Prevalence and factors associated with stages of behavior change for physical activity in adolescents: a systematic review

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Review article

Background: **To analyze prevalence and factors associated with stages of behavior change for physical activity in adolescents.**

Data sources: **A search was performed in SciELO, PubMed, PsycINFO, SPORTDiscus and LILACS. The search terms were "behavior change" OR "stages of change" OR "stages of readiness" OR "readiness to change" OR "transtheoretical model" OR "process to change" OR "decisional balance", and "motor activity" OR "physical activity" OR "physical exercise" and "adolescent" OR "students". After the eligibility criteria, 18 articles were selected.**

Results: **The highest prevalence of adolescents in the precontemplation, contemplation, and preparation stages was found in the Germany, South Korea, and Iran while there were more adolescents in the action and maintenance in South Korea and Brazil. The evidence of association indicated that females are more likely to be in precontemplation, contemplation and preparation. The evidence was inconclusive for age (in relation to the precontemplation, contemplation, action and maintenance stages), economic status (all stages), shift of study (when stratified by gender) and body composition (all stages). No association was found with parental level of education.**

Conclusion: **The findings can help to guide interventions and further research on the topic of behavior changes for physical activity in adolescents.**

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Key words: **adolescent;**
behavior;
motor activity;
students;
transtheoretical model

Introduction

The high prevalence of adolescents with sedentary behavior has prompted initiatives to promote the adoption and maintenance of regular physical activity.[1] Given that an individual's cognitive and behavioral processes interfere with their intention to engage in physical activity, the stages of behavior change for physical activity (SBC/PA) model was postulated.[2] The SBC/PA categorizes individuals according to a five-stage hierarchical model ranging from "least healthy" to "healthiest".

The precontemplation stage implies that individuals are not physically active and are unwilling to change their behaviors in the following six months; individuals in the contemplation and preparation stage are not physically active, but intend to change their behaviors, respectively, in the following six months and 30 days; the action and maintenance stage means that individuals have been physically active, for less than six months and for more than six months, respectively.[2]

Individual factors potentially associated with SBC/PA, such as sex, age, level of education, economic status, study shift and physical fitness, have been studied.[3] Review articles on SBC/PA in adolescents are lacking.[3,4] A review conducted by Dumith et al[3] indicated that older female individuals with a lower educational background and inadequate levels of physical fitness were more likely to be in risk behavior stages (precontemplation, contemplation, and preparation). The fact that a study population comprises only adults limit the planning of specific interventions for adolescents with risk behaviors, since those two age groups differ in psychological, physical, and social aspects.[5]

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In reviewing the literature on the prevalence and factors associated with SBC/PA in adolescents, we expect to assist in: 1) identifying the production of scientific knowledge on the subject; 2) understanding socio-cultural and methodological aspects that interfere with variation in these prevalences; 3) targeting specific interventions for different countries and regions; 4) understanding the influence of sociodemographic characteristics and physical fitness on the willingness to perform physical activities; 5) building evidence to identify individuals more exposed to risk behavior for physical inactivity to prioritize interventions.

This study seeks to answer the following questions: "How the prevalence of SBC/PA is presented in several studies and what factors may explain these prevalences? Adolescents with individual factors are more susceptible to risk behavior stages?" We aimed to find variations in the prevalence of SBC/PA due to the diversity of methodological aspects (study location, type of sample, physical activity recommendation used), and that evidence demonstrating that adolescent females, with advanced age, with parents of low schooling, low income, students of the night shift and inadequate levels of physical fitness are at risk behaviors stages.

The aim of this study was to analyze the studies of prevalence of SBC/PA and the evidence of association between the SBC/PA and sociodemographic factors (sex, age, parental level of education, economic status, study shift) and components of health-related physical fitness (body composition, muscle resistance/strength, flexibility, and aerobic fitness) in adolescents.

Methods

A systematic search was performed in five scientific databases (PubMed, SciELO, PsycINFO, LILACS, and SPORTDiscus). These databases were chosen based on the following reasons: 1) open access; 2) number of publications and number of indexed journals; 3) publications focusing on behavior and physical activity. The authors elaborated three blocks of descriptors: Block 1 contains descriptors for the dependent variable ("behavior change", "stages of change", "stages of readiness", "readiness to change", "transtheoretical model", "process to change", "decisional balance"); Block 2 for the type of behavior ("motor activity", "physical activity", "physical exercise"); and Block 3 for population ("adolescent", "students"). These combinations were synthesized using the Boolean operator "OR" within each block, and "AND" among blocks. No database automatic filter was used. The search process was concluded in October 2014, which was considered the final period of observation for all databases.

