Preventive Medicine Reports 23 (2021) 101472

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/pmedr

Socio-ecological correlates of physical activity in a nationally representative sample of adolescents across Ireland and Northern Ireland

Catherine B. Woods [a,b,*], Emmet Crowley [a,b], Cormac Powell [a,c], Wesley O'Brien [d], Marie H. Murphy [e], Sarahjane Belton [f], Jean Saunders [g], Sinead Connolly [e], Orlagh Farmer [d], Kwok Ng [a,b,h]

[a] Physical Activity for Health, Health Research Institute, Ireland
[b] Department of Physical Education and Sport Sciences, University of Limerick, Ireland
[c] High Performance Unit, Sport Ireland National Campus, Dublin, Ireland
[d] School of Education, Sports Studies and Physical Education Programme, University College Cork, Ireland
[e] Sport and Exercise Sciences Research Institute, Ulster University, United Kingdom
[f] School of Health and Human Performance, Dublin City University, Ireland
[g] Claddagh Statistical Consultancy Services, Shannon & CSTAR@UL, University of Limerick, Ireland
[h] School of Educational Sciences and Psychology, University of Eastern Finland, Finland

ARTICLE INFO

Keywords:
Teenagers
Physical activity
Socio-ecological model
Cross-sectional
Social support
Sport
Physical education
Active transport
Exercise
School type

ABSTRACT

Physical activity (PA) is associated with a range of health benefits for adolescents. Few adolescents meet one hour daily of moderate-to-vigorous physical activity (MVPA). The World Health Organisation (WHO) now recommends an 'on average' accumulation. In light of these updates, comparing correlates associated with meeting versus not meeting the PA guidelines provides limited understanding of adolescent behavioural choices. The aim of this study was to fractionate PA behaviour and investigate influential socio-ecological correlates across a diverse range of PA categories. A nationally representative sample (N = 6,563; age = 13.5 ± 1.9 years; male = 46.2%) completed a researcher supervised self-report survey. Empirically established instruments assessing the socio-ecological correlates of PA were included. Levels of MPVA were categorised into *daily active* (60mins. MVPA.daily), *active* (60mins.MVPA.5–6 days), *somewhat active* (60mins.MVPA.3–4 days) or *inactive* (60mins. MVPA.0–2 days). Descriptive statistics, chi-square analyses and multivariate blockwise binary logistic regression models were run separately for each PA category. Few were daily active (12.7%), 33.6% active, 36.5% somewhat active and 17.2% were inactive. Results showed that correlates differed in terms of direction and strength, depending on individual activity status. Increasing age was positively associated with being somewhat active, but not with being active or daily active. Attending an 'all-girls school' was negatively associated with daily active. High interpersonal support from family, friends or teachers was negatively associated with inactive or somewhat active, reducing the likelihood of adolescents remaining in these unhealthy PA categories. This novel information is useful for exploring previously established inconsistent relationships with PA. More sensitive categorisation and intervention tailoring to diverse PA categories is required.

1. Introduction

Physical activity (PA) guidelines have been developed and adopted by health authorities worldwide. The World Health Organisation's (WHO) guidelines stipulate that adolescents *should accumulate 'an average of' 60 min of moderate-to-vigorous PA daily (60mins.MVPA.day)* and include activities that strengthen muscle and bone development at least 3 times per week (Bull et al., 2020). Adherence to guidelines is associated with reductions in the prevalence of overweight or obesity, development of cardiovascular disease, type II diabetes, reduced depression and anxiety (Pascoe et al., 2020), improvements in school performance and academic achievement (Carlin et al., 2017), and psychosocial health benefits (Eime et al., 2013). Yet, global figures approximate only 20% meet daily MVPA guidelines (Hardy et al., 2017;

* Corresponding author at: Physical Activity for Health Research Cluster, Health Research Institute, Department of Physical Education and Sport Sciences, University of Limerick, Limerick V94 T9PX, Ireland.
E-mail address: Catherine.Woods@ul.ie (C.B. Woods).

https://doi.org/10.1016/j.pmedr.2021.101472
Received 29 October 2020; Received in revised form 18 May 2021; Accepted 23 June 2021
Available online 28 June 2021

Guthold et al., 2020). Intervention is needed, which requires a better understanding of correlates of PA behaviour (Sterdt et al., 2014).

The social ecological model (SEM) provides a useful framework for examining PA correlates (Sallis et al., 2015). Conceptually, concentric circles identify spheres of proximal to distal influences on PA, however the model is limited to how its levels of influence interact. Proximal correlates positively associated with adolescent PA include male gender, high socioeconomic status (SES) and parental social support (Sterdt et al., 2014; Van Der Horst et al., 2007). Distal correlates include school- and community-related variables and the physical environment. Schools can make a valuable contribution to meeting PA guidelines (Ferreira et al., 2007), as physical education (PE) and school sport (outside of curriculum time) provide up to 50% of its time in MVPA (Curtner-Smith et al., 2007). Community sport (non-school clubs) participation is positively associated with PA (Pearson et al., 2014), and known to track across transitional periods in adolescents' lives (Hardie Murphy et al., 2017). Opportunities (generally supervised) to engage in PA (Van Der Horst et al., 2007), access to facilities and recreational areas (Sterdt et al., 2014; Pearson et al., 2014) are also positive correlates. However, examining the correlates of PA behaviour dichotomously (comparing those meeting vs. not meeting daily MVPA guidelines) uses a blunt instrument and provides limited knowledge (Ng et al., 2019) as most adolescents fall into the 'not meeting' category. Given recent amendments to the WHO PA guidelines (Bull et al., 2020), more knowledge is needed to determine if existing correlate patterns differ in terms of their direction (positive, negative, inconsistent), or strength of significant association if analysed across a diverse range of PA behaviour.

The Children's Sport Participation and Physical Activity Study (CSPPA) is a national surveillance system comprising two studies of representative samples of primary and secondary school students across the Republic of Ireland (RoI) (Woods et al., 2010), and most recently including samples from Northern Ireland (NI) (Woods et al., 2019). Consistent with global patterns, CSPPA 2018 found most adolescents did not meet the daily MVPA guidelines (87%), with differences across age, gender, SES, disabilities, and the urban–rural divide. Thus, guided by the SEM, the aim of this study was to examine the demographic, intrapersonal, interpersonal, school- and community-related correlates of PA behaviours on a representative sample of adolescents on the island of Ireland. To build on existing knowledge, the PA categories of *daily active* (60mins.MVPA.7 days), *active* (60mins.MVPA.5–6 days), *somewhat active* (60mins.MVPA.3–4 days) or *inactive* (60mins.MVPA.0–2 days) (Ng et al., 2019) were applied allowing for more sensitive analyses of the socio-ecological correlates salient to adolescents reporting different PA behaviours. This information will provide a comprehensive understanding of the influences on adolescent PA behaviours and inform future intervention development.

2. Methods

CSPPA 2018 was a cross-sectional study and collected data in school settings (Woods et al., 2019). The Research Ethics Committees of the University of Limerick (EHSREC27_11_19), Dublin City University (DCUREC/2017/201) and Ulster University (REC/20/0005) granted ethical approval.

2.1. Procedures

Detailed information on design, protocol and sampling of CSPPA has been published elsewhere (Woods et al., 2019). In brief, the sampling frame involved all primary and secondary schools in the RoI and NI stratified by school gender, SES, location and size. For the RoI, 86 schools were recruited; all CSPPA 2010 schools (N = 114) were re-invited; 65% (n = 74) agreed, 21% (n = 24) declined and 14% (n = 16) could not be contacted or no longer existed, an additional 12 schools were recruited to ensure representativeness. For NI, 51 schools (20 primary, 31 secondary) were invited, of which 29 schools (57% response rate; 9 primary, 20 secondary) were recruited. Within the primary sector, all pupils in the two most senior classes (ages 10–12 years) were invited to take part and within secondary schools, all pupils of a randomly selected year group were invited to participate, capturing the full school intake for that particular year group.

