HOSTED BY

ELSEVIER

CrossMark

Available online at www.sciencedirect.com

ScienceDirect

Journal of Sport and Health Science 4 (2015) 222–227

www.jshs.org.cn

Original article

Correlates of subjectively and objectively measured physical activity in young adolescents

Kelly Kavanaugh [a], Justin B. Moore [a,b,*], Leisha Johnson Hibbett [c], Andrew T. Kaczynski [b]

[a] *Office of Practice and Community Engagement, University of South Carolina, Columbia, SC 29208, USA*
[b] *Department of Health Promotion, Education, and Behavior, University of South Carolina, Columbia, SC 29208, USA*
[c] *Coastal Community Action, Newport, NC 28570, USA*

Received 28 August 2013; revised 13 November 2013; accepted 3 March 2014
Available online 11 July 2014

Abstract

Background: Many studies examining individual-level correlates in youth utilize self-report rather than objective measures of physical activity (PA). This utilization of self-report may result in associations that are not present when examining objectively measured PA. The present study investigates the relationship between hypothesized correlates of PA with objectively and subjectively measured PA.
Methods: Participating children (n = 232, 101 males, mean age = 12.3 years) provided a minimum of four monitored days of PA (via accelerometer) and completed a survey assessing moderate-to-vigorous physical activity (MVPA), sport competence, appearance, enjoyment, and self-efficacy. Height and weight were measured and body mass index (BMI) was calculated.
Results: Hierarchical regression models controlling for sex, race, and BMI Z-score showed that only sex and BMI Z-score were significant correlates of objective MVPA while only sex was a significant correlate of objective total PA. However, in a separate model examining the relationship with subjective MVPA, enjoyment of PA and self-efficacy for PA were the only significant correlates of self-reported PA.
Conclusion: Measuring MVPA via self-report versus accelerometry produces considerably different results in a sample of young adolescents. Future studies should use caution when selecting outcome measures if the intent is to identify modifiable correlates of MVPA in youth.

Keywords: Accelerometry; Enjoyment; Self-efficacy; Youth

1. Introduction

Current research indicates that most children are not meeting the recommended 60 min of moderate-to-vigorous physical activity (MVPA) per day,[1] and physical activity (PA) levels have shown to decrease with age.[2] In hopes of discovering modifiable targets for intervention, many studies have been conducted to identify correlates of PA in youth. Unfortunately, many of these studies rely heavily on self-report measures of PA,[3,4] which are often not well validated.[5] Self-report measures are susceptible to biases related to social desirability, which have been shown to be of particular concern in school-aged children.[6] With the lack of validated measures being used, along with the significant amount of self-report taking place, correlates related to objective MVPA are not well understood.

A number of correlates related to PA in youth have been previously identified. The first is perceived sport competence, which achievement goal theory indicates is a behavioral determinant,[7] and has shown to have a bi-directional relationship with PA. Another is PA enjoyment, which studies suggest is the most salient predictor of PA levels in youth.[8,9] The third correlate is self-efficacy for PA, which is derived

* Corresponding author. Office of Public Health Practice, University of South Carolina, Columbia, SC 29208, USA.
E-mail address: jmoore@mailbox.sc.edu (J.B. Moore)
Peer review under responsibility of Shanghai University of Sport.

2095-2546/$ - see front matter
http://dx.doi.org/10.1016/j.jshs.2014.03.015

from Bandura's social cognitive theory (SCT).[10] Although SCT identifies self-efficacy as a behavioral construct that largely influences an individual's ability to control their motivation, the literature indicates mixed outcomes with relation to PA.[3,4] Sallis et al.[3] showed indeterminate associations, while a more recent review by van der Horst et al.[4] indicated that self-efficacy was positively correlated to PA in adolescents. The fourth correlate is perceived appearance, which is how a person views his or her own body composition and personal aesthetics. Crocker et al.[11] found this variable is significantly and moderately correlated with PA in Canadian school children (aged 10−14 years); however, studies suggested that the relationship between perceived appearance and youth PA is still unclear.[4] A combination of these correlates has been previously studied in regard to both objectively measured total PA and MVPA by Fisher et al.,[12] yet that study employed a younger sample (aged 7−9 years) and did not compare their results to subjective measures. For both total PA and MVPA, the findings suggested there were no significant psychosocial correlations for girls and only a significant association for self-efficacy in boys.[12] Research has shown that attitudes toward physical education (PE) become more negative with age in youth (aged 10−14 years),[13] but it is unclear as to whether the same trend is generalizable to PA more broadly. Therefore, it would be valuable to examine how these four correlates might differ in older youth, how they are associated with MVPA in this age group, and how any such relationships may differ depending on the way PA is measured. Thus, the present study seeks to investigate the relationship between self-perceptional variables and MVPA in older youth, highlighting the importance of using both objective and subjective MVPA measures within the same population.