Criteria of inclusion

The criteria of inclusion were: 1) adolescent's population (age 10-19 years or a mean age within that range) according to the World Health Organization;[6] 2) articles with a cross-sectional or longitudinal design; 3) articles published in Portuguese, Spanish and English.

Criteria of exclusion

The exclusion criteria were: 1) studies that did not rely on the transtheoretical model for physical activity; 2) theses and dissertations; 3) articles of review, intervention, validation and/or reproducibility; 4) studies with specific populations (acute or chronic disease, physical or intellectual disability).

Procedures

The authors of the current work used the method of systematic review in pairs of reviewers. First, article titles and abstracts were reviewed, duplicate articles were identified, and articles were excluded according to the exclusion criteria. Subsequently, the full-text articles were examined and included if they met the criteria. The references of the included articles were also examined; however, no study from the list was deemed eligible for inclusion. If no consensus was reached between pairs, a third reviewer was requested to settle the dispute. The Fig. shows a flow diagram of article search, selection and exclusion.

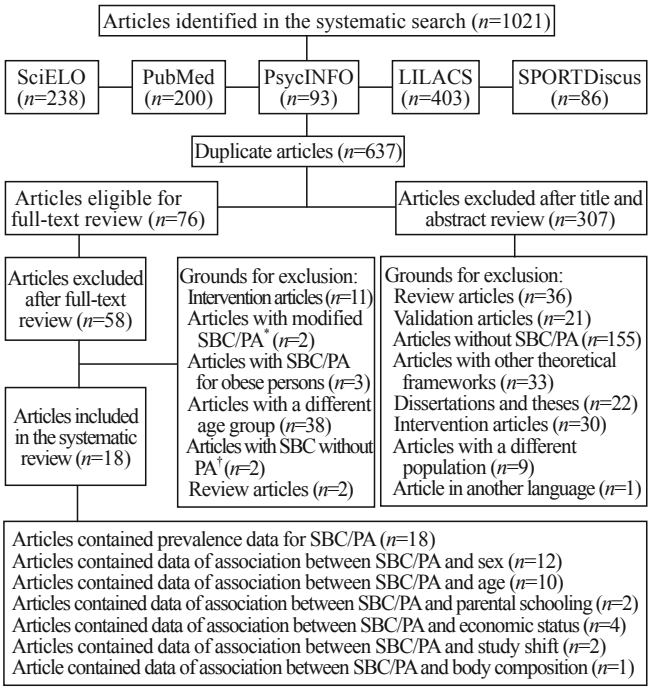

Fig. Study flow diagram for article search, seletion, and exclusion.*: one more stage, "relapse", was added; †: the SBC model was used in the study, but to assess another risk behavior. SBC/PA: stages of behavior change for physical activity.

The articles reviewed in the present study contained the following potential correlates of the SBC/PA: sociodemographic factors (sex, age, parental level of education, economic status, and study shift) and health-related physical fitness (HRPF) components (body composition, muscle resistance/strength, flexibility, and aerobic fitness). However, to broaden the search and prevent the exclusion of potentially relevant studies, no search terms were used for the sociodemographic variables and HRPF components; the selection of

