



ORIGINAL ARTICLE

Is the association between sociodemographic variables and physical activity levels in adolescents mediated by social support and self-efficacy? ☆



Luanna A. Cheng^{a,b}, Gerfeson Mendonça^{a,b,*}, Joana M.S. Lucena^{a,b,c},
Cassiano R. Rech^d, José C. Farias Júnior^{a,b,e}

^a Universidade de Pernambuco (UPE)/Universidade Federal da Paraíba (UFPB), Programa de Pós-Graduação em Educação Física, João Pessoa, PB, Brazil

^b Grupo de Estudos e Pesquisas em Epidemiologia da Atividade Física (GEPEAF), João Pessoa, PB, Brazil

^c Universidade Federal do Tocantins (UFT), Palmas, TO, Brazil

^d Universidade Federal de Santa Catarina (UFSC), Departamento de Educação Física, Florianópolis, SC, Brazil

^e Universidade Federal da Paraíba (UFPB), Departamento de Educação Física, João Pessoa, PB, Brazil

Received 15 March 2018; accepted 24 July 2018

Available online 17 September 2018

KEYWORDS

Adolescence;
Motor activity;
Self-efficacy;
Social support;
Mediated effect

Abstract

Objective: Analyze whether the association between sociodemographic variables and physical activity levels is mediated by psychosocial factors.

Methods: This is a cross-sectional epidemiological study of public and private high school students in João Pessoa, Paraíba state, Brazil. A total of 2540 adolescents (57.0% female) were analyzed (16.4 ± 1.2 years). Physical activity was estimated using a questionnaire, self-efficacy, and parents' and friends' social support by scales, all previously validated.

Results: The association between sex and the physical activity level of adolescents was partially mediated by the social support of parents ($\beta = 0.79$; $p < 0.001$) and friends ($\beta = 2.96$; $p < 0.001$), and the association between age and physical activity level was partially mediated by parents' social support ($\beta = 0.78$; $p < 0.001$). The associations between sex and age and physical activity levels of adolescents were mediated by the social support of parents and friends.

☆ Please cite this article as: Cheng LA, Mendonça G, Lucena JM, Rech CR, Farias Júnior JC. Is the association between sociodemographic variables and physical activity levels in adolescents mediated by social support and self-efficacy?. J Pediatr (Rio J). 2020;96:46–52.

* Corresponding author.

E-mail: gerfeson.edf@hotmail.com (G. Mendonça).

PALAVRAS-CHAVE

Adolescência;
Atividade motora;
Autoeficácia;
Suporte social;
Efeito mediado

Conclusions: Differences in physical activity levels between adolescent females and males and between younger and older adolescents may be partially explained by differences in social support provided by parents and friends. Implementation strategies to increase the social support of parents and friends may help reduce the differences in physical activity levels between these subgroups of adolescents.

© 2018 Published by Elsevier Editora Ltda. on behalf of Sociedade Brasileira de Pediatria. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

A associação entre variáveis sociodemográficas e níveis de atividade física em adolescentes é mediada por apoio social e autoeficácia?

Resumo

Objetivo: Analisar se a associação entre variáveis sociodemográficas e níveis de atividade física é mediada por fatores psicossociais.

Métodos: Este é um estudo epidemiológico transversal com estudantes do ensino médio de escolas públicas e privadas de João Pessoa, Paraíba, Brasil. Foram analisados 2.540 adolescentes (57,0% do sexo feminino) (16,4 ± 1,2 anos). A atividade física foi estimada por meio de questionário, autoeficácia e apoio social dos pais e amigos através de escalas, todas previamente validadas.

Resultados: A associação entre sexo e o nível de atividade física dos adolescentes foi parcialmente mediada pelo apoio social dos pais ($\beta = 0,79$; $p < 0,001$) e dos amigos ($\beta = 2,96$; $p < 0,001$), e a associação entre idade e nível de atividade física foi parcialmente mediada pelo apoio social dos pais ($\beta = 0,78$; $p < 0,001$). A associação entre sexo e idade e níveis de atividade física dos adolescentes foi mediada pelo apoio social de pais e amigos.

Conclusões: As diferenças nos níveis de atividade física entre adolescentes do sexo feminino e masculino e entre adolescentes mais jovens e mais velhos podem ser parcialmente explicadas pelas diferenças no apoio social fornecido pelos pais e amigos. A implementação de estratégias para aumentar o apoio social de pais e amigos pode ajudar a reduzir as diferenças nos níveis de atividade física entre esses subgrupos de adolescentes.

