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CORRELATION OF BODY MASS INDEX (BMI) AND TRICEPS SKINFOLD MEASUREMENT (TSMF) WITH POST EXERCISE HEART RATE (HR) AFTER 3 MINUTE STEP TEST IN CHILDREN

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ABSTRACT Increased post-exercise heart rate (HR) in children can be signal to detect negative behaviours or lifestyle. This cross-sectional study aimed to assess correlation of Body mass index (BMI) and triceps skinfold measurement (TSFM) with post-exercise HR after 3-minute step-test in children. Data of healthy children of both sexes and age group of 6-12 years was collected for: height, weight and TSMF and post- exercise HR after 3-min Kasch Pulse Recovery Test. Out of total of 103 children (61 boys, 42 girls), 21 (20.37%) were obese or overweight. There was very weak correlation between BMI & post Exercise HR (Correlation coefficient r = +0.067, p=0.50) and weak positive but significant correlation found between TSMF & post Exercise HR (r = +0.259, p=0.008). Thus, TSMF was found to be better correlated with physical fitness (as measured by post exercise HR) than BMI.

KEYWORDS : BMI, Post-exercise heart rate, Triceps Skinfold measurement

INTRODUCTION

Childhood obesity has increased in recent years. The most important factors underlying the obesity epidemic are unhealthy eating patterns coupled with lack of physical activity. It is undeniable fact that childhood obesity is on the rise also in India. A recent paper estimates that about 5.74 %- 8.82 % of school children in India are obese. In urban areas of south India, 21.4 % boys and 18.5 % girls aged 13-18 are in overweight or obese category.(Jothi Rajan, 2018)

Physical fitness, including cardiorespiratory fitness, is a parameter of one's health. Physical fitness can be characterized by the post-exercise heart rate (HR), considered as an indicator of cardiorespiratory fitness.(Cole et al., 1999; Golding et al., 1989) The value of post-exercise HR obtained with the step test is suggestive of cardiorespiratory fitness; it gives idea of habitual physical activity and can be useful diagnostic and prognostic health indicator.(Fitchett, 1985)

Body mass index (BMI, kg/m^2) is used as a screening tool for overweight and obesity in various settings, and a high BMI among children is associated with adverse levels of various cardiovascular risk factors, the initial stages of atherosclerosis, and obesity as adult.(Berenson et al., 1998; Reilly et al., 2003) However, a high BMI can be due to either fat mass or fat-free mass(Freedman et al., 2005). A child with a high BMI is likely to have elevated body fatness,(Krebs et al., 2007) but lower levels of BMI are a poor indicator of body fatness among children.(Bray et al., 2002)

The thickness of various skinfolds seems a more direct indication of body fatness than does BMI.(Addo & Himes, 2010; Laurson et al., 2011) Most studies have found that skinfold thicknesses are more strongly associated with the body fatness of children than is BMI.(Sardinha et al., 1999; Sarría et al., 1998; Steinberger et al., 2005)

As physical inactivity and obesity are growing health problems in children, it is necessary to evaluate the temporal trends in obesity and exercise capacity among children. Impaired post-exercise HR in children can be signal of a need for preventing negative behaviours or lifestyle. This study was taken up to evaluate correlation of BMI and TSFM with post-exercise HR. This can give an idea about which of these two parameters can be better indicator of physical fitness of children.

MATERIALS AND METHODOLOGY

This study was cross-sectional study conducted at different schools and societies of of Ahmedabad, Gujarat, India. Children of 6-12 years age group were included in the study. Children with cardiovascular or respiratory co-morbidities or absolute contraindications to physical exercise were excluded from the study. These exclusions were decided based on a parent or caregiver interview, physical examination, and data from medical records. For each participant, due consent was taken from the parents or legal guardian and assent was taken from child after due explanation about procedure. This study was approved by Institutional Ethics committee.

Schools and societies from west zone and new west zone of Ahmedabad, were selected based on lottery method. Children (6–12 years) were selected based on the criteria of age, sex and socio-economic status. Based on lists of students in each of the schools and societies, a proportional sample of children by age and sex was designed and then students from each school or society were then chosen by simple random sampling.

