several of the participants had done this in the past but eventually had given up.

Table 2. Correlation between the weight status and diet quantity among males and female samples at different age groups. #$P < 0.05$.

Obesity (BMI ≥ 25)						
	Males			Females		
Age (y)	Less n = 151	BMI	More n = 400	Less n = 48	BMI	More n = 153
		Kg/m^2			Kg/m^2	
5-11	20.9 ± 0.6		22.6 ± 0.7	20.3 ± 0.3		19.5 ± 0.7
12-17	23.5 ± 0.5		24.1 ± 0.8	22.6 ± 0.5		22.8 ± 0.7
18-25	24.4 ± 0.5		26.1 ± 0.9	24.1 ± 0.6		23.6 ± 0.4#

Correlation between the parent's weight status and the progeny's weight status:

Identifying groups with a high risk of becoming obese is important to prevent the progression of obesity and its attendant health risks, which appear even in young ages. In this study, our results pointed out that there is a positive correlation between the parent's weight status and the progeny's weight status at different age groups (Figure 3A-C). It also showed that the individual from families in which one or both parents are overweight have a substantially higher risk of becoming obese than do progeny whose parents are not overweight (Figure 3D). Moreover, individual from participating families in which one or both parents are obese have a substantially higher risk of becoming obese than do progeny whose parents are not obese. Taken together, our results demonstrate that the identification of such families can provide an additional tool for predicting and/or protecting the future risk of obesity.

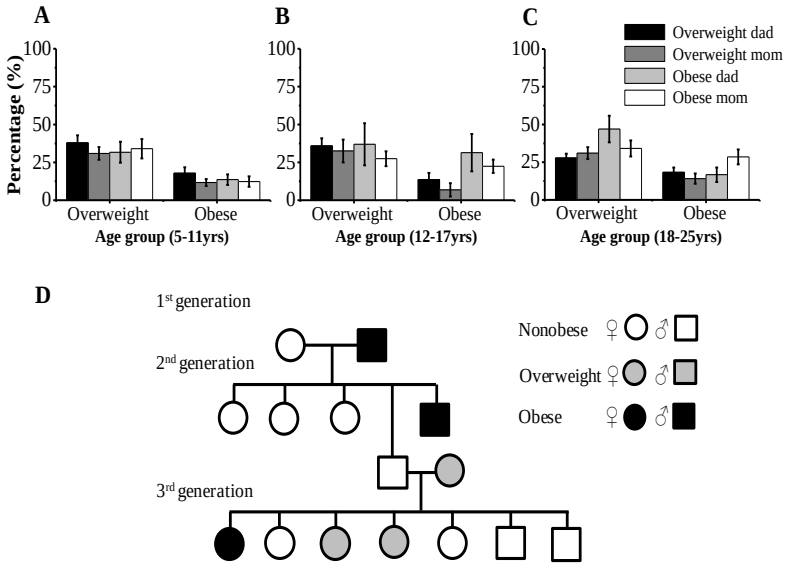

Figure 3. The correlation between the parent's weight status and the progeny's weight status among those studied at different age groups. The percentage of the overweigh and obese Libyans aged between (A) 5-11 years, (B) 12-17 years and (C) 18-25 years. Data are represented as mean ± SEM. # versus nonobese. #$P < 0.05$, One-way ANOVA followed by Post-Tukey test. #$P < 0.05$. One-way ANOVA followed by Post-Tukey test. (D) Family pedigree show correlation between the weight status of the parents and the progeny's weight status.

Correlation between the marriage types and the progeny's weight status:

Next, the aim was to study the possible correlation of marriage types with the progeny's weight status, and to detect whether marriage types are associated with the health status of the obese patients. We found that the percents of overweight and obese patients are greater among close marriages of first degree than second degree, and it becomes more less among far relative marriages at most studied age groups (Figure 4A-C). Overweight was more prevalent among close marriages than other marriages in

those participants aged between 5-11 years (Figure 4A) and those aged between 18-25 years (Figure 4C) than those age between 12-17 years (Figure 4B). Obesity was also prevalent among those aged between 5-11 years (Figure 4A) and 18-25 years (Figure 4C) than those age between 12 and 17 years (Figure 4B). It also showed that progenies from families in which one or both parents are overweight or obese and relative have a substantially higher risk of becoming obese than do progeny whose parents are not overweight or obese and not relative (Figure 4D), illustrating that the marriage types may play an important role in susceptibility to obesity.