© 2018 Publicado por Elsevier Editora Ltda. em nome de Sociedade Brasileira de Pediatria. Este é um artigo Open Access sob uma licença CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Physical activity is associated with a number of physical, social, and psychological benefits in adolescence,^{1,2} as well as having a positive impact on adolescent health and in adulthood.³ In this respect, it is recommended that adolescents engage in at least 60 min of moderate to vigorous physical activity per day.⁴ However, the proportion of adolescents that do not meet these recommendations is high,⁵ especially in the some subgroups, such as adolescent females, older adolescents, and those with lower socioeconomic status.⁵⁻⁷

Several arguments have been presented to explain the lower physical activity levels consistently reported for these subgroups, such as more encouragement and motivation for boys to engage in physical activity⁷ and safe physical environments better suited to physical activity in areas with higher socioeconomic conditions.^{8,9} Few studies have examined factors that may help understand why these subgroups are less physically active.^{6,7}

Social support and self-efficacy for physical activity are important constructs of theories and models that seek to explain physical activity behavior,¹⁰ which were identified as determinants of this behavior¹¹ and mediators of

the effects of interventions on physical activity^{12,13}; it is believed that some of the differences in physical activity levels between the sexes, ages, and socioeconomic conditions may be related to the differences in these psychosocial factors between the subgroups.

However, there are few studies with adolescents that have investigated whether psychosocial factors mediate the association between sociodemographic variables and physical activity level.^{6,7} Cocker et al.,⁶ in study with adolescents from developed countries, investigated differences between sexes or socioeconomic conditions and considered using only a single psychosocial factor as the mediator (self-efficacy). The study that simultaneously investigated psychosocial and environmental factors as mediators of these associations considered only the differences in physical activity levels by socioeconomic level.⁷

Identifying the factors that contribute to lower physical activity levels may help develop interventions with more specific actions, based on changes in psychosocial factors, in order to increase and maintain the physical activity levels of "subgroups considered at risk" (female and older adolescents, and those with lower socioeconomic status). The aim of the study was to analyze if the association between

sociodemographic variables and physical activity levels is mediated by psychosocial factors.

Methods

This is a cross-sectional epidemiological study that used data collected in project "Physical activity level and associated factors in high schools students in João Pessoa, Paraíba state, Brazil: an ecological approach." The study was approved by the Human Research Ethics Committee of the Federal University of Paraíba (0062/2009), and all adolescents <18 years old were authorized with written consent by their legal guardians; those aged >18 years gave their own consent to take part in the study.

In order to determine sample size, a physical activity prevalence of 50% was considered; 95% confidence interval; maximum tolerable error of three percentage points; design effect of two; and a 30% increase to compensate for possible losses and refusals, resulting in a sample of 2686 adolescents.

The sample was selected by a two-stage process. In the first, 30 schools were systematically selected and distributed proportionally by the number of students enrolled in each school (school size), type of school (public or private), and municipal district (North, South, East, West). In the second stage, 135 classes were randomly chosen and distributed proportionally by shift (day or night) and high school grade (1st, 2nd, or 3rd). Detailed information on the sampling process has been previously described.^{14,15}

Data collection took place between May and September of 2009 and was carried out by a previously trained team (40-h training course with monthly updating), composed of six physical education university students supervised by the head researcher, who participated in a pilot study carried out under conditions similar to those of the main survey.

A previously validated questionnaire was filled out by the adolescents during regular school hours, in accordance with instructions provided by the collection team. Questionnaires were filled out anonymously by the adolescents themselves, while in the classroom, according to instructions provided by one of the interviewers, while two other interviewers were available to answer any questions from the adolescents.

