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Reaction time and it's association with body composition in children: A pilot study

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Abstract
The present study’s objective was to determine the relationship between simple reaction time and body composition. The study included 25 children of age 9-12 years who were living in and around Mangalore. Simple reaction time was assessed using Ruler Drop Method and body composition was assessed using BMI and body fat percentage. Karl Pearson's Correlation Coefficient was used to find the relationship between reaction time and body composition. According to the results, reaction time have a weak positive correlation with BMI (r=0.24, p=0.24) and body fat percentage (r=0.3, p=0.13) which is statistically insignificant in children. Thus, it can be concluded that reaction time and body composition might have a statistical relationship in a larger population therefore more studies on this topic are required.

Keywords: Body mass index (BMI), body fat percentage, reaction time, ruler drop method

Introduction

The rate of rise in overweight and obesity among children is quickly nearing dangerous levels [1]. Numerous mental and physical conditions have been associated with obesity [2]. Childhood obesity is a risk factor for adult obesity [3] and is associated with conditions like hypertension, diabetes, and dyslipidemia [4, 5]. A greater appreciation of the significance of recognising and treating those who are overweight or obese has been motivated by disturbing statistics on the incidence of overweight/obesity in adult and paediatric communities, as well as the health effects. The pace of increase in children's overweight and obesity is quickly hitting hazardous rates. Different methods with varying degrees of complexity, expense, and accuracy can be used to determine body composition. In the majority of healthy, non-athletic children and adults, an accurate estimation of body composition can be made using anthropometric measurements like BMI and body fat percentage [6].

The ability to react quickly to environmental stimuli is a crucial and necessary survival skill [7]. Latent duration of the simple sensor motor reaction, also known as reaction time, has been one of the components of this response. Reaction time has traditionally been thought to indicate integrative brain function [8]. Reaction time is a reliable indication of the rate at which the central nervous system processes sensory events and executes them as a motor response [9]. Reaction time can be characterised into 3 kinds: Simple reaction time: - there is just one stimulus one and response in this situation. Recognition reaction time: - there are some stimuli that should be reacted to and others that should not. Choice reaction time: - many stimuli and responses are present [10]. Reaction time has recently been measured using computer-based specialist software. The application of these interventions is restricted due to their high expense and training requirements [11]. As a result, the Ruler Drop Method, which has been previously identified and validated for use in children and adolescents, has been recommended as a more cost-effective, easy, and computer-independent clinical assessment [12, 13]. It's a simple reaction time task that's been shown to be effective with young children [11].

In sports, academics, and defence, reaction time (RT), or the time between the presentation of a signal and the execution of the required motor response, is a real concern [12, 14]. It needs to be thoroughly researched because its potential implications could be far more significant. It's a metric for how rapidly an organism can react to a given stimuli [12]. A shorter reaction time amplifies one's accomplishments in a variety of fields, including athletics, academics, music, dance, driving, and defence. We can forecast reacting abilities in the above-mentioned situations by determining a person's reaction time [12].

Researchers have recently presented evidence supporting the link between obesity and RT in juvenile, adult, and elderly people. The research suggests that overweight/obese people perform worse on RT than their healthy weight counterparts [14-20]. However, for youngsters, contradicting findings regarding the link between obesity and RT have been found [12, 21, 22].

The fact that it is not always reasonable to view body adiposity as a negative factor influencing neuromuscular RT performance, and that body lipid reserves are essential to the development of the nervous system (e.g., the development of the myelin nerve sheath) and thus better reaction time, explains the negative correlation of reaction time with increasing BMI in children [21, 22]. Because there is a discrepancy on this subject, it is necessary to establish a link between simple RT of motor response in children and their body composition. Furthermore, earlier research examining the link between RT and obesity employed BMI as the obesity indicator [14, 16, 17, 18, 19, 20] despite the fact that BMI can be altered by a variety of factors [2].

Considering reaction time as a powerful predictor of a child's sensorimotor co-ordination and efficiency, and in light of conflicting reports about reaction time and its relationship with body composition, as well as a gap in the literature in terms of determining reaction time with reference to body fat percentage of children, the current study aims to investigate the correlation of reaction time with body composition. This data can be utilised to create data-driven interventions to help kids become healthier and more physically fit.

Methodology

Research design and sample: This pilot study was conducted among paediatric population living in and around Mangalore. The study comprised 25 children of all body types (males and females) between the age group 9 to 12 years. History of pre-existing cardiorespiratory and musculoskeletal diseases, any kind of surgery in the last 6 months or any medical conditions which were known to impact the cognitive functioning, which included neurological disorders, head injuries and Diabetes were excluded from the study.