Table 1. Studies on the prevalence of SBC/PA in adolescents

Author, year	Location	Sample			Adopted recommendation for PA	Prevalence SBC/PA (%)					
		n	Age	Sampling			PC	C	P	A	M
Frenn et al, 2003[20]	Not provided	221	11-14	Convenience	20 min, 3 times/wk (vigorous)+30 min, most d (moderate) (NR)	Total	4.0	8.0	9.0	26.0	53.0
						F	No stratification				
						M					
Kim, 2004[8]	Seul, South Korea (northern areas)	671	13-18	Random	30 min, 3 times/wk (ACSM, 1990)[21]	Total	17.5	16.6	20.4	28.3	17.2
						F	24.7	28.1	20.5	20.3	6.4
						M	10.3	5.1	20.3	36.3	28.0
Berry et al, 2005[22]	Not provided	327	15-17	Convenience	15-60 min, 3-5 times/wk (ACSM, 1978)[23]	Total	1.9	6.1	23.4	16.4	51.8
						F	No stratification				
						M					
De Bourdeaudhuij et al, 2005[9]	Flemish Community, Belgium	5931	12-17	Random, representative	Not provided	Total	11.5	16.0	13.8	8.3	50.4
						F	13.2	20.2	17.1	8.8	40.7
						M	8.8	9.3	8.6	7.6	65.7
Frenn et al, 2005[24]	Not provided	127	$\bar{X}$=12.75	Convenience	Not provided	Total	11.9	4.4	8.2	29.1	46.2
						F	No stratification				
						M					
Reis et al, 2005[10]	Brazil (city not provided)	488	14-17	Convenience	30 min, ≥5 times/wk (moderate)+ 20 min, 3 times/wk (vigorous) (NR)	Total	5.5	22.3	14.5	17.8	39.8
						F	7.1	25.2	20.0	18.6	29.0
						M	4.2	20.1	10.4	17.3	47.8
Souza et al, 2005[11]	Recife, Brazil	2271	15-17	Random, stratified, representative	Not provided	Total	5.4	20.7	35.4	11.4	26.9
						F	7.0	26.1	36.9	10.3	19.6
						M	3.4	14.3	33.7	12.7	35.9
Brucksch et al, 2008[18]	Bremen, Germany	1251	16-19	Random	60 min, ≥5 times/wk (Prochaska et al, 2001)[25]	Total	29.8	22.0	10.7	3.4	33.2
						F	30.0	26.9	11.7	4.5	26.9
						M	29.5	19.1	9.7	2.3	39.3
Sas-Nowosielski, 2007[17]	Katowice, Poland	1251	16-19	Not provided	30 min, ≥3 times/wk (NR)	Total	7.5	11.3	43.2	13.1	24.7
						F	7.9	12.5	46.8	13.3	19.3
						M	6.9	9.2	36.5	12.6	34.7
Driskell et al, 2008[26]	United States (22 states)	1116	$\bar{X}$=15	Not provided	60 min, 5-7 times/wk (NR)	Total					
						$\bar{X}$=10.1	10.4	14.9	32.0	8.6	34.1
						$\bar{X}$=12.3	14.7	12.2	16.2	13.8	43.2
						$\bar{X}$=15.8	26.0	21.1	15.9	8.5	28.5
						F	No stratification				
						M					
Silva et al, 2010[12]	Simão Dias, Brazil	281	15-20	Random, stratified, representative	Not provided	Total	6.7	13.5	45.6	10.7	23.5
						F		74.1		25.9	
						M		52.3		47.7	
Viana et al, 2010[13]	Florianópolis, Brazil	400	14-18	Random, representative	Not provided	Total	9.8	8.2	14.5	13.4	54.2
						F	13.3	10.2	18.9	15.3	42.0
						M	6.4	5.8	7.0	11.1	69.4
Hu et al, 2011[27]	Mexico City, Mexico	693	$\bar{X}$=19.5	Convenience	20-60 min, 3-5 times/wk (Marcus et al, 1992)[2]	Total	2.5	11.6	22.8	26.6	36.6
						F	No stratification				
						M					
Silva et al, 2011[19]	Brazil (SC and MG)	1065	14-17	Random, representative	60 min/d (Cavill et al, 2001)[28]	Total					
						SC	2.3	9.0	32.8	14.0	41.9
						MG	3.9	18.1	38.1	12.9	26.9
						F	No stratification				
						M					
Oliveira et al, 2012[14]	Recife, Brazil	4207	14-19	Cluster, representative	Not provided	Total	9.5	21.2	21.8	16.4	31.1
						F	12.2	24.9	24.3	14.7	23.9
						M	5.5	15.8	17.9	18.9	41.9
Pelegrini et al, 2013[15]	Florianópolis, Brazil	1108	14-18	Cluster, representative	Not provided	Total	5.1	18.8	29.5	11.2	35.4
						F	6.4	24.7	30.3	11.5	27.1
						M	3.0	9.8	28.4	10.8	48.1
Sanainasab et al, 2013[16]	Khorramabad, Iran	1551	12-14	Random, representative	300 min/wk (NR)	Total	5.5	26.0	45.8	18.8	3.8
						F	7.4	31.3	46.1	14.1	1.1
						M	4.4	22.5	45.7	21.9	5.5
Burns et al, 2014[29]	Republic of Ireland (nine countries)	871	12-18	Convenience	30 min, 5 times/wk (NR)	Total	4.0	22.0	10.0	14.0	50.0
						F	No stratification				
						M					

SBC/PA: stage of behavior change for physical activity; PA: physical activity; PC: precontemplation; C: contemplation; P: preparation; A: action; M: maintenance; NR: no references; $\bar{X}$: mean; SC: Santa Catarina state; MG: Minas Gerais state; ACSM: American College of Sports Medicine; F: female; M: male.

