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A COMPARATIVE STUDY OF BODY MASS INDEX AND AUDITORY REACTION TIME OF SCHOOL CHILDREN IN SAURASHTRA REGION OF GUJARAT

Physiology

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ABSTRACT

Objectives: To find relation between Body Mass Index (BMI) and Auditory reaction time (ART) in healthy school children of saurashtra region of Gujarat, India.

Material and methods: 109 students were included in the present study. Body weight and height were taken and auditory reaction time was recorded using Direct RT© software. Students having motor and hearing disorders as well as any physical or mental illness were excluded in present study.

Observations: In present study, correlational coefficient test and Chi-square test did give significant p ($p<0.05$) value indicating that there is association between BMI and ART. With increase in BMI, ART value shortens indicating that obesity may increase neuronal conduction velocity. Some studies support present study result while others produce contrasting results. Thus, further research is needed to finally conclude association between BMI and ART.

KEYWORDS

Body Mass Index (BMI), Auditory reaction time, school children, obesity, conduction velocity

INTRODUCTION

For long time Body Mass Index (BMI) has been used as tool for measuring amount of obesity in individuals[1]. Also, it is known that many neurons in human body have myelination. Particularly motor neurons and fast pain sensory neurons have myelination[2]. Myelin is formed from various fatty acids[3]. So, fat is essential requirement for myelination. We also know that myelination of neurons increases neuronal conduction velocity by process of saltatory conduction[4]. So, can we hypothesize that more fat means higher chances of myelination and faster conduction velocity. To find that we used BMI for identifying amount of fat individual has (though BMI is not ideal for fat measurement but its most convenient in mass studies) and auditory reaction time as measure for faster neuronal conduction (as ART is tool for neuronal reflex, so shorter ART means faster response which in turn mean faster conduction velocity).

MATERIAL AND METHODS

The present study includes comparative analysis of BMI and auditory reaction time of 109 healthy students. Approval from Institutional Ethics Committee (IEC) was taken before starting study.

Participating students where in age group of 7 to 12 years. Students from various primary schools were selected. Thorough motor examination and hearing tests were conducted to rule out any muscular or hearing disabilities. Thus, only healthy students were allowed to participate in present study. Those students who were having any kind of physical or mental illness or those unwilling to participate in present study were excluded to ensure any confounding factors which might affect study results.

Prior permission from school principal was taken and study was conducted without disturbing teaching schedule of all students. Consent form was given to students and thoroughly explained whole study procedure and specifically instructed that no invasive procedure is done and this study would not harm them in any manner. Those students who willfully wanted to participate where taking permission from respective class teachers and consent formed was signed by those class teachers as their guardians. All preliminary data like name, age, gender are taken and motor and hearing tests are conducted. Then their weight was taken with portable digital weighing scale. Height of student was measured with measuring tape (in cms). Auditory reaction time test was conducted on laptop using Direct RT© software. Initially test trial was given to student where a headphone connected to PC is applied on student's head and a sound comes randomly, student has to respond to that sound immediately by pressing space bar. The time interval between sound arrival and pressing the space bar is recorded as Auditory reaction time (ART). Such 10 trials are given and then 10 actual recordings are obtained for analysis in the present study.

Results in software are stored in three sets: Minimum Auditory Reaction Time (ART), Maximum ART and Average ART

Care is taken to not allow student to press space bar continuously. Also, sound arrival is randomized so student can't predict when sound will come.

Statistical analysis was done by MedCalc© software version 18. Correlation analysis was done between variables BMI and Average Auditory reaction time of all participating students. $P<0.05$ was considered as significant.

RESULTS

As shown in table below, BMI of study population is grouped into 3 categories i.e. A, B, C.

Group A <15.00, Group B 15.00 to 19.99, Group C 20.00 to 25.00

When Chi-square test was applied to this distribution table, Group A had $p = 0.8288$ (not significant), Group B had $p = 0.0001$ (highly significant), Group C p value could not be obtained due to too small sample size. Overall Chi-square test has $p = 0.0320$ (significant).

