

## Impact of physical activity on the Body Mass Index and self-esteem of adolescents

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ORIGINAL ARTICLE

### ABSTRACT

The object of this study was to analyse the impact of the practice of physical activity on the body mass index (BMI) and self-esteem of adolescents. The samples included 1,011 adolescents, aged between 14 and 18 years. First the BMI was calculated, then the adolescents filled in the Rosenberg Self-esteem Scale (RSS) questionnaire and the International Physical Activity Questionnaire (IPAQ). Student's t-test and the chi-squared test were used for statistical analysis. The Odds Ratio and the Confidence Interval (95%) were also calculated. Female adolescents who are physically active have a 22.4% lower probability of developing overweight/obesity (OR=0.776, CI 95% 0.741-0.813) and 34.4% lower probability of presenting low self-esteem (OR=0.656, CI 95% 0.616-0.698). Participation in physical education classes reduces the probability that male adolescents will present low self-esteem by 88% (OR=0.120 CI 95% 0.043-0.339). In female adolescents, the practice of physical activity at school acts to prevent low self-esteem, as well as helping to control bodyweight increase. In male adolescents' participation in physical education classes acts as a protection against low self-esteem.

*Keywords:* adolescents, IPAQ, RSS, BMI.

### INTRODUCTION

The practice of physical activity (PA) generates physical and psychological benefits in individuals (Dishman et al., 2006) which are more effective and offer a greater cost-benefit ratio than other traditional interventions like psychotherapy and pharmacological interventions (Larun et al., 2006; Liu et al., 2015). Physical activity has even been shown to improve the quality of life of ischemic vascular accident and stroke survivors (Aidar et al., 2011). Furthermore, individuals who carry out PA have greater corporal satisfaction and the perception of a more attractive body (Altıntaş et al., 2014). The benefits for mental health of practicing PA may result in increased social support and a sense of mastery, as well as changes in noradrenalin and neurotransmitters

like dopamine and serotonin (Paluska & Schwenk, 2000). It has also been observed that practicing PA favours other aspects of adolescents' lives, with a healthier parent-child relationship, lower depression indices, better academic performance (Field et al., 2001) and lower rates of use of illegal drugs, alcoholic drinks and cigarettes as compared with adolescents who present more sedentary behaviour (Kirkcaldy et al., 2002).

Self-esteem is the person's perception of him/herself (Shavelson et al., 1976). It is defined as personal self-esteem (Crocker & Major, 2003), reflecting the person's assessment of his/her own value (Liu et al., 2015). Individuals with higher self-esteem are more self-sufficient, have a better corporal self-image, greater leadership capacity and are less liable to

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suffer depression or anxiety (Strong et al., 2005). Low self-esteem in children and adolescents may be a predictor of problems of anxiety and depression (Sowislo & Orth, 2013), criminal behaviour and limited economic prospects during adult life (Trzesniewski et al., 2006); it is therefore necessary to intervene as early as possible in order to cultivate healthier young people and adults. Individuals are psychologically very vulnerable during adolescence; it is therefore important to give them the necessary support to enable them to develop into healthy adults. Adolescents have to face a large number of psychological, biological and behavioural changes which can intensify negative self-perceptions (Harter, 1999). Female adolescents may also be affected by the corporal changes determined by puberty, such as increased body fat, broader hips and bigger breasts, which may generate negative feelings about their own appearance (Malina et al., 2004). Adolescents of both sexes may be affected by corporal dissatisfaction because they do not have the 'ideal body' so widely disseminated by the mass media (Stice et al., 1994; Uchôa et al., 2019), with very slender figures in the case of girls and muscular bodies in the case of boys. Concern over body image may start at the beginning of adolescence, increase during that period and diminish in young adults (Hong et al., 2015), affecting psychological well-being in different phases of life (Koyuncu et al., 2010). To support adolescents and promote prevention measures against low self-esteem it is fundamental not only to identify the factors which generate low self-esteem but also to have instruments which promote psychological well-being in adolescents. The object of this work was therefore to study the impact of practicing physical activity on the body mass index and self-esteem of adolescents.

## METHOD

### Participants

This was a descriptive, observational, cross-sectional study. The size of the sample was defined according to the population of the city of Fortaleza, Brazil, which contains 93,837 secondary school students in public and private

schools (*Censo Escolar*, no date). We applied the formula:

$$n_0 = \frac{1}{E_0^2}$$

where  $n_0$  is the first approach to the sample size and  $E_0^2$  is the tolerable sample error. With a sample error of 4%,  $n$  was 621 students; our total sample was bigger, consisting of 1,011 secondary school students of both sexes in the city of Fortaleza, Brazil; their ages ranged between 14 and 18 years (527 girls and 484 boys). Adolescents were excluded from the study if their parents did not give their informed consent. The study was carried out in accordance with the Helsinki Declaration and was approved by the Ethics Committee for Research on Human Beings, decision number 2.193.376.

