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Correlates of physical activity of children and adolescents: A systematic review of reviews

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Abstract

Objective: The aim of this study was to identify promoting and inhibiting correlates associated with the physical activity (PA) of children and adolescents (aged 3–18). The intention was to demonstrate the complexity of correlates of PA and to determine possible influencing factors.

Design: A systematic review of reviews.

Methods: Systematic database research was carried out in Medline, Cochrane Library, EMBASE, PsycInfo, Springer Link and Thieme Connect. Inclusion criteria were that the study: (a) was classified as a systematic review with or without meta-analysis; (b) was published between 2000 and 2009; (c) dealt with children and adolescents aged 3–18; (d) had as its dependent variable any measure of overall PA; and (e) reviewed associations between quantitatively measured variables and PA. The internal validity of the systematic reviews thus identified was evaluated using a validated quality instrument.

Results: Nine systematic reviews without meta-analysis and one systematic review with meta-analysis were selected. Altogether 16 correlates were identified which were consistently associated with PA of children and/or adolescents: sex, age, ethnicity, parental education, family income, socioeconomic status, perceived competence, self-efficacy, goal orientation/motivation, perceived barriers, participation in community sports, parental support, support from significant others, access to sport/recreational facilities und time outdoors.

Conclusions: Although the findings of the reviews covered are to some extent heterogeneous, it is possible to identify consistent correlates of PA in children and adolescents. The results show that PA is a complex and multi-dimensional behaviour determined by numerous biological, psychological, sociocultural and environmental factors.

Keywords

adolescents, children, correlates, physical activity, systematic review

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Introduction

Physical activity (PA) is essential to the healthy development of children and adolescents, and helps to prevent chronic disorders in later life. Promoting it is a top public health priority throughout the world.[1, 2] Young people with a high level of PA are less prone to cardiovascular risk factors such as high blood pressure, excess weight, smoking and type 2 diabetes.[2–4] Furthermore, PA promotes cognitive abilities and mental health, the greatest effects having been found in relation to self-confidence and depression.[3, 5]

The PA guidelines of the United States Department of Health and Human Services (USDHHS)[6] for children and adolescents, which include 60 minutes or more of PA daily, are not fulfilled in most countries.[2, 7] A wide variety of interventions to promote the participation of children and adolescents in PA have been developed and evaluated. The majority of these studies produced only modest effects.[4, 8, 9] A possible reason is the insufficient knowledge of factors closely related to the activity behaviour of children and adolescents.[5, 10] An important prerequisite for the planning and development of effective interventions is a comprehensive knowledge of key variables affecting involvement in PA.[11, 12] The identification of correlates is therefore highly relevant to public health.[11, 13]

The aim of this systematic review is to identify promoting and inhibiting correlates associated with the PA of children and adolescents (aged 3–18). The intention is to demonstrate the complexity of correlates of PA and to determine possible influencing factors.

Several reviews have been conducted but an integration of findings regarding the wide range of correlates of PA of children and adolescents is missing. Furthermore, various reviews on correlates of PA represent different studies. A systematic review of reviews was conducted to integrate findings on correlates of PA and to give a comprehensive synthesis of literature.

Methods

This paper is based on a systematic review on correlates of PA in childhood and adolescence. The following electronic literature databases were consulted: Medline, Cochrane Library, EMBASE, PsycInfo, Springer Link and Thieme Connect. In order to discover further relevant publications, a manual search was carried out among the references in the identified publications.

The search strategy involved the following keyword combinations and their German translations: activity, physical activity, motor activity, physical fitness, exercise, sport, correlates, determinants, mediators, moderators, facilitators, barriers, motivation, influence, children, adolescents, youth, young people, preschool, teenage, review, systematic review, meta-analysis. Two independent reviewers (ES, SL) screened and selected the articles. This step-by-step analysis was carried out separately by each reviewer; where they differed in their findings, the inclusion or exclusion of the article concerned was discussed until agreement was reached.[14, 15]

In view of the fact that a considerable quantity of evidence has been produced on the topic of correlates of PA in young people, the search was restricted to systematic reviews with or without meta-analysis in the English or German language published between January 2000 and December 2009. Inclusion criteria were: (a) subjects were in the age range 3–18; (b) the dependent variable was any measure of overall PA; and (c) articles reviewed associations between quantitatively measured variables and PA. Exclusion criteria were: (a) exclusively qualitative studies; (b) investigation on the physiological and medical effects of PA; and (c) specific target populations; for example, people with chronic disorders.