2. Materials and methods

2.1. Participant information

A total of 232 students (101 boys and 131 girls) completed the questionnaires, did not indicate that they were sick in the previous week, and provided a minimum of 4 days of accelerometry data (53%). Participants from three middle schools, located in eastern North Carolina were recruited to participate in a study examining PA in rural and urban youth.[14] Institutional review board (IRB) approval was granted and children enrolled in PE, health, or elective courses during either the 2006−2007 or 2007−2008 school years were asked to participate. Research assistants presented the study, its purpose, and incentives (a combination of monogrammed school uniform clothing) to children during classroom hours. Interested participants received parental consent forms to take home and return. In total, approximately 1773 students were eligible and 481 received parental consent. Of these, 441 were present for data collection and assented to participate (25%). Participants were not significantly different in terms of sex or age from the student population, but were more likely to be African-American (57% African-American in student population *vs.* 49% in the sample). Participants were pulled out in small groups from their respective classrooms during school hours to complete a questionnaire and an anthropometric assessment. Students who indicated that something prevented them from doing normal activities in the past week on the questionnaire were excluded from the study. Baseline descriptive statistics for participants are shown in Table 1.

2.2. Instruments

The self-perception profile for children (SPPC) is a 36-item, 5-scale instrument used to measure factors related to self-esteem, including scholastic competence, sport competence, physical appearance, social acceptance, and behavioral conduct, as well as a 6th-subscale for global self-worth.[15,16] Each question pairs two items with polar opposite descriptions (e.g., "Some kids wish their body was different" but "Other kids like their body the way it is"). Children are asked to self-identify the statement that best describes them, and then choose if this is "really true" or "sort of true" for them. Items are scored on a 4-point scale, with higher scores indicating a more positive view of oneself. The current study used the sport competence (14 items; e.g., "Some kids do very well at all kinds of sports") and appearance (22 items; e.g., "Some kids are happy with the way they look") subscales of the SPPC to assess youth's self-perceptions of their athletic abilities and physical appearance, respectively. The SPPC scales have demonstrated good internal consistency (coefficient $\alpha = 0.73-0.81$) and test-retest reliability (all intraclass correlation coefficients ≥ 0.84) in youth aged 8−14 years.[16] The athletic competence and appearance subscales also demonstrated acceptable internal consistencies in the present study (coefficient $\alpha = 0.81$, $\alpha = 0.86$, respectively).

Table 1
Descriptive statistics for the participants (mean ± SD).

	Boy (n = 101)	Girl (n = 131)
Age (year)	12.47 ± 1.13	12.13 ± 1.00
Race[a]		
Black	45 (45)	69 (53)
White	31 (31)	38 (29)
Other race	25 (24)	24 (18)
BMI	21.82 ± 4.70	22.83 ± 5.97
BMI Z-score	0.85 ± 0.96	0.91 ± 1.02
Minutes of MVPA/day[b]	40.10 ± 19.14	22.91 ± 12.79
Minutes of total PA/day[b]	316.81 ± 78.09	291.53 ± 68.46
Subjective MVPA[c]	3.01 ± 0.64	2.80 ± 0.62
Sport competence (range 1.33−4.00)	2.96 ± 0.59	2.73 ± 0.62
Appearance (range 1.00−4.00)	2.94 ± 0.69	2.82 ± 0.73
PA enjoyment (range 1.94−5.00)	4.28 ± 0.50	4.10 ± 0.53
PA self-efficacy (range 1.00−5.00)	3.44 ± 0.84	3.49 ± 0.81

[a] perimeters presented as n (%);
[b] measured by accelerometer;
[c] measured by physical activity questionnaire for older children.
Abbreviations: BMI = body mass index; MVPA = moderate-to-vigorous physical activity; PA = physical activity.