The CSPPA questionnaire (Woods et al., 2010, 2019) was a multi-section, self-report instrument; developmentally appropriate and validated in this population (Woods et al., 2009). The correlates selected are part of a repeated cross-sectional study (CSPPA 2010 and 2018), with the 2018 survey also informed by qualitative research (Tannehill et al., 2015). Questionnaires were completed in school on tablets (Apple iPad 4 or Archos Neon 79b), using the Survey Any Place (Antwerp, Belgium) platform during spring 2018. Questionnaires were completed in small groups (n = 6–35) and were supervised on a 10:1 ratio. Average time to completion was 35 min (range: 28–42 min). Passive parental consent and participant informed assent were obtained prior to taking part in the study.

2.2. Measures

Demographic variables included: gender, age, disability (as measured by the self-report version of the Washington Group Child Functioning Module (yes, no (Mactaggart et al., 2016) and SES (as measured through a child friendly Family Affluence Scale II (FAS) (ICC = 0.75) (Liu et al., 2012) and physical environment factors included school gender (mixed, boys only, girls only), school disadvantage status (as identified by DEIS (delivering equality in schools; RoI) or percent of free school meals (NI),), and location (urban, rural).

2.2.1. Physical activity

A clear definition of frequency, intensity, time and types of PA to meet daily MVPA guidelines was clarified by researchers. Self-reported habitual MVPA was assessed by the number of days during the past 7, and for a typical week, that participants accumulated at least 60 min of MVPA, yielding a composite average of the two items. This measure provides useful comparative data worldwide (Guthold et al., 2020; Biddle et al., 2011; Ng et al., 2020), is reliable (ICC = 0.76) and demonstrates acceptable validity (r = 0.34; n = 235), when compared with accelerometer determined PA (Hardie Murphy et al., 2015; Murphy et al., 2017. Adolescents were categorised as *daily active* (60mins.MVPA.7 days), *active* (60mins.MVPA.5–6 days), *somewhat active* (60mins.MVPA.3–4 days) or *inactive* (60mins.MVPA.0–2 days), with moderate intra-rater reliability scores when categorised into these four groups (r = 0.50) (Ng et al., 2019).

2.2.2. Independent variables

In addition to demographic items, 13 variables were included based on the SEM. Intrapersonal factors included the Physical Activity Enjoyment Scale (Motl et al., 2001; Woods et al., 2012) and checkbox of six commonly cited barriers to PA (Chadwick, 2012). Interpersonal factors included teacher, family and friend social support (Sallis et al., 2002). Participation in PE, school sport and PA were school-related PA factors. A variable on community sport, and two active transport questions were included as community related PA factors. Supplementary Table 1 provides variable description, groupings for analyses and psychometric properties for all independent variables.

2.3. Data analysis

All data analysis used the IBM Statistical Package for Social Sciences (SPSS V.26.0). Data were weighted by the ratio of the proportion of that respondent's gender within that class/year in the school population to the proportion of that respondent's gender within that class/year in the survey sample. Information for weighting was obtained from the Department of Education and Skills (RoI) and the Department of Education Northern Ireland (NI) and is presented elsewhere (Woods et al.,

2019). Missing data was only observed for SES (n = 102, 1.6%). Potential bias from the missing data in the sample was not sufficiently present, as measured through chi-square tests, and these data were removed.

The data were tested for clustering effects at the school level as the main sampling unit. There were 113 schools and through the use of the generalised linear mixed models, the ICC coefficients were calculated against each dichotomous outcome using a random effects intercept model. According to Heck et al. (Heck et al., 2014), 0.05 is often regarded as a conventional threshold for evidence of substantial clustering. There was only indication of clustering effects between low active (0–2 days, ICC = 0.097) and not for the other 3 categories (3–4 days, ICC = 0.009; 5–6 days, ICC = 0.035, 7 days, ICC = 0.048). As no significant clustering effects for the majority of data were found, it was decided not to use multilevel analyses as interpretations may be challenging to report.

Descriptive statistics were calculated for variables across all PA categories to obtain an overview of the sample. Multiple multivariate blockwise binary logistic regression models determined the odds ratios for PA correlates of each PA category based on the SEM. Each PA category was dichotomised whereby each was opposite all other categories, i.e. daily active (7 days) vs others (active, somewhat active, and inactive). Each block represented a model, whereby Model 1 included demographic factors (age, gender, SES, disability, school gender, school disadvantage, school location), model 2, intrapersonal factors (PA enjoyment and barriers to PA), model 3, interpersonal factors (teacher family and friends social support), model 4, school-related PA factors (minutes of PE and school sport) and model 5, community-related PA factors (community sport, active travel to and from school), while controlling for all other variables included at each step. All variables, within models 1–5, were set as categorical covariates. Adjusted odds ratios (OR) were estimated with 95% confidence intervals (CI) and Nagelkerke R Square were included to describe the strength of the model.

3. Results

Of the participants (N = 6,563; age = 13.5 ± 1.9 years; range = 10–20-year olds, male = 46.2%), 12.7% were categorised as daily active, 33.6% were active, 36.5% somewhat active and 17.2% inactive. More males were daily active (male = 60.3%, female = 39.7%, $p < 0.001$), more females were inactive (male = 38.7%, female = 61.3%, $p < 0.001$) or somewhat active (male = 42.8%, female = 57.2%, $p < 0.001$); whereas in the active category, the differences were not statistically significant (Table 1). As age increased, PA levels decreased ($p < 0.001$), as SES increased PA levels increased ($p < 0.001$). More participants with disabilities were in the inactive category than any other group ($p < 0.001$). Girls only schools ($p < 0.001$), school disadvantage ($p < 0.01$) and urban schools ($p < 0.001$) had the highest proportion in the inactive category.

Low perceptions of PA enjoyment were highest in inactive, and high perceptions of enjoyment were highest in daily active categories ($p < 0.001$; Fig. 1). The barrier 'not enough time' (34%; $p = 0.02$) was highest across all PA categories, followed by 'not good enough' (13%; $p < 0.001$) and 'no suitable activities offered' (12%; $p < 0.001$). Barriers were highest in the inactive category and decreased as PA increased (Fig. 2). There were variations in perceptions of social support provided by teachers ($p < 0.001$), family ($p < 0.001$) and friends ($p < 0.001$). Among adolescents who perceived low social support, the majority were inactive or somewhat active (family = 77%; friends = 74% and teachers = 66%). The opposite was true for high perceptions of high social support, with the majority in active or daily active (Fig. 3). See Supplementary Table 2 for detailed results.

The school- and community-related PA correlates showed the largest proportion of those who reported 'never' taking part in school sport (61%; $p < 0.001$) or 'never' taking part in community sport' (78%; $p < 0.001$) were in the inactive category. Furthermore, the greatest proportion of participants engaging in active travel to ($p < 0.001$), and from ($p < 0.001$) school were in the daily active category, whereas car travel was the most prevalent commuting behaviour for both journeys. Although a higher proportion of those in the inactive category reported receiving a minimum duration of PE, no clear pattern across PA categories emerged.

3.1. Model statistics

Results from the final binary logistic regression model (model 5) are reported due to space limitations (see Supplementary Tables 3–7 for models 1–4). There were notable changes in the demographics between models 1–4 and model 5, e.g., disabilities were no longer associated from model 3 onwards, FAS was only associated with high PA. The strength of associations in model 5 are presented individually for demographic (Table 3), intrapersonal, inter-personal factors (Table 4) and school and community-related PA factors (Table 5). Model 5 yielded the largest Nagelkere r-squared values; daily active (r = 0.184), active (r = 0.147), somewhat active (r = 0.122), and inactive (r = 0.324).