The internal validity of the identified systematic reviews was evaluated by two independent reviewers. The quality evaluation was performed on the basis of the standardized instrument of the Ludwig Boltzmann Institute of Health Technology Assessment (LBI-HTA),[15] which was developed along the lines of the US Preventive Service Task Force[16] and the National Health Service (NHS) Centre for Reviews and Dissemination.[17] It was supplemented by two further items for the assessment of the quality of reviews according to Barnes and Baro[18] and Oxman et al.[19] Every item is more specifically detailed by means of different elements that enable the assess of the study quality in detail.[20] Every review was analysed for how far it fulfilled the quality items. The associated quality item was regarded as not or only partly fulfilled if single elements were not or insufficiently answered. The study quality can be divided into three grades:[16]

1. Good: nearly every quality item is answered satisfactorily.
2. Moderate: single quality items are not answered satisfactorily, but there is no critical methodological problem.
3. Insufficient: a critical methodological problem exists or cannot be excluded.

Results

The systematic database research scored 2,214 hits. After a review of the full-text publications, nine systematic reviews without meta-analysis[21–29] and one systematic review with meta-analysis[30] were included in the study. The manual search found no additional reviews (Figure 1).

The quality of eight of the 10 reviews was assessed as being 'moderate'.[21–24, 26, 28–30] The quality of two reviews was assessed as 'good'.[25, 27] On the basis of the evaluation of their methodological quality, all 10 identified reviews were included (Table 1).

The correlates of PA identified in the reviews can be broken down, following Sallis and Owen,[5] into five categories: demographic/biological, psychological/cognitive/emotional, behavioural attributes and skills, social/cultural correlates and physical environment. Not all reviews cover all these categories (Table 2). The primary studies included in the reviews were predominantly cross-sectional studies from the United States. Only one review took into account exclusively theory-based intervention studies with an experimental or quasi-experimental design.[27] The reviews represented 316 unique studies after correcting for studies that were included in more than one review.

Sallis et al.[28] classified the correlates on the basis of their statistical significance as being positively, negatively or inconsistently related or unrelated to PA (Table 3). In the presentation of the results, only those variables are included which were investigated in at least three independent studies.

Tables 4–8 give an overview of the correlates determined in the reviews that were associated consistently positively, negatively or inconsistently with PA. The results are presented broken down by the age groups children (aged 3–12) and adolescents (aged 13–18).

Demographic and biological correlates

Children. The most consistent result is a positive association between sex (boys) and PA.[24, 26, 28, 29] The association between age and PA is inconsistent.[26, 28, 29] Gustafson and Rhodes[24] showed a positive association between socioeconomic status and PA; Ferreira et al.[23] found an inconsistent association. As for the relationship between ethnicity and PA, Sallis et al.[28] found inconsistent results for children. Gustafson and Rhodes[24] demonstrated an association for ethnicity, with white Caucasians being more active than other ethnic groups (e.g. Mexican Americans). With regard to biological correlates, Sallis et al.[28] showed inconsistent associations for weight.