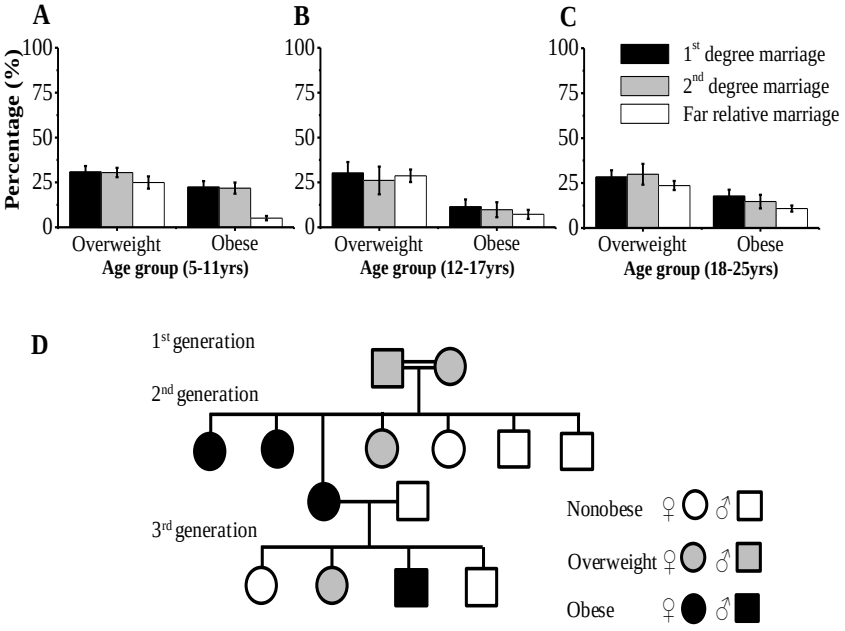

Figure 4. The correlation between the marriage types and the offspring's weight status among some Libyans at different ages. Data are represented as mean ± SEM. Quantification of the percentage of Libyans overweigh and obese aged between (A) 5-11 years, (B) 12-17 years and (C) 18-25 years with regard to marriage type. #$P < 0.05$. One-way ANOVA followed by Post-Tukey test. (D) Family pedigree show correlation between the weight status of the parents and the progeny's weight status.

Correlation between the parent's health status and the progeny's health status:

We next studied the possible relation of the health status of the parents with the prevalence of some cardiometabolic disorders among the members of the participating family members (Figure 5). These results showed that the rate of obesity is more prevalent among patients with diabetes mellitus (Figure 5A) or with hypertension (Figure 5B) than among the general Libyan population (Figure 5C), which indirectly indicates that these disorders are more prevalent among obese than non-obese Libyans. In comparison to general population, we found that Libyan individual from families in which one or both parents are diabetic or hypertensive may have a substantially higher risk of becoming diabetic or hypertensive than do progeny whose parents are not diabetic or hypertensive. It is important to mention that there was no recorded any of selected medical conditions in participants themselves. Together, we demonstrate that the health status of the parents play an important role in progeny's health status.

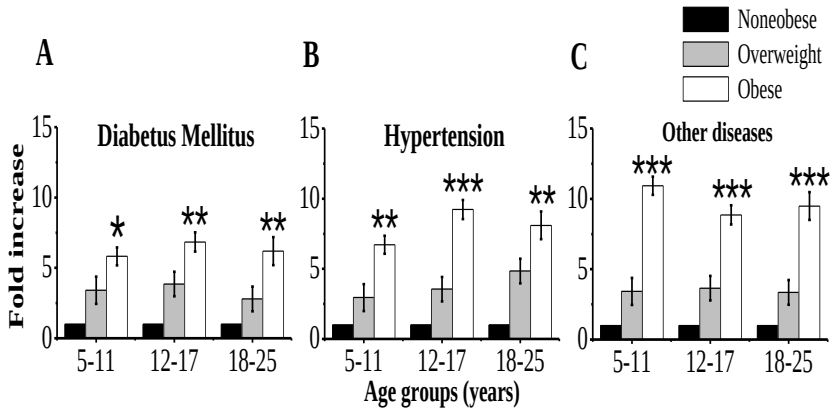

Figure 5. The correlation between the health status of the participants with prevalence of some cardiometabolic disorders among Libyans at different age groups. *P < 0.05, **P < 0.01, ***P < 0.001 One-way ANOVA followed by Post-Tukey test.

Discussion:

In this study, we employed a family pedigree approach to examine the predisposing environmental and genetic factors that might negatively contribute to the Libyan's weight and health statuses at different age groups. In so doing, a number of important insights were gained. The authors conclude that the parent's weight and health statuses involve: 1) increased the percentage of overweight and obese patients; 2) increased genetic predisposing of the offsprings to inherit some diseases in future.

