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Associations between socio-economic position and young people's physical activity and sedentary behaviour in the United Kingdom: A systematic scoping review

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3 **Associations between socio-economic position and young people's physical activity and**
4 **sedentary behaviour in the United Kingdom: A systematic scoping review**
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53 **KEY WORDS:** physical activity; sedentary behaviour; socio-economic position; United
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55 Kingdom; children; adolescents
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ABSTRACT

Objectives

The aim of this scoping review was to examine the extent, range and nature of the evidence on the associations between socioeconomic position and young people's physical activity and sedentary behaviours in the UK.

Method

Published English language studies were identified using database (PubMed, SCOPUS, and Web of Science databases) and manual searches up to and including January 2021. Included were observational studies in children and adolescents (5-18 years) from the UK that assessed associations between socioeconomic position and physical activity or sedentary behaviour.

Results

Fifty-seven publications were included in the review; 36 publications (n=19 studies) of children (5-11 years) and 19 publications (n=14 studies) of adolescents (12-18 years), and two that included both children and adolescents. Most studies utilised cross-sectional data from cohort studies and assessed community level socioeconomic position (Index of Multiple Deprivation (IMD); (IMD; 74%, 14 studies of children; 50%, 7 studies of adolescents). Eighteen studies measured physical activity in children (12 (67%) of studies used device-based measures), and 13 studies measured sedentary behaviour, 8 used device-based measures (62%). Eleven studies of adolescents included a measure of physical activity (3 (27%) utilising device-based measures). Ten studies included a measure of sedentary behaviour, nine used self-report and one utilised device-based measures. Among children, the association between socioeconomic position and measures of either physical activity or sedentary behaviour was highly variable. Among adolescents, the associations were varied with the exception of higher family affluence which was consistently associated with higher reported physical activity.

Conclusion

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3 Current evidence on the association between socioeconomic position and physical activity
4 and sedentary behaviour in young people living in the UK is variable in both methodology
5 and findings. Greater consistency in the use and measures of socioeconomic position as well
6 as outcomes of behaviour are required for meta-analyses and study comparisons.
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10 11 12 13 **ARTICLE SUMMARY**

14 15 16 **Strengths and Limitations of this study**

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19 • This is a comprehensive systematic scoping review following the reporting guidelines
20 of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses
21 Extension for Scoping Reviews (PRISMA-ScR).
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24 • This is a first attempt to synthesise literature surrounding socio-economic position
25 and physical activity and sedentary behaviour in children and adolescents in the UK.
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28 • This review has identified several avenues for future research on socioeconomic
29 position and physical activity and sedentary behaviour.
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32 • This review was limited by the lack of consistency in the use and measures of
33 socioeconomic position and behavioural outcomes.
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BACKGROUND

Low levels of physical activity and high levels of sedentary behaviour are key determinants of poor child development, mental health problems, and unfavourable metabolic and cardiovascular disease risk profiles[1-3]. Many young people are not meeting the recommended minimum of 60 minutes of moderate to vigorous intensity physical activity (MVPA) on average per day[4-6] and spend large proportions of the day sitting and engaged in high volumes of screen-based activities[4, 7]. Establishing regular participation in physical activity and reduced sedentary behaviour early in childhood is fundamental for lifelong health and well-being because there is evidence that physical activity declines through childhood into adolescence while sedentary behaviours increase[8, 9]. Furthermore, there is evidence that physical activity and sedentary behaviour during childhood tracks into adolescence and then adulthood[10-12]. Given this evidence, increasing physical activity, and reducing sedentary behaviour in childhood requires targeted public health efforts.

The development of public health interventions, capable of facilitating health-enhancing shifts in physical activity and sedentary behaviours, requires high-quality evidence of the contextual factors that are barriers or enablers of behaviour change. Socioeconomic position, the social and economic factors that influence what positions individuals or groups hold within the structure of a society[13], is recognized as an important determinant of health and wellbeing, in part because it influences people's attitudes, experiences, Behaviors, exposure to health risk factors and access to services and healthy environments[14, 15]. Children who grow up in lower socioeconomic position households have a higher risk of cardiovascular disease[16, 17] and all-cause mortality[18] than children who live in higher socioeconomic position households[19]. In the United Kingdom (UK), children are the most likely demographic group (compared with working age adults and pensioners) to be living in a household with an income below that needed for a minimum socially acceptable standard of living[20]. It has been consistently shown that children of lower socioeconomic position are more likely to become adults with lower socioeconomic position[21]. Furthermore, there is evidence that obesity follows a consistent socioeconomic gradient among children; a recent meta-analysis found children from low socioeconomic backgrounds were 1.4 times more likely to be obese compared with those

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3 from higher socioeconomic backgrounds[22]. Furthermore, recent data from the UK
4 National Child Measurement Programme found a greater prevalence of childhood
5 overweight, obesity[23] and severe obesity[24] in areas of deprivation. In 2018/19, the
6 combined prevalence of overweight and obesity was 24.1% for children living in the least
7 deprived areas, but 41.5% for children living in the most deprived areas. The data also
8 demonstrates that inequality in childhood obesity in the UK is increasing[25].
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15 While there is clear inequality in obesity prevalence[22], the pattern in the physical activity
16 and sedentary behaviours of young people is less clear. In contrast, in adults , higher
17 socioeconomic position is consistently associated with higher levels of physical activity and
18 lower levels of sedentary behaviour[26], and such associations are seen to be important
19 mechanisms linking lower socioeconomic position to poor current and future health[27].
20 Systematic review findings, which are based on a synthesis of studies from multiples
21 countries, suggest that the evidence of an association between socioeconomic position and
22 physical activity in young people is inconsistent and varies depending on the socioeconomic
23 position indicators measured, the country in which they were assessed, and domains of
24 activity assessed[9]. A recent meta-analysis found that young people in high-income
25 countries from lower socioeconomic position backgrounds (classified as paternal/maternal
26 education, occupation, income, socioeconomic status) exhibit higher levels of sedentary
27 behaviours (both screen-based and non-screen-based) compared to those from higher
28 socioeconomic position backgrounds, with the opposite being seen in low-to-middle income
29 countries (LMIC)[28]. Yet another review found no consistent evidence of an association
30 between parent education (one of the most commonly used markers of socioeconomic
31 position with regards to children's health behaviours) and children's sedentary behaviour
32 and physical activity[29]. The mixed evidence may in part be due to varied indicators of
33 socioeconomic position being incomparable across studies and between countries, which is
34 likely particularly the case for composite indicators because they fail to separate out the
35 different domains of SEP, which might have differing influences on the health behaviours.
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56 In the UK there is a clear socioeconomic pattern in child weight status, but whether this
57 socioeconomic patterning is also clear in physical activity and/or sedentary behaviour
58 among young people in the UK has yet to be determined. Thus, the aim of this scoping
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3 review was to examine the extent, range and nature of the evidence on the associations
4 between socioeconomic position and young people's physical activity and sedentary
5 behaviour in the UK for the purpose of scoping this field of study and identifying gaps in the
6 literature to aid the planning of future research.
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10 11 12 13 **METHOD**

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16 This review was conducted as a scoping review as this allows for the extent, range and
17 nature of the literature to be identified[30]. This review was reported according to
18 procedures documented in the Preferred Reporting Items for Systematic reviews and Meta-
19 Analyses extension for Scoping Reviews (PRISMA-ScR) checklist[31]. The review protocol
20 was registered with Prospero (CRD42019139550).
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26 **Search strategy**

