

## Association between perceived discrimination and physical activity among adolescents

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**Abstract** *Perceived discrimination is a major producer of stress and social trauma and can have negative effects on the physical and mental health of those exposed to it. This study aims to analyze the direct and indirect association between perceived discrimination and physical activity, mediated by common mental disorders in adolescents. This is a cross-sectional study with 2,484 adolescents (aged 18 and 19 years old) from a cohort in São Luís, Maranhão. Structural equation models were used to verify the direct effect of perceived discrimination on physical activity (PA) and its indirect effect mediated by common mental disorders (CMD). The potential of sex to act as an effect-modifying variable was also tested. Discrimination was associated with higher levels of PA in women (SC - Standardized Coefficient direct =0.105, p-value=0.005), and indirectly associated with lower PA via CMD among men (SCindirect =-0.024, p-value=0.017) and women (SCindirect =-0.024, p-value=0.015). Our findings show the association between perceived discrimination and PA in this population of adolescents, attesting that its effects can alter health behaviors and that gender can modify the relation between these variables.*

**Key words** *Discrimination, Physical activity, Mental disorders, Adolescents*

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## Introduction

Discrimination is the distinction or exclusion of groups or individuals in relation to another based on their color or race, ethnicity, age, social condition, disease, disability, religion, gender, or sexual orientation<sup>1</sup>. Discrimination can occur in the daily life of individuals of all age groups, being able to reduce access to goods and opportunities in society<sup>2</sup>.

Perceived discrimination can negatively affect the physical and mental health of those exposed to it. It represents an important source of stress and a type of social trauma<sup>2,3</sup>. Discrimination can affect health in multiple ways. Among them, exposure to stress can lead to negative emotional states and psychological distress which negatively affect health. Moreover, coping with stress can precipitate unhealthy behaviors and habits, such as alcohol and tobacco use, insomnia, social isolation and withdrawal from social, collective and healthy activities, such as physical activity<sup>4</sup>.

The literature highlights mental suffering due to stress, associated with perceived discrimination, as part of the path which relates its exposure to health behaviors, such as the practice of physical activity<sup>5</sup>. However, studies analyzing the association between discrimination and physical activity use such outcome only for adults<sup>6-11</sup>. Adolescents, however, may suffer more from perceived discrimination since its health consequences can last for decades<sup>12</sup>. Moreover, the few studies that have shown an association of these variables<sup>7,9,13</sup> failed to use mediation analysis to assess the mental disorders which may stem from perceived discrimination.

Thus, understanding the possible relation between perceived discrimination and physical activity can emphasize that these factors and their consequences and association can harm the current and future health of individuals exposed to discriminatory situations. Thus, this study aimed to analyze the direct and indirect association of perceived discrimination and physical activity practice, mediated by common mental disorders in adolescents.

## Methods

This is a cross-sectional study, conducted from data of a birth cohort conducted in São Luís-MA, in 1997/1998, by the Universidade Federal do Maranhão. Data in this cohort was collected in three different phases of life: at birth, during

childhood (seven to nine years of age), and in adolescence (18 to 19 years)<sup>14</sup>. This study used only data from the third stage of the cohort.

The perinatal study began at birth and included a systematic sample per hospital (1/7 of total births) in 10 public and private maternity hospitals in São Luís in 1997/1998, resulting in a sample of 2,493 live births<sup>14</sup>. After birth, the first follow-up of this cohort occurred in 2005/2006, in which 673 school-age children aged from seven to nine years old returned for evaluation<sup>14</sup>.

The third stage of data collection began in January 2016, a follow-up of the initial cohort with individuals then aged 18 and 19 years (687 adolescents who participated at birth were included in this stage). To increase its sample and prevent greater losses, individuals who were born in São Luís-MA in 1997 and had not participated in the initial cohort were also included. The 1,828 new members were drawn from data from the Information System on Live Births and found in schools and universities, totaling 2,515 participants. For the analyses, those who were unable or failed to answer the question about perceived discrimination (n=31) were excluded, totaling 2,484 adolescents. Further details on the methods used in the cohort are available in previous studies<sup>14,15</sup>.

## Study variables

### Perceived discrimination (Exposure)

Perceived discrimination was assessed by a question with six answer options, adapted from a study by Lopes and Faerstein<sup>16</sup>: "Have you ever felt discriminated against in some place or by someone in the past year by your color or ethnicity (1), religion or cult (2), illness or physical disability (3), sexual orientation or preference (4), being a man or being a woman (5), or being rich or poor (6)". Possible answer options were yes, no, or I do not know. The variable was dichotomized (yes=1 or not=0), ignoring the category "I do not know". In the collection questionnaire, the term "social or economic condition" was replaced with "being rich or poor".