PA enjoyment was measured using the revised physical activity enjoyment scale (PACES), which consists of 16 bipolar statements that include the stem "When I am physically active …" and end in statements regarding affective responses (e.g., "When I am physically active I enjoy it"; "When I am physically active I feel bored"). Responses are based on a 5-point Likert scale (1 = "Disagree a lot" to 5 = "Agree a lot"). In previous studies using adolescents aged 12−16 years, PACES has shown to have high internal consistency (coefficient $\alpha = 0.90$) and moderate-to-high item−total correlations ($r = 0.38$−0.76).[17] Similar findings have also been found in younger children (aged 8−10 years) of various races.[18] The PACES demonstrated acceptable internal consistency in the present study (coefficient $\alpha = 0.86$).

Self-efficacy for PA was measured through five items regarding a child's confidence in their ability to overcome his or her barriers to PA (e.g., "How sure are you that you can get up early, even on weekends, to exercise?"). A 5-point Likert Scale was used, with answers ranging from "I'm sure I can't" = 1 to "I'm sure I can" = 5. This scale has been used in a previous study of elementary school children, demonstrating good internal consistency (coefficient $\alpha = 0.85$) and a 1-week test-retest reliability of $r = 0.89$.[19] The self-efficacy scale demonstrated acceptable internal consistency in the present study (coefficient $\alpha = 0.72$).

The physical activity questionnaire for older children (PAQ-C)[20] was used to assess subjective MVPA. PAQ-C is a self-administered 7-day PA recall designed for youth aged 9−15 years. It consists of nine items starting with a PA checklist of how often the listed activities were performed in the last 7 days ("no", "1−2", "3−4", "5−6", "7 or more times"), followed by eight questions asking about the level of intensity and amount of days youths were active during PE, lunchtime, after school, evenings, weekend, and during an average week (e.g., "In the last 7 days, during your PE classes, how often were you active (playing hard, running, jumping, throwing)"). Each PAQ-C question has five choices (e.g., "I don't do PE", "hardly ever", "sometimes", "quite often", "always"), converting into a 5-point Likert scale, with higher scores indicating higher PA levels. Previous studies have indicated good test-retest reliability, internal consistency (coefficient $\alpha = 0.79$−0.89),[20] and validity when compared to accelerometry ($\rho = 0.47$ for total PA and $\rho = 0.49$ for MVPA).[21] The final question asks if anything prevented the individual from doing their normal PAs ("yes", "no").

Height and weight were determined for each child using a digital scale and a stadiometer. From this information, BMI was calculated for each participant (kg/m^2). BMI Z-score was calculated from Centers for Disease Control and Prevention growth chart data (National Center for Health Statistics, No Date) using the Epi Info™ program (Version 3.5; Centers for Disease Control and Prevention, Atlanta, GA, USA).

Objective PA data were collected using accelerometry (Model GT1M; ActiGraph, Pensacola, FL, USA). Accelerometers used in the present study have been shown to be significantly correlated with activity related energy expenditure in similar samples of youth ($r = 0.29$−0.54).[22] In the present study, accelerometers were set to collect data in 30-s epochs and affixed to a belt and worn on the participant's right hip. Thirty-second epochs have been shown to capture PA data in older children with acceptable validity[23] while maximizing battery life and memory capacity. Participants were given accelerometers after completing the questionnaires and were instructed to wear the monitor continuously over the next 7 days except when playing contact sports, bathing, swimming, or sleeping. Children were given a handout, which included placement instructions, to take home to their parents, and correct placement was demonstrated in a classroom setting. Teachers were also requested to check the placement of the monitors daily. Movement counts were converted using count thresholds established by Evenson et al.,[24] to determine time spent in sedentary, light, moderate, and vigorous PA. Data were reduced using MeterPlus Software (Santech, Inc., La Jolla, CA, USA). A day was considered "complete" and included in analyses if the monitor was worn for a minimum of 10 h. Thirty minutes of consecutive zeros was considered indicative of non-wear time in concordance with the recommendations of Sirard and Slater.[25] MVPA was calculated as the sum of the time spent in moderate and vigorous activity. Total PA was calculated as the sum of the time spent in light, moderate, and vigorous activity. Children were included if they had at least 4 valid days of available data. Of note, the accelerometer monitoring period occurred in the week following the one assessed by the self-report measure.