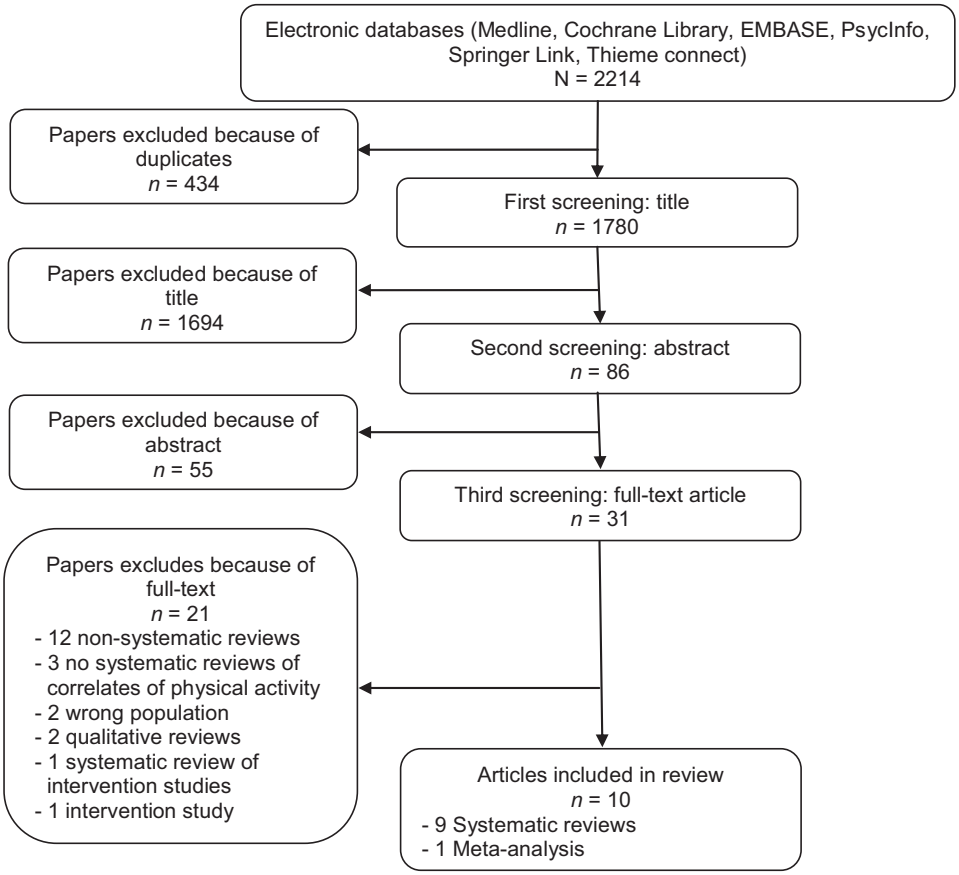

Figure 1. Flow diagram of article selection

Adolescents. Three reviews found a consistent positive association between sex (boys) and PA.[21, 28, 29] Two reviews[21, 28] showed a negative and one review[29] an inconsistent association between age and PA. Hanson and Chen[25] documented a consistently positive association between socioeconomic status and PA: adolescents from higher-status groups were more physically active than those from lower-status groups. Two reviews[21, 29] showed that parental education was positively associated. Two reviews[21, 28] stated that non-Hispanic whites were more active than other ethnic groups. Only Biddle et al.[21] found that an enhanced body mass index (BMI) showed a negative association with PA in female adolescents (Table 4).

Psychological, cognitive and emotional correlates

Children. Sallis et al.[28] showed a consistently negative association between perceived barriers and PA. Intention and preference for PA showed a consistently positive association. Self-efficacy, perceived competence and attitudes/outcome expectation were indeterminately related. The correlates body image, self-esteem, perceived benefits and after school PA attitudes showed no relationship. Van der Horst et al.[29] found a positive association for self-efficacy. For the variable barriers to PA

Table 1. Study quality of reviews

Quality criteria	Sallis et al. (2000)[28]	Biddle et al. (2005)[21]	Davison and Lawson (2006)[22]	Gustafson and Rhodes (2006)[24]	Ferreira et al. (2006)[23]	Hanson and Chen (2007)[25]	Van der Horst et al. (2007)[29]	Hinkley et al. (2008)[26]	Lubans et al. (2008)[27]	Pugliese and Tinsley (2007)[30]
Was the purpose of the review clearly stated?	Yes	Yes	Yes	Yes	Partially	Yes	Partially	Yes	Yes	Yes
Were the inclusion / exclusion criteria appropriate?	Yes	Yes	Yes	Partially	Yes	Yes	Yes	Yes	Yes	Yes
Was the systematic literature search carried out in several databases?	Partially	Partially	Yes	Partially	Yes	Partially	Partially	Partially	Partially	Partially
Was the methodological quality of the studies assessed?	Partially	Partially	No	Partially	Partially	Partially	No	No	Yes	No
Was the methodological quality taken into account in synthesizing the evidence?	No	No	Inapplicable	No	No	Yes	Inapplicable	Inapplicable	Yes	Inapplicable
Were the stated conclusions supported by the data presented?	Yes	Partially	Yes	Yes	Yes	Yes	Yes	Partially	Yes	Yes
Supplement for meta-analysis										
Was publication bias assessed?	—	—	—	—	—	—	—	—	—	Yes
Was heterogeneity adequately analysed?	—	—	—	—	—	—	—	—	—	Yes
Were studies the unit of statistical analysis?	—	—	—	—	—	—	—	—	—	Partially
Study quality	Moderate	Moderate	Moderate	Moderate	Moderate	Good	Moderate	Moderate	Good	Moderate

Table 2. Characteristics of reviews on correlates of physical activity of children and adolescents

