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Correlation between Gross Motor Proficiency and Body Composition in Children with Down Syndrome

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ABSTRACT
Background: People with Down syndrome seem to have a lower physical fitness than their peers without disabilities.
Objective: The aim of this study was to examine the relationship of gross motor proficiency to body composition in children with Down syndrome through the Bruininks-Oseretsky Test of Motor Proficiency-Second Edition (BOT-2).
Subjects and Methods: Twenty children with Down syndrome, aged from 6 to 9 years old of both sexes were participated in this study. They were selected from the public and special needs schools, Cairo government. Assessment of gross motor proficiency using Burininks-Osertsky Test of Motor Proficiency-Second Edition was performed.
Results: The results of this study indicated that gross motor proficiency, after controlling for age and gender, is negatively associated with health-related measures including waist circumference, while there was weak non significance relationship between gross motor proficiency and Body Mass Index.
Conclusion: From the obtained result of this study, it could be concluded that there is a significant correlation between gross motor proficiency and waist circumference in children with Down syndrome.
Keywords: Body composition, Down syndrome, Gross Motor Proficiency.

INTRODUCTION

A whole or partial extra copy of chromosome 21 is what causes Down syndrome (DS). Early after delivery, muscular hypotonia (low muscle tone) and other symptoms can be used to diagnose the disease, and a blood sample's karyotype can be used to confirm the diagnosis. According to estimates, Down syndrome affects between 1 in 1,000 and 1 in 1,200 live births worldwide [(1)].

Biomedical and molecular studies have suggested that the Down syndrome chromosomal anomaly determines a number of changes in protein expression patterns that lead to specific biochemical, physiological, anatomical, and behavioral characteristics like an imbalance of the oxidative metabolism [(2)], a compromised nervous system, musculoskeletal disorders, congenital problems with the heart, congested airways, decreased dynamic lung function, obesity, and poor sinus drainage [(3)].

Due to their low strength, low muscular mass, and high body fat percentage, many persons with Down syndrome are predisposed to cardiovascular health issues [(4)].

Children's ability to move in unison is influenced by a variety of developmental processes, including physical and cognitive maturity as well as chances for motor skill development in the social and environmental context. Additionally, it has been suggested that mastering movement techniques paves the way for an active lifestyle, adds to physical, social, and psychological wellness, and may even be a good predictor of physical activity participation, aerobic fitness, and body mass [(5-8)].

The evaluation of gross motor abilities using norm-referenced scales, such as the Bruininks-Oseretsky Test of Motor Proficiency-Second Edition (BOT-2), which offers a thorough assessment of motor skills and is beneficial to a variety of practitioners, experts, and researchers in a variety of settings [(9-11)].

So, the current study was aimed to examine the relationship of gross motor proficiency to body composition in children with Down syndrome through the Bruininks-Oseretsky Test of Motor Proficiency-Second Edition (BOT-2).

SUBJECTS AND METHODS

This Correlation study included a total of 20 Down syndrome patients of both sexes, with average age from 6 to 9 years, selected from public and special needs schools from Cairo government. This study was conducted between February 2021 to August 2021.

***Ethical Consideration*:**

This study was ethically approved by Ethical Committee, Faculty of Physical Therapy, Cairo University, with number of 012/002553. Written informed consent of all the participants' parents was obtained before the study, and the steps of assessment polices were explained to the students' parents by the investigators. The study protocol conformed to the Helsinki Declaration, the ethical norm of the World Medical Association for human testing.

Inclusion criteria: Children with ability to comprehend the study and have strong intellect.

Exclusion criteria: Children with neurological issues like uncontrolled epilepsy or cardiovascular issues like congenital heart disease [(12)]. Femoral and acetabular osteotomies, as well as situ screw fixation, are examples of orthopedic surgical intervention [(13,14)].

Procedures:

Anthropometry

Participants height was measured without shoes near a wall to the nearest 0.1 cm. Body weight was measured using standard weight and height scale, when not available portable weight scale was used in light indoor clothing without shoes. Body mass index (BMI) was calculated (kg/m^2).

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By contrasting the measured BMI with sex- and age-referenced norms, a percentile value is generated. Height / Body Mass Index (BMI) (m^2) [15].

Using a flexible, non-stretchable plastic tape, the waist's circumference was measured at the level of the umbilicus, halfway between the 10th rib and the top of the iliac crest. The measurement was estimated to the closest 0.1 cm.

Motor proficiency

The second edition of the Bruininks-Oseretsky Test of Motor Proficiency (BOT-2) is a norm-referenced, standardized motor assessment that is offered in two formats: a Complete Form with 53 items and a Short Form with 14 items drawn from the Complete Form. Children between the ages of 4 and 21 may use it. It includes the body coordination composite and the strength and agility composite, two motor composites.