TABLE 1: BMI DISTRIBUTION IN STUDY POPULATION

GROUP	SAMPLE SIZE	MEAN ± SD	MEDIAN
GROUP A	77	13.25 ± 0.89	13.32
GROUP B	29	15.90 ± 1.01	15.58
GROUP C	3	21.75 ± 1.33	21.09
TOTAL	109	14.19 ± 1.96	13.86

As shown in table below, Auditory Reaction Time (ART) of study population is grouped into 5 categories. Group A<500 ms (millisecond), Group B 500 to 999.99 ms, Group C 1000 to 1499.99

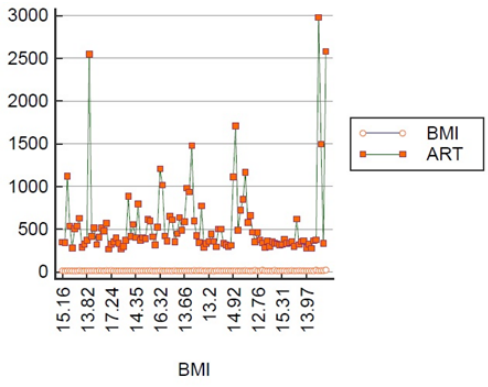
ms, Group D 1500 to 1999.99 ms, Group E 2000 to 2499.99 ms, Group F 2500 to 3000 ms. As shown in table below no child in Group E was found. Highest number of children where in Group A and lowest in Group D.

TABLE 2: ART DISTRIBUTION OF STUDY POPULATION

GROUP	SAMPLE SIZE	MEAN ± SD	MEDIAN
GROUP A	70	355.81 ± 54.35	349.50
GROUP B	28	643.04 ± 136.37	604.00
GROUP C	7	1228.36 ± 185.67	1167.00
GROUP D	1	1707	1707.00
GROUP F	0	0	0
GROUP E	3	2700.67 ± 238.15	2580.00
TOTAL	109	562.57 ± 454.68	398.00

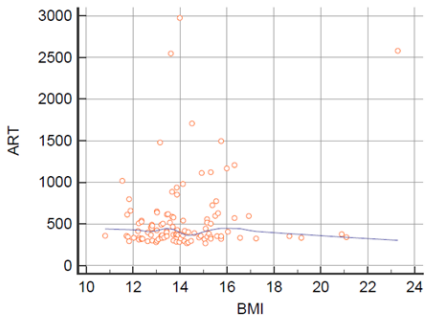
On applying correlational co efficient test between BMI and Auditory reaction time (ART) p = 0.0329 (significant) was found with correlation coefficient r =0.2045. (95% confidence interval for r = 0.01702 to 0.3780)

Below is the graph which shows composite distribution of BMI and ART in present study population.



Graph 1: Distribution of BMI and ART in study population

Also, below is the scatter graph which demonstrates correlation between BMI and ART in study population of present study.



Graph 2: Scatter diagram of relation between BMI and ART in present study

DISCUSSION

From results of chi-square test for whole study population with p = 0.0320 (significant) and correlational co efficient test between BMI and ART with p = 0.0329 (significant), we can confidently deduce that there is relation between BMI and ART.

From scatter diagram its clear that trend is with increase in BMI there is decrease in ART. Thus obesity may increase nerve conduction velocity to some extent as response time are shorter with increase in BMI.

Similar studies by Deepmala Nagorao Deore et al5 has contrasting result to present study where increase BMI resulted in higher ART values indicating poor response time. But other studies like Nene AS et al6 has similar results as present study where increase in BMI resulted in lower ART values indicating faster response time.

CONCLUSIONS

Thus, we can conclude from study that there is association between BMI and Auditory reaction time (ART). Gradually as BMI increases, ART values become shorter with significant p ($p<0.05$) value in both Chi-square test and Correlational Coefficient test.

So, with increase in obesity may increase nerve conduction velocity as response time does indicate how fast motor impulse reach muscles. But it also indicates that whole reflex arc i.e. sensory component, center and motor component must have faster conduction which results into shorter ART values.

However, further research is needed to conclusively indicate that there is direct association between BMI and ART. Larger sample size and better training could give clearer picture about association between BMI and ART.

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