Initially, a construct was created with six perceived discrimination variables that failed to produce a good fit of the model since  $X^2$  showed a significant p-value ( $p < 0.001$ ), a 0.054 RMSEA with a confidence interval higher than 0.065, a 0.92 CFI, a 0.89 TFI, and a 0.092 MRSR. Moreover, the variables of perceived discrimination by religion, disease, and sexual orientation showed low factor loadings (0.442, 0.395, and 0.625, re-

spectively). Therefore, it was decided that packaging perceived discrimination variables could obtain the best fit of the model. This technique was used because preliminary estimates failed to converge when we included the six perceived discrimination variables.

These variables were then summed, resulting in a numerical variable with a value from zero to six. Some authors suggest this strategy to increase reliability, reduce idiosyncratic influences of individual items, simplify interpretation, and obtain the best fit of the model<sup>17</sup>.

### Physical activity (Outcome)

Physical activity (PA) was measured via the international physical activity questionnaire - short form, an instrument comprising seven open questions about physical activity frequency, duration, and intensity (walking, moderate or vigorous) at work, transportation, domestic activities, and leisure time<sup>18</sup>. Physical activity was measured in minutes/week by multiplying weekly frequency by the duration of each activity.

In this study, adolescents were classified as: (1) active (at least 150 minutes of moderate PA or 75 minutes of vigorous PA throughout the week or an equivalent combination of moderate and vigorous PA) and (0) insufficiently active (practicing less than 150 minutes of moderate PA or less than 75 minutes of vigorous PA throughout the week) according to the recommendation of the World Health Organization (WHO) for individuals aged 18 years<sup>19</sup>.

### Common Mental Disorders (Mediator)

Common mental disorders (CMD) were measured using the Self-Reporting Questionnaire (SRQ-20). It consists of a set of non-psychotic symptoms also present in surveys on stress symptoms, such as: difficulty concentrating, irritability, fatigue, drowsiness, forgetfulness, somatic complaints (tremors, headaches), difficulty making decisions, among others. It was developed in 1980 by the WHO<sup>20</sup> and validated in Brazil in 1986<sup>21</sup>, consisting of 20 questions which track psychiatric disorders, including four factors (depressive/anxious mood, somatic symptoms, decreased vital energy, and depressive thoughts). Questions can be answered as yes=1 or no=0, the sum of which becomes a numeric variable between zero and 20<sup>22</sup>.

### Covariates

This study as covariate the socioeconomic classification, based on the 2016 Brazilian Cri-

teria of Economic Classification (CEB), which classifies the market into socioeconomic classes based on the possession of goods, as its covariate. Each possessed good is assigned a score and each class is defined by the sum of that score, such that: A (R\$ 20,888), B1 (R\$ 9,254), B2 (R\$ 4,852), C1 (R\$ 2,705), C2 (R\$ 1,625), D-E (R\$ 768)<sup>23</sup>. Self-reported color/race - stratified into white, Brown or Black - was also used.

### Stratification

Adolescents' gender was considered as a modifying variable of effect in the analysis.

### Theoretical Model

To assess the association between perceived discrimination and physical activity, a theoretical model was constructed (Figure 1). Physical activity is a directly observed numerical variable represented by the rectangle. Perceived discrimination and CMD are directly observed numerical explanatory variables. CEB and color/race are directly observed ordinal categorical variables.

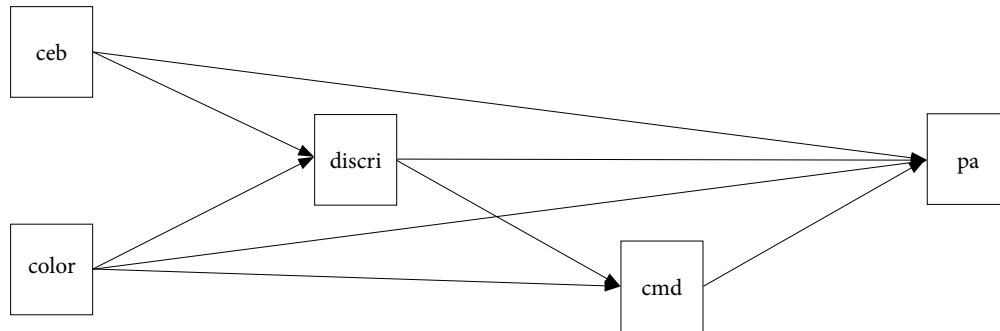
Direct and indirect effects models were estimated in the model. According to our hypothesis, perceived discrimination directly affects CMD and physical activity, CMD directly influences physical activity, perceived discrimination indirectly influences physical activity via CMD, and CEB and color/race can influence perceived discrimination, CMD, and physical activity.