Table 2. Studies of SBC/PA and correlates in adolescents

Associated variables	Author	Association results with SBC/PA				
		PC	C	P	A	M
Sex	Kim[8]	Higher prevalence of girls	Higher prevalence of girls	No difference	Higher prevalence of boys	Higher prevalence of boys
	De Bourdeaudhuij et al[9]	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of girls	No association	Higher prevalence of boys
	Reis et al[10]*	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of girls	No association	Higher prevalence of boys
	Souza et al[11]	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of boys	Higher prevalence of boys
	Bucksch et al[18]	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of boys	Higher prevalence of boys
	Sas-Nowosielski et al[17]*	No association	No association	Higher prevalence of girls	No association	Higher prevalence of boys
	Silva et al[12]	Higher odds (OR=1.37) for girls to be in inactive stages (PC, C and P)			Higher odds for boys	
	Viana et al[13]	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of boys
	Silva et al[19]	SC: higher likelihood (PR=1.25) of girls at inactive stages (PC, C and P) MG: higher likelihood (PR=1.53) of girls at inactive stages (PC, C and P)			SC: higher likelihood for boys MG: higher likelihood for boys	
	Oliveira et al[14]	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of boys	Higher prevalence of boys
	Pelegrini et al[15]	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of boys
	Sanainasab et al[16]	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of girls	Higher prevalence of boys	Higher prevalence of boys
Age	Kim[8]	Higher prevalence of older individuals (16-19 y)	Higher prevalence of older individuals (16-19 y)	No association	Higher prevalence of younger (13-15 y) than older individuals (16-19 y)	Higher prevalence of younger (13-15 y) than older individuals (16-19 y)
	De Bourdeaudhuij et al[9]	Higher prevalence of older (17-18 y) over younger individuals (12-16 y)	Higher prevalence of older (17-18 y) than younger individuals (12-16 y)	Higher prevalence of older (17-18 y) than younger individuals (12-16 y)	Higher prevalence of younger (12-13 y) than older individuals (14-18 y)	Higher prevalence of younger (12-13 y) than older individuals (14-18 y)
	Souza et al[11]	Relapse in SBC/PA with advancing age (negative correlation)				
	Silva et al[12]	No association	No association	No association	No association	No association
	Viana et al[13]	M: no association F: no association	M: no association F: no association	M: no association F: no association	M: no association F: no association	M: no association F: no association
	Silva et al[19]		SC: no association MG: no association		SC: no association MG: no association	
	Oliveira et al[14]	M: no association F: no association	M: higher likelihood for older individuals (17-18 y) F: no association	M: no association F: no association	M: no association F: no association	M: higher likelihood for younger individuals (14-16 y) F: no association
	Pelegrini et al[15]	M: no association F: no association	M: no association F: higher odds (OR=1.90) for older individuals (17-18 y) at C than at M	M: lower odds (OR=0.53) for 16-y-old individuals at P than at M F: no association	M: lower odds (OR=0.35) for older individuals (17-18 y) at A than at M F: no association	M: higher odds for younger individuals (<16 y). F: higher odds for younger individuals
	Sanainasab et al[16]	Higher prevalence of individuals aged 13 y over 12 or 14 y	Higher prevalence of older (14 y) than younger individuals (12 and 13 y)	No association	Higher prevalence of younger (12 y) than older individuals (13 and 14 y)	Higher prevalence of younger (12 y) over older individuals (13 and 14 y)
Parental level of education	Silva et al[12]	No association	No association	No association	No association	No association
	Oliveira et al[14]	M: no association F: no association	M: no association F: no association	M: no association F: no association	M: no association F: no association	M: no association F: no association
Economic status	Souza et al[11]	Advancing SBC/PA with increasing economic status (positive correlation)				
	Silva et al[12]	Higher likelihood (PR=1.41) for lower income individuals			Higher likelihood for higher income individuals	
	Silva et al[19]	SC: no association MG: no association			SC: no association MG: no association	
Study shift	Oliveira et al[14]	M: no association F: no association	M: no association F: no association	M: no association F: no association	M: no association F: no association	M: no association F: no association
	Viana et al[13]	M: higher likelihood to daytime students F: no association	M: no association F: no association	M: higher likelihood to daytime students F: no association	M: higher likelihood to daytime students F: no association	M: higher likelihood to nightly students. F: no association
Body composition	Silva et al[19]	SC: higher likelihood (PR=1.39) of underweight individuals (BMI) than individuals with normal weight (PC, C, P) No association with ∑CF MG: no association to nutritional status (BMI) Higher likelihood (PR=1.23) of individuals with excess body fat (∑CF) than individuals with normal body fat			SC: higher likelihood of individuals with normal weight (BMI) than underweight individuals No association with ∑CF MG: no association to nutritional status (BMI) Higher likelihood of individuals with normal body fat (∑CF) than individuals with excess body fat	