Table 1
Prevalence and chi-square test of independence between MVPA categories and demographics.

	Inactive	Somewhat Active	Active	Daily Active	Total	Chi-square
	n = 1129 (17.2%)	n = 2395 (36.5%)	n = 2205 (33.6%)	n = 834 (12.7%)	n = 6563 (100%)	
	%	%	%	%	%	*p-value*
Age (10–11)	15.0	16.6	22.9	29.0	20.0	<0.001
Age (12–13)	18.1	24.7	31.4	32.1	26.8	
Age (14–15)	29.5	28.2	26.2	21.4	26.9	
Age (16–20)	37.3	30.5	19.5	17.4	26.3	
Gender (Female)	61.3	57.2	49.9	39.7	53.2	<0.001
Gender (Male)	38.7	42.8	50.1	60.3	46.8	
FAS (Low)	28.8	22.9	18.4	20.6	22.1	<0.001
FAS (Medium)	54.4	60.1	59.5	56.5	58.5	
FAS (High)	16.7	17.0	22.1	23.0	19.4	
School Gender (Mix)	64.9	69.3	71.2	76.0	70.0	<0.001
School Gender (Girls)	26.7	22.1	19.1	14.5	20.9	
School Gender (Boys)	8.4	8.6	9.6	9.6	9.0	
Disadvantaged (No)	88.5	91.0	92.5	91.8	91.2	<0.001
Disadvantaged (Yes)	11.5	9.0	7.5	8.2	8.8	
Location (Urban)	53.1	45.6	41.6	43.0	45.2	<0.001
Location (Rural)	47.0	54.4	58.4	57.0	54.8	
Disability (No)	77.9	84.2	88.7	86.9	15.1	<0.001
Disability (Yes)	22.1	15.9	11.3	13.1	85.0	

Table 2
Prevalence and chi-square test of independence between MVPA categories, school and community-related behavioural variables.

	Inactive n = 1129 (17.2%) %	Somewhat Active n = 2395 (36.5%) %	Active n = 2205 (33.6%) %	Daily Active n = 834 (12.7%) %	Total n = 6563 (100%) %	Chi-square *p-value*
School						
PE (0–30 min)	16.9	12.8	9.7	11.2	12.3	<0.001
PE (31–60 min)	25.8	27.9	30.4	33.8	29.2	
PE (61–120 min)	38.2	41.9	40.7	37.8	40.3	
PE (>121 min)	19.0	17.4	19.3	17.2	18.3	
School Sport (Never/week)	61.3	39.6	25.6	22.2	36.4	<0.001
School Sport (1 day/week)	15.0	15.5	15.3	13.6	15.1	
School Sport (2–3 days/week)	18.1	30.4	28.6	23.8	26.8	
School Sport (>4 days/week)	5.6	14.5	30.5	40.4	21.8	
Community						
Community Sport (Never/week)	77.9	44.4	26.3	19.5	40.9	<0.001
Community Sport (1 day/week)	8.0	9.7	6.9	6.8	8.1	
Community Sport (2–3 days/week)	12.5	35.1	30.0	24.5	28.1	
Community Sport (>4 days/week)	1.7	10.8	36.8	49.2	22.9	
Travel To (Car)	41.4	47.4	45.3	45.3	45.4	<0.001
Travel To (Mixed Mode)	31.5	29.9	26.5	22.7	28.1	
Travel To (Active)	27.2	22.8	28.2	32.0	26.5	
Travel From (Car)	32.7	37.2	39.3	37.8	37.2	<0.001
Travel From (Mixed Mode)	34.9	32.7	27.9	23.8	30.4	
Travel From (Active)	32.4	30.1	32.8	38.5	32.5	

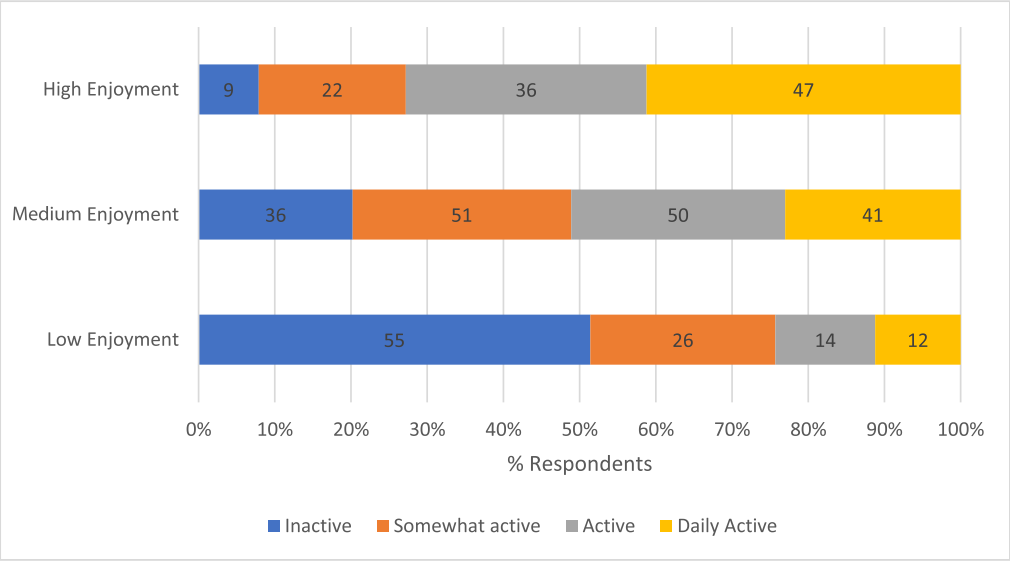

Fig. 1. Perceptions of PA enjoyment by MVPA categories.

3.1.1. Daily active (60mins.MVPA.7 days)

The correlates with positive associations with daily PA were male gender (Table 3), high PA enjoyment, medium to high family social support, high friends social support (Table 4), participation in school- and community-sport (4 + days/week) and actively commuting home from school (Table 5). Being aged 14–15-year-olds and attending a girls-only school were negatively associated with daily active.

3.1.2. Active (60mins.MVPA.5–6 days)

Correlates positively associated with active PA were SES (both medium and high) (Table 3), medium and high levels of enjoyment, medium and high family and friends social support (Table 4), and all types of school- and community-related factors (Table 5). Positive school-related correlates included PE (≥121 min/week had the highest ORs), school sport (of 1 day, 2–3 or 4 + days/week, with 4 + having the highest OR). Positive community-related correlates were community sport (of 2–3 or 4 + days/week, with the OR for 4 + the highest) and active commuting to school. Three variables negatively associated with active PA were age (16–20-year-olds), attending a school that was designated disadvantaged, and the barrier 'no suitable sports/activities that I like were available' (OR 0.77, CI: 0.6–0.9).

3.1.3. Somewhat active (60mins.MVPA.3–4 days)

Correlates positively associated with somewhat active PA were age (14–15- and 16–20-year-olds), attending a designated disadvantaged school (Table 3), friends (medium) social support, the barrier "no suitable sports/activities that I like were available " (OR 1.53, CI 1.24–1.90; Table 4) and community sport (1 day/week (OR 1.29, CI 1.06–1.59) or 2–3 days/week (OR 1.38, CI 1.20–1.59)) (Table 5). Negative associations were male gender, high teacher social support (OR 0.82, CI 0.69–0.97), school sport (4 + days/week; OR 0.70, CI 0.59–0.82), community sport (4 + days/week; OR 0.40, CI 0.34–0.49) and active travel to school (OR 0.63, CI 0.52–0.76), but not from school.