The following sociodemographic variables were used in the present study: sex (male or female); age (measured centesimally and arbitrarily categorized as 14–15 or 16–19 years) and economic class (determined according to the criterion of the Brazilian Association of Research Companies [ABEP],¹⁶ which considers the number of material goods, presence of full-time housekeepers, and the head of the household's schooling level, resulting in economic classes regrouped into A/B [upper class] vs. C/D/E [low-middle class]). The following psychosocial factors associated with physical activity were analyzed in this study: perceived self-efficacy and social support provided by parents and friends. The scales used measures parents' and friends' social support and self-efficacy for physical activity has been previously validated in adolescents from Northeast Brazil.¹⁵

The self-efficacy scale for engaging in physical activity contains ten items that considered the extent to which adolescents believe they are capable of engaging in

physical activity despite the presence of barriers (adverse conditions).¹⁵ All the items were anchored on a four-point Likert scale (strongly disagree = 1, slightly disagree = 2, slightly agree = 3, strongly agree = 4). Based on the sum of the values attributed to each response, self-efficacy scores ranging from 10 to 40 points were assigned.¹⁵

Parents' and friends' social support for physical activity was estimated on a ten-item scale, five items for each.¹⁵ Adolescents reported frequency (never = 1, seldom = 2, often = 3, always = 4) with which parents or friends offered some type of social support (encouragement, joint participation, watching, inviting, commenting, and transporting) for engaging in physical activity during a normal week.¹⁵ Based on the sum of the values attributed to each item, scores ranging from five to 20 points were awarded. Higher values for all construct scores indicated more levels for these variables.¹⁵

Physical activity was measured by a questionnaire previously validated in adolescents from Northeast Brazil.¹⁴ The adolescents reported the frequency (days/week) and duration (min/day) of physical activities performed for at least 10 min in the week preceding data collection. A list containing 24 moderate-to-vigorous activities and active commuting (walking or cycling) was used, with the possibility of adolescents adding one or two activities. The level of physical activity was determined by calculating the product of the duration of practice by the frequency of practice, resulting in a score of minutes per week.

Frequency distribution, mean, standard deviation, median, and 95% confidence interval were used for descriptive analysis of the data. Multiple linear regression was used to determine whether the association between sociodemographic variables (sex, age group, economic class) and physical activity level was mediated by psychosocial factors (self-efficacy and social support). All analyses were conducted using the statistical program Stata 13.0, and considered the cluster sampling design, using the "svy" function of this program. The significance level used was $p < 0.05$.

Initially, multiple linear regression models were used to determine whether sociodemographic variables (sex, age group, and economic class) were associated with the physical activity levels of adolescents. Identifying a significant association between the independent and dependent variables is a necessary condition to analyze mediation.¹⁷

To determine whether the association between sociodemographic variables and physical activity levels is mediated by psychosocial factors, the steps recommended by the literature were applied.^{17,18} Three multiple linear regression models were created, the adolescents' physical activity level being the dependent variable. In the first model, the independent variable (sex) was associated with the dependent variable (physical activity). In the second, the same independent variable and the possible mediating variable (self-efficacy) were associated with the dependent variable, and in the third, self-efficacy was associated with the variable sex. To assess the presence of mediation, the beta coefficient of the variable self-efficacy in the second model was multiplied by the beta coefficient of the variable sex in model 3. The significance level of this mediation coefficient was determined by the Sobel test.¹⁹

The Z-value of the Sobel test is determined based on the following mathematical procedure: $Z = a*b/\text{square root}(b^2*sa^2 + a^2*sb^2 + sa^2*sb^2)$. Where: a = non-standardized beta coefficient for the association between the mediating variable and the dependent variable; b = non-standardized beta coefficient for the association between the independent variable and the mediating variable; and sa^2 and sb^2 = standard errors of beta coefficients “ a ” and “ b ”, respectively. p -values <0.05 show that the psychosocial variable under analysis was a mediator of the association between the sociodemographic variable and physical activity level. This sequence of steps also was used to analyze the social support of parents and friends and the other sociodemographic variables (age group and economic class). All the models were adjusted to body mass index [BMI = body mass (kg)/height (m)²], and to the sociodemographic variables that were not being used, such as independent variables.

Results

Of the 2859 adolescents in the final sample (losses and refusals totaled 17.8% of the cases), 319 were excluded from data analyses, owing to incomplete information on the study variables. There were no statistically significant differences in sociodemographic variables, self-efficacy, social support provided by parents and friends psychosocial, and physical activity level between adolescents included and those excluded from analysis ($p > 0.05$). The complete data of 2540 adolescents were analyzed, 57.1% females, with a mean age of 16.4 years ($SD = 1.2$), 60.7% aged between 16 and 19 years, and 53.9% belonging to economic classes C/D/E. Mean physical activity time was 544.3 ± 701.5 min/week and psychosocial factors obtained 27.5 ± 6.6 , 9.8 ± 3.5 , and 12.2 ± 4.3 points for self-efficacy, and social support provided by parents and friends, respectively (Table 1).