### Statistical analysis

Descriptive analyses were performed for all variables to estimate absolute and relative frequencies and the Fisher's chi-square or exact test were employed for differences between proportions, mean, and standard deviation for the numerical variables and the student t-test was used for mean differences according to gender.

To analyze the direct and indirect effect of perceived discrimination on physical activity, the structural equation model was used to analyze the structural relations representing associations between variables. The proposed model was estimated by the Mplus 8 demo software (Inc., Los Angeles, United States), adopting a 5% significance level. The interaction between adolescents' gender and perceived discrimination was tested. As the interaction effect showed statistical significance, supporting the moderation hypothesis, separate models were tested for men and women.

The adjustment indices used to determine



**Figure 1.** Theoretical model of the association of perceived discrimination with physical activity.

Notes: CEB - socioeconomic status stratified according to the Brazilian Criteria of Economic Classification; Discri - perceived discrimination; CMD - Common Mental Disorders from the Self-Reporting Questionnaire (SRQ-20); PA - Physical activity from the International Physical Activity Questionnaire (IPAQ).

Source: Authors.

good fit were chi-square with  $p > 0.05$ , an upper limit of the 95% confidence interval, a mean quadratic approximation error (MRSEA) below 0.08, and a standardized root mean square residual (SRMR) below 0.05. Values higher than 0.95 were used for the comparative adjustment (CFI) and the Tucker Lewis indices (TFI)<sup>24</sup>. Robust weighted least squares (WLSMV) were used as an estimator.

Associations were assessed via standardized coefficients (SC) and p-values ( $\alpha = 0.05$ ). SC were interpreted according to Kline<sup>24</sup>, in which a SC of about 0.10 indicates a small effect; around 0.30, an average effect; and above 0.50, a strong effect. These coefficients, described as standard deviations, show how response variables impact explanatory ones<sup>25</sup>.

Adolescents were invited to participate in the research and those who agreed signed informed consent forms. This research meets the criteria of Resolutions no. 466/2012 and no. 510/2016 of the National Health Council and its complementaries and was approved by the Research Ethics Committee of the University Hospital - UFMA under opinion number 1,302,489.

## Results

We observed that 21.8% of men reported some type of perceived discrimination, 67.1% were

physically active, and 27.3% belonged to class C2, with a mean 5.6 CMD rate ( $\pm 3.4$ ), whereas 30.5% of women suffered some type of perceived discrimination, only 46.1% were physically active, and 26.3% belonged to class C2, with a mean 8.3 CMD rate ( $\pm 3.8$ ) (Table 1).

Table 2 shows the correlations between the variables used in the model. The highest correlations were between CMD, perceived discrimination, and PA.

We observed an association (via the standardized and non-standardized coefficients of the structural model) between perceived discrimination and higher levels of PA, adjusted by CEB and race/color among women (SCdirect=0.105,  $p = 0.005$ ), between perceived discrimination and CMD, adjusted by CEB and race/color, between men (SCdirect=0.236,  $p < 0.001$ ) and women (SCdirect=0.251,  $p < 0.001$ ), and between CMD and PA in men and women (SCdirect=-0.100,  $p = 0.012$  and SCdirect=-0.96,  $p = 0.011$  respectively) (Table 3). We also found that CEB affected physical activity in men (SCdirect=-0.094,  $p = 0.022$ ) (Figure 2).

The analysis of the standardized results of the direct, indirect, and total effect (sum of direct and indirect effects) of perceived discrimination on PA showed a direct, positive, and statistically significant association among women (SCdirect=0.105;  $p = 0.005$ ) and an indirect negative association among men (SCindirect=-0.024;

p=0.017) and women (SCindirect=-0.024; p=0.015). The total effect of perceived discrimination in CMD-mediated PA among women generated a 0.081 statistically significant standardized coefficient (p=0.025), whereas the to-

tal effect was insignificant among men (SCTotal=0.061; p=0.154) (Table 4).