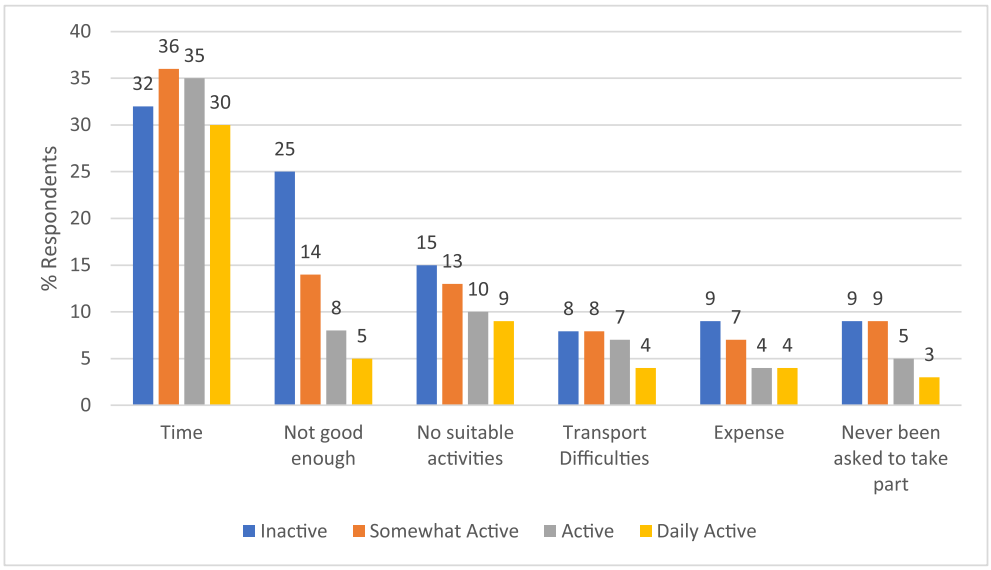

Fig. 2. PA barriers by MVPA categories.

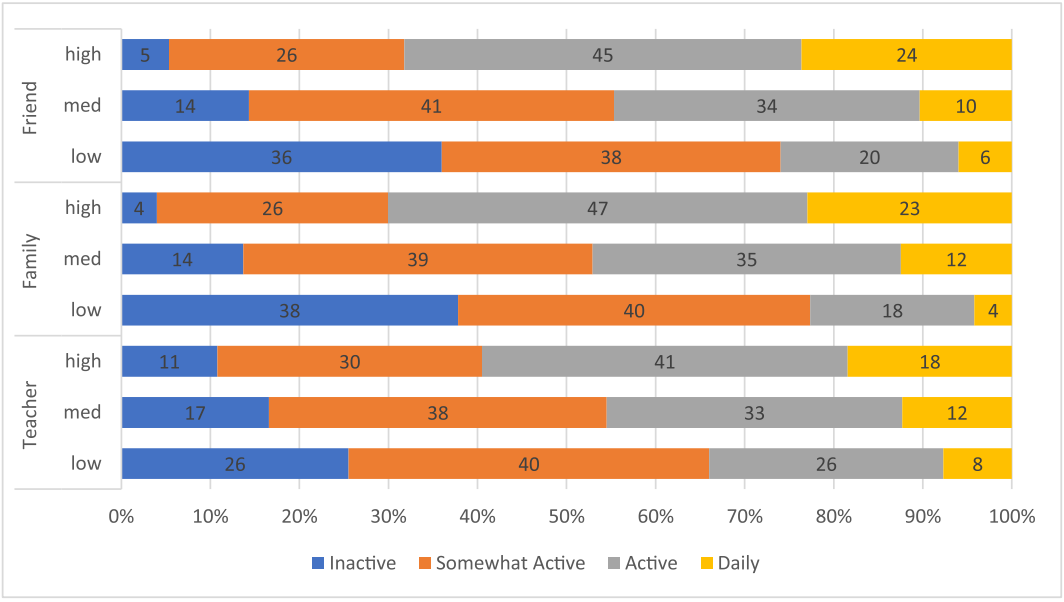

Fig. 3. Perceptions of Teacher, Family and Friend Social Support by MVPA categories.

3.1.4. Inactive (60mins.MVPA.0–2 days)

Correlates positively associated with inactive PA were attending a designated disadvantaged school (Table 3). All other associations were negative. These included age (12–13- and 14–15-year-olds), male gender, PA enjoyment (medium and high), and both family and friends social support (medium and high). Also, PE (31–60 min), school sport (2–3 or 4 + days/week), community sport (1, 2–3 or 4 + days/week) and active travel home from school were negatively associated. The ORs of being in the inactive category reduced by 31% by participating in community sport even once a week (Table 2).

4. Discussion

Active adolescents are likely to become active adults (Hallal et al., 2006), thus strategies for attenuating the PA decline in this age group are needed (Dumith et al., 2011). For this, detailed information on the correlates positively and negatively associated with PA behaviour are essential. Common approaches to PA correlate investigations have compared adolescents who meet daily PA guidelines against those who do not (Connolly et al., 2020; Mehtälä et al., 2020), yet being physically active on a daily basis is a challenge for adolescents nationally and globally (Guthold et al., 2020), one that is reflected in current WHO PA guidelines (Bull et al., 2020). Therefore, this study provided a more nuanced investigation by fractionating PA behaviour and examining the socio-ecological correlates associated with those who were daily active and adding three other categories with decreasing levels of PA 'active', 'somewhat active' and 'inactive'. Findings add novel information, useful for exploring previously established inconsistent relationships (Sterdt et al., 2014; Van Der Horst et al., 2007; Sallis et al., 2000; Biddle et al., 2005; Amornsriwatanakul et al., 2020). For example, previous research found 'no association' between enjoyment and PA (Sterdt et al., 2014; Van Der Horst et al., 2007), our results suggest that this may be too simplistic an interpretation as we found that the PA enjoyment relationship differed in terms of its direction (positive or negative) and its

Table 3
Adjusted odds ratios (OR) with 95% confidence intervals between MVPA categories and demographic factors, Model 5.

	Inactive	Somewhat active	Active	Daily active
	OR's (95% CI)	OR's (95% CI)	OR's (95% CI)	OR's 95% CI
Age (10–11)	1	1	1	1
Age (12–13)	**0.62 (0.47–0.81)**	1.17 (0.98–1.40)	1.01 (0.85–1.20)	0.94 (0.75–1.18)
Age (14–15)	**0.73 (0.56–0.96)**	**1.36 (1.13–1.65)**	0.91 (0.75–1.10)	**0.75 (0.57–0.97)**
Age (16–20)	0.81 (0.61–1.06)	**1.52 (1.26–1.85)**	**0.72 (0.59–0.88)**	0.79 (0.59–1.04)
Gender (Female)	1	1	1	1
Gender (Male)	**0.82 (0.68–0.99)**	**0.78 (0.69–0.89)**	1.11 (0.97–1.27)	**1.73 (1.43–2.10)**
FAS (Low)	1	1	1	1
FAS(Medium)	0.89 (0.75–1.06)	1.02 (0.90–1.17)	**1.15 (1.00–1.33)**	0.84 (0.68–1.03)
FAS(High)	0.97 (0.76–1.22)	0.88 (0.74–1.05)	**1.22 (1.02–1.45)**	0.90 (0.70–1.15)
School Gender (Mix)	1	1	1	1
School Gender (Girls)	1.10 (0.77–1.59)	1.41 (1.08–1.82)	0.86 (0.66–1.12)	**0.65 (0.44–0.96)**
School Gender (Boys)	0.86 (0.68–1.07)	1.13 (0.95–1.33)	0.89 (0.74–1.05)	1.10 (0.84–1.44)
Disadvantaged (No)	1	1	1	1
Disadvantaged (Yes)	**1.42 (1.09–1.83)**	**1.24 (1.01–1.51)**	**0.79 (0.64–0.98)**	0.80 (0.60–1.09)
Location (Urban)	1	1	1	1
Location (Rural)	1.13 (0.94–1.37)	1.02 (0.90–1.17)	1.04 (0.91–1.19)	0.86 (0.71–1.04)
Disability (No)	1	1	1	1
Disability (Yes)	1.07 (0.88–1.29)	1.02 (0.88–1.19)	0.87 (0.74–1.03)	1.19 (0.94–1.51)

Note. Data highlighted in bold denotes statistically significant correlates to MVPA at $p < 0.05$.

strength depending on the individual's activity status. As the effectiveness of PA interventions for adolescents is being questioned (Hartwig et al., 2021; Love et al., 2019), this more holistic approach to correlate investigation that accounts for individual activity status may highlight realistic and acceptable intervention strategies especially for the hard-to-reach groups.