A significant association between sex and age and activity level was identified. Thus, mediation was analyzed for these two variables. Tables 2–4 show the results of the association between sociodemographic factors and the physical activity of adolescents mediated by psychosocial factors.

The association between sex and physical activity level was partially mediated by the social support of parents ($\beta = 0.79$; $p < 0.001$) and friends ($\beta = 2.96$; $p < 0.001$), and the association between age and physical activity level was partially mediated by parental social support ($\beta = 0.78$; $p < 0.001$).

Discussion

The results of this study indicated that the association between the sex and age of adolescents and physical activity level was partially mediated by social support levels provided by parents and friends. These results suggest that differences in physical activity levels between adolescent subgroups (male vs. female; older vs. younger) may be partially explained by differences in perceived social support levels provided by parents and friends.

In this study, self-efficacy was not a mediator of the association between sociodemographic factors and physical activity levels in adolescents. However, Spence et al.⁷ observed that self-efficacy mediated the relationship

Table 1 Sociodemographic characteristics, nutritional status, physical activity level, self-efficacy, and social support of parents and friends in adolescents from João Pessoa, Paraíba, 2009.

Variables	%	<i>n</i>
<i>Sex</i>		
Male	42.9	1091
Female	57.1	1449
<i>Age group</i>		
14–15 years	39.3	1087
16–19 years	60.7	1685
<i>Economic class</i>		
A and B (upper class)	46.1	1132
C, D and E (low-middle class)	53.9	1323
	<i>M (SD)</i>	<i>Md</i>
Physical activity level (min/week)	544.3 (701.5)	301
Self-efficacy for physical activity (points)	27.5 (6.6)	27
Social support of parents for physical activity (points)	9.8 (3.5)	9
Social support of friends for physical activity (points)	12.2 (4.3)	12
BMI (kg/m ²)	20.9 (3.3)	20.4

M, mean; *SD*, standard deviation; *Md*, median; BMI, body mass index.

between sex and physical activity level, demonstrating that adolescents males had higher self-efficacy levels and were more physically active than their female counterparts. Cocker et al.⁶ showed that lower income adolescents exhibited less self-efficacy and were less physically active. No study was found that analyzed perceived self-efficacy as a mediator of the association between age and physical activity in adolescents.

Others research shows that self-efficacy is a mediator of the association between sociodemographic factors and physical activity levels in adolescents^{6,7}; however, the self-efficacy scale contained fewer items, most of which were related to psychological/emotional barriers (feeling tired, lack of motivation) and not physical or social barriers (distant locations, lack of company). Some of the perceived self-efficacy items may be associated with physical activity in certain domains and not others.²⁰ This reinforces the need for new studies using self-efficacy scales with emotional, physical, environmental, social, economic, and cultural barriers, and that the physical activity measure considers activities practiced in different domains, such as leisure, active transportation, or school environment (physical education class).

In cross-sectional^{6,20} and longitudinal²¹ studies, it was observed that self-efficacy is an important construct for the involvement and maintenance of physical activity levels in adolescents. An experimental study²² conducted

Table 2 Mediated effects of self-efficacy for the association between sociodemographic variables and physical activity in adolescents from João Pessoa, Paraíba, 2009.

	Sociodemographic variables	β	Standard error	p-value
<i>Sex – self-efficacy^a</i>				
Model 1	Sex – physical activity	449.57	28.95	<0.001
Model 2	Sex – physical activity	444.76	28.68	<0.001
	Self-efficacy – physical activity	13.72	2.10	<0.000
Model 3	Sex – self-efficacy	0.35	0.29	<0.234
Mediated effect	β sex in Model 2 \times β self-efficacy in Model 3	4.81	4.10	0.241
<i>Age – self-efficacy^b</i>				
Model 1	Age – physical activity	78.08	29.21	0.008
Model 2	Age – physical activity	78.62	28.93	0.007
	Self-efficacy – physical activity	13.72	2.10	<0.001
Model 3	Age – self-efficacy	–0.04	0.29	0.893
Mediated effect	β age in Model 2 \times β self-efficacy in Model 3	–0.54	4.07	0.893
<i>Economic class – self-efficacy^c</i>				
Model 1	Economic class – physical activity	33.12	28.54	0.246

^a Adjusted for age, economic class, and body mass index.

^b Adjusted for sex, economic class, and body mass index.