In our final model for men, X<sup>2</sup> showed an insignificant p-value (p=0.296), a 0.009 RMSEA with a confidence interval higher than 0.084, a

**Table 1.** Descriptive characteristics of the sample of adolescents (n=2,484) from a birth cohort from São Luís, Maranhão, Brazil, 2016.

Variable	Total n (%)	Male n (%)	Female n (%)	p value**
Discrimination (n; %)				<0,001
0	1,829 (73.6)	919 (78.2)	910 (69.5)	
1	425 (17.1)	164 (14.0)	261 (19.9)	
2	157 (6.3)	68 (5.8)	89 (6.8)	
3	57 (2.3)	15 (1.3)	42 (3.2)	
4	11 (0.4)	6 (0.5)	5 (0.4)	
5*	5 (0.2)	3 (0.3)	2 (0.2)	
CMD (±standard deviation)	7.0±3.9	5.6±3.4	8.3±3.8	<0.001
Physical activity (n; %)				
Insufficiently active	1,095 (43.5)	393 (32.9)	702 (53.2)	
Physically active	1,420 (56.5)	803 (67.1)	617 (46.8)	<0.001
Economic classification (CEB) (n; %)				<0.001
A	94 (4.2)	48 (4.6)	46 (3.9)	
B1	156 (7.0)	77 (7.4)	79 (6.7)	
B2	410 (18.4)	210 (20.1)	200 (17.0)	
C1	519 (23.3)	258 (24.7)	261 (22.1)	
C2	597 (26.8)	287 (27.4)	310 (26.3)	
D-E	450 (20.2)	167 (16.0)	283 (24.0)	
Skin color/ethnicity				0.423
White	495 (19.8)	114 (18.8)	271 (20.7)	
Asian	416 (16.6)	771 (64.8)	818 (62.4)	
Black	1,589 (63.6)	195 (16.4)	221 (18.9)	

\*We found no discrimination by more than five types. \*\*Fisher's chi-square or exact test p-value for differences between proportions and student-t for differences between means.

Source: Authors.

**Table 2.** Correlation matrix of variables included in the hypothesis model. São Luís, Maranhão, Brazil, 2016.

Variables	Discrimination	CMD	PA	Skin color/ ethnicity	CEB
Discrimination	1.000				
CMD	0.255 (p-valor = 0.001)	1.000			
PA	0.0364 (p-valor = 0.088)	-0.1233 (p-valor = 0.001)	1.000		
Skin color/ ethnicity	0.0775 (p-valor = 0.001)	-0.0163 (p-valor = 0.446)	0.0164 (p-valor = 0.443)	1.000	
CEB	-0.0149 (p-valor = 0.485)	0.0213 (p-valor = 0.318)	0.0428 (p-valor = 0.045)	0.1707 (p-valor = 0.001)	1.000

Notes: PA - Physical activity; CEB - Brazil Economic Classification; CMD - Common Mental Disorders.

Source: Authors.

0.99 CFI, 0.98 TFI, and a 0.020 SRMR whereas, for women,  $X^2$  showed an insignificant p-value ( $p=0.220$ ), an 0.021 RMSEA with a confidence interval higher than 0.084, a 0.99 CFI, a 0.95 TFI, and a 0.019 SRMR, indicating good model fit.

## Discussion

Our results indicate that, unlike men, perceived discrimination among women was directly associated with higher PA levels, showing that gender modifies the relation between these two variables. We also found that perceived discrimination was associated with higher CMD outcomes associated with lower PA levels in both genders. Perceived discrimination was also indirectly associated to lower PA via CMD in both genders.

This study contains some limitations. Since this is a cross-sectional study, we should carefully analyze effect direction and causality. Moreover, the questionnaire used to assess perceived discrimination has only one question about each type of direct discrimination, ignoring unfair treatment that adolescents may have suffered. However, at the time of data collection and up to now, the literature lacks instruments validated for Brazil and this age group. Moreover, the instrument used to measure PA was a self-reported questionnaire that depends on individuals recalling information. Thus, adolescents may have had difficulties in accurately estimating the time spent in each modality. Still, the questionnaire we used is the most common to evaluate physical

activity among adolescents since it shows low cost, high reproducibility, and global coverage<sup>26</sup>.

The association between perceived discrimination and PA still shows controversial results. If, on the one hand, authors state that discrimination would cause stress that would be associated with lower adherence to healthy behaviors, such as physical activity<sup>4</sup>, on the other, studies suggest that the opposite is possible, especially among women<sup>7,9</sup>.

