Research Article

Correlation of Body Mass Index with Visual Acuity among Adults

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Abstract

At present, increased BMI and visual impairment are becoming serious public health concerns worldwide, according to WHO, in 2022 more than 1 billion people are overweight/obese, and 2.2 billion people are facing far or near visual impairment problems and which is rapidly increasing in most countries. And according to world obesity federation (WOF),5.4 million school-aged Pakistani students will be obese in 2030.

Objective: To assess that body mass index has an association with visual acuity among adults in the population.

Methodology: BMI is being calculated and visual acuity data is noted in the following way. Height was measured using a measuring tape by asking the subject to stand (without any footwear) erect and placing the heel and back against the wall and the readings were taken to the nearest 0.1 cm. Weight was measured using a digital weighing machine, with the subject standing bare feet in such a way as to exert equal weight on both feet. Body Mass Index was evaluated by dividing the weight in kilograms by the square of the height in meters (weight (kg)/Height (m^2)). Visual acuity (VA) of each eye was measured one by one using a Snellen chart. The Snellen's chart was hung on a wall at a distance of six (6) meters from the subject and a height of two (2) meters in a well-lit room. Visual acuity was measured in one eye at a time (poor-vision eye first) with the subject standing opposite the chart and reading out loud the letters on the charts starting from the top line towards down. The other eye (not being examined yet) was covered with an eye occluder by the researcher. The level of the lineup to which the respondents were able to see at that specific distance was recorded. And with that other data about their age, nutritional statuses, work routine, screen, or sleep time were noted on proformas. Then chi-square for qualitative data, spearman correlation, and ANOVA is being used to assess the association having considered p value < 0.05

Results: The bivariate evaluation shows no significant correlation is found between BMI and visual acuity. ANOVA shows a significant relationship between height and visual acuity with a p-value <0.05. Fisher exact test evaluates a significant association between gender and left eye visual acuity with $p < 0.05$.

Conclusion: No association between BMI and visual acuity is found but an association between height and visual acuity is found along with a relation between gender and left visual acuity is formed.

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Keywords:

INTRODUCTION:

At present, increased BMI and visual impairment are becoming serious public health concerns worldwide, according to WHO, in 2022 more than 1 billion people are overweight/obese, and 2.2 billion people are facing far or near visual impairment problems (1) and it is rapidly increasing in most of the countries. And according to world obesity federation (WOF),5.4 million school-aged Pakistani students will be obese in 2030 (2).

The degree of obesity is commonly classified by BMI. According to WHO BMI of 18.5 kg/m 2 or lower is considered underweight, 18.5–22.9 kg/m 2 as normal, 23–29.9 kg/m 2 as overweight, and 30kg/m 2 or greater as obese (3). Obesity affects the quality of life in multiple manners (3). It is a risk factor for chronic diseases like diabetes mellitus, cardiovascular disease, hypertension, stroke, and sleep apnea syndrome (4). According to some studies that obesity is found to be linked with decreased visual acuity (6). Further, sufficient evidence are elaborating that obesity is linked with various eye diseases like diabetic retinopathy, cataract, glaucoma, and age-related macular degeneration (4,5). Various undergoing processes play role in inducing pathophysiology that leads to anterior and posterior segment eye disease in people with higher BMI(7). Some studies have found a link between BMI and anterior segment parameters in individuals with higher BMI. It is known that the depth and angle of the anterior chamber are negatively associated with BMI (8). Also, some studies have shown relationships between the thickness of the retinal nerve fiber layer (RNFLT) and BMI (9). Further, a positive relationship is found between BMI and choroidal thickness (CT) (4). Previous studies either focused on segmental parameters of the eye that are linked with obesity. However, the relationship between obesity with visual acuity is not well established and the relationship with BMI is not clear. Our study aims to determine the relationship between visual acuity and BMI, by a comparison of results between overweight and normal-weight individuals.

METHODS AND METHOD:

Permission and Consent for the study:

The entire protocol for the study was evaluated by the undergraduate students of the Department of Community Medicine, King Edward Medical University, Lahore. Appropriate suggestions were given as well to improve the work. Verbal informed consent was taken from all study participants before recruiting them into the study.