Our analysis found more adolescents reported being 'somewhat active' or 'active' than 'daily active'. Examining the demographic correlates, consistent with existing research, age, gender and SES were significantly related to PA (Guthold et al., 2020; Sterdt et al., 2014; Van Der Horst et al., 2007; Biddle et al., 2005). However, this research provides more in-depth information as we established that more adolescents aged 14-years-or older reported participating in PA 3–4 days a week than 5, 6 or 7 days a week. Intervention developers should be cognisant of this, and informed by the revised WHO guidelines, where minutes can be accrued 'on average' rather than a daily requirement (Bull et al., 2020), could consider tailoring the frequency of PA. An intervention request for a 3–4-day commitment may be more acceptable and cater for the competing priorities -such as examination preparation, part-time jobs etc. that older adolescents face.

Females in RoI/NI were less likely to be physically active daily than males, supporting previous research (Költő et al., 2020; Farmer et al., 2018) and attending 'girls only' schools was found to widen the gender gap. While gender differences in PA are well established, much less is known about the influence of single sex versus coeducational schools on PA. Research favours coeducational PE classes over 'girls only' for minutes of MVPA (McKenzie et al., 2004), similar research should be undertaken to evaluate the impact of school gender on PA. Our analyses

Table 4
Adjusted odds ratios (OR) with 95% confidence intervals between MVPA categories, intra- and interpersonal factors, Model 5.

	Inactive	Somewhat Active	Active	Daily Active
	OR's ((95% CI)	OR's (95% CI)	OR's (95% CI)	OR's (95% CI)
PA Enjoyment (Low)	1	1	1	1
PA Enjoyment (Medium)	**0.48 (0.41–0.57)**	1.24 (1.08–1.43)	**1.59 (1.36–1.87)**	1.16 (0.89–1.50)
PA Enjoyment (High)	**0.35 (0.26–0.46)**	1.03 (0.86–1.24)	**1.62 (1.33–1.96)**	**1.64 (1.23–2.19)**
I have not enough spare time (No)	1	1	1	1
I have not got enough spare time (Yes)	0.85 (0.72–1.01)	1.02 (0.90–1.14)	1.06 (0.94–1.20)	0.97 (0.81–1.16)
I am not good enough at sport (No)	1	1	1	1
I am not good enough at sport (Yes)	1.08 (0.89–1.30)	0.94 (0.80–1.11)	1.01 (0.83–1.23)	0.77 (0.53–1.09)
No suitable sports/ activities that I like were offered (No)	1	1	1	1
No suitable sports/ activities that I like were offered (Yes)	0.88 (0.67–1.16)	**1.53 (1.24–1.90)**	**0.77 (0.60–0.99)**	0.67 (0.44–1.02)
Transport difficulties prevent me from playing/ exercising more (No)	1	1	1	1
Transport difficulties prevent me from playing/ exercising more (Yes)	0.82 (0.62–1.08)	1.01 (0.82–1.25)	1.33 (1.06–1.66)	0.75 (0.51–1.10)
I have never been asked to take part (No)	1	1	1	1
I have never been asked to take part (Yes)	0.95 (0.77–1.18)	0.97 (0.82–1.14)	1.01 (0.85–1.21)	1.04 (0.79–1.36)
Too expensive to do sport (No)	1	1	1	1
Too expensive to do sport (Yes)	0.94 (0.71–1.24)	1.10 (0.88–1.38)	0.83 (0.64–1.08)	1.34 (0.90–1.99)
Teacher Social Support (Low)	1	1	1	1
Teacher Social Support (Medium)	0.92 (0.77–1.10)	1.01 (0.88–1.16)	0.97 (0.83–1.13)	1.11 (0.88–1.41)
Teacher Social Support (High)	0.89 (0.70–1.14)	**0.82 (0.69–0.97)**	1.12 (0.94–1.34)	1.20 (0.92–1.56)
Family Social Support (Low)	1	1	1	1
Family Social Support (Medium)	**0.68 (0.57–0.81)**	1.12 (0.96–1.30)	**1.26 (1.06–1.50)**	**1.74 (1.28–2.38)**
Family Social Support (High)	**0.43 (0.30–0.61)**	0.86 (0.70–1.05)	**1.41 (1.14–1.75)**	**2.04 (1.44–2.91)**
Friends Social Support (Low)	1	1	1	1
Friends Social Support (Medium)	**0.66 (0.56–0.79)**	**1.28 (1.11–1.49)**	**1.29 (1.10–1.53)**	0.93 (0.71–1.21)
Friends Social Support (High)	**0.55 (0.41–0.74)**	0.94 (0.78–1.14)	**1.24 (1.02–1.52)**	**1.50 (1.12–2.00)**

Note. Data highlighted in bold denotes statistically significant correlates to PA.

suggest that medium to high SES was correlated with high levels of PA supporting previous research (Chzhen et al., 2018); additionally, attending a disadvantaged school was associated with 'inactive' and 'somewhat active'. Disabilities were associated with PA in models 1 and 2, but in the final model, and after including interpersonal, school- and community-related factors, these associations were no longer significant, reinforcing the need to focus on contextual factors interacting with body functions in a biopsychosocial model such as the International Classification of Functioning, Disability and Health (WHO, 2001) when considering disabilities. This was unexpected as levels of PA are generally lower among students with disabilities than peers without disabilities. One further consideration with these results are that data were collected from general schools and previous reports have shown differences in PA were detectable only when general school data from 15 countries were combined (Ng et al., 2017). In summary, targeting females and adolescents from low SES backgrounds and giving consideration to contextual factors, particularly school type is vital to addressing current and future inactivity (Eime et al., 2013; Liu et al., 2012; Gavin et al., 2014; Harrington et al., 2016; Craike et al., 2018.

Table 5
Adjusted odds ratios (OR) with 95% confidence intervals for the associations between MVPA categories and behavioural variables, Model 5.