Procedure: The study protocol was approved by the institutional ethics committee of A.J. Institute of Medical Science. Data were collected between August 2021 and January 2022 with the prior permission from parents/legal guardians. The nature and purpose of the study were explained to all of them. Simple Reaction time was measured using ruler drop method and body composition was assessed using BMI and body fat percentage.

Measurement

Simple reaction time using ruler drop method

In order to evaluate simple reaction time, the ruler drop method is used [11, 12, 23] which is a valid clinical metric [10, 12, 24]. The participant was required to sit with their dominant side elbow bent at 90 degrees, their forearms mid-pronated and resting on a flat horizontal table surface, with an open hand resting at the edge of the surface.

The examiner suspended the ruler vertically so that the lower end was lined up 50 mm between the child's hand's web space (thumb and index finger). After the ruler was released from the examiner's grasp, the kid was instructed to grab it as soon as possible. To record the distance travelled, we measured the ruler reading against the lateral border of the dominant index finger. Children was made to watch a demonstration of the test technique and also participated in two practise runs to familiarise themselves with it. The following formula was used to calculate the time it took by the ruler to travel the distance from its beginning point of 50 mm: T = 2d/g, where g is the gravitational constant (9.8 m/s2) and d was the length travelled by a ruler. Each participant completes three trials, and the analysis was done using the mean reaction time. It was made sure that before taking the test, the kids were not engaged in any physical activity because intense physical activity has a big impact on reaction time [10, 11, 12, 23].

Assessment of body composition

Body Mass Index (BMI): Because it assesses excess adiposity in relation to higher body weight, BMI is frequently used to evaluate body composition [25]. A measuring tape was used to measure height barefoot to the closet centimetre. Standard portable weighing equipment was used to measure weight barefoot and in light clothing to the nearest kilogram. The formula used to determine BMI is BMI = weight (kg)/height (m^2) [18, 23].

Body fat percentage

The skinfold technique uses measurements of the thickness of various skin folds all over the body to estimate the amount of body fat. Skinfold thickness measurements' ability to predict body fat % corresponds strongly (r=.70–.90) with hydrodensitometry [6].

The following equations of Slaughter *et al.* [25] were used to determine the body fat percentage. [23, 25, 26].

BF% for children with triceps and subscapular skinfolds <35 mm:

Boys = 1.21 (TSF +SSF) − 0.008 (TSF + SSF) ^{2} − 1.7

Girls =1.33 (TSF + SSF) − 0.013 (TSF + SSF) ^{2} − 2.5

BF% for children with triceps and subscapular skinfolds >35 mm:

Boys=0.783 (TSF + SSF) – 1.7

Girls=0.546 (TSF + SSF) + 9.7

TSF= Triceps skinfold thickness; SSF= subscapular skinfold thickness

Skin calliper was used to measure the triceps and subscapular skinfolds to the nearest 0.2 mm. The skinfold was held between the pads of the index and thumb fingers, and the dial was turned up while the instrument was held perpendicular to the skin surface. At each location, two of these readings were recorded, and the average was taken into consideration [27].

Subscapular skinfold thickness: The child's thickness was gauged when they were standing straight, their shoulders relaxed, and their arms hanging loosely to their sides. Diagonal fold (45-degree angle); 1–2 cm below the inferior angle of the scapula was measured [6].

Triceps skinfold thickness: With the arm held loosely to the side of the body, a vertical fold was taken on the posterior midline of the upper arm, halfway between the acromion and olecranon processes [6].

Statistical Analysis

The demographic characteristics of the participants were tabulated using descriptive statistics. Karl Pearson's correlation analysis was performed between the RDT and BMI and body fat percentage. The statistical package SPSS ver. 21.0 was used for analysis. The statistical significance level was set at *p*<0.05.

Result

The study comprised a total of 25 children with an average age of 10.26±1.28 years, including 12 boys (Age: 10.30±1.31) and 13 girls (Age: 10.23±1.30). Table 1 shows the descriptive data of 25 participants. The mean average of BMI was 18.53±3.65 and body fat percentage was 29.45±6.49. The mean reaction time of the entire sample was 11.91±2.92 ms.

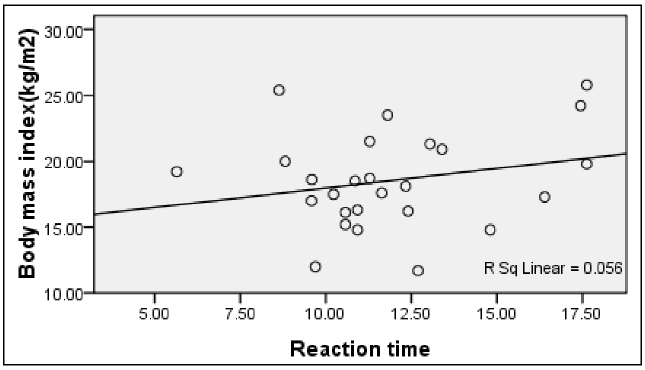
Table 1: Descriptive characteristic of 25 participants.

