

INTERRELATIONSHIPS BETWEEN ANTHROPOMETRIC VARIABLES AND OVERWEIGHT: ANALYSIS OF EFFECTS USING STANDARD DEVIATIONS

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Abstract

Body mass index (BMI) correlates with several anthropometric variables associated with overweight during different ages in childhood, however certain anthropometric variables contribute most to variation in childhood BMI.

When viewing standard deviations, the following BMI data are taken into account: height (H), sitting height (SH), waist circumference (WC), waist to height ratio (WHtR), waist to sitting height ratio (WSHtR), the subscapular skinfold (SSF) and the triceps skinfold (TSF). Most often, age group contributes to a greater extent than gender to variation in BMI with a score of standard deviation (SDS).

The aim of the scientific paper is to analyse the correlation between BMI and anthropometric variables associated with overweight.

In the paper, an analysis of secondary data of a group of respondents was carried out, in order to see the degree of accuracy of BMI in predicting overweight and obesity. According to the methodology obtained for the analysis and interpretation of the data, the method of comparison, the method of specification and the method of synthesis and generalization are being used.

The main results of the research frame are pointing out that the annual increases in BMI relate to a greater extent to lean muscle mass than to fat mass, however, there are variations in relation to gender and age.

Keywords: BMI, gender, age, standard, deviations

1. Introduction

Worldwide, overweight and obesity are becoming a significant problem and challenge. It is a chronic non-communicable disease, which is mostly associated with physical inactivity but also excessive consumption of processed and fast food, without high nutritional value.

One official survey, conducted in school frameworks, and recognized at the world level is the Family Budget Survey conducted by the Brazilian Institute of Geography and Statistics (IBGE) (Maughan, 1999).

According to the obtained results, it was determined that every third adolescent is overweight. According to a deeper analysis of the research, it is established that in fact, during the consumption of the family budget, a larger percentage of finances is set aside for processed food. Consequently, in this way, the prevalence of overweight and obesity among teenagers, but also among adolescents, is justified. All of that

needs to be connected with the way of measuring this condition, but also through the opportunities and strategies in the society itself, for the promotion of health.

All these bad habits, which have a direct impact on childhood obesity, need to be solved by setting up a multidisciplinary approach. All of this can be applied within the framework of appropriate education in nutrition, in a way that will enable the improvement of the components of the body composition, especially the reduction of body fat and the improvement of skeletal muscle mass.

The main research question within this paper is the following: “What is the relation of anthropometric variables and overweight, through the analysis of standard deviation effects?”

2. Literature review

Anthropometry is a general tool for defining overweight and obesity with body mass index (BMI; kg/m²) as the most common variable, using sex- and age-adjusted cutoffs for children (Cole, Bellizzi, Flegal, Dietz, 2000). However, the accuracy of BMI varies, depending on the degree of obesity. Across a series of studies, it has been found that the annual increase in BMI is attributed more to an increase in lean mass than to an increase in fat mass, which varies by gender and age (Maynard, Wisemandle, Roche, Chumlea, Guo & Siervogel, 2001). Consequently, existing changes in BMI percentile do not necessarily reflect changes in adiposity in children over time.

According to Bluher, waist circumference (WC), as well as waist to height (WHtR), is correlated with the amount of abdominal fat, as well as cardiovascular and metabolic risk factors (Bluher, Molz, Wiegand, Otto, Sergejev, Tuschy, L’Allemand, Jander, Kiess & Holl, 2013). In addition, skin folds in different combinations are correlated with negative health risk, and the ability to predict body fat percentage is better than BMI.

An interesting and important fact to analyze is that during childhood and adolescence, the ratio between the upper and lower parts of the body changes significantly, which needs to be taken into account for a series of researches.

However, there is a finding that despite the available definitions of BMI, there is insufficient opportunity for parents as well as health professionals to recognize overweight in a child. The early school years represent a time of greater risk of fat storage and weight gain. Consequently, child obesity as a condition needs to be monitored throughout the entire childhood.

3. Research framework and discussion

In order to set the stage for long-term research from which relevant recommendations can be drawn in use for societal purposes, a thorough insight is needed regarding the impact of body mass index (BMI), correlated with five anthropometric variables associated with overweight in during different ages in childhood. In addition, it is of particular importance to understand which anthropometric variables contribute most to variation in childhood BMI.

In the context of the above, the following BMI data are taken into account: height (H), sitting height (SH), waist circumference (WC), waist to height ratio (WHtR), waist, sitting height ratio (WSHtR), subscapular skinfold (SSF) and triceps skinfold (TSF). With these values and analyses, research was conducted on a group of 4,576 Norwegian children, on average and subgroups of 4.00-15.99 years. It is important to point out that the results themselves were transformed into standard deviation scores (SDS), which were studied using correlation and multiple regression analyses.

Regarding the results obtained from this analysis, it was found that the correlations between BMI SDS and standardized anthropometric variables are, in the most general sense, strong and positive. For all variables, correlations were weakest in the youngest age group and highest between 7 and 12 years of age. In addition, it was found that age group, but not gender, contributed significantly to the variation in BMI SDS. As a concluding observation, a specific response is drawn that the interrelationships between BMI SDS and five standardized anthropometric variables associated with overweight are age-dependent, and were weakest in the youngest age group. Independent of gender and age, WC SDS is superior to other anthropometric variables that contribute to variation in BMI SDS during childhood (Brannsether, Egil, Roelants, Bjercknes, Benedikt & Iussoni, 2014).