School	Inactive	Somewhat active	Active	Daily active
	OR's (95% CI)	OR's (95% CI)	OR's (95% CI)	OR's (95% CI)
PE (0–30 min)	1	1	1	1
PE (31–60 min)	**0.76 (0.59–0.99)**	0.93 (0.77–1.12)	**1.28 (1.05–1.56)**	1.06 (0.81–1.39)
PE (61–120 min)	0.82 (0.65–1.05)	0.96 (0.80–1.15)	**1.24 (1.02–1.51)**	1.01 (0.77–1.33)
PE (>121 min)	0.98 (0.75–1.29)	0.81 (0.66–1.00)	**1.43 (1.15–1.79)**	1.00 (0.73–1.37)
School Sport (Never/ week)	1	1	1	1
School Sport (1 day/week)	0.84 (0.67–1.04)	0.94 (0.80–1.11)	**1.25 (1.05–1.49)**	1.14 (0.87–1.48)
School Sport (2–3 days/ week)	**0.75 (0.61–0.92)**	1.12 (0.97–1.29)	**1.20 (1.03–1.39)**	0.99 (0.78–1.25)
School Sport (>4 days/ week)	**0.38 (0.29–0.52)**	**0.70 (0.59–0.82)**	**1.52 (1.30–1.79)**	**1.66 (1.33–2.08)**
Community				
Community Sport (Never/ week)	1	1	1	1
Community Sport (1 day/ week)	**0.69 (0.53–0.91)**	**1.29 (1.06–1.59)**	1.02 (0.82–1.28)	1.32 (0.94–1.86)
Community Sport (2–3 days/week)	**0.37 (0.30–0.46)**	**1.38 (1.20–1.59)**	**1.32 (1.13–1.54)**	1.16 (0.91–1.48)
Community Sport (>4 days/week)	**0.08 (0.05–0.13)**	**0.40 (0.34–0.49)**	**2.46 (2.08–2.91)**	**2.75 (2.17–3.50)**
Travel To (Car)	1	1	1	1
Travel To (Mixed Mode)	0.86 (0.64–1.16)	0.93 (0.74–1.16)	1.18 (0.92–1.51)	1.04 (0.71–1.51)
Travel To (Active)	1.26 (0.98–1.63)	**0.63 (0.52–0.76)**	**1.34 (1.11–1.63)**	1.12 (0.86–1.45)
Travel From (Car)	1	1	1	1
Travel From (Mixed Mode)	1.19 (0.87–1.62)	1.01 (0.80–1.27)	0.86 (0.67–1.10)	1.00 (0.69–1.46)
Travel From (Active)	**0.76 (0.59–0.98)**	1.12 (0.93–1.34)	0.89 (0.74–1.07)	**1.35 (1.04–1.75)**

Note. Data highlighted in bold denotes statistically significant correlates to PA.

In analysing SEM intrapersonal correlates, high levels of enjoyment were negatively associated with 'inactive', but positively associated with 'active' and 'daily active' categories thus shedding light on previous inconsistent conclusions, where reviews found that perceived enjoyment had 'no association' (Sterdt et al., 2014; Van Der Horst et al., 2007). We found the adolescent barrier 'no suitable sports/activities that I like' to be positively associated with 'somewhat active' but negatively associated with the 'active' category, again clarifying the need to consider activity status when interpreting previous positive (Mehtälä et al., 2020; Davison and Lawson, 2006) or no associations with PA (Van Der Horst et al., 2007; Ferreira et al., 2007). For interpersonal variables, family social support was a strong positive predictor of PA (Rhodes and Lim, 2018; Rhodes et al., 2019; Murtagh et al., 2018). However, our results expand our understanding of previous inconsistent findings on friends, peers and social norms (Van Der Horst et al., 2007; Ferreira et al., 2007; Sallis et al., 2002, 2000), as the perceived intensity of the social support provided was important. Only high social support was significant, positively associated with 'somewhat active', 'active', and 'daily active' categories, and negatively associated with 'inactive' status. Thus, intervention developers using friends social support as an intervention strategy should aim for high levels of support to minimise the likelihood of inactive adolescents remaining in this category, as medium levels of friends social support showed no association with inactive.

We examined the impact of teacher social support on PA, a poorly understood and under researched correlate (Laird et al., 2016), but necessary to understand the impact of school related factors. Accordingly, high teacher social support was negatively associated with 'somewhat active', implying that adolescents who receive teacher support are significantly less likely to be in this PA category and more likely may be in other activity categories (i.e. daily active, high active or inactive). Our research supports the role of teachers (Bocarro et al., 2012; Morton et al., 2016), but recommends that high levels of support are necessary for intervention design and ideally targeted to low active adolescents. School policies, practices and physical environments need to assist teachers to provide this support.

Analysing school- and community-related factors revealed differences in correlates by adolescent activity status. Participating in PE (even at the lowest level), in school- or community sport reduced the likelihood of adolescents being in the 'inactive' category. The community-related factors were influential for the somewhat active, with participation 1–3 days/week positively associated and 4 + days negatively associated with this PA category. This provides evidence for a pathway that could be maximised for engagement in, but also exit out of the 'somewhat active' category. School-related factors were strongest for the 'active' category, but only the highest level of participation (4 + days) for community and school sport were related to 'daily active'. Adolescents who walked or cycled to school, as opposed to taking the car, were less likely to be in the low active and more likely to be in the high active PA categories, supportive of the role of the daily active commute to school (Jones et al., 2019).

The data were analysed from a cross-sectional self-report survey, and this does not allow for causal relations between the variables. This study examined demographic, intrapersonal, interpersonal, school- and community-related correlates of PA. We recommend the inclusion of additional contextual, physical environment and policy variables for a more holistic SEM analysis. All assessments were supervised by a trained CSPPA research team, participants were encouraged to answer honestly, with anonymity and confidentiality adhered to. Self-reported data used at the population level is reflective of the perceptions of PA, rather than actual movement. Some response bias may be present, however, to minimise this, and to enhance the accuracy of responses, developmentally appropriate and psychometrically valid self-report instruments were used.

5. Conclusion

The level of insufficient PA prevalent in adolescents across the island of Ireland is high and demonstrates that it is a complex problem (Ding et al., 2020). This study concludes that depending on the activity status of the individual, influences on PA behaviour may differ and consequently conclusions of null or inconsistent correlate findings may be too simplistic. More sensitive categorisation of PA is required for fuller, more holistic understanding of adolescent behavioural choices. Consequently, we support the revised PA guidelines where every move counts (Bull et al., 2020), and our additional insights suggest tailoring interventions to the influences across diverse PA categories, going beyond the dichotomy of meeting versus not meeting the daily MVPA guidelines. In addition, to solve complex problems, co-ordinated multiple strategies across government sectors and agencies are required. This points to a comprehensive, systematic approach targeting demographic, intrapersonal, interpersonal, school, community, environment and policy levels - a systems approach (Rutter et al., 2019).

Funding

The Research Team would like to thank Sport Ireland, Healthy Ireland, and Sport Northern Ireland for providing the funding for Children's Sport Participation and Physical Activity Study, 2018.

CRediT authorship contribution statement

Catherine B. Woods: Funding acquisition, Project administration, Methodology, Supervision, Validation, Formal analysis, Writing - original draft, Writing - review & editing. **Emmet Crowley:** Formal analysis, Writing - original draft, Writing - review & editing. **Cormac Powell:** Project administration, Methodology, Supervision, Validation, Writing - review & editing. **Wesley O'Brien:** Project administration, Methodology, Supervision, Validation, Writing - review & editing. **Marie H. Murphy:** Funding acquisition, Project administration, Methodology, Supervision, Validation, Writing - review & editing. **Sarahjane Belton:** Funding acquisition, Project administration, Methodology, Supervision, Validation, Writing - review & editing. **Jean Saunders:** Methodology, Validation, Formal analysis, Writing - review & editing. **Sinead Connolly:** Project administration, Methodology, Supervision, Validation, Writing - review & editing. **Orlagh Farmer:** Project administration, Methodology, Supervision, Validation, Writing - review & editing. **Kwok Ng:** Methodology, Supervision, Validation, Formal analysis, Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The Research Team would like to thank:

- Mr. Peter Smyth, Ms. Elizabeth Doyle, and the CSPPA 2018 Steering Group Committee.
- Colleagues and co-investigators on the CSPPA study, the intern/intra students from UL, DCU, UCC and UU and post-doctoral researchers and staff from Ulster (See CSPPA 2019 report for full list).
- All the schools, teachers, principals and staff who helped make this study possible.
- Finally, the Research Team would like to thank the participants without them, this research would not have been possible.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2021.101472.