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28 Search strategies were built around four groups of keywords: socio-economic position,
29 physical activity, sedentary behaviour, and population. Key terms for socio-economic
30 position were used in combination with key terms for physical activity, sedentary behaviour,
31 and population to locate potentially relevant studies. An example of the search strategies is
32 available on request. PubMed, SCOPUS, and Web of Science databases were searched using
33 the key terms up to and including January 2021. In addition, manual searches of personal
34 files were conducted along with screening of reference lists of previous sedentary behaviour
35 and/or physical activity reviews (e.g.[28, 32]) and identified articles which included the key
36 terms.
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47 **Inclusion criteria**

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49 For inclusion, studies were required to: (i) be a cross-sectional or longitudinal observational
50 study or baseline/control arm of an intervention study; (ii) include school-aged children
51 aged 5-11 years and/or adolescents aged 12-18 years (or a mean age within these ranges)
52 from the UK (or for multi-country studies, provide results that were reported separately by
53 country); (iii) include at least one indicator of socioeconomic position; (iv) include at least
54 one quantitative outcome of either physical activity or sedentary behaviour; (v) report a
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3 quantitative estimate of the association between at least one domain of socio-economic
4 position and one domain of physical activity and/or sedentary behaviour; and (vi) be
5 published in a peer-reviewed journal in the English language up to and including January
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9 2021.

10 11 12 13 **Identification of relevant studies**

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16 Potentially relevant studies, following de-duplication, were selected by (1) screening the
17 titles, (2) screening the abstracts, and (3) if abstracts were not available or provided
18 insufficient data, the full text article was retrieved and screened to determine eligibility. At
19 each stage of the review, any uncertainties in articles were discussed by NP and LBS, all data
20 was managed using EndNote X4 reference manager.
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29 **Data charting process**

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31 For each study that met the inclusion criteria, study characteristics and outcomes of interest
32 were extracted using a pre-established data extraction form in Microsoft Excel. Data were
33 extracted by NP and 20% were double checked by LBS, discrepancies over the data
34 extracted (n=1) were resolved through discussion. Extracted data included: Author and year
35 of publication, name and location of study, study type, sample characteristics (i.e. age,
36 gender, ethnicity, sample size), indicator of socioeconomic position, intensity of physical
37 activity assessed (e.g. moderate physical activity), type of sedentary behaviour assessed
38 (e.g. screen time), measures used for physical activity and sedentary behaviour (e.g.
39 questionnaire or device). While data such as sample size, study type and methods used to
40 assess behaviours were extracted and used for appraisal of the studies included,
41 methodological quality or risk of bias of individual studies was not assessed formally, as is
42 standard practice for scoping reviews[31].
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55 **Synthesising associations between indicators of socioeconomic position and physical** 56 **activity and sedentary behaviour** 57 58 59 60

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3 Identified indicators of socioeconomic position were categorised as community and family
4 level indicators and tabulated to highlight the extent, range and nature of the evidence
5 among children and adolescents respectively. Data were described for each outcome and
6 domain of activity (i.e. moderate activity at lunchtime, vigorous activity after school counts
7 per minute etc.), and for each independent sample or subsample that the study provided
8 data on (i.e. girls and boys, different year groups etc).

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16 Indicators of socioeconomic position and behaviour outcomes and domains were extracted
17 as per the reporting in the study and were tabulated according to method of measurement
18 (i.e. device measured or reported behaviour). Most indicators of socioeconomic position are
19 self-explanatory (e.g. maternal education). However, for clarity, the UK Index of Multiple
20 Deprivation (IMD) is a community level measure of deprivation based on home postcodes.
21 The IMD is an overall measure of multiple deprivation experienced by people living in an
22 area based on indices of deprivation including income, employment, health, education, and
23 crime[33]. IMD is assessed on a continuum of high to low deprivation. A high IMD score
24 indicates high levels of deprivation (i.e. lower socioeconomic position). Furthermore, Family
25 Affluence Scale (FAS) is a multidimensional household socioeconomic position measure
26 reflecting material affluence. The FAS is often referred to as the “assets approach” to
27 measuring the material conditions in the family of a child or adolescent who might not be
28 able to accurately report information about parental income or occupation[34]. The assets
29 approach requires children and/or adolescents to report on family ownership of goods
30 and/or family’s access to services that are required for an acceptable standard of living[35].
31 The FAS score is created by summing across indicators and high FAS is indicative of higher
32 socioeconomic position.
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49 Associations between indicators of socioeconomic position and behaviour were coded as ‘+’
50 for positive associations (e.g. higher deprivation associated with higher physical activity), ‘-’
51 for inverse associations (e.g. higher maternal education associated with lower sedentary
52 time) and ‘0’ for non-statistically significant association.
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58 **Patient and public involvement**

59 Patients and the public were not involved in this review.
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RESULTS

The literature searches identified 6761 unique records of which 57 publications were included (Figure 1). These consisted of 36 publications (n=19 studies (22 samples)) of children (5-11 years) and 19 publications (n=14 studies (20 samples)) of adolescents (12-18 years), and two publications that included both children and adolescents.

Studies of children (5-11 years)

Table 1 describes the characteristics of the included 19 studies of children. Twelve were cohort studies (63%). A third (32%, n=6) were studies representative of the UK or Home Nations (i.e. Wales or England). Overall, almost half of articles (n=15, 43%) were from two studies: the nationally representative Millennium Cohort Study (MCS; n=8 articles), and the Sport, Physical Activity and Eating behaviour: Environmental Determinants study (SPEEDY; n=7 articles), which is representative of the East Anglia region of the UK. Eighteen studies were cross-sectional and 3 studies (16%) longitudinal (some used both designs). Sample sizes ranged from 194 to 11,965 participants. Thirteen indicators of socioeconomic position were employed, with articles within studies utilising different indicators. The most commonly assessed indicators were Index of Multiple Deprivation (IMD; 74%, 14 studies), maternal education (26%, 5 studies), family structure (21%, 4 studies), and parent/partner education (21%, 4 studies). Eighteen studies included a measure of physical activity, of which 12 used device-based measures (67%) and 13 assessed sedentary behaviour, of which 8 were device-based (62%).

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Table 1. Characteristics of studies including children aged 5-11 years

Names of studies including children, by region	Characteristics of studies							
	[Reference] & independent samples	Sample size range	Study design	Indicators of SES	Physical activity measure	Physical activity outcomes assessed	Sedentary behaviour measure	Sedentary behaviour outcome assessed
England/UK representative								
Millennium Cohort Study (MCS)	[36]	N=3717 - 11965 6493	Cross-sectional / Longitudinal	IMD; Family/household income; Family structure; Maternal education; Maternal occupational status; Access to garden; Housing tenure; Cars in use.	Device-measured; self(proxy)-report	GPM; MVPA; VPA; Total activity; % meeting guidelines; Sport/exercise participation; Active transport	Device-measured; self(proxy)-report	Sedentary time; TV viewing; Computer use
	[37]							
	[38] I, II							
	[39]							
	[40]							
	[41]							
	[42]							
[43]								
Health Survey for England	[44]	N=1110-3822	Cross-sectional	IMD; Family/household income; Head of household occupation/occupational class	self(proxy)-report	Out of school PA	Device-measured; self(proxy)-report	Sedentary time; TV viewing; Non-TV sitting; Total sedentary behaviour
	[45] B, G							

