Research Article
AMERICAN JOURNAL OF PHARMACY AND HEALTH RESEARCH
www.ajphr.com
2016, Volume 4, Issue 9
ISSN: 2321–3647(online)

Young obese are susceptible to decline in bilateral visual acuity.

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ABSTRACT

Obesity is a growing health issue of all age groups throughout the world that leads to increasing prevalence of different diseases including eye problems. However, there is scarcity of literature available showing association of obesity and refractive errors like myopia especially among young Saudi males. Therefore we design this study to investigate the incidence as well as relation of myopia with obesity in young male Saudi medical students. Around 104 young Saudi medical students were included in the study. Height and weight were measured using standard procedure; Body Mass Index (BMI) and body fat percentage were calculated. Visual Acuity (VA) for both right (Rt) and left (Lt) eyes were recorded separately using E letter chart. Results of the study showed 56% of the participants were overweight or obese with BMI more than 25. Obese group demonstrated significantly higher values of weight, BMI and body fat percentage. Mean values of visual acuity obtained from non-obese and obese subjects were significantly different for Rt. eye(1.29$\pm$0.06 and 1.0$\pm$0.07) and Lt. eye (1.23$\pm$0.06 and 0.98$\pm$0.07) respectively. Myopia is common among medical students and myopics are taller, heavier and have higher BMI.

Keywords: Visual Acuity, Obesity, BMI, E-Chart

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Received 05 September 2016, Accepted 14 September 2016

Please cite this article as: Farooq SN *et al*., Young obese are susceptible to decline in bilateral visual acuity . American Journal of Pharmacy & Health Research 2016.

INTRODUCTION

Obesity gains global attention with its rising incidence and association with numerous diseases and detrimental effects on human health[1]. It is one of the leading preventable cause of death, which is not restricted to any particular age group or socioeconomic class but is increasing in people of all age groups from young to elderly[2,3]. According to World Health Organization (WHO) people having a BMI of 30Kg/m^2 or more are classified as obese whereas, people with BMI between 25-29.9 Kg/m^2 are considered as overweight[4]. Excess energy intake, lack of physical activity, stress and sedentary life style are the common factors responsible for increasing incidence of obesity. Obesity is an established risk factor for cardiovascular diseases[5], hypertension, stroke, type 2 Diabetes[6], osteoarthritis[7] and sleep apnea. It is also reported to reduce lung function. Previously we have established[8] significantly reduced Peak Expiratory Flow Rate in young obese Saudi medical students 18-19 years of age. Moreover, an association was observed between obesity and stress in medical undergraduates 19-20 years of age with significant relationship between body weight, BMI and perceived stress[9]. Obesity is also found to have a role in the etiology of certain type of cancers including breast, prostate, colon and endometrium[10,11]. Several investigators have explored the effects of obesity on eyes and vision. Bergmani et al (2004) reported a negative association of visual acuity with obesity[12]. Where Visual acuity is a measure of how well a person can focus on an object. It is defined as the ability to read a standard test pattern at a certain distance, usually measured in terms of a ratio to "normal" vision. Or simply, it is the measure of the eyes' ability to distinguish object details and shape at a given distance. Factors that determines visual acuity of an individual are[13]:

a. Sharpness of retinal focus within the eye.
b. Health and functioning of retina.
c. Sensitivity of the interpretative part of the brain.

Common cause of low visual acuity is refractive error. Although visual acuity testing assesses only one aspect of visual function, it is the test, when administered in a concise and consistent manner it can detect changes in the integrity of the visual system. Among the available targets for testing visual acuity, Snellen letter, tumbling E, and Allen picture chart are the frequently used ones.