References

Amornsriwatanakul, A., Lester, L., Bull, F.C., Rosenberg, M., 2020. Ecological correlates of sport and exercise participation among Thai adolescents: A hierarchical examination of a cross-sectional population survey. J. Sport Health Sci. 1–14.

Biddle, S.J., Whitehead, S.H., O'Donovan, T.M., Nevill, M.E., 2005. Correlates of participation in physical activity for adolescent girls: A systematic review of recent literature. J. Phys. Activity Health 2 (4), 423–434.

Biddle, S.J., Gorely, T., Pearson, N., Bull, F.C., 2011. An assessment of selfreported physical activity instruments in young people for population surveillance: Project ALPHA. Int. J. Behav. Nutr. Phys. Activity 8 (1), 1–9.

Bocarro, J.N., Kanters, M.A., Cerin, E., Floyd, M.F., Casper, J.M., Suau, L.J., McKenzie, T. L., 2012. School sport policy and school-based physical activity environments and their association with observed physical activity in middle school children. Health & Place 18 (1), 31–38.

Bull, F.C., Al-Ansari, S.S., Biddle, S., Borodulin, K., Buman, M.P., Cardon, G., Carty, C., Chaput, J.P., Chastin, S., Chou, R., Dempsey, P.C., 2020. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br. J. Sports Med. 54 (24), 1451–1462.

Carlin, A., Perchoux, C., Puggina, A., Aleksovska, K., Buck, C., Burns, C., Cardon, G., Chantal, S., Ciarapica, D., Condello, G., Coppinger, T., 2017. A life course examination of the physical environmental determinants of physical activity behaviour: a "Determinants of Diet and Physical Activity"(DEDIPAC) umbrella systematic literature review. PLoS One 12 (8), e0182083.

Chadwick, S., 2012. An examination of physical activity participation, sedentary behaviour, health, correlates of physical activity and physical activity enjoyment among Irish adolescents. Masters thesis. Dublin City University, Dublin, Ireland.

Chzhen, Y., Moor, I., Pickett, W., Toczydlowska, E., Stevens, G.W., 2018. International trends in 'bottom-end' inequality in adolescent physical activity and nutrition: Health behaviour in school-aged children (HBSC) study 2002–2014. Eur. J. Public Health 28 (4), 624–630.

Connolly, S., Carlin, A., Johnston, A., Woods, C., Powell, C., Belton, S., O'Brien, W., Saunders, J., Duff, C., Farmer, O., Murphy, M., 2020. Physical activity, sport and physical education in northern ireland school children: A cross-sectional study. Int. J. Environ. Res. Public Health 17 (18), 6849–6866. https://doi.org/10.3390/ijerph17186849.

Craike, M., Wiesner, G., Hilland, T.A., Bengoechea, E.G., 2018. Interventions to improve physical activity among socioeconomically disadvantaged groups: An umbrella review. Int. J. Behav. Nutr. Phys. Activity 15 (43), 1–11.

Curtner-Smith, M., Sofo, S., Chouinard, J., Wallace, S., 2007. Health-promoting physical activity and extra-curricular sport. Eur. Phys. Educ. Rev. 13 (2), 131–144.

Davison, K.K., Lawson, C.T., 2006. Do attributes in the physical environment influence children's physical activity? a review of the literature. Int. J. Behav. Nutr. Phys. Activity 3 (19), 1–17.

Ding, D., Varela, A.R., Bauman, A.E., Ekelund, U., Lee, I.M., Heath, G., Katzmarzyk, P.T., Reis, R., Pratt, M., 2020. Towards better evidence-informed global action: Lessons learnt from the Lancet series and recent developments in physical activity and public health. Br. J. Sports Med. 54 (8), 462–468.

Dumith, S.C., Gigante, D.P., Domingues, M.R., Kohl III, H.W., 2011. Physical activity change during adolescence: a systematic review and a pooled analysis. Int. J. Epidemiol. 40 (3), 685–698.

Eime, R.M., Young, J.A., Harvey, J.T., Charity, M.J., Payne, W.R., 2013. A systematic review of the psychological and social benefits of participation in sport for children and adolescents: Informing development of a conceptual model of health through sport. Int. J. Behav. Nutr. Phys. Activity 10 (1), 1–21.

Farmer, O., Duffy, D., Cahill, K., Lester, D., Belton, S., O'Brien, W., 2018. Enhancing the evidence base for Irish female youth participation in physical activity - the development of the Gaelic4Girls program. Women Sport Phys. Activity J. 26 (2), 111–123.

Ferreira, I., Van Der Horst, K., Wendel-Vos, W., Kremers, S., Van Lenthe, F.J., Brug, J., 2007. Environmental correlates of physical activity in youth – a review and update. Obes. Rev. 8 (2), 129–154.

Gavin, A., Keane, E., Callaghan, M., Kelly, C., Molcho, M., Nic Gabhainn, S., 2014. The Irish health behaviour in school-aged children (HBSC) study, Galway and Dublin: Health Promotion Research Centre. National University of Ireland, Galway and Department of Health, Dublin.

Guthold, R., Stevens, G.A., Riley, L.M., Bull, F.C., 2020. Global trends in insufficient physical activity among adolescents: A pooled analysis of 298 population-based surveys with 1.6 million participants. Lancet Child Adolescent Health 4 (1), 23–35.

Hallal, P.C., Victora, C.G., Azevedo, M.R., Wells, J.C., 2006. Adolescent physical activity and health. Sports Med. 36 (12), 1019–1030.

Hardie Murphy, M., Rowe, D.A., Belton, S., Woods, C.B., 2015. Validity of a two-item physical activity screening measure for assessing attainment of physical activity guidelines in Irish youth. BMC Public Health 15, 1080. https://doi.org/10.1186/s12889-015-2418-6.

Hardie Murphy, M., Rowe, D.A., Woods, C.B., 2017. Impact of physical activity domains on subsequent physical activity in youth: a 5-year longitudinal study. J. Sports Sci. 35 (3), 262–268.