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UK Time Use Survey	[46] I	N=1269	Cross-sectional	Maternal employment			self(proxy)-report	TV viewing
Ireland								
Growing-up-in-Ireland	[47]	N=8568	Cross-sectional	Head of household occupation/occupational class; Family structure; Maternal education	self(proxy)-report	PA; PA	self(proxy)-report	TV viewing
	[48]							
Children's Sport Participation and Physical Activity study (CSPPA)	[49] I	N=446	Cross sectional	FAS	Self-report	PA		
Scotland								
Growing-up-in-Scotland	[50]	N=774	Cross-sectional	IMD	Device-measured	PM; Light PA; MVPA	Device-measured	Sedentary time
Other (no name)	[51] I, II	N=1700-1906	Repeated cross-sectional	IMD;	self(proxy)-report	Out of school activity	self(proxy)-report	Screen-time
East Anglia								
The Sport, Physical activity and Eating behaviour, Environmental Determinants in Young People study (SPEEDY)	[52]	N=316-2064	Cross-sectional; Longitudinal	Composite SEP score; IMD; Car ownership; Family structure; Parent education; Home ownership	Device-measured	Light PA; MVPA; VPA;	Device-measured; self(proxy)-report	Sedentary time; Screen-time; Total sedentary behaviour; Non-screen-based
	[53]							
	[54]							
	[55]							
	[56]							
	[9]							
[57]								

								sedentary behaviour
West Yorkshire								
No name	[58]	N=160	Cross-sectional	IMD	Device-measured	Light PA; MVPA	Device-measured	Sedentary time
North-East England								
Gateshead Millennium Study	[59]	N=480	Cross-sectional	Maternal education	Device-measured	MVPA	Device-measured	Sedentary time
North-West England								
SportsLinx	[60]	N=6337	Cross-sectional	IMD	self(proxy)-report	Sport/exercise participation	self(proxy)-report	TV viewing; video game use
Other (no study name)	[61]	N=194-223	Cross-sectional	IMD	Device-measured; self(proxy)-report	MVPA; VPA; Total activity; Active travel		
	[62]							
	[63]							
South-West England								
B-PROACTIV	[64]	N=685-1714	Cross-sectional Longitudinal	IMD; Parent education; Family structure	Device-measured self(proxy)-report	MVPA; Active travel	self(proxy)-report	Screen-viewing
	[65] I, II							
	[66]							
Avon Longitudinal Study of Parents and Children (ALSPAC)	[67]a	N=4813	Cross-sectional	Maternal education	Device-measured	CPM; Light PA; MVPA	Device-measured	Sedentary time
EarlyBird study	[68]	N=300	Longitudinal	IMD	Device-measured	CPM		
Personal and Environmental	[69] B, G	N=552-629	Cross-sectional	IMD; Car ownership;	Device-measured	CPM; Light PA;	Device-measured	Sedentary time

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Associations with Children's Health study (PEACH)	[67]b			family/household income; Maternal education; Parent education		NVPA		
International <i>Study</i> of Childhood Obesity, Lifestyle and the Environment (ISCOLE)	[70]	N=425	Cross-sectional	Parent education	Device-measured	Light PA; MPA; VPA; Meeting MVPA guidelines		
Other (no name)	[71]	N=1307	Cross-sectional	IMD; Free-school meal entitlement	Device-measured	CPM		

Note: B = Boys; G = Girls; I, II = independent samples. For reference 38 I = children aged 5 years, II = children aged 11 years; 46 I = children aged 8-11 years; 49 I = primary school aged children; 51 I = children in 2006 II = children in 2010; 65 I = children age 5-6 years, II = children aged 8-9 years; IMD = Index of Multiple Deprivation; CPM = counts per minute; MPA = moderate physical activity; MVPA = moderate-to-vigorous-physical activity; PA = physical activity; VPA = vigorous physical activity; TV = television

Socio-economic position and physical activity

Table 2 describes the findings for associations with physical activity in children. Twelve indicators of socioeconomic position were examined in association with physical activity, and associations were variable, irrespective of the measure of physical activity (self-report vs device), with many samples within studies showing different results depending on the outcome of behaviour assessed.

IMD was examined in association with device-based physical activity in 8 samples from 7 studies, with reported physical activity in 9 samples from 7 studies. Most samples from studies of device-based physical activity reported no association, whereas the samples with reported physical activity showed mixed results. Maternal education and parent/partner education were examined in association with device-based activity in 4 samples from 4 studies and 2 samples from 2 studies of reported physical activity, respectively. Both family level indicators of socioeconomic position showed inconclusive results with device-based activity (Table 2). The association between family structure and device assessed physical activity was examined in 3 samples from 3 studies. Within 2 samples, there were no associations and within 1 sample there were no associations for weekday and weekend day MVPA and positive associations for CPM, MVPA and meets guidelines.

Studies that examined the association of family/household income (n=1) and maternal employment (n=1) with device measured physical activity reported mixed results that varied by physical activity outcome. Furthermore, one study found an association between higher socioeconomic status (composite score) and lower MVPA and total physical activity. One study found that those children entitled to free school meals had higher levels of school-time physical activity.

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Table 2. Synthesis of the evidence on associations between community and family-level indicators of socioeconomic position and physical activity in children (aged 5-11 years)

Indicator of socioeconomic position	No. of samples (no. of studies)	Device-based PA (n samples [[references] (outcome)])			No. of samples (no. of studies)	Reported PA (n samples [[references] (outcome)])		
		Positive association (+)	Inverse association (-)	No association (0)		Positive association (+)	Inverse association (-)	No association (0)
Community level								
Index of Multiple Deprivation (IMD)	8 (7)	1 [36] (MVPA)	1 [[58] (light PA)]	7 [[61] (MPA and VPA during: school time, out of school, before school, after school, class time, recess time, lunch time), [71] (school-time CPM), [50] (CPM, LPA, MVPA), [68] B, G, [57], [58] (MVPA)]	9 (7)	5 [[61] II (out of school PA), [63] (AT), [45] B, G (out of school PA), [42] (AT)]	3 [[60] (weekend S/E), [66] (AT), [42] (S/E)]	3 [[60] (weekday S/E), [51] I (out of school PA), [62]29 (PA level)]
Family level								
Maternal education	4 (4)	1 [[40] (VPA)]	3 [[67]a (PA, CPM), [67]b (PA), [41]	4 [[59], [36] [67]a (MVPA),	1 (1)	1 [[67] (MPA, VPA)]		

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			(MVPA, CPM, meets guidelines)]	[67]b (MVPA, CPM)]				
Family structure / parental status	3 (3)	1 [[39] (CPM, MVPA, meets guidelines)]		3 [[52] (after school MVPA, weekend MVPA), [37] (CPM), [41] (CPM, MVPA, meets guidelines), [64] (weekday and weekend day MVPA)]		1 (1)	1 [[47] (MVPA)]	1 [[47] (VPA)]
Parent/partner Education	2 (2)		1 [[52] (after school MVPA), [9] (LPA)]	2 [[52] (weekend MVPA), [53] (weekday and weekend VPA), [9] (MVPA), [70] (LPA, MPA, VPA)]		1 (1)	1 [[66] (AT)]	
Family/household Income	1 (1)	1 [[40] (VPA)]	1 [[43] (MVPA)]	1 [[41] (MVPA, CPM, meets guidelines)]		2 (1)	2 [[38] I, II (S/G)]	
Maternal Employment (unemployed/not in full-time employment)	1 (1)	1 [[39] (CPM, MVPA, meets guidelines)]		1 [[37] (CPM)]		1 (1)	1 [[47] (MVPA)]	1 [[47] (VPA)]

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Family Affluence Scale (FAS)	1 (1)			1 [[49] I (meets guidelines)]				
Composite SES score (high SES)	1 (1)		1 [[57] (MVPA and total activity)]					
Free School Meal entitlement	1 (1)	1 [[71] (school-time PA)]						
Home Ownership	2 (2)			2 [[52] (after school and weekend day MVPA), [41] (CPM, MVPA, meets guidelines)]				
Access to a garden	1 (1)			1 [[41] (CPM, MVPA, meets guidelines)]				
Number of cars in use	1 (1)		1 [[41] (CPM, MVPA, meets guidelines)]					

Note: PA = Physical activity; CPM = counts per minute; MVPA = moderate-to-vigorous physical activity; VPA = vigorous physical activity; MPA = moderate physical activity; LPA = light physical activity; S/E = sport/exercise; AT = active travel; B = boys; G = girls.