	Total (n=25) Mean ± SD	Boys (n=12) Mean ± SD	Girls (n= 13) Mean ± SD
Age	10.26±1.28	10.30±1.31	10.23±1.30
Weight	38.19±7.95	38.02±9.47	38.35±6.48
Height	142.5±9.97	139.61±8.36	145.4±10.92
BMI	18.53±3.65	18.73±3.61	18.33±3.83
Body fat %	29.45±6.49	29.91±8.20	28.99±4.48
Reaction time	11.91±2.92	11.44±2.33	12.37±3.45

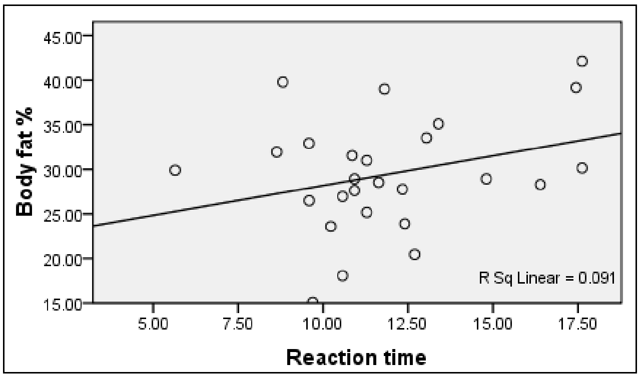
Pearson's correlation analysis revealed a weak positive correlation of reaction time with BMI (r 0.24, *p*>0.05) and body fat percentage (r= 0.3, *p*>0.5) but statistically insignificant (table 2, graph 2, 3)

Table 2: Karl Pearson's Correlation Coefficient (r) to compare between body composition and reaction time. Correlation is significant at the 0.05 level (2-tailed).

	Body mass index(BMI)		Body fat percentage	
Reaction time	r=0.24	p=0.24	r=0.3	p=0.13



Graph 1: Correlation between BMI and reaction time



Graph 2: Correlation between body fat % and reaction time

Discussion

The present study investigated relationship between reaction time and body composition in 25 children of age between 9-12 years. The results indicate weak positive but statistically non-significant relationship between the RT test and the obesity indices like BMI and body fat percentage.

However, a number of earlier investigations have found a positive statistically significant link between RT and obesity (as determined by BMI) in young, adult, and older individuals [14, 16–19]. According to neurophysiological research BMI affects cognition, attention, and memory as well as the brain regions responsible for vocabulary, speed of processing and reasoning, [15, 28]. The secretions of adipose tissue, such as hormones, cytokines, and growth factors that affect brain function, have also been proposed as a basis for this relationship [29].

Thus, discrepancy noted in the results of present study which shows statistically non-significant correlation might be due to the use of different methods to assess the reaction time. Ruler drop method was opted to assess reaction time in this study while other RT tests (such as choice RT, audio-visual RT, etc.) have been used in the previous similar studies [14- 19].

Whereas, the findings of the present study contradict with findings of the study conducted by Grantham *et al.* [22] where he examined the association between markers of adiposity and neurological performance on 3731 youths (5-20 years) inclusive of all body types and demonstrated a direct negative correlation between adiposity and neuromuscular reaction time (P=0.000). These findings indicate that body lipid reserves are integral to the development of the nervous system even amongst children within the healthy weight ranges.

Contradictory to the result of above mention studies research done by Aranha *et al.* [11], which was to estimate normative range for reaction time in children between 6 and 12 years of age says that there is no significant association of BMI with reaction time. Which is also in agreement with the study conducted by Esmaeilzadeh *et al.* [21] where he examined the relationship between RT and weight status in 533 school boys of age 9-12 years and found no significant relationship between RTclin and the obesity indices (BMI, fat%, Waist to height ratio and WC) in them (*p*>0.05).

Although the strength of the present study was the use of body fat percentage as the obesity index because most of the previous study just used BMI, it's one of the limitation was smaller sample size. Furthermore, this study could not measure various components of reaction time (e.g., choice RT, audiovisual RT and etc.). Therefore, future similar studies should consider using such a measure to provide more complete assessment. Keeping in view of the conflicting reports about the reaction time and its relation with body composition, more studies with larger sample size is needed.

Conclusion

It is concluded from the present study that reaction time is having a weak positive correlation with body composition like BMI and body fat percentage and as the association was not found to be statistically non-significant, further studies with large population are invited to prove this relation.

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