The reasons for the positive association between perceived discrimination and PA are still unclear but studies suggest that greater engagement in physical activity among discriminated women is a way of dealing with stress or other mental disorders due to discriminatory situations. Previous studies have indicated that the regular practice of physical activity is positively associated with well-being and negatively associated with stress, depression, and anxiety<sup>27-29</sup>. Moreover, although young people consider physical activity very important for health reasons, a higher percentage of them relate its importance to the maintenance of good form<sup>30</sup>. Therefore, this association may reflect that the women in our sample developed an adaptive and chartering strategy due to the stress they experienced in discrimination situations.

We found no direct association between perceived discrimination and PA among men, which may be due to discrimination resulting in negative health behaviors, such as alcohol consumption, illicit drug use, and risky sexual behavior<sup>31-33</sup>. These results may also be due to the

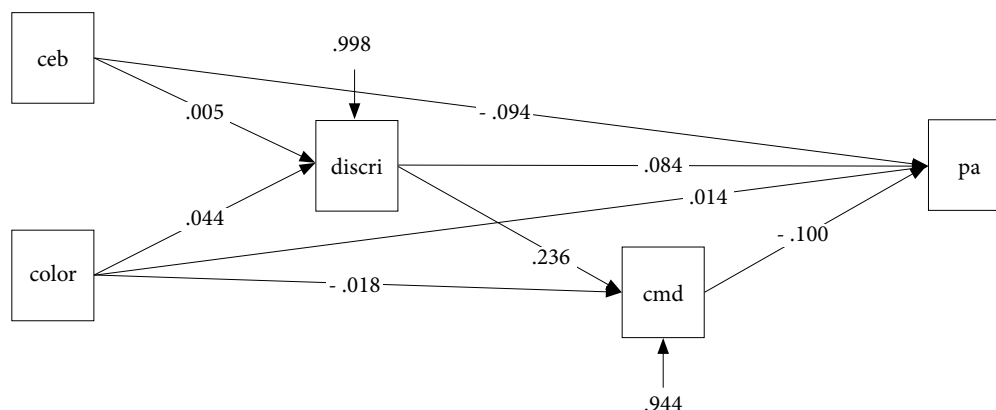
**Table 3.** Structural equation model standardized and non-standard coefficients.

Effects	Men			Women		
	Standard coefficients	Non-standard coefficients	p-value	Standard coefficients	Non-standard coefficients	p-value
Discrimination $\leftarrow$ CEB	0.005	0.003	0.866	0.059	0.035	0.051
Discrimination $\leftarrow$ color/ethnicity	0.044	0.053	0.154	0.118	0.155	<0.001
CMD $\leftarrow$ Discrimination	0.236	1.091	<0.001	0.251	1.168	<0.001
CMD $\leftarrow$ color/ethnicity	-0.018	-1.103	0.650	-0.045	-0.276	0.130
PA $\leftarrow$ Discrimination	0.084	0.117	0.053	0.105	0.129	0.005
PA $\leftarrow$ CMD	-0.100	-0.030	0.012	-0.096	-0.025	0.011
PA $\leftarrow$ CEB	-0.094	-0.070	0.022	-0.064	-0.047	0.086
PA $\leftarrow$ color/ethnicity	0.014	0.024	0.728	-0.019	-0.031	0.609

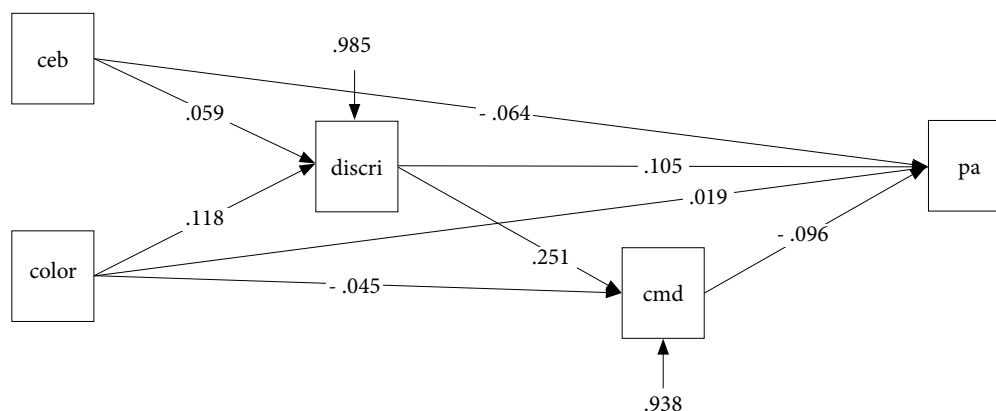
Notes: PA - Physical activity; CEB - Brazil Economic Classification; CMD - Common Mental Disorders.