Review	Years covered	Sample characteristics	Databases used	No. of studies reviewed	Study design	No. of reviewer	Correlates studied
Sallis et al. (2000)[28]	1970–98	Boys and girls	MEDLINE	108	85 cross sectional	n.d.	Demographic/biological
		3–18 years	PsycInfo		23 prospective		Psychological/cognitive/emotional behavioural attributes and skills
							Social/cultural
							Physical environment
Biddle et al. (2005)[21]	1999–2005	Girls only	MEDLINE	50	41 cross sectional	n.d.	Demographic/biological
		10–18 years	Web of Science		9 prospective		Psychological/cognitive/emotional behavioural attributes and skills
			PsycInfo				Social/cultural
			SPORTDiscus				Physical environment
Hanson and Chen (2007)[25]	1979–2007	Boys and girls	PsycInfo	34	27 cross sectional	n.d.	Demographic/biological
		10–21 years	PubMed		7 longitudinal		
Van der Horst et al. (2007)[29]	1999–2005	Boys and girls	PubMed	57	51 cross sectional	2	Demographic/biological
		4–18 years	PsycInfo		6 prospective		Psychological/cognitive/emotional behavioural attributes and skills
							Social/cultural
							Physical environment
Hinkley et al. (2008)[26]	1980–2007	Boys and girls	MEDLINE	24	21 cross sectional	n.d.	Demographic/biological
		2–5 years	PubMed		3 longitudinal		Psychological/cognitive/emotional behavioural attributes and skills
			CINAHL				Social/cultural
			SPORTDiscus				Physical environment
			PsycInfo				
			Health Source				
Lubans et al. (2008)[27]	n.d.	Boys and girls	PubMed	7	Intervention	1	Psychological/cognitive/emotional

Table 2. (Continued)

Review	Years covered	Sample characteristics	Databases used	No. of studies reviewed	Study design	No. of reviewer	Correlates studied
		5–18 years	EMBASE PsycInfo SPORTDiscus				
Davison and Lawson (2006)[22]	1990–2006	Boys and girls	PubMed	33	29 cross sectional	2	Physical environment
		3–18 years	PsycInfo EBSCO CINAHL TRANSPORT		4 longitudinal		
Ferreira et al. (2006)[23]	1980–2004	Boys and girls	MEDLINE	150	143 cross sectional	2	Demographic/biological
		3–18 years	PsycInfo Web of Science EMBASE SPORTDiscus		7 longitudinal		Social/cultural Physical environment
Gustafson and Rhodes (2006)[24]	n.d.	Boys and girls	MEDLINE	34	29 cross sectional 5 longitudinal		Demographic/biological
		3–18 years	PsycInfo PubMed Academic Search Elite SPORTDicus			3	Social/cultural
Pugliese and Tinsley (2007)[30]	1960–2005	Children and adolescents	ERIC	30	n. d.	n.d.	Social/cultural
		2–18 years	PsychLit PubMed Web of Science				

Note: n.d. = not described.

Table 3. Rules for classifying correlates regarding strength of evidence of association with physical activity

% of studies supporting association	Summary code	Meaning of code
0–33	0	No association
34–59	?	Indeterminate, inconsistent association
60–100	+	Positive association
	−	Negative association

Table 4. Demographic and biological correlates of physical activity of children and adolescents

Correlates	References	Assoc. (+/−/?)[a] in children	Assoc. (+/−/?)[a] in adolescents
Sex	Biddle (A), Gustafson (C), Hinkley (C), Sallis (C/A), van der Horst (C/A)	+ (m) / + (m) / + (m) / + (m)	− (f) / + (m) /+ (m)
Age	Biddle (A), Sallis (C/A), van der Horst (A)	?	− / − / ?
Socioeconomic status	Ferreira (C), Gustafson (C), Hanson (A)	? / +	+
Parental education	Biddle (A), van der Horst (C/A)	?	+ / +
Father's education level	Ferreira (C)	?	
Mother's education level	Ferreira (A)		+
Family income	Biddle (A)		+
Occupational status of the household head	Ferreira (A)		?
Ethnicity	Biddle (A), Gustafson (C), Sallis (C/A), van der Horst (A),	+ / ?	+ / + / ?
BMI/skinfolds	Biddle (A), Sallis (C/A)	?	− / ?
Parent obesity	Hinkley (C), Sallis (C)	? / +	

Notes: [a] (+) indicates positive association; (−) indicates negative association; (?) indicates indeterminate association; A, adolescents; Assoc., association; C, children; f, female; m, male; PA, physical activity; see Table 1 for full authorship and years of publications of references in question.

(e.g. perceived lack of time, lack of interest), self-perception and enjoyment of PA, the authors found no association.

Adolescents. According to Sallis et al.,[28] the only correlates positively associated with PA were: achievement orientation, perceived competence and intention to be active. Depression showed a negative association. Perceived benefits, self-efficacy, body image, attitudes, knowledge and enjoyment of PA were inconsistently associated. Other variables – for example, perceived barriers, self-esteem and self-motivation – showed no relationship. Three reviews[21, 27, 29] found a consistently positive association between self-efficacy and participation in sport by adolescents. In the review by Biddle et al.,[21] perceived competence was associated positively and perceived barriers negatively. Lubans et al.[27] and Van der Horst et al.[29] showed a positive association for the variable attitude/outcome expectation (Table 5).