2.3. Data analyses

All data were imported into STATA v12 (StataCorp, LP, College Station, TX, USA) for cleaning, screening for normality and analyses. Subjective MVPA and total PA were normally distributed. Objective MVPA was slightly positively skewed, but not to a degree to warrant transformation. Following data screening, descriptive statistics were extracted and Pearson correlations were generated. Since the dependent variables were continuous and the independent variables included a mixture of continuous and dichotomous variables, two linear regression models were created for each dependent variable (subjective MVPA, objective MVPA, and objective total PA): the first model consisting of descriptive variables (age, race, gender, and BMI Z-score), and the second model comprised of descriptive variables plus four perception variables (sport competence, appearance, PA enjoyment, and PA self-efficacy). Significance was set at $p < 0.05$.

3. Results

No differences were observed on any of the measured variables between those who provided accelerometer data and those who did not with the exception of enjoyment of PA, which was higher in those without 4 valid days of accelerometer data compared to those with less than 4 days of data (4.28 *vs.* 4.16, $p < 0.05$). While the mean age was similar for both boys (12.5 ± 1.1) and girls (12.1 ± 1.0), girls had a slightly higher mean BMI (22.8 ± 6.0) compared to boys

Table 2
Youth psychosocial variables in relation to total PA, objective, and subjective MVPA.

Variable	Objective MVPA (r)[a]		Objective total PA (r)[a]		Subjective MVPA (r)[b]	
	Simple	Partial[c]	Simple	Partial[c]	Simple	Partial[c]
Boy (n = 101)						
Sport competence	0.069	0.064	0.026	0.016	0.180	0.164
Appearance	0.188	0.186	0.104	0.100	0.029	0.020
PA enjoyment	0.116	0.113	−0.038	−0.042	0.361**	0.357**
PA self-efficacy	0.002	−0.005	−0.112	−0.126	0.317**	0.301**
Girl (n = 131)						
Sport competence	0.109	0.090	0.069	0.072	0.285**	0.286**
Appearance	0.093	0.033	0.119	0.128	0.182*	0.185*
PA enjoyment	0.191*	0.180*	0.187*	0.189*	0.438**	0.438**
PA self-efficacy	0.134	0.118	−0.012	−0.010	0.490**	0.491**

[a] measured by accelerometer.
[b] measured by physical activity questionnaire for older children.
[c] partial correlation coefficients adjusted for BMI Z-score.
*$p < 0.05$; **$p < 0.01$.
Abbreviations: PA = physical activity; MVPA = moderate-to-vigorous physical activity.

(21.8 ± 4.7), but this difference was not statistically significant. Accelerometry data showed that, on average, boys participated in more daily minutes of MVPA than girls did (40.1 ± 19.1 *vs.* 22.9 ± 12.8, $p < 0.01$). This was consistent with the self-reported MVPA data, as boys reported being more physically active than girls (3.0 ± 0.6 *vs.* 2.8 ± 0.6, $p < 0.01$).

Perceived sport competence was slightly higher in boys (3.0 ± 0.6) than in girls (2.7 ± 0.6). This same trend was found for appearance (boys (2.9 ± 0.7); girls (2.8 ± 0.7)) and PA enjoyment (boys (4.3 ± 0.5); girls (4.1 ± 0.5)). PA self-efficacy was the only self-perception variable that was slightly higher in girls (3.5 ± 0.8) than in boys (3.4 ± 0.8). These differences were only statistically significant for perceived sport competence ($p < 0.01$).

The associations between self-perception variables and objective MVPA, objective total PA, and subjective MVPA are shown in Table 2. When looking at subjective MVPA, PA enjoyment (boys ($r = 0.361$); girls ($r = 0.438$)) and PA self-efficacy (boys ($r = 0.317$); girls ($r = 0.490$)) were both independently and significantly correlated with the self-reported amount of MVPA in both boys and girls (all $p < 0.01$). Subjective MVPA was also positively and significantly correlated with appearance ($r = 0.182$, $p < 0.05$) and sport competence ($r = 0.285$, $p < 0.01$) in girls, although the magnitude of association was smaller. These relationships were only slightly attenuated when adjusting for BMI Z-score. For both objectively measured MVPA and total PA, only the association between PA enjoyment ($r = 0.19$ for each, $p < 0.05$) was significant in girls. This relationship was slightly attenuated when adjusting for BMI Z-score, but remained significant.