### Instruments

The equipment used to take anthropometric measurements were an electronic scale (*Filizola*<sup>®</sup>-110), a stadiometer (*Sanny*<sup>®</sup>) and an anthropometric tape (*Sanny*<sup>®</sup>). The body mass index (BMI) was used to measure body fat, calculated as the body mass divided by the square of the body height and expressed in units of kg/m<sup>2</sup> and analysed by gender. BMI was calculated by the following formula: BMI = mass/height<sup>2</sup>. The results of the BMI calculation were sub-divided into Accentuated thinness (BMI between 16.0-16.99), Thinness (BMI between 17.00-18.49) Normal (BMI between 18.5-24.9), Overweight (BMI between 25.0 and 29.9), Obese (BMI=30.0).

The practice of physical activity was assessed through the following parameters: 1- Participation in physical education classes (yes/no); 2- Practice of physical activity outside school at least 2 days per week (yes/no); 3- International Physical Activity Questionnaire (IPAQ).

The object of the IPAQ is to evaluate the participant's level of physical activity in the last week, classifying him/her as sedentary (physical activity for < 10 minutes/week); active (vigorous activity 3 days per week for at least 20 minutes/session or jogging 5 days per week for at least 30 minutes/session, or any activities on

≥ five days per week in total); or very active (vigorous activity ≥ 5 days per week and ≥ 30 minutes per session, or vigorous activity ≥ 3 days per week and ≥ 20 minutes per session + moderate activity or walking ≥ 5 days per week ≥ 30 minutes per session). IPAQ has been validated for the Brazilian population (Matsudo et al., 2001).

To evaluate self-esteem we used the Rosenberg Self-esteem Scale (RSS), created by (Rosenberg, 2015) and validated for the Brazilian population by (Hutz & Zanon, 2011). This scale consists of ten statements related with a set of feelings of self-esteem and self-acceptance which indicate overall self-esteem. The answers to the items are given on a four-point Likert-type scale: totally agree, agree, disagree and totally disagree. The scores were categorized into low self-esteem (≤ 25 points), medium self-esteem (26 to 29 points) and high self-esteem (30 to 40 points).

### Procedures

The adolescents filled in the questionnaires for the Rosenberg Self-esteem Scale (RSS) to assess self-esteem, and the IPAQ (International Physical Activity Questionnaire) to assess the

level of physical activity. Practice of physical activity out of school and participation in physical education classes were also analysed. In addition, the BMI of each adolescent was calculated. The result of each instrument was analysed.

### Statistical analysis

Descriptive statistics were presented as mean, standard deviation (SD), range, and frequency (% values). Student's t-test was used for comparison between quantitative variables. The chi-squared test was used for qualitative variables. Odds Ratios (ORs) and Confidence Intervals (CI) 95% were calculated. Statistical analysis used SPSS, version 20.0. The statistical significance was set at  $p < 0.05$ .

## RESULTS

The characteristics of the study participants are shown in Table 1. The mean BMI in girls was 20.75 ( $\pm$  2.25) for normal weight adolescents and 27.52 ( $\pm$  2.49) for overweight/obese adolescents ( $p = 0.000$ ). In boys the mean BMI was 20.81 ( $\pm$  2.12) for normal weight adolescents and 27.74 ( $\pm$  2.63) for overweight/obese adolescents ( $p = 0.000$ ).

Table 1

Comparison of quantitative variables in adolescents aged between 14 and 18 years, by sex.

Variables	Values	Sex		p-value
		Females	Males	
Age (years)	Mean (SD)	15.6 (1.0)	15.7 (1.1)	0.105
Weight	Mean (SD)	56.0 (9.99)	63.7 (12.46)	0.001
BMI	Mean (SD)	21.8 (3.50)	22.0 (3.65)	0.468
Fat	Percentage (SD)	24.4 (4.23)	13.8 (13.79)	0.001
RSS	Mean (SD)	27.6 (5.25)	28.1 (4.79)	0.098
IPAQ	active/sedentary	99.2% / 0.8%	73.3% / 26.4%	0.000

Note: SD= Standard deviation, BMI= Body Mass Index, IPAQ= International Physical Activity Questionnaire, RSS = Rosenberg Self-esteem Scale.