Note: the number of samples in the summary columns (positive (+), Inverse (-) and No association (0)) will not always add up to the 'no. of samples' if, for example, studies have examined associations between an indicator of SEP and more than one domain of physical activity, and the direction of association is different for each outcome and/or one article has independent samples (i.e. boys and girls) and results differ for each sample.

Socio-economic position and sedentary behaviour

Table 3 presents results for associations with sedentary behaviour in children. Ten indicators of socioeconomic position were examined, and associations were variable, irrespective of the measure of sedentary behaviour (self-report vs device), with many samples within studies showing different results depending on the behaviour assessed.

IMD was examined in 7 samples from 6 studies of device-based sedentary behaviour, and in seven samples from 5 studies of reported sedentary behaviour. The results were mixed and differed within samples depending on the outcome of sedentary behaviour assessed.

Maternal education was negatively associated with device measured sedentary time in 2 out of 3 samples, whereas parent/partner education showed mixed associations.

Family/household income was not associated with device measured sedentary time in all 3 samples but was associated with lower reported sedentary behaviours in 3 samples. Other indicators of socioeconomic position such as composite scores of socioeconomic status, occupational social class, and access to a garden showed mixed results with sedentary behaviour. Car ownership and family structure were consistently unrelated to sedentary behaviour.

Table 3. Synthesis of the evidence on associations between community and family-level indicators of socioeconomic position and sedentary behaviour in children (aged 5-11 years)

Indicator of socioeconomic position	No. of samples (no. of studies)	Device-based sedentary time (n samples [[references] (outcome)])			No. of samples (no. of studies)	Reported sedentary behaviour (summary n samples [[references] (outcome)])		
		Positive association (+)	Inverse association (-)	No association (0)		Positive association (+)	Inverse association (-)	No association (0)
Community level								
Index of Multiple Deprivation (IMD)	7 (6)	3 [[69]B, G (after school ST, weekend ST), [58] (ST)]		6 [[50], [68], [44] [57] (ST), [54] (after school ST, weekend ST), [69]B, G (before school ST, school day ST)]	7 (5)	5 [[50] (weekday VG), [51]I, II (ScrT)]		4 [[44] (TV, non-TV sitting), [60] (weekend TV), [65]I, II (weekday and weekend day ScrT), [42] (TV, C)]
Family level								
Composite SES score	2 (2)	2 [[54] (after school ST, weekend ST), [44] (ST)]		1 [[57] (ST)]	1 (1)	1 [[56] (non-screen SB)]	1 [[56] (total SB)]	1 [[56] (screen-based SB)]
Family/household Income	3 (2)			3 [[69]B, G (after school ST, weekend ST, before school ST,	3 (2)		3 [[44] (TV), [38]I, II (weekday TV viewing, weekday C)]	1 [[44] (non-TV sitting)]

				school day ST), [44] (ST)]				
Occupational social class	2 (2)	1 [[39] (ST)]		1 [[44] (ST)]	2 (2)		2 [[44], [48] (TV)]	1 [[44] (non-TV sitting)]
Parent/partner Education	3 (2)	2 [[69]B (after school ST, school day ST), [69]G (school day ST)]		3 [[53] (ST), [69]B (weekend ST, before school ST, school day ST) [69]G (after school ST, weekend ST, before school ST, school day ST), [9] (ST)]	2 (1)		1 [[65] II (weekday and weekend day ScrT)]	1 [[65] I (weekday and weekend day ScrT)]
Maternal Employment					1 (1)	1 ([66] I (TV)]		
Maternal education	3 (3)	2 [[67]a, b (ST)]		1 [[59] (ST)]				
Family structure / parental status	2 (2)			2 [[54] (after school ST, weekend ST), [39] (ST)]				
Car ownership	3 [2]			3 [[55] (after school ST and weekend ST), [69]B, G (after school ST, weekend ST, before school				

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				ST, school day ST)					
Access to a garden	2 (1)		2 [[69]B, G (after school ST, weekend ST)]	2 [[69]B, G (before school ST, school day ST)]					

Note: ST = sedentary time; TV = television viewing; ScrT = screen-time; SB = sedentary behaviour; VG = video games use; C = computer use; B=boys; G=girls

Note: the number of samples in the summary columns (positive (+), Inverse (-) and No association (0) will not always add up to the 'no. of samples' if, for example, studies have examined associations between an indicator of SEP and more than one domain of physical activity, and the direction of association is different for each outcome and/or one article has independent samples (i.e. boys and girls) and results differ for each sample.

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Studies of adolescents (12-18 years)

Table 4 describes the characteristics of the 14 included studies of adolescents. Eight were cohort studies with 6 studies using data representative of the UK or Home Nations. Five publications (28%) were from the Health Behaviour in School aged Children Study (HBSC) study, 2 from the Avon Longitudinal Study of Parents and Children (ALSPAC) (11%), 2 from the Health Behaviour in Teens study (11%), with the remaining articles from single studies. All studies conducted cross-sectional or repeated cross-sectional analyses, with one also utilising a longitudinal design. Sample sizes ranged from 286 to 16,421. Eight indicators of socioeconomic position were employed. Most frequently assessed was IMD (50%, 7 studies). Twelve studies measured physical activity, of which three (25%) used devices. Ten studies measured sedentary behaviour; 9 used self-report and 1 device-based measurement.

Table 4. Characteristics of studies including adolescents aged 12-18 years

Names of studies including adolescents, by region	Characteristics of studies							
	[Reference] reference numbers of articles & independent samples	Sample size range	Study design	Indicators of SES	Physical activity measure	Physical activity outcome assessed	Sedentary behaviour measure	Sedentary behaviour outcome assessed
England/UK representative								
Project STIL (Sedentary Teenagers and Inactive Lifestyles)	[72] B, G	N=1171	Cross-sectional	IMD; Family structure; Parent occupation	self(proxy)-report	Sport/exercise participation	self(proxy)-report	TV Viewing; Computer use; Total sedentary behaviour
Health Behaviour in School aged Children study (HBSC)	[73] B, G	N=5148-16,421	Cross-sectional; Repeated cross-sectional	FAS	self(proxy)-report	MVPA; VPA		
	[74] 20							
UK Time Use Survey	[46] II	N=835	Cross-sectional	Maternal employment			self(proxy)-report	TV viewing
Programme for International Student assessment (PISA)	[75] B, G	N not specified	Cross-sectional	Family wealth	Self-report	MPA; VPA		

No name	[76]	N=3348	Cross-sectional	IMD			Self-report	TV viewing; Streaming
Ireland								
Young Hearts study 2000	[77]	N=2016	Cross-sectional	Maternal occupation	self(proxy)-report	PA	self(proxy)-report	Screen-time
Health Behaviour in School aged Children study (HBSC)	[73] B, G	N=975-4098	Cross-sectional; Repeated cross-sectional	FAS	self(proxy)-report	MVPA; VPA		
	[74]							
Children's Sport Participation and Physical Activity study (CSPPA)	[49] II	N=1508	Cross sectional	FAS	Self-report	PA		
Scotland								
Health Behaviour in School aged Children study (HBSC)	[78] B, G	N=19073	Cross-sectional	FAS	self(proxy)-report	VPA		
Wales								
Health Behaviour in School aged Children study (HBSC)	[79]	N=7376-9194	Cross-sectional	FAS	self(proxy)-report	MVPA; PA; VPA	self(proxy)-report	Screen-time
	[80]							

