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Anthropometric Indicators of Executive Drivers as Physiological Correlates of Visual Capacities

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Abstract

With growing global advent of occupation and physical activity guidelines to prevent weight gain, anthropometric measures of height and weight have "stand tall" in checkmating an individual's nutritional status through mass index (BMI). In recent times, studies have implicated abnormal weight gains in visual malfunctions. Current Study was therefore undertaken to examine in humans, specifically executive drivers, the effect of anthropometric changes (BMI, Weight and height) on visual capacities. Sixty-eight (68) executive drivers who were confirmed to be staff of the Delta State University, Abraka, Delta State, Nigeria were ethically recruited for the study. Subjects were then grouped into four (4 groups) based on their nutritional/BMI status. While Group 1 comprised of those with lower than normal BMI values (undernourished), Group 2 composed of subjects with normal nutritional (BMI) status (Control), with Groups 3 and 4 being over-nourished and obese participants respectively. For each sampled subject, selected visual function/capacities [Visual Acuity (VA), Ophthalmoscopy and Intra-Ocular Pressure (IOP)] were obtained and mapped against their respective BMI. Upon statistical analysis of data, study observed a higher mean value [ophthalmoscopy] in the early hours of morning than noon day. Intraocular pressure was also seen to be higher in the right than left eyes, increasing arithmetically at noon than morning. A statistically significant decrease ($p < .05$) in visual functions with increased BMI and day time was also noticed. Study therefore proved that IOP rises in Delsu executive drivers in the late noon day than early hours of the morning. We recommend a similar study for several other employees across government parastatals in the state.

Keywords: Visual Acuity, Intra-Ocular Pressure, Body Mass Index.

INTRODUCTION

Ophthalmoscopy is a medical procedure that probes for the functional capacity of the human eyes. It is fretful of the performance of medical eye examinations and correctness of eyeglasses and contact lenses[1,2].

In Ophthalmology, Vision refers to the intrinsic ability of humans to see objects at optimal focus, irrespective of their properties; including color, form, magnitude, specifics, complexity, and disparity. Basically, in humans, this optimal capability of the eye is accomplished through the intricate ability of the brain to work with the eye, whilst forming real world images from the environs. Visual mechanisms are initiated when a ray of light bounces (reflects) off illuminated objects. Upon entering the eyes, the rays are then transduced into nerve electrical signals called receptor potential [2]. Through the optic nerve, these electrical signals then leave the eyes as nerve-action potential, traveling to the visual cortex of the brain for integration and decisive outputs. At this point, they are then deciphered and transposed to form real and erect images, providing us with sight of the viewed object [3].

In medical practice though, human nutritional status is often assessed through the Body Mass Index, BMI. Till present times, the relationship between BMI and the functional capability of the human eyes is yet to be clearly understood [4].

The BMI as it were, indicates in mathematical terms; body weight divided by height (in meters square) [5]. It is an important index of cardiovascular health risk, and has been linked with several disease complications, including visual problems as seen in diabetic retinopathies. Studies have pegged BMI of 25 to 29.9 to be overweight, were as, those of about 30 or above is seen as obese **[2]**. Though the relationship between BMI and several other physiologic variables have been shown to vary with gender, age, ethnicity

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and socioeconomic status [5], A linear relationship is commonly observed between visual functions and increasing BMI [6], especially owing to the well-established effect of increased BMI with such diseases as Diabetes Mellitus (DM); which is often complicated as Diabetic Retinopathy in sufferers.

In physiological terms, visual functions are described in terms of visual acuity and fields. It is a measure of one's ability to distinguish details and shapes, and is measured with the aid of standard chart of alphanumeric letters and symbols called the Snellen letter chart [7,8]. To perform acuity test, subjects with a 20/200 visual acuity are often made to stand at a distance of meters 6 m (20 ft) as against a person with normal sight who usually should see at 60 m (200 ft) [9].