Association of obesity with various ocular problems like, Cataract[14], age related Maculopathy[15], Diabetic retinopathy[16] and Glaucoma[17] have already been reported. According to Glynn et.al.[18]obesity is positively related with cataract. Further they are of the opinion that, both overall

obesity, measured as BMI, and abdominal adiposity, measured as waist-to-hip ratio (WHR) [19], are independent risk factors for cataract. However, in another study Weintraub[20] points out obesity as a risk factor for cataract in general and for posterior subscapular type in particular even after adjusting for variables like age, smoking and diabetes. The Beaver Dam Eye Study[21] reported a significantly positive association of intraocular pressure (IOP) with several factors including BMI. Hirvela and colleagues observed a positive association between obesity and age related maculopathy[22]. On the basis of these findings, obesity can be implicated not only in targeting the visual system from different directions. It starts affecting the visual system significantly in the form of reduced visual acuity or an error of refraction from an early age. Moreover, an increased prevalence of myopia is observed among medical students[23].The incidence of obesity in all age groups generally and in the younger age group particularly is a serious issue for Saudi Arabian society. Around 50% of students aged 18-19 years are in the pre-obese or obese category[8]. As such they are more vulnerable to different diseases including the visual problems. Also there is scarcity of literature related to the effect of obesity on the visual acuity in general and among the Saudi population in particular. Therefore, we designed this study to investigate whether obesity has any deteriorating effect on the visual acuity of young medical students and also to determine the extent of deterioration in terms of percentage of affected students.

MATERIALS AND METHOD

Ethics

An Earlier approval for the study was obtained from the institutional ethics committee. An informed consent was signed by all the participants.

Sample Size

Young healthy male Saudi medical students (N=104) gave written consent and were included in this study. All participants were from Makkah Al Mukarrama region and had no history of eye problems during the last three years. There was no complain of itching, redness, pain or watering from the eye at the time of examination.

Anthropometric measurements

Before examining the visual acuity, weight and height were measured using standard clinical protocol[24]. BMI of each participant was calculated using the formula; body weight (kilograms)/height (metre)^2. On the basis of BMI participants were categorised as non-obese

18.5-24.9 and 25 > as Obese[25]. Body Fat% (BF %) was estimated from the BMI taking into account age and gender[26]. The following formula was used for this purpose.

Current BMI, age, and gender:

Adult Body Fat % = (1.20 × BMI) + (0.23 × Age) - (10.8 × gender) - 5.4 [Gender values for male =1, female = 0].

Measurement of Visual Acuity

Visual Acuity was tested using stand board tumbling E chart with the subject standing at a distance of 5meters from the board. Studies have shown that visual acuity measurements using a tumbling E chart are virtually the same as those obtained from testing with a standard Snellen eye chart[27]. Both the eyes were tested one by one and the non-testing eye was kept close using an eye occluder. The subject start identifying the direction of E lines from the top biggest letter by pointing in the same direction as the lines of the E and continue from line to line downwards till he was unable to identify the direction of E line clearly. The last line he clearly identified is taken as his visual acuity and the distance written besides this line is recorded. Visual acuity is then calculated by dividing the distance of subject from stand board i.e. 5m/distance written beside the last clearly identified line. For example 3.15m or 1.98m. If result of this division is > than 1 visual acuity is normal but if 1 or < than 1 means weak. Same procedure was repeated for the other eye.

Statistical Analysis

Descriptive statistics were calculated for mean age, visual acuity, BMI, body fat percentage. A two tailed Pearson correlation was used to analyze association between visual acuity and other parameters. A *P* value of 0.05 or less was considered statistically significant. All statistical analysis were performed using prism (GraphPad 6 Software, La jolla CA USA)

RESULTS AND DISCUSSION

In the present study the effect of obesity on visual acuity is observed in young Saudi adults mean age 20±1 years. The study was conducted from October to December 2015.

Inclination of obesity among adults

Participants were classified on the basis of their BMI in non-obese/normal and obese groups. Around 46 subjects (44%) with a BMI ≤25 were categorized as non-obese while 58 individuals (56%) with BMI > 25 were labeled as obese. More than half of young Saudi adults were found overweight or obese. This is an alarming trend in this age group and it should be actively addressed. Mean values of Height, weight, Body fat% and BMI are represented in (Table1).

These values showed significant difference between non-obese and obese groups being higher in obese participants for all parameters except height which was also greater in obese but non-significant.