Source: Authors.

## 2a. Men



## 2b. Women



**Figure 2.** Structural equation model of the effects of perceived discrimination on physical activity by gender.

Notes: CEB - socioeconomic status stratified according to the Brazilian Criteria of Economic Classification; Discri - perceived discrimination; CMD - Common Mental Disorders from the Self-Reporting Questionnaire (SRQ-20); PA - Physical activity from the International Physical Activity Questionnaire (IPAQ).

Source: Authors.

**Table 4.** Standardized direct, indirect, and total effect of the structural equation model using discrimination as a response variable.

Effects	Men			Women		
	Direct effect (p-value)	Indirect effect (p-value)	Total (p-value)	Direct effect (p-value)	Indirect effect (p-value)	Total (p-value)
Physical Activity ← Discrimination	0.084 (0.053)	-0.024 (0.017)	0.061 (0.154)	0.105 (0.005)	-0.024 (0.015)	0.081 (0.025)

Source: Authors.

very trajectory of physical activity among adolescents. A study<sup>34</sup> developed in England showed an overall decline in this practice among its par-

ticipants since they were aged seven years old onward. Only one group (19% of the boys) had a high level of moderate or vigorous physical ac-

tivity, which remained stable between seven and 15 years of age.

We also found an indirect association via CMD between perceived discrimination and lower PA in both genders, i.e., discriminated individuals who suffered from mental disorders practiced less PA. We expected this since mental disorders can negatively affect adolescents' physical health and changes in physical activity levels can affect mental health. A systematic review with a meta-analysis showed a significant association between sedentary behavior and increased psychological malaise (such as depression) and lower psychological well-being (such as life satisfaction and happiness) in children and adolescents<sup>35</sup>. If regularly performed, moderate physical exercise regulates oxidative stress, improving cellular antioxidant defense<sup>36</sup>.

Psychological inflexibility can also explain this indirect association, an effect defined as the difficulty of changing perceptions or making certain decisions, even when the environment evinces their advantages. This effect may be present in situations of suffering and in anxiety conditions, such as CMD<sup>37</sup>.

Thus, experienced psychological inflexibility can heighten perceived stressors and their effects on individuals' behaviors. The discrimination suffered, which would perhaps have failed to substantially change PA practice, may be a significant source of stress in people who are more vulnerable to CMD, leading to several possible effects, among them, PA reduction.

Despite the aforementioned limitations, the strength of this study is its use of structural equation modeling, a technique used to evaluate causative associations and the complex interrelations between multiple variables in epidemiological and public health studies. Its use is advantageous

since it discriminates direct effects into explanatory and response variables and better adjusts for confounding variables and mediation analysis<sup>24,38</sup>.

Another point we should mention is that this study is one of the first developed with adolescents, promoting the early identification that perceived discrimination may relate to changes in PA practice. Early identification is important because higher levels of PA in adolescence also relate to the higher practice in adulthood<sup>39</sup>. Practicing PA is associated with health benefits, including reduced risk of cardiovascular diseases, diabetes, various types of cancer, falls, dementia, and obesity in all age groups<sup>40,41</sup>. Moreover, discrimination negatively affects adolescents' mental health, well-being, and behavior<sup>42</sup>. Thus, the earlier it is identified, the fewer consequences it will have on their current and future life.

This study showed a direct and positive association between perceived discrimination and PA between women and an indirect association, mediated by CMD, between men and women, showing that the effects of this relation can differently affect the physical health of this age group depending on individuals' gender. Thus, our results indicate that perceived discrimination may be associated with the practice of physical activity among adolescents, affecting health behaviors in individuals who need to deal with social pressures and body changes affecting their physical and mental health. Although the positive association and causality of this effect are still unclear, perceived discrimination is an event that can bring several harms to health. Thus, we need programs to combat discrimination and identify and treat mental disorders among adolescents, policies which may contribute to increasing PA practice in this age group.



## Collaborations

C Martins Neto contributed to the design, analysis and interpretation of data, writing of the article and approval of the published version. SC Confortin, ABS Lima e LSN Mouzinho contributed to the interpretation of data, writing of the article and approval of the published version. BLCA Oliveira contributed to the design, interpretation of data, critical review of the article and approval of the published version.

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