Meanwhile, in the pathophysiology of glaucoma, when the aquous humor (the fluid that bathes the eye lens) fails to drain properly, the fluid thus fails to drain up; leading to increased buildup of intra-ocular pressure (IOP, and glaucoma as a result [6,10]. This increased IOP is responsible for the compression and damage to the optic nerve that supposedly fires visual impulses to the visual cortex in brain. This damage thus results in loss of vision.

Age, Race and other factors have been implicated in recent times as primary risk factors for increase in intraocular pressure, which ultimately results in glaucoma. Available studies posit that about 2% of subjects above 40 years reportedly suffer from glaucoma, with about 8% of those above 70 years showing higher prevalence rates in Asians than any other race in the world. The disease is asserted to run in families, even though it is said never to be inherited in a regular and expectable form. Glaucoma is also reported to affect about 6 to 8 times a number of blacks than whites, with the blacks said to develop it at an earlier age than the whites, whilst suffering more critical visual loss than whites in any case [11,12]. Several factors reportedly also escalate the risk of having the disease; include diabetes mellitus, shortsightedness, hypertension, and long-term use of steroid medications.

Also, there is a large body of research suggesting a BMI-related difference in visual processing and acuity by extension [13]. There are also strong evidences of age and gender related changes in BMI in relation to visual acuity [14]. However, the extent to which these differences can be used to index cortical visual processing as influenced by changes in visual acuity is yet to be systematically investigated [15,16].

With increasingly contradicting data from studies on the roles of exercises on short, available findings have posit that regularly engaging in exercise and BMI checkup may be useful in the prediction and achievement of long-term weight control. It is believed that regular exercise will also improve some BMI related health conditions, including those of ocular concerns as it relates to diabetes mellitus.

Purpose of Study

Although risk factors for the increased intraocular pressures (that result in glaucoma) are well understood, the link between glaucoma and different nutritional status of humans (assessed through the BMI) remains unknown. Therefore, current study was designed to investigate the relationship between anthropometric variables [weight, height, waist circumference and BMI] and those of visual functions [visual acuity, ophthalmoscopy, and intra-ocular pressure levels] in staff drivers of delta State University (Delsu), Abraka, Delta State. Specifically, study;

i. Investigated the relationship between selected anthropometric variables and visual functions in humans

ii. Examined the link between nutritional status of humans with visual functions

iii. Ascertain the effect of BMI on visual acuity, intraocular pressures and ophthalmoscopy of Delsu drivers

MATERIALS AND METHODS

Study Design

Study adopted the cross sectional type of research design. Here, a total of sixty eight (68) male drivers who were full time staff of the Delta State University, Abraka, Delta State, Nigeria were recruited for the exercise. These subjects were grouped into four (4) based to their nutritional status, using the WHO standard of 2003 [1,2];

Under-nourished (BMI < 20 kg/m^2)

Normal (BMI of 20 to 24.9 kg/m^2)

Over-nourished (BMI of 25 to 29.9 kg/m^2)

Obese (BMI ≥ 30 kg/m^2)

Study Population

Study population comprised of full time staff drivers of aforementioned institution (Delsu) who were resident in Abraka, a rural community of Ethiope East Local Government Area of Delta State, Nigeria.

Inclusion Criteria

Subjects who were driver staff of the target institution (Delsu), who regularly engage, through driving activities, their eyes in visual processing tasks, not on long-term use of such medications like topical atropine, anti-glaucoma, anti-inflammatory drugs, cortisone and/or other steroids were selected for the study; Non-contact lens wearing drivers no symptom of dry eye or other ocular conditions were also selected for the study.

Exclusion Criteria

Subjects with eye make-ups, systemic conditions such as hypothyroidism, diabetes mellitus were excluded.

Ethical Considerations

Ethical letter was obtained from the Bio-Research and Ethics committee of the College of Health Sciences, Delta State University, Abraka, Delta State. Also, informed written consent was sought from participants before investigation. Consent forms were administered to seek participants' permission. Only subjects who consented were actually investigated.