Table 5. Psychological, cognitive and emotional correlates of physical activity of children and adolescents

Correlates	References	Assoc. (+/−/?)[a] in children	Assoc. (+/−/?)[a] in adolescents
Intention	Sallis (C/A), van der Horst (A)	+	+ / ?
PA preference	Sallis (C)	+	
Perceived barriers	Biddle (A), Sallis (C), van der Horst (A)	−	− / ?
Lack of time barrier	Biddle (A)		−
Perceived competence	Biddle (A), Sallis (C/A), van der Horst (A)	?	+ / + / ?
Self-efficacy	Biddle (A), Lubans (A), Sallis (C/A), van der Horst (C/A)	? / +	+ / + / ? / +
Attitudes, outcome expectation	Lubans (A), Sallis (C/A), van der Horst (A),	?	+ / ? / +
Goal orientation	Sallis (A), van der Horst (A)		+ / +
Depression	Sallis (A)		−
Perceived physical appearance/body image	Biddle (A), Sallis (A)		+ / ?
Enjoy exercise	Sallis (A)		?
Benefits of PA	Sallis (A)		?
Knowledge of exercise/ health	Sallis (A)		?

Notes: [a](+) indicates positive association; (−) indicates negative association; (?) indicates indeterminate association; A, adolescents; Assoc., association; C; PA, physical activity; C, children; see Table 1 for full authorship and years of publications of references in question.

Behavioural attributes and skills

Children. Two reviews[26, 28] determined inconsistent associations for the behaviour-related variable sedentary time (television/video games) with PA, while one[29] found no relationship. Sallis et al.[28] showed a positive association for the variables healthy diet and previous PA.

Adolescents. Sallis et al.[28] found a consistently positive association for the variables previous PA and participation in community sports. As with van der Horst et al.,[29] sedentary time (television, video games) was not found to be associated with PA. Biddle et al.[21] founnd inconsistent results in this respect. For the variable smoking behaviour, two reviews[28, 29] demonstrated an inconsistent and one review[21] a consistently negative association (Table 6).

Social and cultural correlates

Children. Sallis et al.[28] and Ferreira et al.[23] found no consistent association for any of the sociocultural variables investigated (including parental PA, parental support, peer influence). Two reviews[24, 29] showed positive associations for parental support. Hinkley et al.[26] were the only authors to find a positive association for parental PA. Pugliese and Tinsley[30] found in their meta-analysis a small significant positive association for parental behaviour ($p < .001$). The results showed that encouragement ($p < .01$), instrumental behaviour (e.g. paying membership dues; $p < .05$) and modeling ($p < .001$) were significantly positively related to children's PA.

Table 6. Behavioural attributes and skills of physical activity of children and adolescents

Correlates	References	Assoc. (+/−/?)[a] in children	Assoc. (+/−/?)[a] in adolescents
Healthy diet	Sallis (C/A)	+	?
Cigarette use	Biddle (A), Sallis (A), van der Horst (A)		− / ? / ?
Previous PA	Sallis (C/A)	+	+
Sedentary time (TV, video games)	Biddle (A), Hinkley (C), Sallis (C)	? / ?	?
Sedentary after school	Sallis (A)		−
Sedentary on weekends	Sallis (A)		−
Sensation seeking	Sallis (A)		+
Participation in community sports/organized sports	Biddle (A), Sallis (A)		+ / +

Notes: [a](+) indicates positive association; (−) indicates negative association; (?) indicates indeterminate association; A, adolescents; Assoc., association; C, children; PA, physical activity; see Table 1 for full authorship and years of publications of references in question.

Adolescents. Two reviews[28, 29] found no relation for parental PA. Parental support showed consistently positive associations.[21, 28, 29] In two reviews[21, 28] the influence of peer-related variables (peer support/influence) was indeterminate. Van der Horst et al.[29] showed a positive association for friend support. Ferreira et al.[23] found no relevant relationship for the influence of models such as parents, siblings and friends in respect of activity and other family influences; for example, support and encouragement (Table 7).

Physical environment correlates

Children. Two reviews found that the proximity of parks/playgrounds and access to facilities and programmes had a consistently positive relationship to PA,[22, 28] while two others found no association.[23, 29] In three reviews,[23, 26, 28] time spent outdoors was positively associated. PA-related policies in school (e.g. time spent outside, access to equipment, play structures in school) correlated positively with PA.[22, 23] This also applied to transport infrastructure (presence of sidewalks, sidewalk/street conditions), whereas road hazards (e.g. number of roads to cross, traffic density/speed) showed a consistently negative relationship. Perceived neighbourhood safety was not associated.[22, 23, 28] Two reviews[23, 28] showed inconsistent associations between PA and season and milieu (rural/urban).