Body Coordination: This motor-area composite assesses the ability of the major muscles that support posture and balance to be controlled and coordinated. The motor abilities required for playing sports and a variety of leisure activities are measured by the Bilateral Coordination subtest. The tasks call for coordination of the upper and lower limbs both sequentially and simultaneously, as well as body control. The Balance subtest measures the ability to control one's movements, which are crucial for maintaining posture whether standing, moving, or reaching.

Strength and Agility: This motor-area composite assesses the ability to regulate and coordinate the major muscles used for movement, particularly in competitive and leisure sports. The subtest for running agility and speed measures these traits. The purpose of the Strength subtest is to evaluate trunk, upper, and lower body strength.

Statistical analyses

All statistical calculations were done using computer program IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) release 22 for Microsoft Windows. Data were statistically described in terms of mean ± standard deviation (± SD), median and range, or frequencies (number of cases) and percentages when appropriate. Numerical data were tested for the normal assumption using Kolmogorov Smirnov test (Shapiro Wilk test). Comparison of numerical variables between the study groups was done using Student t test for independent samples. Correlation between various variables was done using Pearson moment correlation equation for linear relation of normally distributed variables and Spearman rank correlation equation for non-normal variables/non-linear monotonic relation. Two- sided p values less than 0.05 was considered statistically significant.

RESULTS

Twenty children with DS participated in this study. The mean ± SD age of the study group was 7.715±1.09 years with minimum of 6.3 years and maximum of 9.7 years (Table 1).

Table (1): Descriptive statistics of the age of the study

Age (Years)	$\overline{X} \pm SD$	Minimum	Maximum
	7.715±1.09	6.3	6.7

$\overline{X}$: Mean SD: Standard Deviation

Gender distribution:

The sex distribution of the study group revealed that there were 8 girls with reported percentage of 40% while the number if boys were 12 with reported percentage of 60% as shown in table (2).

Table (2): The frequency and distribution of gender in the study sample

	Sex distribution	
	Girls	Boys
No. (%)	8 (40%)	12(60%)
Total	**20 (100%)**	

Table (3) reveals mean, standard deviation, minimum, maximum of gross motor composite standard score, maximal oxygen consumption and flexibility according to gender.

Table (3): Descriptive statistics of GMC according to gender

Gender		GMC
Female	Mean±SD	33.88±2.232
	Median	33.50
	Minimum	32
	Maximum	39
Male	Mean±SD	34.75±2.137
	Median	35
	Minimum	30
	Maximum	39

SD= Standard deviation, GMC= Gross Motor Composite

The correlation between gross motor proficiency and body mass index:

As shown in table (4) and figure (1) there was no significant correlation between gross motor proficiency and BMI (r= -0.141; P > 0.05).

Table (4): Correlation between GMC and BMI

Correlation	R	P	S
GMC - BMI	-0.141	0.553	**NS**

R= Pearson correlation coefficient, P= Probability, S= Significance, NS= Non Significance, GMC= Gross Motor Composite, BMI= Body Mass Index

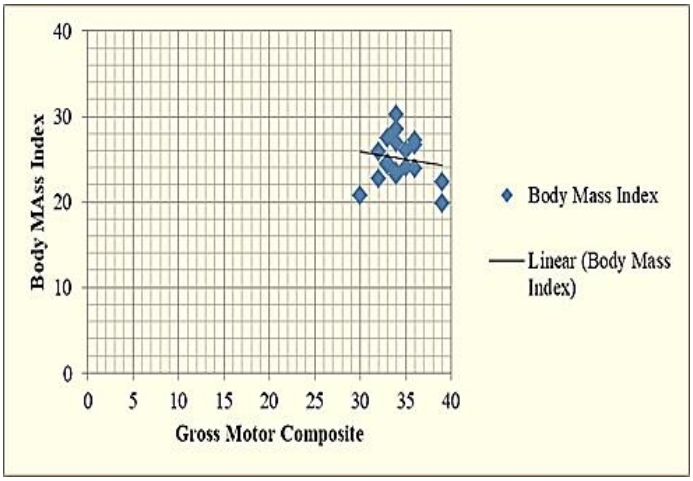

Figure (1): Correlation between Gross motor composite and Body mass index.

The correlation between gross motor proficiency and Waist Circumference:

As shown in table (5) and figure (2) there is significant negative correlation between gross motor proficiency and BMI (r= -0.451; P < 0.05).

Table (5): Correlation between GMC and WC

Correlation	R	P	S
GMC - WC	**-0.451**	**0.046**	**S**

R= Pearson correlation coefficient, P= Probability, S= Significance, NS= Non Significance, GMC= Gross Motor Composite, WC= Waist Circumference.