^c Adjusted for sex, age, and body mass index. Reference: sex – 0 = female and age group – 0 = 16–19 years.

Table 3 Mediated effects of social support of parents for the association between sociodemographic variables and physical activity of adolescents from João Pessoa, Paraíba, 2009.

	Sociodemographic variables	β	Standard error	p-value
<i>Sex – social support of parents^a</i>				
Model 1	Sex – physical activity	456.88	27.98	<0.001
Model 2	Sex – physical activity	419.77	27.34	<0.001
	Social support of parents – physical activity	47.08	3.94	<0.001
Model 3	Sex – social support of parents	0.79	0.14	<0.001
Mediated effect	β sex in Model 2 \times β social support of parents in Model 3	37.11	7.44	<0.001
<i>Age – social support of parents^b</i>				
Model 1	Age – physical activity	72.27	28.22	0.010
Model 2	Age – physical activity	35.58	27.56	0.197
	Social support of parents – physical activity	47.08	3.94	<0.001
Model 3	Age – social support of parents	0.78	0.14	<0.001
Mediated effect	β age in Model 2 \times β Social support of parents in Model 3	36.72	7.48	<0.001
<i>Economic class – social support of parents^c</i>				
Model 1	Economic class – physical activity	36.93	27.60	0.181

^a Adjusted for age, economic class, and body mass index.

^b Adjusted for sex, economic class, and body mass index.

^c Adjusted for sex, age, and body mass index. Reference: sex – 0 = female and age group – 0 = 16–19 years.

in twenty-four high schools (twelve in the experimental group) demonstrated that interventions to improve perceived self-efficacy resulted in a direct increase in physical activity levels. Other studies^{20,22} have also demonstrated that adolescents with greater perceived self-efficacy are less influenced by the presence of barriers.

In the present study, the association between sex and physical activity level was partially mediated by the social support of parents and friends. This demonstrates that adolescent males reported receiving more social support from parents and friends than their female peers. These findings would partially explain the higher physical activity levels normally observed in males.^{23–25} However,

considering the bidirectional relationship between physical activity and social support, it can be assumed that more physically active adolescents receive more social support because they are more physically active, as identified in a comprehensive systematic review.²⁵

Using an ethnographic approach, Gonçalves et al.²⁴ observed lower physical activity levels in adolescent females who received less social support from their family. In this study, the authors also found that different physical activity levels between the sexes could be related to how adolescents were raised. Adolescent males are generally freer to meet friends and travel further from home. On the other hand, adolescent females are restricted to locations and

Table 4 Mediated effects of social support of friends for the association between sociodemographic variables and physical activity in adolescents from João Pessoa, Paraíba, 2009.

	Sociodemographic variables	β	Standard error	p-value
<i>Sex – social support of friends^a</i>				
Model 1	Sex – physical activity	456.88	27.98	<0.001
Model 2	Sex – physical activity	311.63	28.25	<0.001
	Social support of friends – physical activity	49.12	3.17	<0.001
Model 3	Sex – social support of friends	2.96	0.17	<0.001
Mediated effect	β sex in Model 2 \times β social support of friends in Model 3	145.3	12.74	<0.001
<i>Age – social support of friends^b</i>				
Model 1	Age – physical activity	72.27	28.22	0.010
Model 2	Age – physical activity	56.82	26.88	0.035
	Social support of friends – physical activity	49.12	3.17	<0.001
Model 3	Age – social support of friends	0.32	0.17	0.075
Mediated effect	β age in Model 2 \times β social support of friends in Model 3	15.7	8.72	0.076
<i>Economic class – social support of friends^c</i>				
Model 1	Economic class – physical activity	36.93	27.60	0.181

^a Adjusted for age, economic class, and body mass index.

^b Adjusted for sex, economic class, and body mass index.

^c Adjusted for sex, age, and body mass index. Reference: sex – 0 = female and age group – 0 = 16–19 years.

activities nearer to their homes.²⁴ Kirby et al.²³ observed that older adolescents and boys had greater freedom to practice physical activity on the street and in parks without the presence of an adult. This was not the case for girls, whose activities were restricted by their parents.²³ These findings demonstrate that, given their upbringing, adolescent females, in addition to receiving less direct social support, have fewer interactions with other social groups.