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Active Children Through Individual Vouchers Evaluation Project	[81] B, G	N=270	Cross-sectional	IMD	Device-measured	MVPA;			
East of England / Anglia									
ROOTS study	[82]	N=825	Cross-sectional	IMD	Device-measured	Light PA; MPA; PAEE		Device-measured	Sedentary time
East of England Healthy Hearts Study (EEHHS)	[83]	N=6240	Cross-sectional	IMD	self(proxy)-report	PA		self(proxy)-report	Screen-time
Midlands									
Other (no name)	[84] [85]	N=611	Cross-sectional	IMD; Family structure	self(proxy)-report	Active travel		self(proxy)-report	Sedentary behaviour
Greater London									
Health Behaviour in Teens study (HBTs)	[86] B, G [87] B, G	N=4320-5863	Cross-sectional; Longitudinal	IMD; Family structure	self(proxy)-report	VPA		self(proxy)-report	Screen-time
South-West England									
Avon Longitudinal Study of Parents and Children	[88] [89]	N=5595-6406	Cross-sectional	Head of household occupation; Maternal education	Device-measured; self(proxy)-report	MVPA; Total activity; Inactivity		self(proxy)-report	TV Viewing

(ALSPAC)								
Other (no name)	[90] G	N=286	Cross-sectional	Head of household occupation	self(proxy)-report	VPA		

For reference 46 II = adolescents age 14-18 years; 49 II = post primary school age

IMD = Index of Multiple Deprivation; CPM = counts per minute; MPA = moderate physical activity; MVPA = moderate-to-vigorous-physical activity; PA = physical activity; VPA = vigorous physical activity; PAEE = physical activity energy expenditure; TV = television

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Socio-economic position and physical activity

Seven indicators of socioeconomic position were examined in association with physical activity. Three samples from two studies examined IMD in relation to device-measured physical activity, and nine samples from four studies examined IMD in relation to reported physical activity, with mixed results (Table 5). Results for IMD and adolescent physical activity were mixed, regardless of measurement. Head of Household Occupation was unrelated to reported physical activity in 4 out of 5 samples. Higher affluence (assessed with FAS) was positively associated with reported physical activity in all 8 samples (from 2 studies), but unrelated to device-measured physical activity in one study. The association between other indicators of socioeconomic position showed varied and inconclusive associations with adolescent physical activity.

Socio-economic position and sedentary behaviour

Seven indicators of socioeconomic position were examined in association with adolescent sedentary behaviour. Six samples (4 studies) examined the association of IMD with reported sedentary behaviour, with four showing a positive association with sedentary behaviour and two showing no associations. (Table 6). Head of Household Occupation was examined in 5 samples from 4 studies; results were mixed and varied across samples according to outcome assessed. Family structure was examined in 5 samples from 3 studies. Living in single parent households was associated with higher levels of reported sedentary behaviour in 4 (out of 6) samples.

Table 5. Synthesis of the evidence on associations between community and family-level indicators of socio-economic position and physical activity in adolescents (aged 12-18 years)

Indicator of socioeconomic status	Device-based physical activity (n samples [references (outcome)])				Reported physical activity (n samples [references (outcome)])			
	No. of samples (no. of studies)	Positive association (+)	Inverse association (-)	No association (0)	No. of samples (no. of studies)	Positive association (+)	Inverse association (-)	No association (0)
Community level								
IMD (high deprivation)	3 (2)	1 [[81]G (MVPA)]	1 [[82] (LPA)]	2 [[82] (MVPA, PAEE), [81]B (MVPA)]	6 (4)		4 [[86] G (VPA), [87] G (VPA), [84] (AT), [72] B (weekday S/E), [72] G (weekday S/E, weekend S/E)]	3 [[86] B (VPA), [87] B (VPA), [72] B (weekend S/E), [83] (PA level)]
Family level								
Maternal education	1 (1)			1 [[88] (MVPA, CPM)]	1 (1)		1 [[89] (inactivity)]	
Head of Household Occupation / occupational/social class	1 (1)			1 [[88] (MVPA, CPM)]	5 (4)	1 [[77] (PA)]		4 [[72] B, G (weekday S/E, weekend S/E), [89] (inactivity), [90] (VPA)]
Family/household Income					1 (1)			1 [[89] (inactivity)]

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Family Affluence Scale (FAS) / family wealth	1 (1)			1 [[49] II (meets guidelines)]	8 (2)	8 [[73] UK, Ir, [74] UK, Ir, [79] [78] B, G (VPA), [79], [80] VPA), [73] UK, Ir (PA guidelines), [75] B, G (out of school MP) and VPA]		
Family structure / parental status (single parents)					4 (2)			4 [[86] B, G (VPA), [72] B, G (weekday and weekend S/E)]
Parent/partner Education	1 (1)		1 [[88] (CPM)]	1 [[88] (MVPA)]				

Note: UK = United Kingdom; Ir = Ireland

Note: the number of samples in the summary columns (positive (+), Inverse (-) and No association (0) will not always add up to the 'no. of samples' if, for example, studies have examined associations between an indicator of SEP and more than one domain of physical activity, and the direction of association is different for each outcome and/or one article has independent samples (i.e. boys and girls) and results differ for each sample.

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Table 6. Synthesis of the evidence on associations between community and family-level indicators of socio-economic position and sedentary behaviour in adolescents (aged 12-18 years)

Indicator of socioeconomic position	Device-based sedentary time (n samples [references (outcome)])				Reported sedentary behaviour (n samples [references (outcome)])			
	No. of samples (no. of studies)	Positive association (+)	Inverse association (-)	No association (0)	No. of samples (no. of studies)	Positive association (+)	Inverse association (-)	No association (0)
Community level								
Index of Multiple Deprivation (IMD)	1 (1)		1 [[82] (ST)]		6 (4)	4 [[66] B, G, [87] B, G, [83] (ScrT), [76] (TV streaming)]		2 [[72] B, G (TV, total SB, C)]
Family level								
Maternal education					1 (1)		1 [[89] (TV)]	
Family/household Income					1 (1)		1 [[89] (TV)]	
Head of Household Occupation / occupational/social class					5 (4)	3 [[72] B (weekend TV and C), [72] G (weekday total SB), [77] (weekend ScrT)]	2 [[72] G (weekend TV), [77] weekday ScrT]]	4 [[72] B, G (weekday TV C, weekend total SB), [72] B (weekday total SB), [72] G (weekend C), [89], [90] (TV)]
Family Affluence Scale (FAS) / family wealth					1 (1)			1 [[79] (ScrT)]

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Family structure / parental status (single parents)					5 (3)	4 [[85] B, G (Scr), [72] B (total SB, weekend TV, weekday C), [85] total SB)]		2 [[72] B, G (weekday TV, weekend C), [72] G (total SB, weekend TV, weekday C)]
Maternal Employment					1 (1)	1 [[46] 37 II (TV viewing)]		

Note: the number of samples in the summary columns (positive (+), Inverse (-) and No association (0) will not always add up to the 'no. of samples' if, for example, studies have examined associations between an indicator of SEP and more than one domain of physical activity, and the direction of association is different for each outcome and/or one article has independent samples (i.e. boys and girls) and results differ for each sample.