Research focus and discussion aimed at insight into the interrelationships of anthropometric variables to characterize overweight, also show strong, i.e. positive correlations between BMI and SDS, and other traditional anthropometric variables used to describe fat models (WC SDS, WHtR SDS, SSF SDS and TSF SDS).

The research found that BMI represents a more general fat pattern than abdominal fat pattern. According to Nooyens, it is interesting to note that skin folds predict body fat percentage more accurately than BMI (Nooyens et al., 2007), while they also correlate with negative risk factors, such as lipid and insulin concentrations (Freedman et al. al., 1999).

One of the aspects that deserves discussion is, in addition to paying attention to BMI, that attention should also be paid to the changes in fat mass, and changes in the skin folds that indicate a change in the amount of subcutaneous, deposited fat.

However, according to Juliusson, age appears to be a significant predictor of BMI. In that context, however, a research model is highlighted in which a similarity with the model of parental perception is seen, where parents, as well as health care workers, have difficulties in recognizing overweight in preschool children. Consequently, a parent may often consider a child not overweight, especially male children, independently of BMI (Juliusson et al., 2010b).

Within the study conducted, WC SDS correlated most strongly with BMI across all ages, with WHtR SDS and SSF SDS. However, what is noteworthy about this research is that it was conducted during the period of puberty for the boys and girls who are the target group, with which rapid changes in growth and maturation occur. However, the same cannot be considered as a certain unified correlation pattern.

Another example of impact analysis is the condition of athletes. It's about the relationship between body fat and physical performance. At the same time, determining the level of body fat in athletes is very

important, which requires a particularly precise assessment method. In athletes, high lean mass (muscle and bone) weight reduces the performance of weight-based indicators such as body mass index (BMI) (Moses, Duduyemi, 2016). Therefore, BMI in athletes may provide insufficiently accurate or precise data.

According to the data obtained in this study, it is seen that in men (athletes and non-athletes), the ratio between the waist and the hips of the anthropometric indices has the highest correlation ($r = 0.821$ and $r = 0.889$, respectively) with the percentage of body fat. Among women (athletes and non-athletes), BMI from the anthropometric indices has the highest correlation ($r = 0.780$; $r = 0.863$) with the percentage of body fat.

An index (BRI) and a body fat index (BAI) are used in the analysis. Moreover, neither the BAI nor the BRI were superior to traditional indices of obesity for predicting metabolic syndrome (Mets). In addition, the weakest predictive ability is shown by the BAI, while the BRI shows potential for use as an alternative measure of obesity in assessment. According to the results, visceral fat index (VFI) and percentage body fat (PBF) tend to increase with age in both sexes.

Regarding anthropometric variables, the relationship between weight-based anthropometric indicators (such as body mass index) and body fat in male athletes is found to be significantly higher than female athletes. Percent body fat tended to be significantly more correlated with WC than with BMI in men and significantly more correlated with BMI than with WC in women. Also, WSR (waist to height ratio) tends to be higher, correlated with body fat percentage than WC (Santos, Silva, Matia, Magalhaes, Minderico, 2015).

4. Conclusions

There are a number of studies reporting a poor relationship between body mass index and body fat percentage in male athletes. On the other hand, certain studies identify the body mass index as a correct index (for example for female athletes).

The main conclusions that emerge from the mentioned research within the framework of this paper, refer to variables related to BMI and overweight. However, it is established that the age limit, that is, the age groups, does not change the order of the mentioned correlations within this paper, neither between the variables related to BMI and overweight, nor between other variables. Moreover, the correlations between WC SDS and the ratios (WHtR SDS, WSHtR SDS) were stronger than those of BMI SDS. In applied research, the interaction with respect to age group was significant for all variables, while gender was not a significant predictor in these models.

Regarding the research conducted on a group of athletes, it is initially analyzed that the main concern of athletes is to achieve a suitable weight. However, an accurate assessment of body composition is also important, thus initiating the importance of the relationship between body fat and physical performance, thereby determining the level of body fat in athletes. The main conclusions in this context are that in athletes, both high and low-fat tissue may be disadvantageous for athletes, requiring a more precise

assessment method. According to the above, it is concluded that the use of BMI among athletes may not provide completely accurate anthropometric information, and a more accurate model must be found.

5. Recommendation

What is drawn as a conclusion, but also a recommendation within the framework of further research, is to enable conditions to additionally compare different anthropometric traits with direct measures of body composition of moderately overweight children. In this way, conditions will be created to better identify obesity, but also for an overall study of the associated health risk in this target group.

Furthermore, as a recommendation, it is pointed out that in the absence of more sophisticated methods, it is necessary to assess the anthropometric status, as well as the use of appropriate indices, which should be selected according to gender. In addition, indices may be different assessable in different societies, which also has its own impact.

Limitations of the study

In the framework of this paper, already conducted researches, secondary data, have been used. They are of particular importance in order to obtain an answer to the research question, but also to draw relevant conclusions regarding the problem. However, in the future it is necessary to practice the implementation of an empirical framework of research in this domain, with the aim of obtaining data that are in direct coordination with the needs in given social frameworks.

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