Anthropometric measurements; Height, weight and triceps skin fold were measured. Height was measured by stadiometer in centimeter to nearest 0.1 cm. Weight was measured by digital weighing scale with 0.1 kg sensitivity. Body mass index of child was calculated with help of "BMI Percentile Calculator for Child and Teen" by centre for disease control and prevention (CDC).(CDC, 2019) The participants were subjected to a 3-min Kasch Pulse Recovery Test (KPR Test).(Kasch, 1961; Jankowski et al., 2015) The KPR Test consisted of climbing a 0.305-meter (12 inch) step at a rate of 24 steps up and down per minute. The rate of climbing was defined by a metronome set at 96 beats (signals) per minute. The heart rate (HR) was recorded with IBP electronic pulse analyser. Throughout the test, HR was monitored continuously (i.e., during 3 min of exercise [step test] and during 1 min and 5 sec of recovery [seated position]). Only the values of post-exercise HR (i.e., the values recorded 1 min after completion of the test [no later than 5 sec]) was included in the further analysis. HR during restitution were recorded with the participant in the seated position; participants were instructed to sit still, breath normally, and not engage in conversation. The test was considered incomplete whenever instructions are not properly followed (e.g., due to an improper climbing rate, conversation, or refusal to exercise). The test was discontinued if the exercise HR exceeded 180 beats per minute for more than 15s and participants were excluded from the study.

Triceps skinfold thickness was measured following recommended protocols. (Addo & Himes, 2010; Ramírez-Vélez et al., 2016) Skinfold thickness was measured using a BASELINE skinfold calliper, at triceps; halfway between the acromion process and the olecranon process of both sides. Every child was evaluated for three times and average value was calculated for left and right side each. To further reduce bias, average value of right and left was considered as final value.(Moreno et al., 2002)

This study was conducted with objective to assess correlation of both BMI and triceps skinfold measurement (TSFM) with post-exercise heart rate after 3-minute step-test in children of age group of 6-12 years.

RESULTS

Data was collected from different schools and societies of Ahmedabad, Gujarat, India. Data of total 103 children (61 boys, 42 girls) of 6-12-years age group was included in Analysis. Four children were excluded from study due to excess heart rate. Following table (Table-1) describes weight category (%), mean BMI, mean TSFM, and mean post-exercise HR. About 20% children were either obese or overweight.

Table: 1 Demographic Data, BMI, TSMF and post-exercise HR of study population

Parameter	Value (N=103)
Gender (n) -Boys -Girls	 61 42
Weight category (%) -Underweight -Healthy weight -Overweight -Obese	 20.39% 59.22% 13.59% 6.78%
BMI (mean ± SD)	16.47 ± 3.17
TSFM (mean ± SD)	9.86 ± 3.87
Post-Exercise HR (mean ± SD)	99.22 ± 11.97

Using Spearman's correlation test, correlation coefficient was calculated of BMI with TSMF and post exercise HR and of TSFM with post exercise HR. (Figures 1-3)

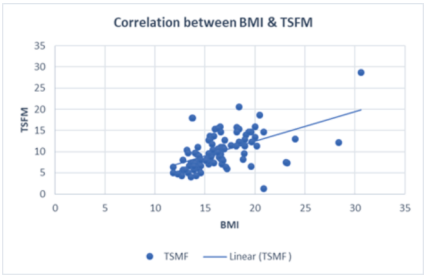

Figure 1: Correlation between BMI & TSFM Correlation coefficient r = +0.646 p<0.001

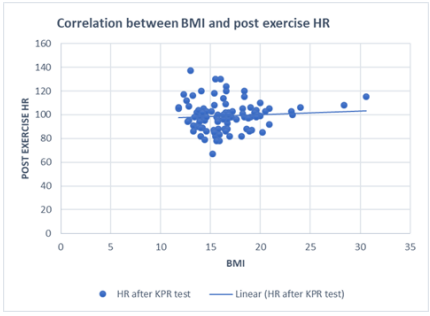

Figure 2: Correlation between BMI &post-exercise HR. Correlation coefficient r = +0.067, p=0.50

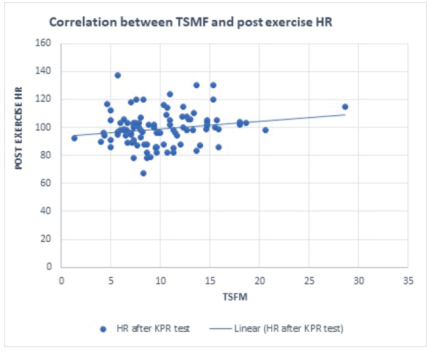

Figure 3: Correlation between TSMF &post-exercise HR. Correlation coefficient r = +0.259, p=0.008

Correlation between BMI and TSMF was found to be strong, positive and significant (r = +0.646 p<0.001) (Figure-1). TSMF was showing weak positive but significant correlation with post exercise HR (r = +0.259, p=0.008) while BMI was showing very weak positive correlation with post exercise HR (r = +0.067, p=0.50). (Figures-2 & 3).