Hierarchical regression models predicting objective and subjective MVPA are shown in Table 3. The first model contained only the descriptive variables as predictors explained 25%, 5%, and 3% of the variance in objective MVPA ($p < 0.01$), objective total PA ($p < 0.05$), and subjective MVPA ($p = 0.113$), respectively. The second model contained the descriptive and perception variables as predictors explained 27%, 7%, and 27% of the variance in objective

Table 3
Hierarchical regression models of objective MVPA, objective total PA, and subjective MVPA in relation to perceptions in middle school youth.

Model	Objective MVPA[a]			Objective total PA[a]			Subjective MVPA[b]		
	b	SE	β	b	SE	β	b	SE	β
Model 1[c]									
Age (year)	−0.454	0.984	−0.027	−5.292	4.542	−0.077	0.012	0.040	0.020
Race[e]	−2.446	2.274	−0.062	−17.770	10.493	−0.110	−0.025	0.091	−0.018
Sex[f]	17.223**	2.111	0.476	27.228**	9.743	0.184	0.208	0.085	0.162
BMI Z-score	−2.547*	1.049	−0.141	−1.955	4.839	−0.026	−0.040	0.042	0.062
Model 2[d]									
Age (year)	−0.230	0.993	−0.014	−4.429	4.587	−0.064	0.034	0.035	0.057
Race[e]	−1.836	2.287	−0.047	−14.122	10.566	−0.088	−0.026	0.081	−0.019
Sex[f]	16.208**	2.186	0.448	22.749*	10.101	0.153	0.131	0.077	0.102
BMI Z-score	−2.203*	1.063	−0.122	−1.138	4.909	−0.015	−0.005	0.038	−0.008
Sport competence	−0.393	1.987	−0.013	−3.060	9.178	−0.026	0.135[†]	0.070	0.131
Appearance	2.266	1.652	0.090	11.922	7.632	0.116	−0.035	0.058	−0.040
PA enjoyment	4.025	2.315	0.118	15.448	10.697	0.110	0.306**	0.082	0.254
PA self-efficacy	−0.447	1.421	−0.020	−10.468	6.566	−0.116	0.221**	0.050	0.284

[a] measured by accelerometer.
[b] measured by physical activity questionnaire for older children.
[c] for objective MVPA: $r^2 = 0.248$, $F(4, 227) = 18.74$, $p < 0.001$; for objective total PA: $r^2 = 0.047$, $F(4, 227) = 2.78$, $p < 0.05$; for subjective MVPA: $r^2 = 0.032$, $F(4, 227) = 1.89$, $p = 0.113$.
[d] for objective MVPA: $r^2 = 0.269$, $F(8, 223) = 10.23$, $p < 0.001$; for objective total PA: $r^2 = 0.071$, $F(8, 223) = 2.12$, $p < 0.05$; for subjective MVPA: $r^2 = 0.270$, $F(8, 223) = 10.33$, $p < 0.001$.
[e] race 1 = white, 0 = other.
[f] sex 1 = male, 0 = female.
*$p < 0.05$; **$p < 0.01$; [†]$p = 0.06$.
Abbreviations: BMI = body mass index; MVPA = moderate-to-vigorous physical activity; PA = physical activity.

MVPA ($p < 0.01$), objective total PA ($p < 0.05$), and subjective MVPA ($p < 0.01$), respectively. For the full models, only sex (MVPA and total PA) and BMI Z-score (MVPA) were significant predictors. For subjective MVPA, PA enjoyment and PA self-efficacy were both significant predictors ($p < 0.01$), while sport competence approached significance ($p = 0.06$).

4. Discussion

4.1. Differences in associations between objectively and subjectively measured MVPA

As previous research on psychosocial correlates of PA has relied heavily on self-report measures, this study highlights the importance of providing comparative objective measures. While accelerometry data may offer a more accurate indication of actual MVPA involvement, the objectively measured MVPA in this study showed no significant, independent correlations with any of the psychosocial variables were examined in the univariate analyses in boys. Yet, when PA was measured subjectively, each perceptual variable was significantly and positively correlated with MVPA in girls, while PA enjoyment and PA self-efficacy was significantly correlated with MVPA in boys. Since psychosocial measures are subjective in nature, those who have more positive perceptions may also perceive themselves as being more physically active than they actually are. Research has already indicated that children tend to overestimate their PA levels,[25] which may account for this difference.