Decline in Visual Acuity of young obese

Table 1: Characteristics of subjects

	Non Obese	Obese
Number of subjects	N=46	N=58
Age (Years)	20 ± 1.5	20 ± 1.5
Weight (Kg)	63.16 ± 6.08	87.66 ± 14.65
Height	1.70 ± 0.05	1.71 ± 0.07
Body fat percentage	14.66 ± 2.11	24.23 ± 5.03
Body mass index (BMI)	21.88 ± 1.76	29.86 ± 4.19

Values are mean ± Standard deviation (SD)

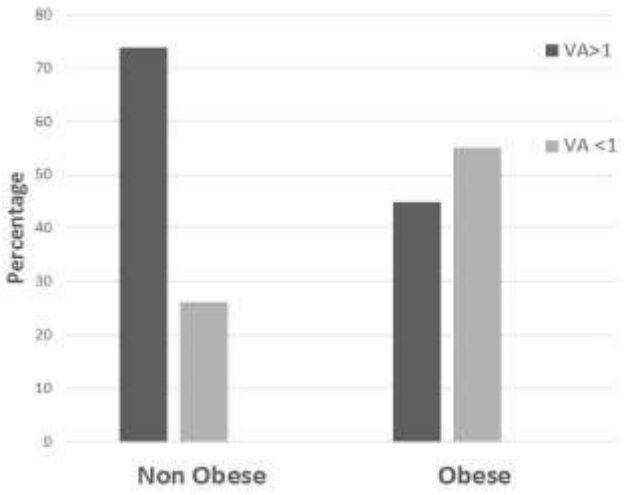

Figure 1: visual acuity declines with Obesity

The percentage of Non-obese (46) individuals with visual acuity >1 is significantly high (73.91%) as compared to subjects with visual acuity <1 (26.09%). Whereas, among Obese (n=58) the percentage of individuals with visual acuity <1 are in majority (55%)

According to report for Elena Messina (2006)[28] 6/6 or 20/20 is not a perfect human vision rather, it is the near average for adults in their 60s. Further it should be interpreted as the limit of normal vision with which an individual can cope well enough in school or industry and hence does not

require correction. As such good vision in young adults with no visual impairment is generally between 20/16 and 20/12. Our participants are all young adults therefore, we choose the same standard given by above authors and categorized our non-obese and obese subjects into two groups, one with visual acuity <1 as weak vision and those having visual acuity ≥ 1 as normal vision. We explored that, of non-obese category 33 subjects (74%) demonstrated visual acuity of≥ 1 thus representing normal vision while 13 of them (26%) have visual acuity < 1 representing some weakness of their visual system that may or may not need correction (Figure 1). However, a decline was observed in the percentage of obese individuals with normal visual acuity as only 25 (45%) subjects among them were found to have normal visual acuity of ≥ 1whereas, 33 of them (55%) possesses < 1 (Figure 1); which is more than double the percentage of non-obese individuals with weak vision (visual acuity <1). So demonstrating the influence of obesity on visual acuity. Further, if the whole study group is analyzed collectively 42% of the participants were found to have visual acuity < 1 which is not a healthy sign considering the age and socioeconomic status of the subjects and the environmental conditions around them.

Comparison of Bilateral Visual Acuity between Non-obese & obese

Mean values of visual acuity obtained from non-obese and obese subjects for Rt. eye were 1.29±0.06 and1.0±0.07 while for Lt.eye1.23±0.06 and 0.98±0.07 respectively. Statistical comparison of these results showed that the obese participants have 22.5% and 20% significantly reduced visual acuity in their Rt. and Lt. Eye respectively compared to the non-obese subjects (Figure 2). In this study we were unable to observe any significant difference in the mean values of visual acuity obtained from Right vs Left Eyes in both Non-obese and obese groups. So we can state that, irrespective of the underlying mechanism involved obesity has a bilateral negative effect on visual acuity.