DISCUSSION

It is well reported in literature that skinfold testing provides a more accurate assessment of body composition i.e. percentage of body fat than BMI.(Etchison et al., 2011; Trang et al., 2019)

Etchison et al, conducted study to evaluate BMI and skinfold measurements as indicators for obesity in which anthropometric data (height, weight, percentage body fat, age, and sex) were recorded from 33,896 student athletes. According to BMI percentile, 13.31% of student athletes were obese, while using the skinfold method, only 5.95% were obese. Out of those classified as obese by the BMI, 62% were considered false positives by the skinfold method. Authors concluded that, skinfold testing provided a more accurate body assessment of fat than BMI in study population. (Etchison et al., 2011)

Study by Mondal and Mishra,(Mondal & Mishra, 2017) analysed effect of BMI and body fat percentage on maximal oxygen consumption in healthy young adults. This study was conducted on 54 (male=30, female=24) healthy young adults of age group18-25 years BMI showed weak negative correlation (r= -0.3232, p=0.0171) with $VO2_{max}$ while Body Fat% showed strong negative correlation (r= -0.7505, p<0.001) with $VO2_{max}$. Authors concluded that, increase in body fat was associated with decreased level of $VO2_{max}$ and body fat percentage was better parameter than BMI for prediction of low $Vo2_{max}$.

Zanovac et al,(Zanovec et al., 2009) conducted a study to examine the association of self-reported physical activity with body composition in 290 college students (49% male, 60% White) 18–25 years of age. Authors found that, in this population of young adults, participants in the highest activity group had a more fit body composition profile characterized by lower percentage of body fat, lower fat mass, and a higher lean-tissue mass, while same was not reflected in BMI.

The use of skinfold testing as a simple and reliable test to determine body fat. As BMI utilizes only body weight and height and does not consider overall body composition, muscular individuals may be classified as obese. Even though BMI is widely used, it seems to be a poor indicator for obesity and physical fitness in children and young adults. Health professionals and coaches should be aware of the limitations of using BMI while using it to determine health status of children or young adults. (Etchison et al., 2011; Mondal & Mishra, 2017; Trang et al., 2019; Zanovec et al., 2009)

Similarly, in this study, very weak correlation was observed between BMI and post exercise HR, while correlation of with post exercise HR with TSFM (measure of body composition) was weak positive and significant. Present study showed that; rather than BMI, skinfold measurement should be used by parents, teachers and healthcare providers to identify unfit children and offer timely intervention. These findings need to be confirmed in larger population of children.

CONCLUSION

There was very weak positive correlation found between BMI and post exercise HR, while there was weak positive and significant correlation between TSFM and post exercise HR. Thus, TSMF was found to be better correlated with physical fitness (as measured by post exercise HR) than BMI.

Acknowlegement and Conflict of Interest

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CONFLICT OF INTEREST: None.

REFERENCES:

1. Addo, O. Y., & Himes, J. H. (2010). Reference curves for triceps and subscapular skinfold thicknesses in US children and adolescents. The American Journal of Clinical Nutrition, 91(3), 635–642.
2. Berenson, G. S., Srinivasan, S. R., Bao, W., Newman, W. P., Tracy, R. E., & Wattigney, W. A. (1998). Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults. The Bogalusa Heart Study. The New England Journal of Medicine, 338(23), 1650–1656.
3. Bray, G. A., DeLany, J. P., Volaufova, J., Harsha, D. W., & Champagne, C. (2002). Prediction of body fat in 12-y-old African American and white children: Evaluation of methods. The American Journal of Clinical Nutrition, 76(5), 980–990.
4. CDC. (2019, May 9). BMI Calculator for Child and Teen. Centers for Disease Control and Prevention.
5. Cole, C. R., Blackstone, E. H., Pashkow, F. J., Snader, C. E., & Lauer, M. S. (1999). Heart-rate recovery immediately after exercise as a predictor of mortality. The New England Journal of Medicine, 341(18), 1351–1357.
6. Etchison, W. C., Bloodgood, E. A., Minton, C. P., Thompson, N. J., Collins, M. A., Hunter, S. C., & Dai, H. (2011). Body Mass Index and Percentage of Body Fat as Indicators for Obesity in an Adolescent Athletic Population. Sports Health, 3(3), 249–252.
7. Fitchett, M. A. (1985). Predictability of VO2 max from submaximal cycle ergometer and bench stepping tests. British Journal of Sports Medicine, 19(2), 85–88.
8. Freedman, D. S., Wang, J., Maynard, L. M., Thornton, J. C., Mei, Z., Pierson, R. N., Dietz, W. H., & Horlick, M. (2005). Relation of BMI to fat and fat-free mass among