*: studies not included in the evidence summary. SBC/PA: stages of behavior change for physical activity; PC: precontemplation; C: contemplation; P: preparation; A: action; M: maintenance; BMI: body mass index; ∑CF: summation of cutaneous folds; SC: Santa Catarina state; MG: Minas Gerais state; OR: odds ratio; PR: prevalence ratio; F: female; M: male.

studies containing those variables was done by hand search. A summary of evidence of the association studies was prepared according to Sallis et al[7] for each SBC/PA. Agreement between results was estimated by the proportion between the number of studies indicating the direction of the association and the total number of studies reviewed. This procedure is used in reviews concerning physical activity and enables the assessment of agreement between findings.[7]

Results

In total, 1021 studies were identified in the systematic search. The duplicate articles (n=637) were excluded, which resulted in 384 studies for title and abstract review. In this process, 76 articles were selected for full-text reading; after content analysis, 18 articles were included in the present review. All included studies contained prevalence data for SBC/PA, with some studies presenting prevalence data discriminated by sex (n=11).[8-18]

Of the studies that examined associations between SBC/PA and sociodemographic variables, twelve with sex,[9-18] ten with age,[8,9,11-16,19] two with parental level of education,[12,14] four with economic status[11,12,16] and two with study shift.[13,14] Regarding the association between the SBC/PA and HRPF, one study[19] analyzed only one of the components of HRPF (body composition). No other study reviewed assessed associations with the other HRPF components (muscle strength/resistance, flexibility, and aerobic fitness).

The characteristics of the studies assessing the prevalence of SBC/PA in adolescents are depicted in Table 1. The studies were published between 2003 and 2014. Seven of them were carried out in South American countries,[10-15,19] three failed to mention the study location,[20,22,24] two were conducted in North America,[26,27] two in Asia,[8,16] and four in European countries.[9,17,18,29] All included studies (n=18) were cross-sectional. Total prevalence rates for SBC/PA varied: from 1.9%[22] to 29.8%[18] for precontemplation; 4.4%[24] to 26.0%[16] for contemplation; 8.2%[24] to 45.8%[16] for preparation; 8.3%[9] to 29.1%[24] for action, and 3.8%[16] to 54.2%[13] for maintenance. Studies assessing the association between SBC/PA and sociodemographic factors and/or body composition are listed in Table 2.

In the summary of evidence for the sociodemographic variables (Supplemental Table), studies with convenience sampling and those that not providing this methodological information were not included. The studies on the association between SBC/PA and sex showed girls were more likely to be in the precontemplation, contemplation, and preparation stages. The literature reports that the association between SBC/PA and age is discrepant. Some studies indicated that older adolescents were more likely to be in risk behavior stages while others showed no association. When stratified by sex, the studies showed that younger male adolescents were more likely to be in the maintenance stage. By contrast, the studies that analyzed the association between SBC/PA and parental level of education indicated no association.

The literature was inconclusive with respect to the association between SBC/PA and economic status, since individuals of lower economic status were in stages of risk behavior in some studies while others found no association. One study found higher prevalence of boys of the night shift in the maintenance stage.[13] Regarding the evidence for HRPF, the studies were inconclusive when analyzing the association of body composition and all SBC/PA, since both underweight and overweight were associated with risk behavior stages (Supplemental Table).

Discussion

Since the 1980s, the SBC model has been used for interventions on health-related risk behaviors-initially aimed at tobacco smoking.[30] Concerning physical activity, the first study to propose the use of the model was published around one decade later.[2] Since then, the number of publications with adult studies that investigated the correlates of SBC/PA greatly increased, especially from the year 2000 onwards.[3] It is believed that studies involving adolescents were carried out later (in the period 2003-2005) because this age group is relatively free from chronic diseases; and thus, understanding the risk factors for such diseases (e.g., insufficient physical activity) was not considered as a priority of this age group.[31] However, as the prevalence of physically inactive adolescents increased and early preventive actions in health were promoted, scientific interest in changing this behavior also increased.[32]

Studies have revealed a greater concentration of research in South America. Increased research funding in South America may be an explanation for this finding.[33] The increase in research in South America is the beginning to develop the promotion of health and physical activity in this population. [34]

About 40% of included studies were conducted in Brazil. The fact that the prevalence of overweight among adolescents have quadrupled from 1975 to 2009 could justify the increase of epidemiological studies on physical activity, since changes in this behavior would promote reduction of public health costs and reduce the leading cause of deaths from chronic diseases in the long term.[34,35] There has been an increasing interest of Brazilian researchers in assessing individuals at school

age, unlike what was found in various international surveys that were not included in this review for evaluating university population (mean age >19 years). In Brazil, access to schools for adolescents aged 15-19 years is 87.7% (regardless of economic level); therefore, school is an important place for monitoring the health of students.[36]

