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The Relationship between Body Mass Index and Skipping and Hopping Skills of Fundamental Movement, in Children Aged 10-12 Years

MAHBOOB KHANGHOLI
Islamic Azad University
Borujerd Branch, Borujerd
Iran
HAMID FOROGHIPOUR[1]
Physical Education Department, Islamic Azad University
Borujerd Branch Borujerd
Iran
MEHDI ROOZBAHANI
Islamic Azad University
Borujerd Branch, Borujerd
Iran

Abstract:

The aim of this study was to investigate the relationship between body mass index (BMI) and two selected fundamental skill patterns (skipping and hopping) in girls aged 10-12 years. The design of the study was quasi-experimental and the type was causal-comparative (Ex-Post Facto). Field research was utilized for conducting the study. The sampling population encompassed all fourth to sixth grade female students in elementary school in Samen (Hamedan – IRAN) and the samples were selected via clustering sampling method and among all the collected data, 120 subjects were assigned to three groups of thin, normal, obese using simple random sampling. After assigning BMI, they were located in thin level (n=40), normal level (n=40), and obese level (n=40) groups according to the BMI Chart. Test of Gross Motor Development (TGMD-2) devised by Ulrikh (2002) was used to estimate the locomotors development indices (skipping and hopping). In order to ensure normality of the distribution of the data and to determine the relationship between variables, the Kolmogorov-Smirnov test and the Pearson correlation

[1] Corresponding author: foroghiborojerd @yahoo.com

coefficient were used. The results demonstrated that no significant relationship between thinness and the growth of skipping movement pattern (p =0.81). However, a significant relationship was observed between thinness and the growth of hopping movement pattern (p =0.001). In terms of obesity, a negative significant relationship was found between obesity and the enrichment of skipping movement pattern (p =0.001); whereas, the relationship between obesity and the growth of hopping movement pattern was not significant (p =0.15).

Key words: Body Mass Index, Skipping movement pattern, Hopping movement pattern, BMI Chart group levels, Iran

Introduction

Growth is a complex and perpetual process. Children's movement skills have constantly varied in the course of their lives, and these movement alterations bring about psychological, social and cognitive changes. Therefore, attending to the development of movement skills in children, in effect, is devoting attention to the general and comprehensive growth of the children. The specialists in the growth viewpoint assert movement development has its main root in genetics, while environment plays a minor role in it. In this view, the movement skills are construed to get formed spontaneously regardless of the differences in various environments. This principal notion has had a considerable impact on numerous concepts in education and research in the twentieth and twenty-first centuries (2).

On the contrary, in the information processing view, the focus is on the behavioral or environmental factors affecting movement development. According to this view, the process of learning and movement development is akin to the function of a computer which is able to operate via external or environmental input (2). One of the most critical issues, which has been the crux of considerable research in recent years and to which pediatricians, parents, and physical education

teachers have dedicated special attention, is the development of fundamental movement skills (3). Fundamental movements are comprise of locomotor skills, manipulative skills, and noticeable stability and are the foundation of sporting skills that are based on dynamical systems theory. This theory lays emphasis on the interaction of three systems, namely, the person, environment, and responsibility in the development process. According to Goodway (2003), fundamental movement skills are regarded as the foundation of advanced sporting skills (9) and in addition to their impact on the improvement of athletic and specialized sports skills, they can contribute to the efficiency of people's movement in their daily lives; therefore, fundamental movement skills are required to receive sufficient attention in preschool and primary education owing to the fact that failure to achieve the advanced levels of these skills will bring about diverse problems not only in the development of subsequent skills but also in the improvement of the putative skills in older ages. Concerning the conformation and quality of these skills, body composition has been deemed as one of the chief criteria and has long been of great interest to the researchers investigating development and evolution of body. Sheldon divides human body into three categories of endomorph, mesomorph, and ectomorph. Benefice et al. (1996) point out that body type (body size and composition) is one of the most prominent environmental factors that can exert an influence on the fundamental movement skills, especially in the childhood (4). Hence, Body Mass Indicator (BMI), as an indicator of two vital development factors, namely, the height and weight, can influence on the processes of movement and physical development. Okely, et al. (2004) investigated the relationship between body composition and fundamental skills among children and adolescents; and they came into the conclusion that during the performance of fundamental object-control and locomotor skills, nonoverweight girls and boys who were not overweight could outperform the overweight children. Logan

Samuel (2008), delving into the relationship between body type and movement skill, deduced that there was an inverse correlation between BMI and object-grabbing skill (11). In the same vein, Nervik et al. (2011), in their study entitled "the relationship between body mass index and gross motor development in children aged 3 to 5 years", concluded a strongly significant and meaningful relationship between body mass index and the level of motor development among children in a way that the more BMI was (outside the normal range), the more desirable the level of motor movement was (13). Despite profuse research on the development of fundamental skills and the impact of various factors on them, to the best of the researcher's knowledge, no study has been designed to explore the relationship between body type and the development of these patterns (especially skipping and hopping patterns) to date. As a result, the present study was set forth to determine the relationship between body mass index and the selected fundamental skill patterns (skipping and hopping) in girls aged 10 to 12 years.