### IPAQ

The participants in this study, of both sexes, were predominantly active. Most of the sedentary and physically active adolescents presented BMI ≤ 24.9 (Table 2). Most girls (99.2%) and boys (73.3%) were physically active, with significant differences in habitual physical activity found between sexes ( $p = 0.000$ , OR=47.512, CI 95% 17.406-129.688).

Female adolescents who are physically active have a 22.4% lower probability of becoming

overweight/obese (OR= 0.776, CI 95% 0.741-0.813). In male adolescents it could not be proved that physical activity prevents overweight and obesity (OR= 1.352, CI 95% 0.870-2.100). We observed that female adolescents who are physically active have a 34.4% lower probability of presenting low self-esteem (OR= 0.656, CI 95% 0.616-0.698). For males, PA was not a protection factor against low self-esteem (OR= 0.966, CI 95% 0.638-1.464).

Table 2  
Percentage of boys and girls by BMI and level of physical activity

Sex	BMI	IPAQ		p value
		Active	Sedentary	
Girls	BMI ≤ 24.9	74.2%	2.2%	0.524
	BMI ≥ 25	23.2%	0.5%	
Boys	BMI ≤ 24.9	69.8%	2.9%	0.104
	BMI ≥ 25	25.2%	2.1%	

Note: BMI= Body Mass Index, IPAQ= International Physical Activity Questionnaire

Table 3  
Percentage of boys and girls by BMI and level of self-esteem

Sex	BMI	RSS		p-value
		High self-esteem	Low and medium self-esteem	
Girls	BMI ≤ 24.9	30.4%	52.7%	0.022
	BMI ≥ 25	4.0%	12.9%	
Boys	BMI ≤ 24.9	30.6%	51.3%	0.665
	BMI ≥ 25	6.3%	11.8%	

Note: BMI= Body Mass Index, RSS = Rosenberg Self-esteem Scale

### RSS

High self-esteem was less frequent than low and medium self-esteem in adolescents of both sexes, in both normal weight and overweight adolescents (Table 3).

Normal weight adolescents of both sexes presented similar mean values for self-esteem (score RSS females= 27.92; score RSS males= 28.19) ( $p=0.448$ ). In the overweight/obese group, we observed that female adolescents presented significantly lower mean RSS scores than males (score RSS females= 26.53; score RSS males= 27.96) ( $p= 0.027$ ). Overweight/obese female adolescents have 1.87 times higher probability of presenting medium/low self-esteem than normal weight adolescents ( $p=0.008$ , OR=1.873, CI 95% 1.171-2.995). Increase in bodyweight was not a determining factor for lower self-esteem in male adolescents ( $p= 0.570$ , OR=1.132, CI 95% 0.738-1.736). Sex did not determine an increase in the probability that an adolescent would present low self-esteem ( $p= 0.283$ , OR= 0.868, CI 95% 0.671-1.123).

### Physical activity outside school

Physical activity was practised outside school by 63.2% of male adolescents and 42.5% of female adolescents. Swimming was the sport most frequently practised by girls (57.5%), followed by weight-training (12.1%), jogging (8.9%), dance (6.8%) and other sports totalling

14.7% (volleyball, running, basketball, handball, functional training, wrestling and cycling). Among male adolescents, 36.8% reported swimming, followed by volleyball (23.8%), weight-training (14.9%) and other sports totalling 24.5% (running, basketball, handball, functional training, wrestling and cycling).

We observed that female adolescents who habitually practice PA outside school have 1.7 times higher probability of presenting normal weight than those who do not practice PA outside school (CI 95% 1.072-2.695). Among males no differences were observed in BMI related with PA outside school (OR= 0.723, CI 95% 0.450-1.162). Practising PA outside school did not affect the self-esteem of female ( $p= 0.621$ ) or male adolescents ( $p= 0.163$ ).

### Participation in physical education classes

16.3% of girls ( $n= 86$ ) and 10.7% of boys ( $n= 52$ ) reported that they did not participate in physical education classes in school. We observed that the self-esteem of boys who did not participate in physical education classes in school was significantly lower than that of girls who did not participate in physical education classes (RSS=  $24.50 \pm 3.31$  for boys; RSS=  $26.72 \pm 4.52$  for girls) ( $p= 0.003$ ).

Medium self-esteem was found in boys (RSS=  $28.57 \pm 4.75$ ) and girls (RSS=  $27.78 \pm 5.37$ ) who participated in physical education classes in school, however the mean value for

male adolescents was significantly higher than for females ( $p= 0.022$ ).