Epidemiology:

It is well known that obesity is a global epidemic, resulting in major morbidity and premature death. According to WHO estimates in 2008, there were 1.5 billion adults who were either overweight or obese. In 2010, more than 40 million children aged 5 or younger were overweight [3]. The prevalence of obesity is increasing in Libya and over all the world. Previous study in which Libya was ranked as 78^{th} out of 194 countries in the list of world's fattest countries, showed that about 53.2% of adults aged 15 or older were overweight or obese [8]. However, in reality, the situation is worse as a national survey in 2008-2009 showed that 63.5% of Libyan adults were either overweight or obese [9]. Prior studies have shown that about 30.5% of Libyan adults are obese [9], 16.9% of children aged 5 or younger (8), and 6.1% of children aged between 10 and 18 are obese (9). The rate of obesity significantly increases with age, from 4.2% in those aged between 10 and 12 to 46% in those aged between 55 and 64 [9-12]. The mean BMI in Libyan adults is 27.7 kg/m^2 (26.4 kg/m^2 in males and 29 kg/m^2 in females). Consistent with these findings, the obesity is rampant among Libyans who aged between 5-11 years, 12-17 years, and 18-25 years. There was no significant difference between male and female children with regard to overweight or obesity; however, overweight was almost two times more common among males than females, whereas obesity was more prevalent among females than males, a trend being observed worldwide. A

possible explanation for this would be that females tend to lead sedentary lifestyles than males and also because Libyan females indulge in binge eating as they spend much time at home and also attend more social gatherings, which are usually associated with consumption of abundance of food. Hormonal factors might also play a role in fat accumulation in females than in males [1].

In comparison, the 2008-2009 survey [9] showed an increase in the prevalence of obesity by 2.42 times, mainly among males. We, however, think that the real increase is much more than reported as the obesity definition that was adopted by Rao and others in 1985 [13] study was ≤ 29 kg/m^2 for males and ≤ 36 kg/m^2 for females, a clear overestimation of the obesity rate, and many patients who were not considered obese by the 2008-2009 definition were reported as obese in the 1984 or 2008 report. Moreover, unlike the 2008-2009 survey in which the study sample was randomly selected and representative of the whole population, it is unclear whether the control group from which Rao and others. estimated the prevalence of obesity in otherwise healthy Libyans was randomly selected. Nevertheless, we still can make a valid comparison between the percent of females with BMI ≥ 36 kg/m^2, which has increased 1.1 times, from 25.1% in 1984 and 30.5 % in 2008 to 32.6 % in this study.

Etiology:

In this study, the association of genetic predisposition with a high risk of being obese patient at different age groups was studied. Studies of twins suggest the existence of genetic factors in human obesity [14]. The percent of the obesity that can be attributed to genetics varies, depending on the population examined, from 6 to 85% [14]. It is postulated that certain ethnic groups, in an equivalent environment, may be more prone to obesity than others [15-16]. Surprisingly, obesity is much more prevalent in Libyan adults than in Tunisian adults [9, 17] despite both populations having more or less the same genetic background, which raises the possibility of environmental factors as the main cause of the increased prevalence of adult obesity in Libya. The results show

that there is a positive relation between a high risk of being obese and the parent's weight status (Figure 3-5), illustrating that genetic and familial components play an essential role in inheriting such a diseases.

Although obesity has an important genetic makeup, environmental factors are probably the predominant factors in the current epidemic [9, 17]. The identification of children at high risk of obesity is particularly important. Many of epidemiological studies reported that energy intake, total calorie consumption and composition of diet (a diet high in fat and low in vegetables and fruits) play a major role in the pathogenesis and susceptibility to obesity [9, 17-19]. Over the last decade, Libyan diet has become more influenced by Western food culture, and Libyans are now consuming more diets high in sugar and saturated fat in the form of fast foods. It is reported that the rate of artificial feeding, but not breast-feeding is shown to be associated with a higher risk of obesity in Libya [20]. This may partially explain the high rate of obesity in Libya adolescents aged 11 or younger. In this study, some young adults who were questioned about their subjective opinions on the causes of their obesity, replied that they enjoyed eating and that they considered this aspect as a contributing factor.