When discussing the variation in prevalences for each SBC/PA association, the identification of study location, type of sampling and physical activity recommendation influence the outcome.[4] The lowest prevalences in the precontemplation (1.9%), contemplation (4.4%) and preparation stages (8.2%) were found in studies with convenience sampling.[22,24] The selection bias present in convenience sampling may have distorted the estimated prevalences (selecting more active individuals), and caution should be taken when extrapolating those data.

In contrast, the highest prevalences in the precontemplation (29.8%), contemplation (26.0%) and preparation stages (45.8%) were found in studies that classified those who performed at least 300 minutes per week of physical activity as very active.[16,18] These data are worrisome, since epidemiological evidence of young individuals indicated that the effects of physical activity on health are due to the regular practice of minimum 60 minutes on five days a week.[37] Although this recommendation has been indicated, some studies included in the review used earlier recommendations that were less rigid,[10,17,27] which makes classification of stages discrepant across studies.

The lowest prevalence in the action stage was found in a study conducted in Belgium (8.3%); however, the prevalence of individuals in the maintenance stage was 50.4% in this study.[9] This high prevalence of adolescents in the maintenance stage was due to actions that encouraged social support and increased self-efficacy that were developed in Belgium.[4,30] The lowest prevalence of individuals in the maintenance stage (3.8%) was found in adolescents from Iran.[16] Cultural aspects of the country could account for these higher rates. For example, the heavy demands placed on adolescents for academic performance, the lack of safe and easily accessible venues for the practice of physical activity, poor social support, low self-esteem, lack of information on physical activity.[38]

Studies with higher prevalence in action (29.1%) and maintenance stages (54.2%) did not indicate recommendations of physical activity patterns.[13,24] The lack of methodological information from the studies limits this discussion. Many of these studies did not present the recommendation of physical activity used.[4] We emphasize the importance of the presentation of physical activity recommendation used in future research to contribute to further analysis on the variation of these prevalences.

According to the analysis of SBC/PA correlates, females were more likely to be in the precontemplation (100% agreement between studies), contemplation (100% agreement) and preparation (90% agreement) stages while males were more prevalent in the action and maintenance stages (72% and 100% agreement, respectively). The literature stresses that females are less engaged in physical activity than males due to sociocultural factors, since they are directed to home-making and family care.[38]

There was inconclusive evidence for the association between SBC/PA and age in studies with overall data for the precontemplation (57% agreement between studies), contemplation (57% agreement), action (42% agreement) and maintenance (57% agreement) stages. The inconsistency in the action stage indicates that few studies support either a positive or negative association and more studies are warranted.[7] The studies with data stratified by sex that assessed the association of age with the SBC/PA only found an association among males for the maintenance stage, with younger individuals (<16 years old) more likely to be in that stage. Of note, only 30% of the studies performed this type of analysis, which was insufficient to provide stronger evidence.

The literature is inconclusive with respect to the association between SBC/PA and economic status (50% agreement).[11,12,19] One possible explanation is that the three studies that assessed SBC/PA versus economic status were developed in distinct regions of Brazil, a continent-sized country with a variety of lifestyles and regional inequalities that influence the living conditions of the population.[39] No association was found between SBC/PA and economic status in the study by Silva et al conducted in the Brazilian Southeast and South.[19] Those regions are the richest in the country,[39] as opposed to the Northeast, where the studies of Souza and Duarte,[11] and Silva et al[12] found increasing economic status with the progress through the SBC/PA. Further studies are required to confirm these findings because all the three studies were conducted in Brazil.

Studies that analyzed the relationship between SBC/PA and study shift presented contradictory data when stratified by gender (50% agreement). It is noteworthy that surveys were conducted in areas with significant cultural and social differences[39,40] which can influence the characterization of students from different shifts.

The studies assessing the association between SBC/PA and body composition[19] yielded inconclusive results (50% agreement), since one study found that underweight individuals were more likely to be in inactive stages while another showed overweight/obese individuals to be more likely to be in inactive stages. Body composition seems to interfere with the willingness to engage in physical activity. Underweight

individuals may have fatigue and malaise as a result of impaired growth and metabolic alterations.[41] Excess adiposity can limit the performance of certain exercises and impact one's self-esteem and motivation to practice.[42] The fact that only two studies analyzing the relationship between SBC/PA and body composition does not indicate that such evidence is conclusive.