Methodology

This study sought to examine the relationship between body mass index and selected fundamental patterns (skipping and hoping) in girls aged 10 to 12 years. These skills had been formed in the past; in other words, the researcher did not impose any independent variables on the subjects. Based on the putative points, the design of the study was quasi-experimental and the type is causal-comparative (Ex-Post Facto). The study was also conducted according to field research. All fourth to sixth grade female students in elementary school in the city of Samen were considered as the sampling population of this study. Among them, 120 samples were assigned to three groups of thin, normal, obese subjects using simple random sampling. The body mass index was gauged via measuring the weight and

height and using the corresponding formulas. After the computation of the body mass index of the subjects, based on the Percentile Chart, they were located in there groups of thin (1-25 percentile), normal (65-36 percentile), and obese (100-76 percentile) subjects. Test of Gross Motor Development (TGMD-2), which was developed by Ulrich (2002) and measures the development and circuit processes of fundamental movement patterns in children (14), was used to estimate the indices of selected locomotor development.

To run the test, while performing motor skills, all the subjects were videotaped via three video cameras taking video from back, front, and side angles simultaneously. Each pattern was evaluated based on some certain performance criteria. The content of each criterion was a part of an advanced model of that pattern in terms of the function of the limbs and trunk. The subjects were asked to do each pattern again. After each turn, all performance were received the perfect score (1) or score (0) (based on the performance criterion) (1).

In order to check the normal distribution of the data, the Kolmogorov-Smirnov test was used, and the Pearson correlation coefficient was run to determine the relationship between variables.

Results

Groups	Movement patterns	Correlation coefficient	Level of significance
Thin	Skipping	0.059	0.83
	Hopping	-0.83	0.001*
Obese	Skipping	-0.54	0.001*
	Hopping	0.26	0.15
Average	Skipping	0.27	0.07
	Hopping	0.076	0.70

* This is significant at the level of 0.05 ($p \leq 0/05$).

Table 1. The results of Pearson correlation coefficient test concerning the relationship between body mass index and the growth of selected movement patterns

As demonstrated in Table 1, the correlation coefficient and the significance level indicate that there was a significant negative relationship between thinness and the growth of hopping movement pattern (p =0.001). A significant negative relationship between obesity and skipping movement patterns was also observed (p = 0.001).

Discussion and conclusion

Results showed that there was no significant relationship between thinness and the growth of skipping movement patterns; however, a significant relationship was found between thinness and hopping movement patterns. These findings were inconsistent with the results reported in Nervick et al.'s (2011) study. In their study, they explored the relationship between body mass index and movement development in children aged 3 to 5 years and concluded that there was a significant and meaningful relationship between body mass index and motor development among children. One explanation for this differentiation may be the age difference of the subjects in this study (8-10 years old) and Nervick et al.'s (2011) study (3-5 years old). Another reason can be attributed to the differences in the methodology since the test type and procedure could lead to some differences in the results. In the present study, subjects located in the obese group were classified according to body mass index, whereas in other studies, the basis of classification was the therapeutic interventions or the subjects' treatments for reducing obesity in medical clinics. The noteworthy point regarding the significant correlation between thinness and hopping is that due to their tallness and high center of mass, these subjects could not maintain the balance; therefore, the balance was lower, which brought about poor performance in hopping skill. The other finding of this study was that there was a significant relationship between obesity and the growth of skipping movement patterns. A possible reason could be

ascribed to the fact that the skipping movement pattern is required a high neuromuscular coordination, and as noted before and according to the results of some research, neuromuscular coordination in people suffering from obesity is low. So obesity can be stated to be a debilitating factor for the representation of skipping movement pattern. This finding is aligned with the results of Hardy et al.'s (2012) study in which they reported obese children had less movement balance compared to normal children (10). This happens maybe owing to the naturally lower levels of motor activities in obese children and this fact can exert an adverse influence on the development of fundamental movement skills. Nonetheless, no relationship between obesity and the growth of hopping movement pattern was observed, which is consistent with the results reported in Vertinak et al.'s (2011) study. Looking into the relationship between body mass index and gross motor skills, Vertinak et al. (2011) demonstrated no linear relationship between gross motor skills and body mass index (15); however, this result does not support the results of Murano et al.'s (2011) study in which they investigated the fundamental movement patterns in obese and normal-weight preschool children and concluded that in terms of movement patterns, the performance of obese children was weaker in comparison with that of children with normal weight. Probably the difference is due to the sampling since the subjects in this study were naturally adopted from school while the subjects in Murano et al.'s (2011) study were chosen clinically (among those who visited the doctor). On the other hand, the results can also be attributed to the test utilized in this research and those studies that did not confirm this relationship might use other tests such as Oseretsky Test. Regarding the relationship between the normal weight and the growth of skipping and hopping movement patterns, no significant relationship was found. This finding does not support the results of Murano et al.'s (2011) study. They looked into the fundamental movement

patterns in obese and normal-weight preschool children and reported that the obese children indicated weaker locomotor patterns than the normal-weight children.

One of the key differences between the obese and normal-weight persons in locomotor patterns is that obesity generates problems in motor-perceptual coordination (6). It can also be stated that the negative relationship between high body mass index and fundamental movement skills is determined by mechanical and cognitive factors, motor parts, body mass transfer, coordination of the parts, and the movement range. On the whole, based on previous findings, obese children may suffer from motor-perceptual disorders; because of the time required for them to process the sensory information and motor control, they show weaker motor behavior. As a result, the comparison of motor-perceptual behavior between obese and thin persons should also be examined in subsequent tests. The cause-and-effect influences of body mass index and fundamental movement patterns found in this study using limited sampling population cannot be confidently generalized to all contexts; so, more research is required to shed more light on the relationship between BMI and the traits of movement development. On the other hand, in such cases, it would be better to undertake longitudinal research which yields more precise results than the cross-sectional study. In the end, the design of appropriate educational programs and the enrichment of the environment can provide opportunities for practicing and developing manipulative skills which are deemed to be the base of children's sporting and specialized sports skills.

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