When looking at regression models, the models that included the four psychosocial variables as predictors of objective MVPA/total PA indicated that none of them was a significant predictor of either. These results were surprising as PA enjoyment is often considered intrinsic motivation for PA and is often reported as a correlate of PA in youth.[3] The models that used the psychosocial variables to predict subjective MVPA did show that PA enjoyment and PA self-efficacy were significant predictors. While not consistent with the objectively measured PA models, the findings hold promise for PA promotion activities since enjoyment is potentially modifiable through intervention. For example, Dishman et al.[9] found that a school-based intervention increased PA in high school youth and that this increase was mediated by changes in enjoyment of PA. While MVPA was measured using a well-validated self-report measure results should be interpreted with caution in light of the present findings. As suggested by both Dishman et al.[9] and the results of the current study, future research should employ objective measures of PA, especially when seeking to identify mediators of intervention effects in youth.

4.2. Limitations

Unlike many previously published studies, this investigation incorporated well-validated objective and subjective MVPA measures on the same children. However, while it demonstrated several strengths such as this, the current study was also not without its limitations. For one, the study was cross-sectional in design, which does not permit causal conclusions. Selection bias is a possibility as the study sample was based on geographical convenience. The sample size was also smaller than desired to facilitate generalizability, although similar studies have reported using similar sizes.[12] A potential Hawthorne effect (observational bias as a result of being watched) may have also occurred, as students were pulled from class in small groups to answer questionnaires. Questionnaires were completed the week before the accelerometers were worn, and accelerometers could not be worn while swimming, indicating potential measurement biases. This study either did not examine an exhaustive list of psychosocial variables that have been identified previously. While measuring a more extensive list would be preferable (e.g., perceived social support, task goal orientation, perceived accessibility, *etc*.), schools have a limited amount of available time and further burdening the teachers and students would have been detrimental to the study. Lastly, a convenience sample of middle schools was used, with geographical differences between groups. While the literature indicates that children living in more rural environments are more physically active,[26] emerging research also suggests a geographical and seasonal relationship in which urban children have been shown to be significantly more active in the winter compared to rural children, but significantly less active in the summer.[27] Therefore, future studies should consider the impact of seasons and the built environment (perceived and objective) in regards to objective and subjective PA.

5. Conclusion

The current study contributes to the literature by highlighting the importance of using well-validated objective and subjective measures of MVPA on the same subjects, when investigating their relationships with psychosocial variables among adolescents. While many articles have previously stressed this need in future research,[28] few studies have actually done this. As such, this research offers quantitative support for the continued recommendation that future studies continue to apply both measures of PA when studying its effects on psychosocial variables, as the observed relationships do not appear to be consistent from one PA assessment method to another. Additionally, future research should consider employing a composite measure of PA that would allow for the unique contribution of each. While beyond the scope of the present investigation, such a composite variable would hypothetically capture the unique variance of each method thus providing a better indicator of PA. PA programs and interventions should also focus on making activities enjoyable for youth as this has consistently been shown to be correlated with both objective and subjective PA, and in this case, the desirable outcome of MVPA.

Acknowledgments

The authors would like to thank Dr. Michael W. Beets for his assistance in the preparation of this manuscript. This work

was funded by the Centers for Disease Control and Prevention (K01-DP001126). This work is solely the responsibility of the authors and does not necessarily represent the official views of the Centers for Disease Control and Prevention.