One limitation of the present review is the fact that no instrument was used to calculate the methodological quality score of the studies, because of the lack of robust instruments with specific criteria to evaluate cross-sectional studies. But aspects of methodological quality were pointed out in the present review (sampling procedure and recommendation of physical activity).

One noteworthy strength of this review is that it fills a gap in the scientific literature, which offers no review of prevalence and correlates of SBC/PA in adolescents. The results of the current review identified methodological aspects of the studies that could have influenced the study outcomes. In addition, this review encompassed the entire age range of adolescence (10-19 years). The summary of evidence listed the recommendations of studies given the inconclusive results, or possibilities of further studies of aspects that are still unclear. The current study did not establish a timeframe for the search, which could suggest publication bias depending on the period of the studies retrieved. Five databases were searched-one in the field of psychology (PsycINFO), three international (PubMED, SciELO and SPORTDiscus), and another from Latin America (LILACS)-which allows for an overview of the body of research on this subject.

Conclusions

The highest prevalence rates of risk behavior (precontemplation, contemplation, and preparation) were found in the United States, South Korea, and Iran, while the highest rates of preventive behavior (action and maintenance) were found in South Korea and Brazil. Female adolescents were more likely to be in risk behavior stages (precontemplation, contemplation and preparation), while males were more prevalent in preventive health behavior stages (action and maintenance). The studies analyzing the age variable from overall data presented inconclusive evidence for the precontemplation, contemplation, action, and maintenance stages; however the studies with sex stratification only found an association for males in the maintenance stage (greater prevalence of younger individuals). The variables including economic status, study shift and body composition yielded inconclusive results of association across the SBC/PA because of the lack of studies.

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References

1 World Health Organization. Global recommendations on physical activity for health. Geneva: World Health Organization, 2010.
2 Marcus BH, Rossi JS, Selby VC, Niaura RS, Abrams DB. The stages and processes of exercise adoption and maintenance in a worksite sample. Health Psychol 1992;11:386-395.
3 Dumith SC, Domingues MR, Gigante DP. Stages of change toward physical activity: a review of literature. Rev Bras Cineantropom Desempenho Hum 2008;10:301-307.
4 Garber CE, Allsworth JE, Marcus BH, Hesser J, Lapane KL. Correlates of the stages of change for physical activity in a population survey. Am J Public Health 2008;98:897-904.
5 Kann L, Kinchen S, Shanklin SL, Flint KH, Hawkins J, Harris WA, et al. Youth risk behavior surveillance-United States, 2013. Morb Mortal Wkly Rep Surveill Summ 2014;63:1.
6 Young people's health-a challenge for society. Report of a WHO Study Group on young people and "Health for All by the Year 2000". World Health Organ Tech Rep Ser 1986;731:1-117.
7 Sallis JF, Prochaska JJ, Taylor WC. A review of correlates of physical activity of children and adolescents. Med Sci Sports Exerc 2000;32;963-975.
8 Kim Y. Korean adolescents' exercise behavior and its relationship with psychological variables based on stages of change model. J Adolesc Health 2004;34:523-530.
9 De Bourdeaudhuij I, Philippaerts R, Crombez G, Matton L, Wjindaele K, Balduck AL, et al. Stages of change for physical activity in a community sample of adolescents. Health Educ Res 2005;20:357-366.
10 Reis RS, Petroski EL. Application of the social cognitive theory to predict stages of change in exercise for Brazilian adolescents. Rev Bras Cineantropom Desempenho Hum 2005;7:62-68.
11 Souza GS, Duarte MFS. Behavior change stages related to physical activity in adolescents. Rev Bras Med Esporte 2005;11:104-108. [In Portuguese]
12 Silva DA, Smith-Menezes A, Almeida-Gomes M, de Sousa TF. Stages of behavioral change regardind physical activity in students from a Brazilian town. Rev Salud Publica (Bogota) 2010;12:623-634. [In Portuguese]