In general, the first phase of adolescence is a period in which individuals distance themselves from the family environment, identifying more with their peers and sharing their same behavior.²⁶ In this study, more support from friends to engage in physical activity was observed in boys. This may be due to the fact that most physical activities engaged in by these adolescents were collective in nature, such as team sports.^{26,27} By contrast, females show greater preference for sedentary (watching television, talking on the telephone) or social activities (school-related tasks).^{28,29} Furthermore, they report more barriers and/or less interest in physical activities.²⁹

The present study showed that the association between age and physical activity levels in adolescents was partially mediated by parental social support, only in males (data not shown). Thus, lower levels of physical activities in older adolescents would be partially attributed to less parental social support. Some types of parental social support have more influence on older adolescents, such as joint participation, transport, or commenting on their activity.³⁰ Moreover, parents often encourage older adolescents to become involved in social commitments such as work, internships, and college entrance preparatory courses.²⁰ This increase in social commitments may result in adolescents spending less time with their parents.

This study has some limitations: a causal relationship cannot be established between the variables analyzed because the study is cross-sectional. However, it is important to consider that the associations were in the direction

expected (positive) and have been previously observed in longitudinal studies.^{23,28} Another limitation was using the combined measure of parental social support instead of one measure for the father and another for the mother. Although both sources of social support are important for adolescent involvement in physical activities, the effect of social support provided by the father and the mother may be different, such as the father giving more encouragement to his son, through joint participation, whereas the mother might support her daughter by taking her to the physical activity venue.^{23,24,28} Another limitation was assessing the physical activity by questionnaire, and future studies should include objective measures of physical activity.

The study also has strengths: it used a representative sample of high school students and had sufficient statistical power to test the hypotheses put forward; there was a low percentage of losses and refusals (17.8%), and no significant difference between adolescents included and excluded from the analyses; it considered important confounding factors in the regression models; and it used an instrument that exhibited satisfactory validity levels, internal consistency, and reproducibility that was applied by a previously trained team.

It can be concluded that the association between sex and age and the physical activity levels of adolescents was partially mediated by the social support provided by parents and friends. In this respect, the lower physical activity levels of adolescent females and older individuals may be partially due to the lower social support provided to these subgroups by parents and friends. Intervention strategies to enhance the levels of physical activity in the subgroups at risk (females and older adolescents) should include measures to increase the social support provided by parents and friends, whether through more encouragement, logistical resources, joint participation, or watching adolescents take part in physical activities.

Conflicts of interest

The authors declare no conflicts of interest.

Acknowledgements

To the Coordination for the Improvement of Higher Education (CAPES) for the research scholarship. To the Department of Education of Paraíba, and administrators, professors, and students of the schools that took part in the study. To the physical education interns who made up the data collection team.