DISCUSSION

The purpose of this scoping review was to examine the extent, range and nature of the evidence on the association between socioeconomic position and young people's physical activity and sedentary behaviour in the UK. Of the 56 included publications, almost 65% reported data for children. Across childhood and adolescence, a substantial proportion of the evidence base is derived from studies that recruited nationally representative samples, but the majority of reported analyses were cross-sectional. Considerable variation in the characterisation and measurement of the exposures / outcomes examined in this review combined to provide a mixed picture with regard to the association of socioeconomic position with physical activity and sedentary behaviour in young people living in the UK.

Socioeconomic position of young people is typically inferred based on characteristics measured at the parental (e.g. maternal education, occupational status), household (e.g. housing tenure, household income) or neighbourhood (e.g. area deprivation) level. The pathways through which these different indicators may influence children's health in general are complex[40] and the magnitude of the observed inequalities is known to vary by indicator[41]. Across the included literature, 14 indicators of socioeconomic position were used. This heterogeneity may explain the lack of consistent associations found in this review and others[9]. Furthermore, the evidence presented here also highlights that the same indicator of socioeconomic position may have different associations with subcomponents/domains of physical activity and sedentary behaviour. For example, higher maternal education and higher household income was shown to be associated with higher levels of vigorous physical activity but with lower levels of moderate physical activity in children[40]. Similar findings have been seen in the adult literature, for example in a recent study of over 40,000 British adults, lower educational attainment was associated with higher active travel and occupational activity, but lower weekly leisure-time physical activity[91]. In addition, we did not observe clear evidence that associations between specific markers of socioeconomic position and physical activity were opposite in sedentary behaviour, consistent with previous evidence that the correlations between these two behaviours are low[9]. This exemplifies the importance of specificity in the definition of the

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3 socio-economic exposure and the domain of the outcome of interest in observational
4 research and in the design and delivery of interventions.
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9 In the present review, the most common indicator of socioeconomic position used was IMD.
10 IMD provides a measure of the level of deprivation experienced by people living in a small
11 area (approximately 1500 residents) based on indices of deprivation including income,
12 employment, health, education, and crime[33]. While census data collected on IMD is key
13 for targeting services to help tackle deprivation, it is not a direct or necessarily meaningful
14 measure of deprivation at the individual level[92]. Nonetheless, area-level markers of
15 socioeconomic position may still be insightful for examining potential influences on physical
16 activity or sedentary behaviour and for geographical targeting of interventions. Social
17 Scientists argue that area-based measures of socioeconomic position may be more relevant
18 for adolescents than household measures because of the growing amount of time that they
19 spend outside of the household and engaging with their community[3, 8]. In the present
20 review, IMD was not associated with device measured physical activity or sedentary
21 behaviour but showed positive, negative, and null associations with self- or proxy reported
22 outcomes. This could, in part, be because the questionnaires used to collect reported
23 physical activity tend to collect information on purposeful bouts of more organised activity
24 that can be recalled. Thus, questionnaires are likely to pick up sports participation and
25 leisure time activity that arguably could be more closely associated with area level
26 deprivation. For example, recalled bouts of sports/exercise may be more closely linked to
27 facilities, green space, play parks, and perceived safety which have previously been shown
28 to be related to structured activity[30]. The inability of device-based assessment to capture
29 specific activity types means that such associations may have been obscured in studies that
30 used this methodology.
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51 The evidence presented here is characterized by substantial variability in the markers of
52 socioeconomic position used across different studies, but they are generally similar to those
53 seen in the literature for adults. Collection of common indicators used in adult studies (such
54 as income, employment and education) can be problematic in this younger population, as
55 many young people cannot accurately describe their parent's education, income or details
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3 of their current employment, and collection of data from parents could result in high levels
4 of missing data. It has thus been suggested that assessing material circumstances, such as
5 number of assets in the home as used in the Family Affluence Scale (FAS) might be valuable
6 because these circumstances are easier to recall[93]. In addition, multidimensional
7 measures, like the FAS, have their strength in capturing an overall measure of
8 socioeconomic position rather than looking at single domains. This can be important when
9 the study is interested in the overall concept of socioeconomic position as opposed to the
10 constituent parts[7, 94]. In the present review, FAS was only used in three studies of
11 adolescents. One of these was the HBSC study which showed, consistently (across 5
12 publications), that higher affluence was associated with higher self-reported MVPA, VPA,
13 and meeting physical activity guidelines. Data (not included in the review) from the HBSC
14 study reveals this same trend across other European countries and for other health
15 behaviours, such as fruit and vegetable consumption (i.e. higher affluence associated with
16 higher consumption), and health outcomes, such as obesity[31]. Advantages of the FAS
17 include that it is relatively straightforward for young people to complete and that it
18 recognises that socioeconomic position is a complex concept that cannot be fully described
19 or have its complete meaning defined in any single measure. It further recognises that as
20 young people age they start spending more time outside of the home, and thus may
21 become more influenced by their community/neighbourhood environment. However,
22 limited research is available on its validity and comparison with other measures of socio-
23 economic position[6].

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42 The majority of the device-based measures of physical activity and sedentary behaviour
43 characterised behaviour at daily or weekly level, which may be too broad to ascertain
44 associations with markers of socioeconomic position. Emerging literature shows that
45 physical activity and sedentary behaviours are most varied out of school (e.g. structure day
46 hypothesis[40]), and that weekend activity behaviour is more susceptible to seasonal
47 variation than weekday activity[39]. One study in the present review for example, found
48 that IMD was associated with higher levels of after school sedentary time and sedentary
49 time on weekends, but not associated with before school or school day sedentary time[69].
50 However, limited research is available on whether this also holds true for physical activity.
51 Thus, the structure of the school day may be an equalizer to children's socioeconomic
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3 differences in sedentary behaviour and suggests a need to focus on behaviour change
4 efforts outside of school.
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10 Finally, there may be a different association between socioeconomic position and intensity
11 of physical activity, although the evidence base is scarce. One large-scale study in 7-year-
12 olds[67] showed that children from less affluent families (and certain ethnic minorities
13 groups) spent less time in vigorous physical activity. Vigorous physical activity, compared
14 with lower intensity physical activity, has a stronger association with adiposity[5], and this
15 socioeconomic disparity in inactivity intensity may partly help explain inequalities in obesity
16 prevalence.
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23 **Future research**

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26 Future research which has at the heart of its aim to understand the relationship between
27 socioeconomic position and health behaviour outcomes should consider using
28 multidimensional, simple to report measures of socioeconomic position in studies of
29 children and adolescents, that are comparable across studies and countries, but also include
30 community/neighbourhood measures of socioeconomic position. Consistency in reporting
31 socioeconomic position and physical activity and sedentary behaviour levels would allow
32 harmonisation of data across studies and meta-analyses. There is a need to have a better
33 theoretical understanding of how measures of socioeconomic position apply to children,
34 and how their influence would operate on physical activity and sedentary behaviours to
35 understand whether there are specific measures of socioeconomic position that would be
36 more appropriate to focus on in these types of studies.
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47 National surveys, such as Health Survey for England, need to make informed decisions
48 regarding the socioeconomic position indicators and ensure that the same measure is
49 included over time to assess secular trends, whilst adding new measures as knowledge
50 evolves on measures of socioeconomic position. There is also a need to consider routine
51 inclusion of device measured physical activity, alongside questionnaires, within health
52 surveys to capture varied types and intensity of activities. More qualitative research
53 examining the barriers and facilitators to physical activity and reducing sedentary
54 behaviour/screen use in different populations, varying in socioeconomic position would also
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3 be insightful for intervention development and policy change. Lastly, research needs to
4 consider how and when the concept and definition of socioeconomic position in young
5 people changes, to inform the refinement of relevant and valid indicators of socioeconomic
6 position.
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10 11 12 13 **Strengths and Limitations of the review**

