ARTICLE IN PRESS

Original research

Validation of an observation tool to assess physical activity-promoting physical education lessons in high schools: SOFIT+

Stuart J. Fairclough [a,b,*], R. Glenn Weaver [c], Siobhan Johnson [a], Jack Rawlinson [a]

[a] Department of Sport and Physical Activity, Edge Hill University, UK
[b] Department of Physical Education and Sports Science, University of Limerick, Ireland
[c] Department of Exercise Science, Arnold School of Public Health, University of South Carolina, United States

ARTICLE INFO

ABSTRACT

Objectives: SOFIT+ is an observation tool to measure teacher practices related to moderate-to-vigorous physical activity (MVPA) promotion during physical education (PE). The objective of the study was to examine the validity of SOFIT+ during high school PE lessons.
Design: This cross-sectional, observational study tested the construct validity of SOFIT+ in boys' and girls' high school PE lessons.
Methods: Twenty-one PE lessons were video-recorded and retrospectively coded using SOFIT+. Students wore hip-mounted accelerometers during lessons as an objective measure of MVPA. Multinomial logistic regression was used to estimate the likelihood of students engaging in MVPA during different teacher practices represented by observed individual codes and a combined SOFIT+ index-score.
Results: Fourteen individual SOFIT+ variables demonstrated a statistically significant relationship with girls' and boys' MVPA. Observed lesson segments identified as high MVPA-promoting were related to an increased likelihood of girls engaging in 5–10 (OR = 2.86 [95% CI 2.41–3.40]), 15–25 (OR = 7.41 [95% CI 6.05–9.06]), and 30–40 (OR = 22.70 [95% CI 16.97–30.37]) s of MVPA. For boys, observed high-MVPA promoting segments were related to an increased likelihood of engaging in 5–10 (OR = 1.71 [95% CI 1.45–2.01]), 15–25 (OR = 2.69 [95% CI 2.31–3.13]) and 30–40 (OR = 4.26 [95% CI 3.44–5.29]) s of MVPA.
Conclusions: Teacher practices during high school PE lessons are significantly related to students' participation in MVPA. SOFIT+ is a valid and reliable tool to examine relationships between PE teacher practices and student MVPA during PE.

© 2017 Sports Medicine Australia. Published by Elsevier Ltd. All rights reserved.

1. Introduction

Physical inactivity is observed globally[1] with approximately 20% of adolescents accumulating the recommended 60 min/day of moderate-to-vigorous physical activity (MVPA).[2] An age-related decline in objectively measured MVPA is observed starting as young as 6–7 years [3] with activity levels lowest among adolescents.[4] Age-appropriate physical activity opportunities during school are advocated to enhance the health and wellbeing of students[5] through comprehensive school physical activity programmes.[6] Physical education (PE) is key to such programmes, which aims to influence physical activity participation directly through activity engagement during lessons, and indirectly through development of skills, knowledge, and confidence that can enable lifelong activity participation.[7]

Students' MVPA during PE varies, depending on lesson content,[8] student ability,[8] the teaching environment,[9] and grade level.[10] A recent systematic review reported that high school students spent 40.5% of lesson time in MVPA during PE,[10] which is lower than the 50% threshold recommended in the United Kingdom [12] and United States.[11,12] When MVPA in high school PE is expressed in absolute terms (i.e., minutes), it can however significantly contribute towards adolescents achieving MVPA guidelines.[10] MVPA during PE occurs within a pedagogical context which targets psychomotor, cognitive and affective outcomes.[10] Thus, evaluation of PE quality relative to physical activity promotion requires additional indicators which complement MVPA.

The System for Observing Fitness Instruction Time (SOFIT)[13] is a valid and reliable observation instrument which provides valuable data to inform researchers' and practitioners' understanding of the relationship between PE pedagogy and MVPA engagement

during PE. Recently, SOFIT was modified (SOFIT+) to comprehensively measure teacher practices that both promote and limit MVPA during PE.[14] In addition to Lesson Context, SOFIT+ includes sections to capture Activity Contexts, Teacher Behaviours, and Activity Management (Supplementary file 1). Analysis of 20 US elementary school PE lessons demonstrated that SOFIT+ produced valid and reliable data related to teacher practices for optimising students' MVPA during PE.[14] It is unknown though how applicable SOFIT+ is in high school PE lessons, which can vary from elementary school in respect of structure, activity content, physical environment, and student engagement. The study purpose therefore, was to examine the validity of SOFIT+ during high school PE lessons.

2. Methods

A detailed description of the SOFIT+ instrument is provided elsewhere.[14] In brief, SOFIT+ is a systematic observation instrument designed to capture teacher practices related to students' engagement in MVPA (Supplementary file 1). SOFIT+ consists of two phases: During phase one *Lesson Context* and *Activity Context* are coded, while *Teacher Behaviours* and *Activity Management* variables are captured in phase two. Phases one and two are completed continuously and consecutively in 20-s intervals throughout the entirety of the observed lesson. At the lesson's end an exit checklist is completed to record lesson location, weather, equipment amount and type, and lesson content.