References

1. Gortmaker SL, Lee R, Cradock AL, Sobol AM, Duncan DT, Wang YC. Disparities in youth physical activity in the United States: 2003−2006. *Med Sci Sports Exerc* 2012;**44**:888−93.
2. Nader PR, Bradley RH, Houts RM, McRitchie SL, O'Brien M. Moderate-to-vigorous physical activity from ages 9 to 15 years. *JAMA* 2008;**300**:295−305.
3. Sallis JF, Prochaska JJ, Taylor WC. A review of correlates of physical activity of children and adolescents. *Med Sci Sports Exerc* 2000;**32**:963−75.
4. van der Horst K, Paw MJ, Twisk JW, Van Mechelen W. A brief review on correlates of physical activity and sedentariness in youth. *Med Sci Sports Exerc* 2007;**39**:1241−50.
5. Biddle SJ, Gorely T, Pearson N, Bull FC. An assessment of self-reported physical activity instruments in young people for population surveillance: project ALPHA. *Int J Behav Nutr Phys Act* 2011;**8**:1.
6. Klesges LM, Baranowski T, Beech B, Cullen K, Murray DM, Rochon J, et al. Social desirability bias in self-reported dietary, physical activity and weight concerns measures in 8- to 10-year-old African-American girls: results from the girls health enrichment multisite studies (GEMS). *Prev Med* 2004;**38**:S78−87.
7. Maehr ML, Zusho A. *Achievement goal theory. Handbook of motivation at school*. New York: Routledge; 2009.p.77.
8. Barr-Anderson DJ, Young DR, Sallis JF, Neumark-Sztainer DR, Gittelsohn J, Webber L, et al. Structured physical activity and psychosocial correlates in middle-school girls. *Prev Med* 2007;**44**:404−9.
9. Dishman RK, Motl RW, Saunders R, Felton G, Ward DS, Dowda M, et al. Enjoyment mediates effects of a school-based physical-activity intervention. *Med Sci Sports Exerc* 2005;**37**:478−87.
10. Bandura A. *Social foundations of thought and action: a social cognitive theory*. Englewood Cliffs: Prentice-Hall; 1986.
11. Crocker PRE, Eklund RC, Kowalski KC. Children's physical activity and physical self-perceptions. *J Sports Sci* 2000;**18**:383−94.
12. Fisher A, Saxton J, Hill C, Webber L, Purslow L, Wardle J. Psychosocial correlates of objectively measured physical activity in children. *Eur J Public Health* 2011;**21**:145−50.
13. Arabaci R. Attitudes toward physical education and class preferences of Turkish secondary and high school students. *Elem Educ Online* 2009;**8**:2−8.
14. Moore JB, Brinkley J, Crawford TW, Evenson KR, Brownson RC. Association of the built environment with physical activity and adiposity in rural and urban youth. *Prev Med* 2013;**56**:145−8.
15. Harter S. *Manual for the self-perception profile for children*. Denver: University of Denver; 1985 [Dissertation].
16. Muris P, Meesters C, Fijen P. The self-perception profile for children: further evidence for its factor structure, reliability, and validity. *Pers Individ Dif* 2003;**35**:1791−802.
17. Crocker PRE, Bouffard M, Gessaroli ME. Measuring enjoyment in youth sport settings: a confirmatory factor analysis of the physical activity enjoyment scale. *J Sport Exer Psychol* 1995;**17**:200−5.
18. Moore JB, Hanes JC, Duda JL, Yin Z, Gutin B, Barbeau P. Measuring enjoyment of physical activity in young children: validation of the physical activity enjoyment scale. *J Appl Sport Psychol* 2009;**21**:S116−29.
19. Trost SG, Pate RR, Ward DS, Saunders R, Riner W. Correlates of objectively measured physical activity in preadolescent youth. *Am J Prev Med* 1999;**17**:120−6.
20. Crocker PRE, Bailey DA, Faulkner RA, Kowalski KC, McGrath R. Measuring general levels of physical activity: preliminary evidence for the physical activity questionnaire for older children. *Med Sci Sports Exerc* 1997;**29**:1344−9.
21. Janz KF, Lutuchy EM, Wenthe P, Levy SM. Measuring activity in children and adolescents using self-report: PAQ-C and PAQ-A. *Med Sci Sport Exerc* 2008;**40**:767−72.
22. Plasqui G, Bonomi AG, Westerterp KR. Daily physical activity assessment with accelerometers: new insights and validation studies. *Obes Rev* 2013;**14**:451−62.
23. McClain JJ, Abraham TL, Brusseau Jr TA, Tudor-Locke C. Epoch length and accelerometer outputs in children: comparison to direct observation. *Med Sci Sports Exerc* 2008;**40**:2080−7.
24. Evenson KR, Catellier DJ, Gill K, Ondrak KS, McMurray RG. Calibration of two objective measures of physical activity for children. *J Sports Sci* 2008;**26**:1557−65.
25. Sirard JR, Slater ME. Compliance with wearing physical activity accelerometers in high school students. *J Phys Act Health* 2009;**6**(Suppl. 1): S148−55.
26. Joens-Matre RR, Welk GJ, Calabro MA, Russell DW, Nicklay E, Hensley LD. Rural-urban differences in physical activity, physical fitness, and overweight prevalence of children. *J Rural Health* 2008;**24**:49−54.
27. Loucaides CA, Chedzoy SM, Bennett N. Differences in physical activity levels between urban and rural school children in Cyprus. *Health Educ Res* 2004;**19**:138−47.
28. Demetriou Y, Höner O. Physical activity interventions in the school setting: a systematic review. *Psychol Sport Exerc* 2012;**13**:186−96.