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16 Strengths of the review include the systematic methodology and reporting in accordance
17 with PRISMA-SCR guidelines. The present review also examined and reported the results of
18 children and adolescents separately allowing the complete extent, range, and nature of the
19 evidence to be synthesised. Meta-analytic synthesis would have enabled more precise
20 quantification of the direction and magnitude of reported associations, but this was deemed
21 inappropriate due to heterogeneity in the exposure and outcome measures used and is also
22 outside of the scope of a scoping review of this nature. We recognise the value of
23 qualitative research on this topic and acknowledge that a mixed-studies review may have
24 provided additional insight. However, given the volume of research on this topic, a more
25 focussed quantitative research review was undertaken as a starting point.
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36 **CONCLUSIONS**

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39 A large number of indicators of socioeconomic position have been studied in relation to
40 physical activity and sedentary behaviour among children and adolescents in the UK, and
41 the evidence is mixed. It is clear that physical activity and sedentary behaviours of children
42 and adolescents are complex and influenced by multiple indicators of socioeconomic
43 position that are, in most cases, different across age stages, outcomes examined, and
44 measurement tools. Greater consistency in the use and measures of socioeconomic position
45 as well as outcomes of behaviour are required for meta-analyses and study comparisons.
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52 More longitudinal studies that adopt devices (such as accelerometers) to measure physical
53 activity and sedentary time in addition to questionnaire-based measures are required.
54 Furthermore, there is need for further development, refinement and agreement of relevant
55 socioeconomic position measures for use in children and adolescents so that studies can
56 consistently use an established set of appropriate socioeconomic position measures which
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3 capture relevant aspects of the household, individual and community socioeconomic
4 position to enable the development of a more methodologically consistent evidence base.
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18 Trust.
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26 **AUTHOR CONTRIBUTIONS**

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28 NP and LBS conceptualised the work and developed the research question. NP developed
29 the methods. All authors contributed to the interpretation of the data, to editing and
30 revising drafts of the manuscript, and approved the final version to be published.
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36 **COMPETING INTERESTS**

37
38 No competing interests
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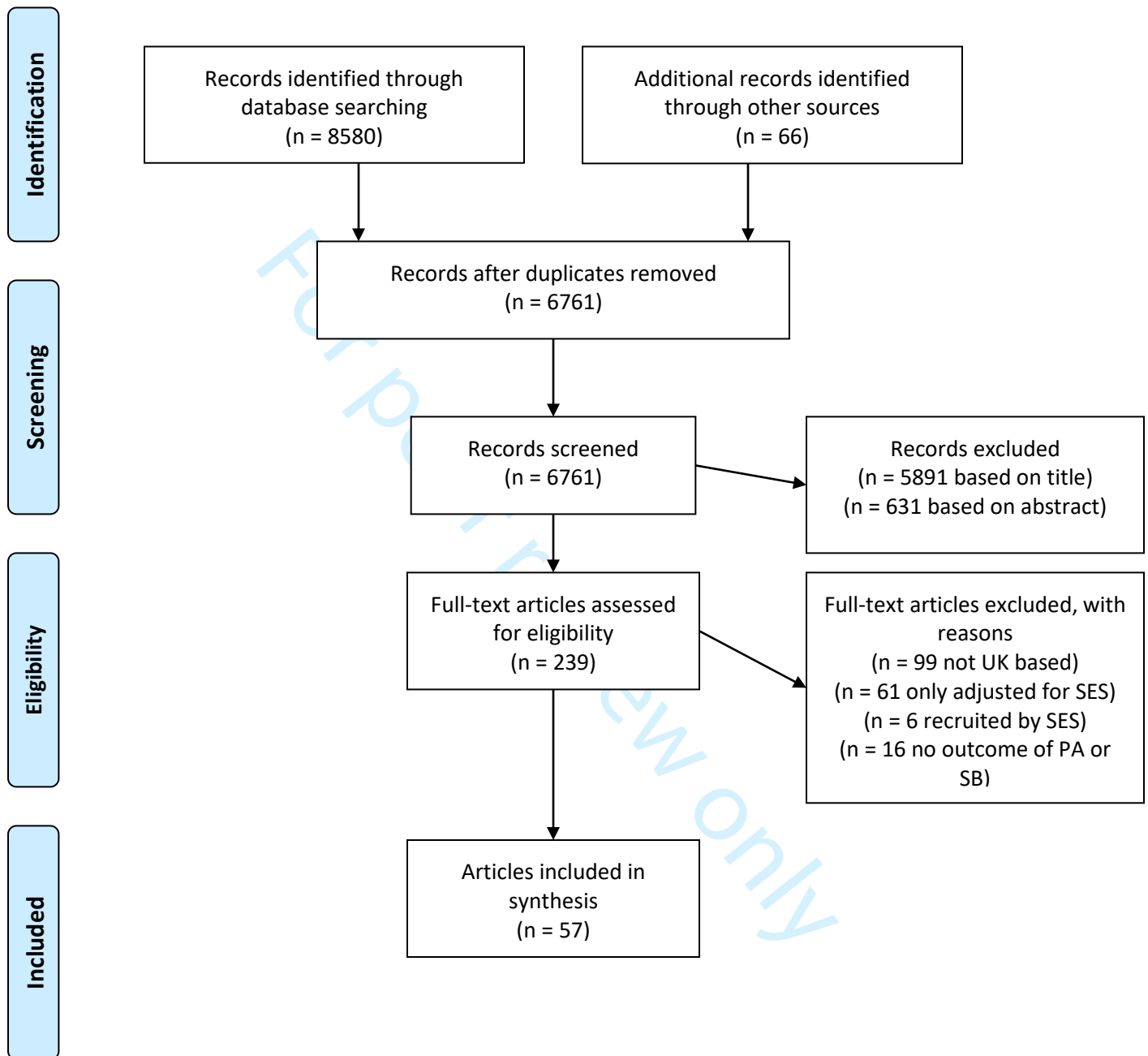
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Figure 1. Flow diagram of search strategy

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	



SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med.* 2018;169:467–473. doi: 10.7326/M18-0850.



BMJ Open

Associations between socio-economic position and young people's physical activity and sedentary behaviour in the United Kingdom: A scoping review

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3 **Associations between socio-economic position and young people's physical activity and**
4 **sedentary behaviour in the United Kingdom: A scoping review**
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9 Lauren B Sherar¹
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56 **KEY WORDS:** physical activity; sedentary behaviour; socio-economic position; United
57 Kingdom; children; adolescents
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ABSTRACT

Objective To examine the evidence on the associations between socioeconomic position and young people's physical activity and sedentary behaviours in the United Kingdom.

Design Scoping review

Data sources PubMed, SCOPUS, and Web of Science databases were searched for articles published up to and including January 2021.

Eligibility criteria for selecting studies Observational studies in children and adolescents (5-18 years) from the UK that assessed associations between at least one indicator of socioeconomic position and at least one outcome of physical activity and/or sedentary behaviour.

Data extraction and synthesis Data were extracted by one reviewer and 20% were double checked. Indicators of socioeconomic position were tabulated with domains of physical activity and sedentary behaviour.

Results Fifty-seven publications were included in the review; 37 publications from 20 studies (k=23) of children and 21 publications from 15 studies (k=23) of adolescents. Most studies were cross-sectional. 63% of studies of children, and 40% of studies of adolescents assessed Index of Multiple Deprivation (IMD). Eighteen studies measured physical activity in children, thirteen measured sedentary behaviour. Eleven studies of adolescents included a measure of physical activity, ten included a measure of sedentary behaviour. Among children and adolescents, the association between socioeconomic position and measures of either physical activity or sedentary behaviour was highly variable depending on the measure of both socioeconomic position used and the behavioural outcome, with the exception of higher family affluence which was consistently associated with higher reported physical activity among adolescents.