Procedure:

Determination of BMI

Determination of BMI was based on a weight-to-height ratio that does not distinguish between muscle and fat. To obtain this, we applied the standard mathematical relation (below) after obtaining subjects weights and heights at any point;

$$BMI = \frac{\text{Weight (kg)}}{\text{Height (m}^2\text{)}}$$

Measurement of Visual Acuity

Using the near-vision snell's letter chart, participants' visual acuities were measured and held in close range of around 20 m in a room with standard ambient lighting. The valuation was done by asking subjects to read and state the direction of the gap in the chart, at different stimulus; both with the left and right eyes. Next, the corresponding Snellen ratio at which this was read from the chart (to the smallest font size) was obtained with fewer than two errors out of the 8 to 16 items at each font size was read as the estimate of visual acuity. Defected Participants were then made to use any corrective lenses during the course of testing. However, information on the recency and accuracy, of their optical correction was not known, prior to examination.

RESULTS

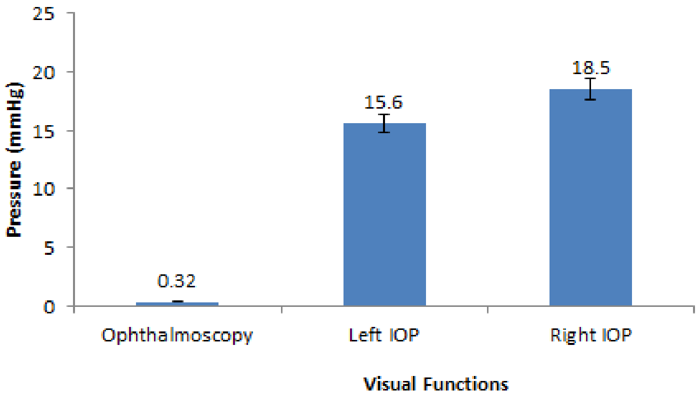

Figure 1: Comparative differences in average Intra-Ocular Pressures (IOP) between eyes of Delsu Staff Drivers

From figure 1 (above), a noticeable increase in average intra-ocular pressure (IOP) of the right eye than that of the left (Left IOP) was observed for sampled subjects, irrespective of age and/or duration of active service. Also, there was a statistically significant decrease ($p<.05$) in ophthalmoscopy outcome, suggesting increased intraocular pressure with a relatively low opacity in visual function.

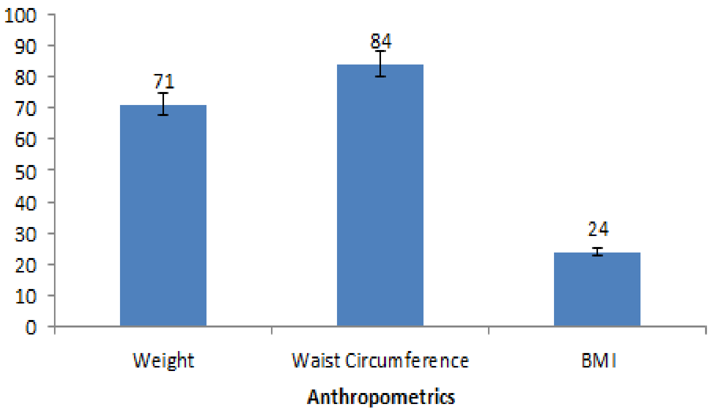

Figure 2: Comparative difference in Selected Anthropometric variables of Delsu Drivers

From figure 2 (above), compares selected average anthropometric variables in sampled participants. Here, most sampled drivers appeared to have increased weight with accompanying BMI and waist circumference. Here, BMI was seen to be lowest on an average when compared with other parameters.