Ethical approval for this cross-sectional study was granted by Edge Hill University's Sport and Physical Activity Department Research Ethics Committee (SPA-REC-2015-367). Informed consent was collected from eight PE teachers from a convenience sample of two high schools located in medium-high socioeconomic-status and urban areas of West Lancashire, northwest England. Students in school years 7–9 (11–14 years old) were then invited to participate, after which passive informed assent (students) and consent (parents) were obtained. Twenty-one single-gender PE lessons (i.e., only girls or only boys) taught by the usual teacher were observed over nine school days from January–February 2017.

On observation days, upon arrival to PE class, each student received an ActiGraph GT3x+ accelerometer (ActiGraph; Pensacola, FL) set to record at 30 Hz, which was attached to their right hip via an elastic belt. The time that the teacher commenced teaching the lesson was noted by a research assistant. Students then participated in their normally scheduled PE lessons, which were video-recorded using a tripod-mounted GoPro HERO4 camera (GoPro; San Mateo, CA) which captured the entire teaching area. At the end of the lesson, the time was recorded and the accelerometers were collected. SOFIT+ observations were completed via Pendragon Forms Universal© on a Samsung Galaxy Tablet© by viewing the videos. Two lessons were lost due to failed audio recording and accelerometer malfunction, leaving 19 PE lessons in the final sample.

Two trained observers completed all SOFIT+ observations. Training was conducted via Skype (Microsoft; Redmond, WA) by the second author, and consisted of classroom training and video analysis. During the 60 min classroom training observers reviewed the study protocols, familiarised themselves with the SOFIT+ instrument, committed observational codes to memory, and practiced coding video recorded PE lessons. During video analysis the observers practiced coding SOFIT+ training videos of PE lessons. The criterion for inter-rater agreement was set at ≥80% using interval-by-interval agreement for each category.[15] To establish initial reliability both observers coded SOFIT+ training videos until the criterion percent agreement was met for each instrument code (i.e., eight lessons coded). Both observers were proficient in the use of SOFIT+ after approximately 14 h of training, after which, data

collection in the schools commenced. During the data collection period seven additional lessons, which were included in the sample for this study, were coded by both observers independently, to ensure observer drift did not occur.[15]

Content validity of the SOFIT+ variables (representing teacher practices) has been established previously in elementary schools;[14] this study explored the relationship between the SOFIT+ variables and high school students' accelerometer-derived MVPA. The presence or absence of teacher practices was compared to MVPA using the time-stamped aligned data. One SOFIT+ scan was completed every 40 s (i.e., 20 s to complete phases one and two, respectively) with data from one accelerometer epoch collected every 5 s. This created 40 s segments where one SOFIT+ scan and eight 5 s accelerometer epochs aligned. To test the construct validity of the SOFIT+ instrument in high PE lessons, two methods were used. First, the individual MVPA-promoting practices were examined in relation to students' MVPA. Second, an index-score, representing the total number of MVPA-promoting practices, was created for each 40 s segment. The process to create the index-score described in the original SOFIT+ study[14] is briefly described here: the index-score included the *Lesson Context*, *Activity Context*, and *Teacher Behaviour* variables. However, Fitness, Skill Practice, Game Play, and Free Play were not included as they overlap conceptually with the broader Motor Content *Lesson Context*. Thus, 16 variables were included in the index-score for a possible range of scores of 0 (i.e., all MVPA-limiting variables and no MVPA-promoting variables present) to 16 (i.e., all MVPA-promoting variables and no MVPA-limiting variables present). The creation of the index-score allows assessment of the relationship between overall MVPA supportiveness in each 40 s segment and students' MVPA. Similar to the original SOFIT+ study, the limited number of lessons included in this study did not allow for the examination of their effect on student MVPA, because variables in the Activity Management section are hypothesised to have an effect on students' MVPA at a lesson level.[14]

Accelerometer data were downloaded using Actilife (v 6.13.3, ActiGraph; Pensacola, FL). Wear time was checked then data were scored using the lesson start and end time filters, with PE lesson MVPA calculated from vertical axis counts.[16] All statistical analyses were completed using STATA (v.14.2, College Station, TX). General descriptive statistics were calculated for SOFIT+ variables and accelerometer derived activity data for students. To examine construct validity, all SOFIT+ variables were collapsed into 40 s segments (i.e., one SOFIT+ scan per segment) with each variable dichotomized as present or not present. MVPA data was then stratified into four categories: no MVPA, 5–10 s of MVPA, 15–25 s of MVPA, and 30–40 s of MVPA. The likelihood of students engaging in each category (i.e., 5–10 through 30–40 s of MVPA) when a teacher practice was recorded simultaneously was then estimated using multinomial logistic regression with students engaging in no MVPA as the referent group. The 40 s segments were then divided into two groups: high and low MVPA promotion. High MVPA promotion was defined as an index-score at or above the median score, with low as below the median score. Multinomial logistic regression models estimated the relationship of the index-score to students' engagement in 5–10, 15–25, and 30–40 s of MVPA. All statistical models were run separately for boys and girls and accounted for clustering of scans within children.

3. Results

A total of 225 students (117 boys) were observed across the 19 PE lessons (10 boys' lessons). Girls and Boys lessons lasted for 34.1 (±2.1) and 38.2 (±4.2) min on average, respectively. Boys accumulated 11.9 (±4.5) and girls 11.0 (±4.5) min of MVPA on average. Lesson content included soccer (n = 5), rugby (n = 2), and handball