Adolescents. Two reviews[22, 28] showed a positive association between opportunities to exercise or access to facilities, while two others[23, 29] found no association (Table 8).

Discussion

The literature analysis shows very heterogeneous and inconsistent results with regard to correlates of PA of children and adolescents. This inconsistency even exists when results of previous and current reviews are compared. One possible cause is the lack of consistency in methods of measuring PA between the studies. These include (non-validated) self-reports of children/parents/adolescents,

Table 7. Social and cultural correlates of physical activity of children and adolescents

Correlates	References	Assoc. (+/−/?)[a] in children	Assoc. (+/−/?)[a] in adolescents
Parents' PA	Gustafson (C), Hinkley (C), Sallis (C), van der Horst (C)	? / + / ? / + (m)	
Father's PA	Biddle (A), Ferreira (C/A), Gustafson (C)	+ / ?	+ / ?
Mother's PA	Biddle (A), Gustafson (C)	? (f)	?
Parent PA participation with youth	Sallis (C)	?	
Number of active parents	Gustafson (C)	+	
Sibling PA	Sallis (A)		+
PA from significant others (parents, friends, other adults)	Ferreira (A)		?
Parent support	Biddle (A), Ferreira (A), Gustafson (C), Sallis (A), Pugliese (C), van der Horst (C/A)	+ / + / +	+ / ? / + / +
Direct parental help in PA	Sallis (A)		+
Support from significant others	Ferreira (C/A), Sallis (A)	?	+ / +
Support from peers	Biddle (A), Sallis (A)		? / ?
Support from friends	van der Horst (A)		+
Subjective norms/social influence	Ferreira (A), Sallis (A), van der Horst (A),		? / ? / +
Classmates problems/teasing	Ferreira (A)		?
Parental socialization behaviours (modelling, encouragement, instrumental behaviour)	Pugliese (C)	+	

Notes: [a](+) indicates positive association; (−) indicates negative association; (?) indicates indeterminate association; A, adolescents; Assoc., association; C, children; f, female; m, male; PA, physical activity; see Table 1 for full authorship and years of publications of references in question.

as well as objective measuring methods (e.g. accelerometer). These may lead to discrepancies in the activity levels measured.[31, 32] The majority of the primary studies use self-reports. Younger children in particular are hardly able to report their past behaviour accurately.[32, 33] Objective measurement methods reduce the response bias.[33] A further limitation is the study design of the primary studies. Except for Lubans et al.,[27] these are predominantly cross sectional surveys which do not allow any conclusions with regard to causal relationships.[11, 28, 34] The inconsistency of the results may be attributable to the only moderate methodological quality of the majority of the systematic reviews. Even if none of the reviews contains a critical methodological problem, a systematic distortion of the results is a probability.[15] Moreover, the correlates identified do not permit any statements to be made with regard to subgroups, such as young people from migrant families or socially disadvantaged backgrounds, since most of the reviews do not differentiate between such groups. Another limitation is that the classification model of evidence used by Sallis et al.[28] only provides a relative assessment of the consistency of associations with PA. Using this model, it is not possible to assess the strength of associations.

Table 8. Physical environment correlates of physical activity of children and adolescents

Correlates	References	Assoc. (+/−/?)[a] in children	Assoc. (+/−/?)[a] in adolescents
Access to facilities/ programmes and recreational areas	Davison (C/A), Sallis (C)	+ / +	+
Access to destinations	Davison (A)		+
Proximity of playgrounds and parks	Davison (C)	+	
Opportunities to exercise	Sallis (A)		+
Time outdoors	Ferreira (C), Hinkley (C), Sallis (C)	+ / + / +	
Season	Ferreira (C/A), Sallis (C)	? / ?	?
Milieu	Ferreira (C/A), Sallis (C/A)	? / ?	
Weather	Hinkley (C)	?	
PA-related policies in school (e.g. time allowed for free play/spent outside, school play areas)	Davison (C), Ferreira (C)	+ / +	
School type	Ferreira (A), Hinkley (C)	+	+
Distance to school	Davison (C)	−	
Limited public transport	Ferreira (C)	?	
Presence of sidewalks/ sidewalk conditions	Davison (C)	+	
Connectivity of street network	Davison (C)	?	
Road hazards (e.g. number of roads to cross, traffic)	Davison (C)	−	
Crime/area deprivation	Davison (C)	−	

Notes: [a](+) indicates positive association; (−) indicates negative association; (?) indicates indeterminate association; A, adolescents; Assoc., association; C, children; PA, physical activity; see Table 1 for full authorship and years of publications of references in question.