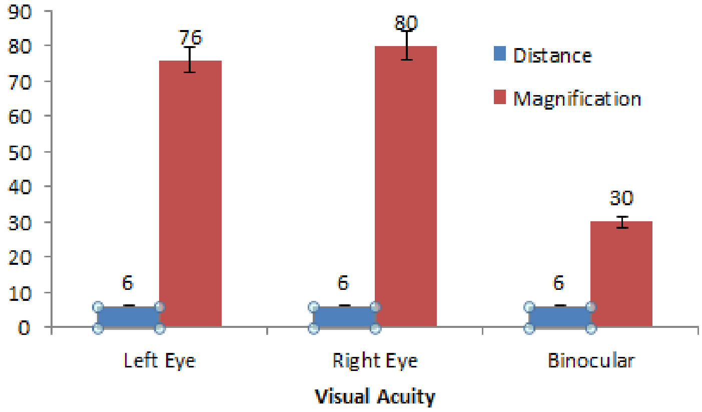

Figure 3: Comparative difference in Visual Acuity for sampled subjects

Above figure observed that for most sampled drivers, visual acuity was barely good with one eye in use, compared to binoculars. The right eye showed a relatively high mean value when compared to the left, implicating better acuity in left than right for most cases.

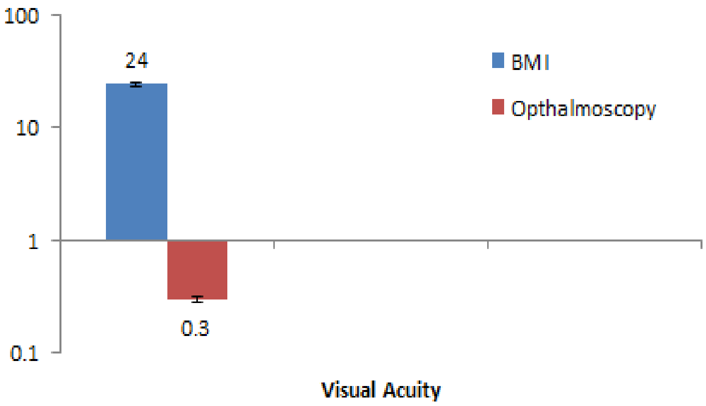

Figure 4: Comparative Changes in BMI and Ophthalmoscopy among Delsu Drivers

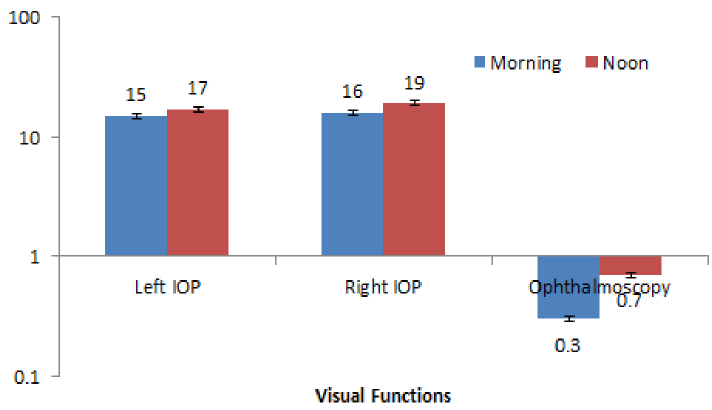

Figure 5: Changes in Intra-Ocular Pressures with Ophthalmoscopy at different time of the day in Delsu drivers

DISCUSSION

Globally, about 6.7 million humans reportedly show loss of vision with both eyes as a result of glaucoma. This is thought to result from increased intraocular pressures [2]. This makes the ailment second in the rankings of major causes of blindness. Also, about 120,000 Americans allegedly have bilateral loss of vision, which is a known leading cause of preventable blindness across the globe. Currently, over 2 million people the world over are being treated for glaucoma; with an estimated 1 million additional cases of the disease are undiagnosed [1,2].

In this study, the effect(s) of selected anthropometric variables (Weight, height and BMI) on visual functions [visual acuity, ophthalmoscopy, and intra-ocular pressures] of staff drivers of the Delta state university, Abraka, delta State, Nigeria was investigated.