13 Viana MS, Andrade A. Stages of change in physical exercise behavior among adolescents. Rev Bras Cineantropom Desempenho Hum 2010;12:367-374. [In Portuguese]
14 Oliveira NKR, Barros MVG, Reis RS, Tassitano RM, Tenório MCM, Bezerra J, et al. Stages of change for physical activity among adolescents. Motriz Rev Educ Fis 2012;18:42-54. [In Portuguese]
15 Pelegrini A, Silva DAS, Corseuil HX, Silva JMFL, Pestroski EL. Stages of change in physical activity-related behavior in adolescentes from a Brazilian state capital. Motriz Rev Educ Fis 2013;19:770-775.
16 Sanainasab H, Saffari M, Nazeri M, Zarchi AK, Cardinal BJ. Descriptive analysis of Iranian adolescents' stages of change for physical activity behavior. Nurs Health Sci 2013;15:280-285.
17 Sas-Nowosielski K. Leisure-time physical activity of adolescentes within the framework of the transtheoretical model. Stu Phys Cult Tourism 2007;14:67-76.
18 Bucksch J, Finne E, Kolip P. The transtheoretical model in the context of physical activity in a school-based sample of German adolescents. Eur J Sport Sci 2008;8:403-412.
19 Silva DA, Pelegrini A, Grigollo LR, da Silva AF, Petroski EL. Differences and similarities in stages of behavioral change related to physical activity in adolescentes from two regions of Brazil. Rev Paul Pediatr 2011;29:193-201.
20 Frenn M, Malin S. Diet and exercise in low-income culturally diverse middle school students. Public Health Nurs 2003;20:361-368.
21 American College of Sports Medicine. The recommended quantity and quality of exercise for developing and maintaining cardio-respiratory and muscular fitness in healthy adults. Med Sci Sports Exerc 1990;22:265-274.
22 Berry T, Naylor PJ, Wharf-Higgins J. Stages of change in adolescents: an examination of self-efficacy, decisional balance, and reasons for relapse. J Adolesc Health 2005;37:452-459.
23 American College of Sports Medicine. The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness in healthy adults. Med Sci Sports Exerc 1978;10:7-10.
24 Frenn M, Malin S, Villarruel AM, Slaikeu K, Freeman J, Nee E. Determinants of physical activity and low-fat diet among low income African American and Hispanic middle school students. Public Health Nurs 2005;22:89-97.
25 Prochaska JJ, Sallis JF, Long B. A physical activity screening measure for use with adolescents in primary care. Arch Pediatr Adolesc Med 2001;155:554-559.
26 Driskell MM, Dyment S, Mauriello L, Castle P, Sherman K. Relationships among multiple behaviors for childhood and adolescent obesity prevention. Prev Med 2008;46:209-215.
27 Hu D, Taylor T, Blow J, Cooper TV. Multiple health behaviors: patterns and correlates of diet and exercise in a Hispanic college sample. Eat Behav 2011;12:296-301.
28 Cavill N, Biddle S, Sallis JF. Health enhancing physical activity for young people: statement of the United Kingdom expert consensus conference. Ped Exerc Sci 2001;13:12-25.
29 Burns C, Murphy JJ, MacDonncha C. Year in school and physical activity stage of change as discriminators of variation in the physical activity correlate profile of adolescent females. J Phys Act Health 2014;11:721-728.
30 Prochaska JO, DiClemente CC. Stages and processes of self-change in smoking: toward an integrative model of change. J Consulting Clin Psychol 1983;51:390-395.
31 World Health Organization. Noncommunicable diseases country profiles 2011. Scand J Soc Med 2011;14:7-14.
32 Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U, et al. Global physical activity levels: surveillance progress, pitfalls, and prospects. Lancet 2012;380:247-257.
33 Catanzaro M, Miranda G, Palmer L, Bajak A. South American science: big players. Nature 2014;510:204-206.
34 Hallal PC, Parra DC, Azevedo MR, Pratt M, Brownson RC. Research on physical activity and health: where is Latin America? J Phys Act Health 2010;7 Suppl 2:S129-S130.
35 Brazilian Institute of Geography and Statistics (IBGE). Research on family budgets-POF 2008-2009. Expenses, income and living conditions. Rio de Janeiro: IBGE, 2010.
36 Brazilian Institute of Geography and Statistics (IBGE). National School Health Survey. Rio de Janeiro: IBGE, 2012.
37 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;146:732-737.
38 Seabra AF, Mendonça DM, Thomis MA, Anjos LA, Maia JA. Biological and socio-cultural determinants of physical activity in adolescents. Cad Saude Publica 2008;24:721-736. [In Portuguese]
39 Brazilian Institute of Geography and Statistics (IBGE). National accounts. Regional accounts of Brazil 2011. Rio de Janeiro: IBGE, 2013.
40 Sousa SZ, Oliveira RP. Evening high school: democratization and diversity. Educ Rev 2008;31:53-72.
41 Sawaya AL. Malnutrition: long-term consequences and nutritional recovery effects. Estud Av 2006;20:147-158. [In Portuguese]
42 Anton SD, Perri MG, Riley JR 3rd. Discrepancy between actual and ideal images; Impact on eating and exercise behaviors. Eat Behav 2000;1:153-160.

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