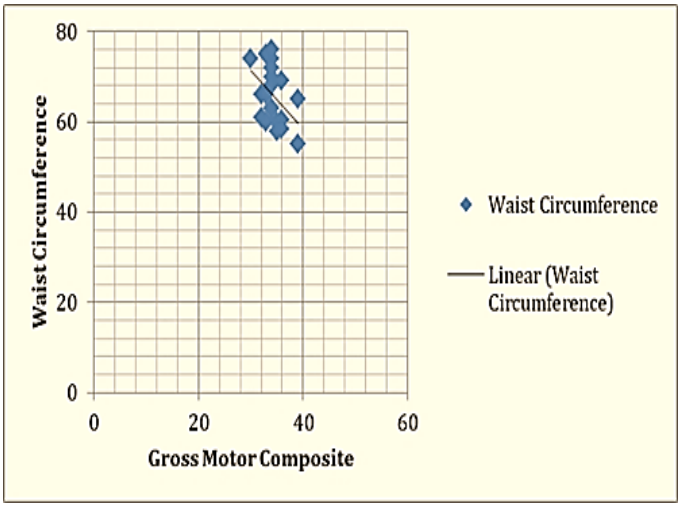

Figure (2): Correlation between Gross motor composite and Waist Circumference

DISCUSSION

intellectual disability (ID) is most frequently inherited through a trisomy of chromosome 21, which is a genetic disease called down syndrome (DS) [16]. Significant health issues include congenital heart disease, obstructive sleep apnea, celiac disease, and endocrinopathies are linked to DS. Thyroid issues, poor bone mass, diabetes, small height, and a predilection towards obesity are typical characteristics of endocrine problems [16,17].

In this study we determined Fundamental motor skills (FMS) of the children with down syndrome through Burniniks-Osertesky of Motor Proficiency-second edition (BOT-2). Over half of the studies had included FMS as a predictor of children's developmental achievements [18, 19]. Proficiency of FMS is prerequisites for functioning in activities of daily living as well as for participation in sport specific activities [20]. Insufficient FMS in children with Down syndrome likely lead to experience frustration and difficulty in learning of more advanced skills [6].

Previous studies suggested that the role of overweight/obesity in youth with DS doesn't currently explain lower aerobic capacity in persons with DS [20-21].

The causes of the development of overweight and obesity in DS are: hypotonia (decreased muscle tone), susceptibility to systemic inflammation, metabolic diseases and/or slow metabolism [22]. Usually, people affected by DS consume less healthy food, and show physical limitations, depression, and lack of social and financial support. Besides, medications contribute to weight gain [23].

Previous study reported that total motor proficiency (fine and gross motor skills), after controlling for age and gender, is negatively associated including weight, BMI and WC [24].

It was also suggested that there was reciprocal significance between the gross motor proficiency (composites of manual coordination, body coordination, and strength and agility) and negatively correlation with the measure of BMI [25].

Down syndrome had better run performance than their peers with DS independent of age, sex, and BMI [26], thus, poor running performance of children and adolescents with ID, with and without DS, is not consequence of age, sex, or BMI.

It was intended to select the age of children in this study to be ranged from 6-9 years to be cooperative and follow instruction during assessment of motor proficiency and HRPF. It was reported that children have the developmental potential to master most of the FMS by the age of 6 years [19].

The results showed that the participants with DS exhibited poor voluntary control of postural sway and insufficient motor ability [27]. Children with Down syndrome delays in motor developments as results of associated impairments including muscle hypotonia, joint hyperlaxity, delayed acquisition of postural control, poor balance and some children have congenital heart diseases and obesity.

Although we used a small numbers of children in the analysis of gender differences between the performances of boys and girls with DS as supported by previous study [28]. The results of this study detect no significant difference between GMC.

As proved by previous studies and **CDC [15] and Bertapelli *et al.* [29]**, the results of this study supported those children with Down syndrome have higher BMI and WC values than their peers without down syndrome

(WDS). Those results prove that children with Down syndrome suffer from overweight and obesity.

This study stresses the importance of interventions facilitating motor skills. The knowledge of differences in gross motor skills in children with DS should be of great interest to physical educators and could be of benefit in designing and planning of physical activity programs or sports according to the children's abilities for improving gross motor skills.

With better gross motor skills, children and youth with DS could participate more in daily living activities, in addition to physical and sporting activities. Although individuals with DS show slower motoric development that their non-disable peers [30, 31], they could participate in many exercise or sportive activities.

CONCLUSION

From the obtained results of this study, it could be concluded that there is a negative significant correlation between gross motor proficiency and waist circumference in children with Down syndrome. While there was no correlation between gross motor proficiency and Body Mass Index in children with Down syndrome.

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