References

- Singh A, Uijtdeuwilgen L, Twisk JW, Mechelen W, Chinapaw M. Physical activity and performance at school a systematic review of the literature including a methodological quality assessment. *Arch Pediatr Adolesc Med.* 2012;166:49–55.
- Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman RK, Gutin B, et al. Evidence based physical activity for school-age youth. *J Pediatr.* 2005;146:732–7.
- Telama R, Yang X, Leskinen E, Kankaanpää A, Hirvensalo M, Tammelin T, et al. Tracking of physical activity from early childhood through youth into adulthood. *Med Sci Sports Exerc.* 2014;46:955–62.
- World Health Organization. Global recommendations on physical activity for health. Geneva, Switzerland: World Health Organization; 2010. Available from: http://www.who.int/dietphysicalactivity/factsheet_recommendations/en/ [accessed 02.01.18].
- Sallis JF, Bull F, Guthold R, Heath GW, Inoue S, Kelly P, et al. Progress in physical activity over the Olympic quadrennium. *Lancet.* 2016;388:1325–36.
- Cocker K, Artero EG, Henauw S, Dietrich S, Gottrand F. Can differences in physical activity by socio-economic status in European adolescents be explained by differences in psychosocial correlates? A mediation analysis within the HELENA (Healthy Lifestyle in Europe by Nutrition in Adolescence) study. *Public Health Nutr.* 2012;15:2100–9.
- Spence JC, Blanchard CM, Ciark M, Piotnikoff RC, Storey KE, McCargar L. The role of self-efficacy in explaining gender differences in physical activity among adolescents: a multilevel analysis. *J Phys Act Health.* 2010;7:176–83.
- Mendonça G, Florindo AA, Rech CR, Freitas DK, Farias Júnior JC. Perceived neighborhood environmental characteristics and different types of physical activity among Brazilian adolescents. *J Sports Sci.* 2018;36:1068–75.
- Sallis JF, Cerin E, Conway TL, Adams MA, Frank LD, Pratt M, et al. Physical activity in relation to urban environments in 14 cities worldwide: a cross-sectional study. *Lancet.* 2016;387:2207–17.
- Bandura A. Health promotion by social cognitive means. *Health Educ Behav.* 2004;31:143–64.
- Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJ, Martin BW. Correlates of physical activity: why are some people physically active and others not? *Lancet.* 2012;380:258–71.
- Lubans DR, Foster C, Biddle SJH. A review of mediators of behavior in interventions to promote physical activity among children and adolescents. *Prev Med.* 2008;47:463–70.
- van Stralen M, Yildirim M, te Velde SJ, van Mechelen W, Chinapaw M. What works in school-based energy balance behaviour interventions and what does not? A systematic review of mediating mechanism. *Int J Obes.* 2011;35:1251–65.
- Farias Júnior JC, Lopes AS, Mota J, Santos MP, Ribeiro JC, Hallal PC. Validity and reproducibility of a physical activity questionnaire for adolescents: adapting the Self-Administered Physical Activity Checklist. *Rev Bras Epidemiol.* 2012;15:198–210.
- Farias Júnior JC, Lopes AS, Reis RS, Nascimento JV, Borgatto AF, Hallal PC. Development and validation of a questionnaire measuring factors associated with physical activity in adolescents. *Rev Bras Saude Matern Infant.* 2011;11:301–12.
- ABEP – Brazilian Association of Research Companies. Brazil Economic Classification Criterion; 2009. Available from: <http://www.abep.org/new/codigosConduas.aspx> [accessed 26.11.09].
- Rucker DD, Preacher KJ, Tormala ZL, Petty RE. Mediation analysis in social psychology: current practices and new recommendations. *Soc Personal Psychol Compass.* 2011;5:359–71.
- MacKinnon DP, Fairchild AJ, Fritz MS. Mediation analysis. *Annu Rev Psychol.* 2007;58:593–614.
- Sobel ME. Asymptotic confidence intervals for indirect effects in structural models. *Sociol Methodol.* 1982:3.
- Allison KR, John JM, Dwyer JJM, Makin S. Self-efficacy and participation in vigorous physical activity by high school students. *Health Educ Behav.* 1999;26:12–24.
- Dishman RK, Saunders RP, Motl RW, Dowda M, Pate RR. Self-efficacy moderates the relation between declines in physical activity and perceived social support in high school girls. *J Pediatr Psychol.* 2009;34:441–51.
- Dishman RK, Motl RW, Saunders R, Felton G, Ward DS, Dowda M, et al. Self-efficacy partially mediates the effect of a school-based physical-activity intervention among adolescent girls. *Prev Med.* 2004;38:628–36.
- Kirby J, Levin KA, Inchley J. Parental and peer influences on physical activity among Scottish adolescents: a longitudinal study. *J Phys Act Health.* 2011;8:785–93.
- Gonçalves H, Hallal PC, Amorim TC, Araújo CL, Menezes AM. Socio-cultural factors and level of physical activity in early adolescence. *Rev Panam Salud Publica.* 2007;22:246–53.
- Mendonça G, Cheng LA, Melo EN, Farias Junior JC. Physical activity and social support in adolescents: a systematic review. *Health Educ Res.* 2014;30:822–39.
- Seabra AF, Mendonça DM, Thomis MA, Anjos LA, Maia JA. Biological and socio-cultural determinants of physical activity in adolescents. *Cad Saude Publica.* 2008;24:721–36.
- Mendonça G, Cheng LA, Farias Júnior JC. Practice of physical activity patterns in adolescents in a city of Northeastern Brazil. *Cien Saude Colet.* 2018;23:2443–51.
- Bauer KW, Laska MN, Fulkerson JA, Neumark-Sztainer D. Longitudinal and secular trends in parental encouragement for healthful eating, physical activity, and dieting throughout the adolescent years. *J Adolesc Health.* 2011;49:306–11.
- Standiford A. The secret struggle of the active girl: a qualitative synthesis of interpersonal factors that influence physical activity in adolescent girls. *Health Care Women Int.* 2013;34:860–77.
- Duncan SC, Duncan TE, Strycker LA. Sources and types of social support in youth physical activity. *Health Psychol.* 2005;24:3–10.