Study Population:

The study was conducted in the KEMU and its affiliated Mayo Hospital, Lahore. The participants of this research were the adult population of KEMU and its affiliated Mayo Hospital, Lahore. The participants were selected using a simple random sampling technique.

Inclusion Criteria:

The study participants included in this study were the adult population of 15 to 45 years of age of KEMU and its affiliated hospital.

Exclusion Criteria:

The exclusion criteria were based on people ages below 15 and above 45 and those with any of the following diseases: Cataract, glaucoma, corneal opacity, macular degeneration, diabetic retinopathy, any previous eye surgery, malignancy, and any systemic disease.

Study Design:

The study was a cross-sectional study. The sample size was estimated using a 95% confidence level and 6% absolute precision with an expected percentage of good visual acuity of 89.9%. Data was collected by getting responses from the participants about their socio-demographic features as well as by measuring their weight, height, and visual acuity using standard procedures.

Methodology:

Height was measured using a measuring tape by asking the subject to stand (without any footwear) erect and placing the heel and back against the wall and the readings were taken to the nearest 0.1 cm. Weight was measured using a digital weighing machine, with the subject standing bare feet in such a way as to exert equal weight on both feet. Body Mass Index was evaluated by dividing the weight in kilograms by the square of the height in meters (weight (kg)/Height (m2)). Visual acuity (VA) of each eye was measured one by one using a Snellen chart. The Snellen's chart was hung on a wall at a distance of six (6) meters from the subject and a height of two (2) meters in a well-lit room. Visual acuity was measured in one eye at a time (poor-vision eye first) with the subject standing opposite the chart and reading out loud the letters on the charts starting from the top line towards down. The other eye (not being examined yet) was covered with an eye occluder by the researcher. The level of the lineup to which the respondents were able to see at that specific distance was recorded. And with that other data about their age, nutritional statuses, work routine, screen, or sleep time were noted on proformas.

Statistical analysis:

Age, height, weight, BMI, and VA (expressed numerically) were taken for all the study participants. Mean and Standard Deviation were calculated for age, height, weight, BMI, and visual acuity of both eyes. Detailed bivariate evaluations were carried out using the Spearman correlation test for association between continuous variables (between VA and then anthropometric parameters), one way- ANOVA was performed for visual acuity and parameters like height, weight, and BMI and Chi-square test for association between categorized versions of study variables (VA: normal and abnormal/low and BMI: normal, underweight, overweight, obese). The level of statistical significance was taken for $p < 0.05$. Data were analyzed using SPSS version 23.

RESULTS

There were a total of 186 participants. 38.6% were males and 59.78% were females. The whole population was grouped as underweight, normal weight, overweight and obese according to their

BMI data as recommended by WHO. The majority of the patients were normal weight (95) and rest of them were underweight (32) and overweight (48) and very few were obese (11). Other baseline characteristics are given in table 1.

Table 1: Descriptive Stats

Variable	Mean	Standard Deviation
Age	24.56	6.31
Weight	62.04	12.31
Height in meter	1.64	.09
BMI	22.97	4.28
VA in the right eye (fractions were converted to decimals)	.53	.40
VA in the left eye	.55	.40

Normal-weight individuals included in this study were more in number and the division between the normal and low visual acuity among normal BMI persons were somewhat approximate but underweight, overweight, and obese groups had more participants with low visual acuity in both right and left eyes as compared to normal visual acuity. In the normal weight group percentage of normal visual acuity in the right eye (58.7%) and left eye (59.5%) and the percentage of low visual acuity in the right eye (45.9%) and left eye (44.9%) were comparable, showing no significance. No significant relation was observed between visual acuity and BMI in the right eye (P=0.190) and left eye (p=0.217).