A number of limitations are mentioned in this study. In view of the defined inclusion and exclusion criteria, only nine reviews without meta-analysis and one review with meta-analysis were included. It may be that other publications with different keywords were overlooked.[35] No distinction was made with regard to its intensity (moderate or intensive) or the type of PA (play, walking, swimming). The most recent primary study dated back to 2008.[27]

Although the limitations mentioned restrict the meaningfulness of the present paper's results, it does give a comprehensive and systematic overview of correlates of PA of children and adolescents.

From the systematic literature research, 16 correlates were identified that were consistently in at least two reviews associated with PA of children and/or adolescents (Table 9). Consistent correlates which either promote or inhibit PA can be identified in each of the five correlate categories. The two reviews with a good study quality document consistent positive associations with PA for three variables: socioeconomic status,[25] self-efficacy and attitudes/outcome expectations.[27] It can be deduced from the results that PA is determined by numerous complex and multi-dimensional

Table 9. Summary of correlates related to physical activity of children and adolescents

Category	Correlates	Children Assoc. (+/−)[a]	Comment	Adolescents Assoc. (+/−)[a]	Comment
Demographic/ biological	Sex (m)	+	4 of 4 reviews determined a positive association	+	3 of 3 reviews determined a positive association
	Age			−	2 of 3 reviews determined a negative association
	Ethnicity (white Caucasian)			+	2 of 3 reviews determined a positive association
	Parental education			+	3 of 3 reviews determined a positive association
	Family income			+	2 of 2 reviews determined a positive association
	Socioeconomic Status			+	1 review with a good study quality determined a positive association
Psychological/ cognitive/ emotional	Perceived competence			+	2 of 2 reviews determined a positive association
	Self-efficacy			+	3 of 4 reviews determined a positive association, 1 of these with a good study quality
	Goal orientation/ motivation			+	2 of 2 reviews determined a positive association
	Attitudes, outcome expectation			+	2 of 3 reviews determined a positive association, 1 of these with a good study quality
	Perceived barriers			−	2 of 2 reviews determined a negative association
Behavioural attributes and skills	Participation in community sports/ organized sport			+	2 of 2 reviews determined a positive association
Social/cultural	Parent support	+	3 of 5 reviews determined a positive association	+	3 of 4 reviews determined a positive association
	Support from significant others			+	2 of 2 reviews determined a positive association
Physical environment	Access to facilities/ programmes and recreational areas	+	2 of 4 reviews determined a positive association	+	2 of 4 reviews determined a positive association
	Time outdoors	+	3 of 3 reviews determined a positive association		

Notes: [a](+) indicates positive association; (−) indicates negative association; Assoc., association; m, male

biological, psychological, sociocultural and environmental correlates. The findings support the increasing interest among public health professionals in socioecological models to promote PA.[5, 11]

Demographic and biological correlates

One consistent finding is that boys are more active than girls and that PA decreases with increasing age. According to Biddle and Mutrie,[36] the influences of sex and age on PA are consistent results that can be accepted as being reliable with regard to young people. Moreover, the findings indicate that adolescents from families of low socioeconomic status are restricted in their opportunities for activity.[21, 23, 25] This result may be considered as consistent because of the good study quality of the review of Hanson and Chen.[25] Among younger children, PA is most frequently informal in nature and so scarcely gives rise to additional costs. In youth PA may become more expensive – for example, through membership of sports clubs, which makes socially disadvantaged adolescents less likely to become active.[23] The results regarding the influence of ethnicity show that it does correlate with adolescents' PA.[21, 28] The demographic correlates indicate that there are subgroups of inactive young people for whom special target group-related invention programmes need to be developed; for example, girls, certain ethnic groups and socially disadvantaged children and adolescents.[5, 13]

Psychological, cognitive and emotional correlates

Although Sallis et al.[28] documented an indeterminate association with self-efficacy, three reviews showed that self-efficacy is a positive correlate of PA.[21, 27, 29] Because of the good methodological quality of the review of Lubans et al.,[27] this finding may be taken to be consistent. In Bandura's[37] social-cognitive theory, self-efficacy is regarded as one of the most important behaviour-related determinants.[5, 38] The results support the demand for PA-related interventions to include self-efficacy as an important target variable.[38, 39]

The perceived (sporting) competence and goal orientation were closely related to sport motivation.[36] Two reviews were able to identify positive relationships between these variables and adolescents' PA. The negative associations between perceived barriers and PA[21, 28] resemble the findings of studies of adults, in which lack of time and lack of interest are identified as major barriers.[5, 12]