Hardy, L.L., Mihrshahi, S., Bellew, W., Bauman, A., Ding, D., 2017. Children's adherence to health behavior recommendations associated with reducing risk of non-communicable disease. Preventive Med. Reports 8, 279–285.
Harrington, D.M., Murphy, M., Carlin, A., Coppinger, T., Donnelly, A., Dowd, K.P., Keating, T., Murphy, N., Murtagh, E., O'Brien, W., Woods, C., 2016. Results from Ireland north and south's 2016 report card on physical activity for children and youth. J. Phys. Activity Health 13 (s2), S183–S188.
Hartwig, T.B., Sanders, T., Vaconcellos, D., Noetel, M., Parker, P.D., Lubans, D.R., Andrade, S., Ávila-García, M., Bartholomew, J., Belton, S., Brooks, N.E., 2021. School-based interventions modestly increase physical activity and cardiorespiratory fitness but are least effective for youth who need them most: An individual participant pooled analysis of 20 controlled trials. Br. J. Sports Med. Pp.1-10.
Heck, R.H., Thomas, S.L., Tabata, L.N., 2014. Multilevel modeling of categorical outcomes using IBM SPSS, 2nd edition. Routledge, New York.
Jones, R.A., Blackburn, N.E., Woods, C., Byrne, M., van Nassau, F., Tully, M.A., 2019. Interventions promoting active transport to school in children: A systematic review and meta-analysis. Prev. Med. 123, 232–241.
Költő, A., Gavin, A., Molcho, M., Kelly, C., Walker, L., Nic Gabhainn, S., 2020. The Irish health behaviour in school-aged children (HBSC) Study 2018. National University of Ireland Galway, Galway.
Laird, Y., Fawkner, S., Kelly, P., McNamee, L., Niven, A., 2016. The role of social support on physical activity behaviour in adolescent girls: A systematic review and meta-analysis. Int. J. Behav. Nutr. Phys. Activity 13 (1), 79.
Liu, Y., Wang, M., Villberg, J., Torsheim, T., Tynjälä, J., Lv, Y., Kannas, L., 2012. Reliability and validity of family affluence Scale (FAS II) among adolescents in Beijing, China. Child Indic. Res. 5 (2), 235–251.
Love, R., Adams, J., van Sluijs, E.M.F., 2019. Are school-based physical activity interventions effective and equitable? A meta-analysis of cluster randomized controlled trials with accelerometer-assessed activity. Obes. Rev. 20 (6), 859–870.
Mactaggart, I., Cappa, C., Kuper, H., Loeb, M., Polack, S., 2016. Field testing a draft version of the UNICEF/Washington Group Module on child functioning and disability. Background, methodology and preliminary findings from Cameroon and India. Alter 10 (4), 345–360.
McKenzie, T.L., Prochaska, J.J., Sallis, J.F., Lamaster, K.J., 2004. Coeducational and single-sex physical education in middle schools: Impact on physical activity. Res. Q. Exerc. Sport 75 (4), 446–449.
Mehtälä, A., Villberg, J., Blomqvist, M., Huotari, P., Jaakkola, T., Koski, P., Lintunen, T., Mononen, K., Ng, K., Palomäki, S., Sääkslahti, A., 2020. Individual-and environmental-related correlates of moderate-to-vigorous physical activity in 11-, 13-, and 15-year-old Finnish children. PLoS One 15 (6), e0234686.
Morton, K.L., Corder, K., Suhrcke, M., Harrison, F., Jones, A.P., van Sluijs, E.M., Atkin, A. J., 2016. School polices, programmes and facilities, and objectively measured sedentary time, LPA and MVPA: Associations in secondary school and over the transition from primary to secondary school. Int. J. Behav. Nutr. Phys. Activity 13 (54), 1–11.
Motl, R.W., Dishman, R.K., Saunders, R., Dowda, M., Felton, G., Pate, R.R., 2001. Measuring enjoyment of physical activity in adolescent girls. Am. J. Prev. Med. 21 (2), 110–117.
Murphy, J.J., Murphy, M.H., MacDonncha, C., Murphy, N., Nevill, A.M., Woods, C.B., 2017. Validity and reliability of three self-report instruments for assessing attainment of physical activity guidelines in university students. Meas. Phys. Educ. Exerc. Sci. 21 (3), 134–141.
Murtagh, E.M., Barnes, A.T., McMullen, J., Morgan, P.J., 2018. Mothers and teenage daughters walking to health: Using the behaviour change wheel to develop an intervention to improve adolescent girls' physical activity. Public Health 158, 37–46.
Ng, K., Tynjälä, J., Sigmundová, D., Augustine, L., Sentenac, M., Rintala, P., Inchley, J., 2017. Physical activity among adolescents with long-term illnesses or disabilities in 15 European countries. Adapted Phys. Activity Quarter. 34 (4), 456–465.
Ng, K., Hämylä, R., Tynjälä, J., Villberg, J., Tammelin, T., Kannas, L., Kokko, S., 2019. Test-retest reliability of adolescents' self-reported physical activity item in two consecutive surveys. Arch. Public Health 77 (9), 1–8.
Ng, K.W., Sudeck, G., Marques, A., Borraccino, A., Boberova, Z., Vasickova, J., Tesler, R., Kokko, S., Samdal, O., 2020. Associations between physical activity and perceived school performance of young adolescents in health behavior in school-aged children countries. J. Phys. Activity Health 1 (aop), 1–11.
Pascoe, M., Bailey, A.P., Craike, M., Carter, T., Patten, R., Stepto, N., Parker, A., 2020. Physical activity and exercise in youth mental health promotion: A scoping review. BMJ Open Sport Exercise Med. 6 (1), e000677.
Pearson, N., Braithwaite, R.E., Biddle, S.J., van Sluijs, E.M., Atkin, A.J., 2014. Associations between sedentary behaviour and physical activity in children and adolescents: a meta-analysis. Obes. Rev. 15 (8), 666–675.
Rhodes, R.E., Lim, C., 2018. Promoting parent and child physical activity together: Elicitation of potential intervention targets and preferences. Health Educ. Behav. 45 (1), 112–123.
Rhodes, R.E., Spence, J.C., Berry, T., Faulkner, G., Latimer-Cheung, A.E., O'Reilly, N., Tremblay, M.S., Vanderloo, L., 2019. Parental support of the Canadian 24-hour movement guidelines for children and youth: prevalence and correlates. BMC Public Health 19 (1385), 1–12.
Rutter, H., Cavill, N., Bauman, A., Bull, F., 2019. Systems approaches to global and national physical activity plans. Bull. World Health Organ. 97 (2), 162–165.
Sallis, J.F., Prochaska, J.J., Taylor, W.C., 2000. A review of correlates of physical activity of children and adolescents. Med. Sci. Sports Exerc. 32 (5), 963–975.
Sallis, J.F., Taylor, W.C., Dowda, M., Freedson, P.S., Pate, R.R., 2002. Correlates of vigorous physical activity for children in grades 1 through 12: comparing parent-reported and objectively measured physical activity. Pediatric Exercise Sci. 14 (1), 30–44.
Sallis, J.F., Owen, N., Fisher, E., 2015. Ecological models of health behavior. Health Behav. Theory Res. Practice 5, 43–64.
Sterdt, E., Liersch, S., Walter, U., 2014. Correlates of physical activity of children and adolescents: A systematic review of reviews. Health Educ. J. 73 (1), 72–89.
Tannehill, D., MacPhail, A., Walsh, J., Woods, C., 2015. What young people say about physical activity: The Children's Sport Participation and Physical Activity (CSPPA) study. Sport, Educ. Soc. 20 (4), 442–462.
Van Der Horst, K., Paw, M.J.C.A., Twisk, J.W., Van Mechelen, W., 2007. A brief review on correlates of physical activity and sedentariness in youth. Med. Sci. Sports Exerc. 39 (8), 1241–1250.
WHO, 2001. International Classification of Functioning, Disability and Health. World Health Organization, Geneva.
Woods, C.B., Tannehill, D., Quinlan, A., Moyna, N. and Walsh, J. (2010). The children's sport participation and physical activity study (CSPPA). Research Report no. 1. School of Health and Human Performance, Dublin City University and the Irish Sports Council, Dublin, Ireland: Sport Ireland.
Woods, C., Powell, C., Saunders, J.A., O'Brien, W., Murphy, M.H., Duff, C., Farmer, O., Johnston, A., Connolly, S. and Belton, S. (2019). The children's sport participation and physical activity study (CSPPA). Research Report no. 1. Physical Activity for Health, Health Research Institute, Department of Physical Education and Sport Sciences, University of Limerick, Ireland: Sport Ireland.
Woods, C.B., Nelson, N.M., O'Gorman, D.J., Foley, E., Moyna, N.M., 2009. The Take PART study (physical activity research for teenagers): rationale and methods. J. Phys. Activity Health 6 (2), 170–177.
Woods, C.B., Tannehill, D., Walsh, J., 2012. An examination of the relationship between enjoyment, physical education, physical activity and health in Irish adolescents. Irish Educ. Stud. 31 (3), 263–280.