It is well known that sedentary lifestyle lowers energy expenditure and enhances weight gain. Globally, there has been a marked shift toward less physically demanding work. Consistent with others [9], we found that ~ 44% of Libyan adults do not perform sufficient exercise (51.7% of females and 36% of males). We think this is mainly because of increasing dependence on mechanical transportation and greater availability of effort-saving equipments domestically. The increase in television viewing time, use of computers, and video games could be other possible contributors to the rise in the prevalence of obesity among Libyan young adults and younger.

Worldwide, overweight and obesity result in major morbidity and premature death as they are predisposing factors for multiple pathological conditions [3, 21-23]. Consistent with others

[3, 21-25], the current study found that the rate of obesity is more prevalent among individuals with diabetes mellitus and hypertension than general population (Figure 5), which indirectly indicates that familial components play a crucial role in inheriting such a diseases. The risk of chronic disease in populations increases progressively from a BMI of 21 kg/m^2. A high BMI is associated with increased rate of death from all the aforementioned causes and also from cardiovascular disease [24]. It has been found that those with BMI $\geq$ 30 kg/m^2 at age 40 lived 6 years less than those with lesser BMI, and those with BMI between 25 and 29.9 kg/m^2 at age 40 lived about 3 years less than healthy subjects [25]. Obese subjects also had up to 2.4 times the number of sick leaves as did normal-weight subjects, and the annual drug costs were significantly higher in obese people [26].

Conclusion:

The prevalence of obesity among Libyans is very high, and it has increased dramatically since 1984. The epidemic of obesity is not limited to Libya, but it is a global problem. Obesity is much more prevalent among Libyan females than males, and it increases progressively with age in both sexes. The Social and genetic factors play a crucial role in the current obesity epidemic in Libya. This study provides comparable and useful data to build on for this plan of action. With its known significant morbidity and mortality, obesity should draw the attention of the healthcare community in Libya.

استخدام تحليل النسب في العائلات الليبية في طرابلس للتنبؤ باحتمال الإصابة بمرض السمنة وأمراض القلب الايضية في البالغين

محمد عبدالسلام القريو *
عبدالحكيم شعبان النفاتي *
منـــال محمـــد أمحيـا *

المستخلص:

أصبحت الزيادة في الوزن ظاهرة سائدة وفي تزايد مستمر في عدة مجتمعات. سجلت عدة دراسات إمكانية وجود علاقة بين السمنة والإصابة بعدة حالات مرضية. الهدف من هذه الدراسة هو تحليل مدى انتشار ظاهرة السمنة في فئات عمرية مختلفة من المجتمع الليبي وتقدير إمكانية ارتباط الحالة الصحية للوالدين بالحالة الصحية للأبناء لاستخدامها في التنبؤ بمدى احتمالية إصابتهم بمرض السمنة وأمراض القلب الأيضية مثل السكري وضغط الدم.

اعتمدت هذه الدراسة على عينة عشوائية في مراحل عمرية مختلفة من طلبة مدارس مدينة طرابلس، كان العدد الكلي للعينة 865 فردا (460 ذكور و405 إناث)، وكانت الفئات العمرية على النحو الآتي: فئة الأطفال (5–7 سنوات) وفئة المراهقين (12–17) وفئة صغار البالغين (18–25 سنة). واستخدم المعدل المعياري العالمي للسمنة كمرجع لتصنيف العينات إلى إحدى المجموعات الآتية: طبيعي (non–obese) ووزن زائد (overweight) وسمين (obese).

من النتائج لوحظ أن مجموعة الوزن الزائد ومجموعة السمين تزداد بشكل تصاعدي مع زيادة العمر. كما سجلت الدراسة أن ظاهرة الوزن الزائد سائدة وبشكل كبير في صغار البالغين (الذكور والإناث) ثم في فئة المراهقين والأطفال. تم ملاحظة أن

* قسم علم الحيوان – كلية العلوم – جامعة طرابلس .

معدل السمنة عالي في صغار البالغين في كلا الجنسين (الذكور بنسبة 29.5% والإناث بنسبة 33.6%)، كما لوحظ أن معدل السمنة في الإناث كان أعلى بـ 1.1 مرة من الذكور.

للسمنة علاقة وطيدة جدا بالعوامل الوراثية والبيئية مما يؤدي للإصابة بعدة أمراض خطيرة. وكما في العالم فإن مرض السمنة في المجتمع الليبي في ازدياد مستمر وهناك ضرورة ملحة لإعداد خطة من أجل تقليل معدل السمنة في المجتمع الليبي. إن هذه الظاهرة تحتاج إلى لفت نظر الباحثين لإجراء المزيد من الدراسات والأبحاث للتعرف على سبب حدوث هذا المرض وإمكانية علاجه أو الحد من انتشاره.

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