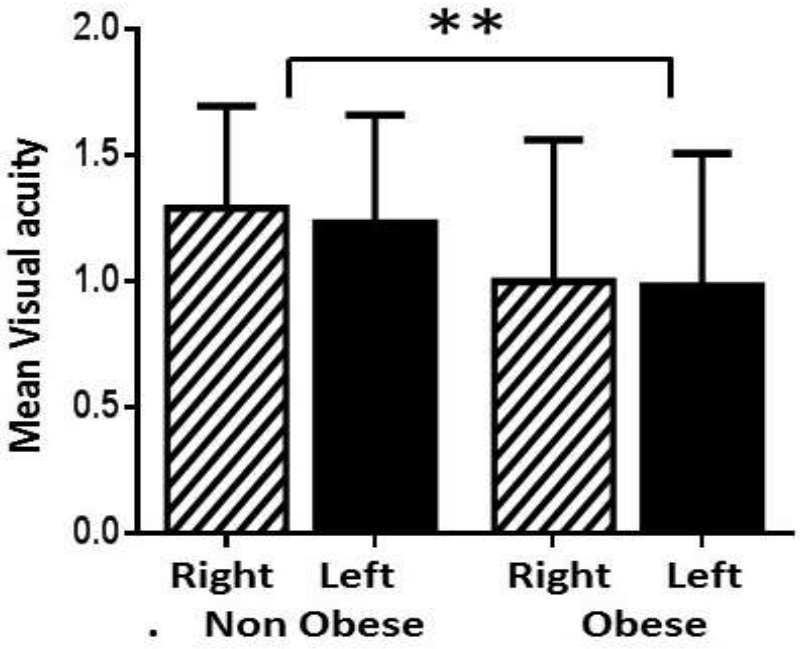

Figure 2: Comparison of Bilateral Visual acuity between Non-obese and Obese

Bilateral visual acuity comparisons shows that Non obese have better visual acuity.

A significant decline can be seen in visual acuity of obese subjects. A P <0.05 was considered significant

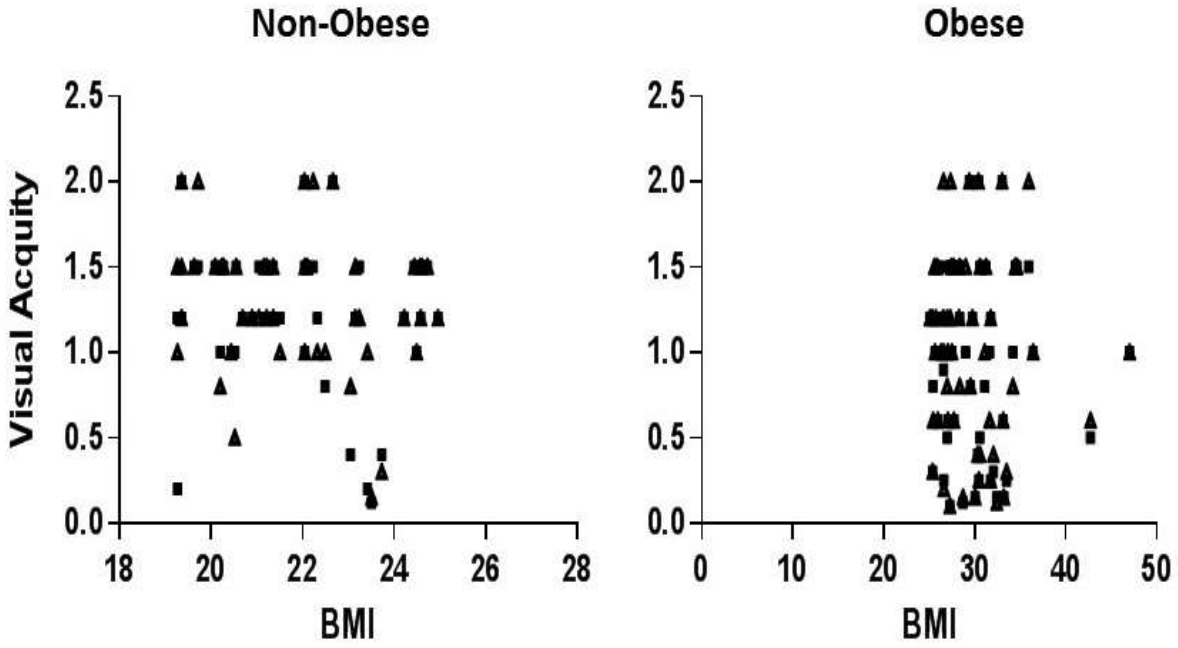

Figure 3: Correlation of Body mass index and bilateral visual acuity

There is not a significant correlation between BMI and Bilateral visual acuity for both Non-Obese (n=48) and Obese (56)

Association of bilateral visual acuity and body mass index

We further analyzed any association between bilateral visual acuity Vs. body mass index, height, weight and body fat percentage. Hence, no significant association was observed.