Behavioural attributes and skills

This category provides evidence of an association between PA and participation in organized/community sport. The findings imply that more programmes need to be offered in the area of community sport in order to increase the number of young people taking part. The most comprehensively investigated variable in this category was 'sedentary time'. In neither age group could a consistent relationship be found in this respect. In a meta-analysis by Marshall et al.,[40] a negative association between television and PA was demonstrated, but with only a slight effect. Altogether, the findings on sedentary activities were contradictory. The results may point to the fact that sedentary activities do not, as is often assumed, necessarily replace PA. Girls and boys may be adequately active and nevertheless spend a lot of their time pursuing sedentary activities.[3, 41] Nevertheless, excessive media consumption is an important risk factor in the development of obesity among children.[5, 40, 42]

Social and cultural correlates

The findings of the reviews with regard to sociocultural correlates support the assumption that there is a close relationship between social variables and PA. A consistently positive association

was found for parental support, for both age groups. No unambiguous conclusion can be drawn with regard to parental PA. One possible explanation of these differences is that the association between the children's and the parents' PA is probably influenced by the mediators 'parental support' and 'encouragement'.[24] Parents presumably act not only as models, but also as so-called 'gate keepers' for PA by, for example, driving their children to sporting events or enrolling them in sports clubs. In this way, even parents who are not themselves physically active can support their children.[24] Although parents represent only one of many socialization agents (e.g. peers, schools), socialization of health-related behaviour occurs within the family. Parental convictions, attitudes and behaviour substantially influence the child's health-related behaviour.[30, 43] It is highly relevant for parents to be well informed about the importance of PA in childhood.[12]

Physical environment correlates

One consistent finding is that the time children spend outdoors correlates positively with their PA. From this one can deduce that most opportunities for activity are outside and that time spent outdoors is associated with activity. A further consistent finding is that proximity and access to leisure/training facilities lead to a higher level of activity among young people. The results demonstrate that adequate facilities need to be provided close to where young people live in order to promote activity. In the past it has not been adequately investigated what aspects contribute to young people using or not using certain facilities. It is assumed that socially determining factors such as the payment of dues and the attractiveness of the facility influence its use.[43] The findings of the systematic reviews indicate that the environment in which young people live should be so designed as to provide incentives to take exercise in daily life and promote enjoyment of it. PA facilities such as playgrounds, recreation grounds with sports pitches and cycle tracks should be easily accessible and safe to use.[22, 23]

School structures also show a positive association with children's PA.[22, 23] School offers numerous opportunities for young people to be active; for example, physical education classes, extracurricular sporting activities or exercise during breaks.[23] Various investigations confirm that well-developed and implemented school programmes promote PA in youth[4, 9, 44] and can contribute to the prevention of obesity.[45]

Differences between children and adolescents in the physical activity correlates

The reviews identify a larger number of consistent correlates for adolescents (Table 9). Particularly in the category of psychological correlates, no consistent variables can be found for children. One possible cause may be that certain variables are not relevant in that age group; or it could be due to inadequacies in the studies and the difficulty of measuring psychological constructs in this population. Researchers therefore have to rely on reports from parents or other relevant persons.[5, 26, 28] In the category of environmental factors, more correlates are identified for children than for adolescents. According to Sallis and Owen,[5] it might be that environmental influences decline in adolescence, while social and psychological factors gain in importance. In both age groups, associations can be identified between PA and the correlates sex, parental support and access to facilities/recreational areas. Future studies need to pay more attention to associations for children and adolescents of different age groups in order to be able to examine differences in the correlates depending on the stage of development.[46]

Conclusion

This systematic review integrates findings from previous reviews that examined correlates of PA of children and adolescents. Individual and population-related interventions focusing on correlates that can be modified or influenced are more likely to bring about behaviour changes.[47] The correlates identified serve as a guide to the nature of any such intervention.[5] Demographic correlates – for example, sex, age and ethnicity – can be used to steer interventions and programmes in accordance with the target group. Homogeneous groups displaying differing patterns of motivation and self-perception may be recorded and strategies developed that enhance the effectiveness of programmes to promote PA among these groups.[5, 48] There is a need for studies that include the socioecological model and pay greater attention to correlates of PA within subgroups.[36] For the future, it would be advisable not only to ensure an appropriate study design but also to use consistent, reliable and validated measurement methods in the assessment of PA. Using multiple measures of PA provides a more complete description of children's activity.[32] Preventive interventions should pursue a multi-dimensional approach and include correlates from all areas of influence.[5] It is very likely that there is a synergistic relationship between individual, social and environmental factors that affect PA.[49] The aim of policy and practice should be to create political and infrastructural conditions that promote PA among young people and are easily and especially equally accessible to all children and adolescents.

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