We observed that for boys, participating in physical education classes was a protection factor against low self-esteem ( $p= 0.000$ ; OR= 0.120, CI 95% 0.043-0.339), while the same was not the case for girls ( $p= 0.087$ ; OR=0.660, CI 95% 0.394-1.106).

The mean BMI value presented no differences between adolescents who did or did not participate in physical education classes in school (male  $p= 0.99$ ; female  $p= 0.879$ ).

### DISCUSSION

The object of this study was to analyse the impact of PA on the self-esteem and BMI of adolescents. We also studied the influence of BMI on the level of self-esteem.

In this research we found that female adolescents who practise PA have a lower probability of presenting low self-esteem than sedentary adolescents, and that PA also acted as a protection factor against weight gain. The findings of this study corroborated previous studies. In a longitudinal study in 197 non-Hispanic girls aged 9, 11 and 13 years, (Schmalz et al., 2007) observed that higher PA at the ages of 9 and 11 predicted greater self-esteem at 11 and 13, suggesting that PA is important for increasing self-esteem in adolescent girls, particularly younger girls with higher risk of becoming overweight. In a meta-analysis, (Liu et al., 2015) reported that PA is an effective intervention method for improving self-esteem in adolescents, noting the importance of practising exercise at school, as well as the need to increase PA among young people in order to promote physical and mental health. Obesity in childhood and adolescence is a predictor of health consequences in adults, independent of the weight of the adult individual (Watts et al., 2005); PA is one of the best solutions for fighting obesity in adolescence (Barlow et al., 2002).

In the present study, weight increase played a more important part in low self-esteem among female adolescents than males, corroborating the finding of (Altıntaş et al., 2014), who state that BMI is an excellent predictor of self-esteem

in female adolescents. This may be because girls are more worried about having a more slender figure; this pattern of beauty is often difficult to attain, which may affect the self-image of female adolescents (Thompson & Heinberg, 1999). Boys are also affected by the rigorous patterns of beauty stipulated by the media, however for them the requirement is to have stronger, more muscular bodies, so a higher BMC is less important for them than for girls (Pope Jr et al., 1997).

This investigation did not show that physically active male adolescents present better self-esteem than their sedentary peers, however participation in physical education classes in school determined an 88% lower probability of having low self-esteem than found in boys who did not participate in physical education classes, corroborating previous studies (Strong et al., 2005). This finding may be because participation in school sports programmes may have an immediate effect on self-image during adolescence, especially in collective sports such as football, handball and volleyball (Bluehardt et al., 1995) in which the adolescent can stand out from his class-mates and thus have a better self-concept and higher self-esteem. For girls, participation in physical education classes in school did not represent a determining factor for increasing their self-esteem, perhaps because the object of female adolescents when practising exercise is more focused on weight loss in order to attain a more slender figure, or else on health, so that it is important to be physically active but not necessarily in school surroundings.

In the present study, a higher percentage of male adolescents reported practising PA outside school than females, however the beneficial effects were observed in girls who practised PA out of school, as they have 1.7 times higher probability of presenting normal weight than girls who did not practise PA outside school. This shows that it is important to encourage extramural PA in female adolescents as a resource for controlling overweight in adolescence. In a review study, (Strong et al., 2005) indicated that school-age children should participate in at least 60 minutes of moderate or vigorous PA every day; the time may be

cumulative in school in physical education classes, intramural sports and before and after school programmes in order to raise their self-esteem and control bodyweight. Although it is not the only factor, sedentarism promotes weight gain and increases the probability that the adolescent will have low self-esteem. Excessive use of the computer, videogames and social networks are sedentary activities which are very common among adolescents and which must be discouraged so that they spend more time practising PA. The present study shows that both sexes can benefit from the practice of physical exercise, but that the approach needs to be different. In males, interventions should prioritise encouraging participation in physical education classes at school, while in females the focus should be on the practice of extramural physical activity. The results of the present study are important to support the creation of specific intervention programmes to supply the specific needs of each group.

One limitation of this study is that the design measured only the answers at the moment of enquiry, and no associations could be made over time. Another limitation is that self-esteem was not analysed according to the socio-economic level of the families. The expressive sample studied in this work was representative of the city of Fortaleza; however, it is not representative for Brazil, and studies should be carried out in other large population centres as the type of pressure affecting adolescents may differ.

### CONCLUSION

Game Participation in physical education classes in school is a protection factor against low self-esteem in male adolescents. In female adolescents, the practice of physical activity at school acts to prevent low self-esteem, as well as helping to control bodyweight increase.

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Nothing to declare.

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