Myopia is one of the common causes of visual impairment all over the world. It is gaining popularity as a public health issue because of its potential to produce sight threatening ocular complications and the huge socioeconomic burden associated with it. It is one of the common problems faced by the students particularly the medical students. Marwaha komal[31]in her study on medical, engineering and arts students observed maximum myopic prevalence of 45% among the medical students. Our results also demonstrated 42% students having VA 1 or less than 1 i.e myopic or at the border line. This indicates the need to investigate the possible reasons for the declining VA in young Saudis and to take preventive measures as well.

According to our results 56% of the participants are overweight or obese with a BMI of more than 25. This high incidence of obesity in young Saudi males is possibly because of lack of nutritional education, reduced physical activity, parental obesity and due to living in an environment in which their parent may display and support behavior that promotes over eating and lack of exercise[29].

However, in our opinion there are two other reasons as well that are playing an important role in the rise of obesity among young Saudis. First is increase intake of high glycemic index diet, along with fat containing and refined foods. Secondly, overwhelming use of mobiles, laptops and tablets both for academic as well as recreation purposes thus, reducing the outdoor physical activity and sports.

Under these circumstances the higher level of myopia represented by our obese group compared to the non-obese participants can be explained on the basis of findings of Mutti Do who reported less time in sports activity to be associated with myopia[30]. Further, it is worth-mentioning here that, many workers[31,32] reported increased outdoor time as an important protective factor against myopia. There are several possible hypotheses to explain that outdoor activity could protect against myopia. The viewing distance is far in an outdoor area and the accommodation, tension from ciliary body or tension in the extra-ocular muscle of convergence would be relaxed. An emmetropic eye viewing a distant object would reduce the hyperopic blur when viewing a nearby object. Moreover, sunlight in the outdoor area induce pupil constriction resulting in a greater depth of field and less image blurring. Strong light intensity induce dopamine release from the retina and act as an inhibitor of eye growth[33]. We are of the opinion that, our obese students because of their heavy academic engagements as well as due to their sedentary life style and

laziness are likely to spent less time outdoor particularly in the day time and will prefer other indoor activities over sports during their leisure time. As such becoming obese and worsening their myopia as well.

It has been reported by many workers that, near work is an important environmental factor associated with myopia[34]. Our participants being medical students are bound to do excessive near work i.e. reading a lot to fulfill their academic requirements both using books as well as computers.

Available literature reveals another aspect of refractive errors. Many researchers have investigated the association between anthropometric parameters of height, weight, BMI and refraction and other ocular parameters both in children and adults. Seang SM[35] (2002), reported that, taller children have longer eye ball, deeper vitreous chamber, flatter corneas and more negative refraction (myopic) while heavier children have short vitreous chamber and more hyperopic refraction. Two other studies on adults a population based Finnish study[36] and a study on Danish Draftees[37] showed that myopic males are 1.9 and 0.8cms taller than emmetropes. Gardiner PA[38] also reported that, children with progressive myopia increases both in height and weight more quickly than those with stationary myopia. However, according to cardian et al(2002)[39]myopes are not only taller but heavier as well with higher BMI. Our results are in accordance with Cardian[39] et al as our obese group with higher levels of myopia also demonstrated higher values of height, weight and BMI compared to the non-obese group. We can explain this association of higher anthropometric parameters along with higher values of myopia in our obese participants on the basis of mechanism proposed by cardian[39] et al.

CONCLUSION

We can conclude that medical students are vulnerable to myopia. Intake of high glycemic index and load diets, lack of sports and physical activity, less out door time and prolong durations of near work are the main factors responsible for the increased prevalence of both obesity and higher levels of myopia. Myopics are taller, heavier and have higher BMI. This higher prevalence of both obesity and myopia among young Saudi population should be taken seriously and measures need to be taken to reduce its prevalence. Awareness among the people should be develop through health education programs about obesity and myopia. People from all age groups generally and young persons especially should be encouraged to spend more time out door on regular basis performing some physical activity or playing some sports. Children at an

early stage of their education should be trained about how to read a book and how to use the computers in order to ovoid eye fatigue during near work.

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