Figure 1 of this study compares average Intra-Ocular Pressures (IOP) for left and right eyes each amongst Delsu executive drivers. From the result, there was a statistically significant decrease ($p<.05$) in ophthalmoscopy outcome, suggesting increased intraocular pressure with a relatively low opacity in visual function. Also, a noticeable increase in average intra-ocular pressure (IOP) for right eye than that of the left (Left IOP) was observed for sampled subjects [15]. This difference was noticed irrespective of age and/or duration of active service. This finding agrees that those of previous literature, specifically from the works of Ebeigbe *et al.,* 2014 [16], who reported age and gender independent changes in BMI in relation to visual acuity (Araoye et al, 2003); even though the extent to which these differences were used in the assessment of cortical visual processing as influenced by changes in intraocular pressure was poorly assayed [17-19].

Again from figure 2, a comparison on average anthropometric variables (selected) in sampled participants was made. Here, most sampled drivers were observed to have increased weight with accompanying BMI and waist circumferences, even though their average BMI was apparently lowest on comparison with other sampled parameters. The implication of this is that, average BMI for Executive drivers was relatively low compared to their high level of weight gain. The reason for this may not be far-fetched, and could implicate consisted work as against sedentary life style that ordinarily should increase BMI, as against weight gain. Though few studies have reported on the relationship between anthropometric variables in executive drivers, the report of Doughty*et al* , apparently supports the results of this study, positing that continuously engaging in mild to moderate exercises (as seen in these drivers) may improve on anthropometric health indicators like the BMI.

Also assayed in participants was a relationship between the BMI and ophthalmic changes (figure 4). Ophthalmic examinations as this can reveal the presence of several disorders as simple visual problems to infections such as conjunctivitis and trachoma. It may also reveal other health problems like high blood pressure, diabetes mellitus, and brain tumors. For this study, we observed a statistically significant change between BMI and visual opacity (as returned by ophthalmoscopy) in the average of 0.3%; suggestive of a 0.3% average prevalence of glaucoma in sampled participants.

Glaucoma is known to increase pressure within the optic nerve, thus, leading to blindness. As a serious eye disease, Ophthalmologists generally diagnose its sufferers with the aid of a tonometer, with this device; they simply measure fluid pressures within the ocular system, and thereafter, treat with drugs if diagnosed at early stages [20]. Though macular degeneration, yet another common eye disease in the United States is also thought to cause loss center field vision as a result of retina nerve damage, Macular degeneration is also generally irreversible, and may not respond to treatment [21].

Noteworthy of mention in this study is the observed changes in Intra-Ocular Pressures with Ophthalmoscopy at different time of the day in in sampled subjects (Figure 5). By this, intraocular pressure was seen to be higher at noon day than early hours of the morning; apparently posing highest in the right than the left eyes. By implication, the IOP build up at noon may be traceable to increased driving activity (probably due to increased environmental temperatures) that could exacerbate the human blood pressure, building up the intracranial pressure that may ultimately affect the IOP [22]. This finding concurs with those of Christopher *et al* (2016) [23].

CONCLUSION

The precise relationship between the human BMI and blood pressure as cardiovascular risk factor for increased intraocular pressures is yet to be clearly understood. In addition, clearly determined scientific relationships of these basic health questions such as; is BMI related to visual functions and capacities? If so, does the relationship holds during visual processing tasks like driving? Has BMI any relationship with visual acuity and opacity?

Scientific determination of these relationships with normal BMI and intraocular pressure changes as seen in this study has shown a positive correlation, suggesting that under normal health condition; especially with good nutritional status as indexed via BMI, one may have an increased IOP in all age categories under resting state. Therefore, the finding that the relationship between intraocular pressure of subjects with high BMI significantly correlated agree with reports of this study, indicating that high BMI may adversely affect intra-ocular pressure and visual acuity in humans

Recommendation

Similar study for several other employees across government parastatals in the state is highly recommended.

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Conflict of interest: There was no conflict of interest in the study.

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