TABLE 2: VA values in both right and left eye in all categories of BMI

BMI	Overall	Right eye		Left Eye	
		N	Low VA	N	Low VA
Underweight	32(17.2%)	10(13.3%)	22(19.8%)	11(13.9%)	21(19.6%)
Normal	95(51.1%)	44(58.7%)	51(45.9%)	47(59.5%)	48(44.9%)
Overweight	48(25.8%)	19(25.3%)	29(26.1%)	16(20.3%)	32(29.9%)
Obese	11(5.9%	2(2.7%)	9(8.1%)	5(6.3%)	6(5.6%)

To evaluate normal visual acuity and low visual acuity in terms of height, weight, and BMI; analysis of variance (ANOVA) was used. There was a significant relation found between height

and visual acuity for both the right eye [F (1,184)=6.13,p=0.014] and left Eye [F (1,184) =5.58, p=0.019]. Weight and BMI showed no significant relation with visual acuity as given in table 3.

TABLE 3: Result of ANOVA to the comparison of height, weight, and BMI between studied groups for the right and left eye

variable	Right Eye				Left Eye			
	Sum of squares	df	F	P	Sum of squares	df	F	p
height	3410.09	1	6.13	0.014	3110.65	1	5.58	0.019
weight	0.97	1	0.06	0.936	82.54	1	543	0.462
BMI	2.14	1	0.037	0.848	1.25	1	0.02	0.884

Fisher's exact test was used to determine if there was a significant association between visual acuity and gender. There was a statistically significant association between visual acuity and gender in the left eye (p=0.035). However, no statistically significant association was found in the right eye (p=0.221).

TABLE 4: Frequency of normal and low VA among genders

Visual Acuity		Overall N=186	Male N=73 (39.24%)	Female N=113 (60.75%)
Right Eye	Normal	75(40.32%)	25 (33.33%)	50(66.66%)
	Low VA	111(59.67%)	48(43.24%)	63(56.75%)
Left Eye	Normal	79(42.47%)	24(30.37%)	55(69.62%)
	Low VA	107(57.52%)	49(45.79%)	58(54.20%)

DISCUSSION:

In this study, the majority of the participants were female and there were participants with normal BMI and normal visual acuity. The value of visual acuity in the left eye was found significant (< 0.05) when evaluated based on gender with the fisher exact test but statistically no significant values were found for the right eye. Various anthropometric values were evaluated with the values of visual acuity of both eyes.

Firstly, in this study, no significant relationships were found between BMI and the visual acuity of both eyes. Other studies provided a significant relationship between visual acuity and obese/overweight than normal/underweight having. a p-value < 0.001 (10). And the difference in result in our study could be due to the age range, such as a study in China (11) conducted on children age ranging 6 to 18 years found a significant association of visual acuity among underweight and obese which is probably because this age is greatly affected with nutritional status; and other reasons could be participants that belong to medical undergraduate programs, quite a screen time like approximately 6-7 hours per day, daily routine

activities and daily nutrient intake may acting as cofounders.

Secondly, the evaluation of visual acuity with weight was also done separately to check any relationship with them but in this study, no significant relationship was found and this is possibly due to the same reasons discussed above. Thirdly, height was also evaluated in this study with visual acuity of both eyes and the tests provided a significant relation of visual acuity with the given parameter with p value less than 0.05, and such same relation was also found in the study conducted in Kano state in Nigeria (12) and but this relationship was limited to the female gender in this study.

The importance of the current study is that no such study was first conducted in this area and analysis of variance provides the strong relationship between height the visual acuity the data also provides the amusing result of the association of left eye visual acuity with gender which was reported in very few studies and this study form the foundation of these results. The findings in the study vary from the findings in the different studies probably due to the geographic distribution of the population that was taken for the study as many of the participants were university-going their nutrition intake compared with their daily workloads and requirements.

This study had a sample of 15 to 45 years of age but many of the participants of age 30s and 40s were not included due to their health conditions like hypertension or diabetes or another ocular disease. The limitation of the study was the population size, which can be increased by including other universities or colleges of other programs so the results can be more generalized the other limitation is that the majority of the data collected in this study was by the adults in their 20s, so other studies can be done further for the other ages. And other anthropometric measures like head circumference, muscle mass, and body fat could also be used to further assess their association with visual acuity.

CONCLUSION:

An association between BMI and visual acuity was not formed in this study, a significant association was found between height and visual acuity and the association of left eye visual acuity and gender were also found.

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