children and adolescents. International Journal of Obesity (2005), 29(1), 1–8.
9. Golding, L. A., Myers, C. R., & Sinning, W. E. (1989). Y's way to physical fitness: The complete guide to fitness testing and instruction. Champaign, IL : Published for YMCA of the USA by Human Kinetics Publishers.
10. Jankowski, M., Niedzielska, A., Brzezinski, M., & Drabik, J. (2015). Cardiorespiratory Fitness in Children: A Simple Screening Test for Population Studies. Pediatric Cardiology, 36, 27–32.
11. Jothi Rajan, M. A. J. R. (2018). Childhood Obesity: The Indian Scenario Compared with World Wide. Current Research in Diabetes & Obesity Journal, 5.
12. Kasch, F. W. (1961). A comparison of the exercise tolerance of postrheumatic and normal boys. 15, 35–40.
13. Krebs, N. F., Himes, J. H., Jacobson, D., Nicklas, T. A., Guilday, P., & Styne, D. (2007). Assessment of child and adolescent overweight and obesity. Pediatrics, 120 Suppl 4, S193-228.
14. Laurson, K. R., Eisenmann, J. C., & Welk, G. J. (2011). Body fat percentile curves for U.S. children and adolescents. American Journal of Preventive Medicine, 41(4 Suppl 2), S87-92.
15. Mondal, H., & Mishra, S. P. (2017). Effect of BMI, Body Fat Percentage and Fat Free Mass on Maximal Oxygen Consumption in Healthy Young Adults. Journal of Clinical and Diagnostic Research: JCDR, 11(6), CC17–CC20.
16. Moreno, L. A., Rodríguez, G., Guillén, J., Rabanaque, M. J., León, J. F., & Ariño, A. (2002). Anthropometric measurements in both sides of the body in the assessment of nutritional status in prepubertal children. European Journal of Clinical Nutrition, 56(12), 1208–1215.
17. Ramírez-Vélez, R., López-Cifuentes, M. F., Correa-Bautista, J. E., González-Ruíz, K., González-Jiménez, E., Córdoba-Rodríguez, D. P., Vivas, A., Triana-Reina, H. R., & Schmidt-RioValle, J. (2016). Triceps and Subscapular Skinfold Thickness Percentiles and Cut-Offs for Overweight and Obesity in a Population-Based Sample of Schoolchildren and Adolescents in Bogota, Colombia. Nutrients, 8(10).
18. Reilly, J. J., Methven, E., McDowell, Z. C., Hacking, B., Alexander, D., Stewart, L., & Kelnar, C. J. H. (2003). Health consequences of obesity. Archives of Disease in Childhood, 88(9), 748–752.
19. Sardinha, L. B., Going, S. B., Teixeira, P. J., & Lohman, T. G. (1999). Receiver operating characteristic analysis of body mass index, triceps skinfold thickness, and arm girth for obesity screening in children and adolescents. The American Journal of Clinical Nutrition, 70(6), 1090–1095.
20. Sarría, A., García-Llop, L. A., Moreno, L. A., Fleta, J., Morellón, M. P., & Bueno, M. (1998). Skinfold thickness measurements are better predictors of body fat percentage than body mass index in male Spanish children and adolescents. European Journal of Clinical Nutrition, 52(8), 573–576.
21. Steinberger, J., Jacobs, D. R., Raatz, S., Moran, A., Hong, C.-P., & Sinaiko, A. R. (2005). Comparison of body fatness measurements by BMI and skinfolds vs dual energy X-ray absorptiometry and their relation to cardiovascular risk factors in adolescents. International Journal of Obesity (2005), 29(11), 1346–1352.
22. Trang, L. T., Trung, N. N., Chu, D.-T., & Hanh, N. T. H. (2019). Percentage Body Fat is As a Good Indicator for Determining Adolescents Who Are Overweight or Obese: A Cross-Sectional Study in Vietnam. Osong Public Health and Research Perspectives, 10(2), 108–114.
23. Zanovec, M., Lakkakula, A. P., Johnson, L. G., & Turri, G. (2009). Physical Activity is Associated with Percent Body Fat and Body Composition but not Body Mass Index in White and Black College Students. International Journal of Exercise Science, 2(3), 175–185.