Conclusion

Physical activity and sedentary behaviours of children and adolescents in the UK are complex and influenced by multiple indicators of socioeconomic position that are, in most cases, different across age stages, outcomes examined, and measurement tools. Greater

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3 consistency in the use and measures of socioeconomic position as well as outcomes of
4 behaviour are required for robust country-specific meta-analyses.
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10 **ARTICLE SUMMARY**

11 **Strengths and Limitations of this study**

- 12 • This is a comprehensive scoping review following the reporting guidelines of the
13 Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for
14 Scoping Reviews (PRISMA-ScR).
15
- 16 • This is a first attempt to examine the extent of the literature surrounding socio-
17 economic position and physical activity and sedentary behaviour in children and
18 adolescents in the UK.
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- 20 • This review was limited by the lack of consistency in the use and in the measures of
21 socioeconomic position and behavioural outcomes.
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- 23 • Meta-analytic synthesis would have enabled more precise quantification of the
24 direction and magnitude of reported associations, but this was deemed
25 inappropriate due to heterogeneity in the exposure and outcome measures used
26 and is also outside of the scope of a scoping review of this nature.
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45 **BACKGROUND**

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47 Low levels of physical activity and high levels of sedentary behaviour are key determinants
48 of poor child development, mental health problems, and unfavourable metabolic and
49 cardiovascular disease risk profiles[1-3]. Many young people in the United Kingdom are not
50 meeting the recommended minimum of 60 minutes of moderate to vigorous intensity
51 physical activity (MVPA) on average per day[4-6] and spend large proportions of the day
52 sitting and engaged in high volumes of screen-based activities[4, 7]. Establishing regular
53 participation in physical activity and reduced sedentary behaviour early in childhood is
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3 fundamental for lifelong health and well-being because there is evidence that physical
4 activity declines through childhood into adolescence while sedentary behaviours increase[8,
5 9]. Furthermore, there is evidence that physical activity and sedentary behaviour during
6 childhood tracks into adolescence and then adulthood[10-12]. Given this evidence,
7 increasing physical activity, and reducing sedentary behaviour in childhood requires
8 targeted public health efforts.
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17 The development of public health interventions, capable of facilitating health-enhancing
18 shifts in physical activity and sedentary behaviours, requires high-quality evidence of the
19 contextual factors that are barriers or enablers of behaviour change. Socioeconomic
20 position, the social and economic factors that influence what positions individuals or groups
21 hold within the structure of a society[13], is recognized as an important determinant of
22 health and wellbeing, in part because it influences people's attitudes, experiences,
23 behaviors, exposure to health risk factors and access to services and healthy
24 environments[14, 15]. Children who grow up in lower socioeconomic position households
25 have a higher risk of cardiovascular disease[16, 17] and all-cause mortality[18] than children
26 who live in higher socioeconomic position households[19]. In the United Kingdom (UK), a
27 quarter of children and young people are living in a household with an income below that
28 needed for a minimum socially acceptable standard of living[20]. It has been consistently
29 shown that children of lower socioeconomic position are more likely to become adults with
30 lower socioeconomic position[21].
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44 A wide variety of markers have been used to denote socioeconomic position in
45 epidemiological and population health studies to date. This has included family-level
46 indicators, such as parental education and/or characteristics of the home environment (e.g.,
47 car or home ownership). Other markers reflect socio-economic position at the macro- or
48 community-level, such as the Index of Multiple Deprivation, which is derived based on home
49 postal code and has versions that are country specific (i.e. England and Scotland have
50 different IMD). Socio-economic position may also be captured at the individual-level, via
51 assessments of child's ownership of particular assets (e.g., a computer), or the amount of
52 pocket-money received[22]. Such markers may be used individually or incorporated within
53 broader, family-level metrics. Systematic review findings, which are based on a synthesis of
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3 studies from multiples countries, suggest that the evidence of an association between
4 socioeconomic position and physical activity in young people is inconsistent and varies
5 depending on the socioeconomic position indicators measured, the country in which they
6 were assessed, and domains of activity assessed[19, 23]. A recent meta-analysis found that
7 young people in high-income countries from lower socioeconomic position backgrounds
8 (classified as paternal/maternal education, occupation, income, socioeconomic status)
9 exhibit higher levels of sedentary behaviours (both screen-based and non-screen-based)
10 compared to those from higher socioeconomic position backgrounds, with the opposite
11 being seen in low-to-middle income countries (LMIC)[24]. Yet another review found no
12 consistent evidence of an association between parent education (one of the most
13 commonly used markers of socioeconomic position with regards to children's health
14 behaviours) and children's sedentary behaviour and physical activity[25]. The mixed
15 evidence may in part be due to varied indicators of socioeconomic position being
16 incomparable across studies and between countries, which is likely particularly the case for
17 composite indicators because they fail to separate out the different domains of SEP, which
18 might have differing influences on the health behaviours.
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36 In the UK there is a clear socioeconomic pattern in child weight status[26, 27], but whether
37 this socioeconomic patterning is also clear in physical activity and/or sedentary behaviour
38 among young people in the UK has yet to be determined. To the best of our knowledge,
39 there has been no previous review focusing on data from the UK only. Thus, the aim of this
40 scoping review was to examine the extent, range and nature of the evidence on the
41 associations between socioeconomic position and young people's physical activity and
42 sedentary behaviour in the UK for the purpose of scoping this field of study and identifying
43 gaps in the literature to aid the planning of future research.
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53 **METHOD**

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56 This review was conducted as a scoping review as this allows for the extent, range and
57 nature of the literature to be identified[28]. This review was reported according to
58 procedures documented in the Preferred Reporting Items for Systematic reviews and Meta-
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3 Analyses extension for Scoping Reviews (PRISMA-ScR) checklist[29]. The review protocol
4 was registered with Prospero (CRD42019139550). Ethics approval was not required for a
5 scoping review.
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8 9 **Search strategy**

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11 Search strategies were built around four groups of keywords: socio-economic position,
12 physical activity, sedentary behaviour, and population. Key terms for socio-economic
13 position were used in combination with key terms for physical activity, sedentary behaviour,
14 and population to locate potentially relevant studies. An example of the search strategy is
15 provided as a supplementary file. PubMed, SCOPUS, and Web of Science databases were
16 searched using the key terms up to and including January 2021. In addition, manual
17 searches of personal files were conducted along with screening of reference lists of previous
18 sedentary behaviour and/or physical activity reviews (e.g.[24, 30]) and identified articles
19 which included the key terms.
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30 **Inclusion criteria**

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32 For inclusion, studies were required to: (i) be a cross-sectional or longitudinal observational
33 study or baseline/control arm of an intervention study; (ii) include school-aged children
34 aged 5-11 years and/or adolescents aged 12-18 years (or a mean age within these ranges)
35 from the UK (or for multi-country studies, provide results that were reported separately by
36 country); (iii) include at least one indicator of socioeconomic position; (iv) include at least
37 one quantitative outcome of either physical activity or sedentary behaviour; (v) report a
38 quantitative estimate of the association between at least one domain of socio-economic
39 position and one domain of physical activity and/or sedentary behaviour; and (vi) be
40 published in a peer-reviewed journal in the English language up to and including January
41 2021.
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54 **Identification of relevant studies**

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56 Potentially relevant studies, following de-duplication, were selected by (1) screening the
57 titles, (2) screening the abstracts, and (3) if abstracts were not available or provided
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3 insufficient data, the full text article was retrieved and screened to determine eligibility. At
4 each stage of the review, any uncertainties in articles were discussed by NP and LBS, all data
5 was managed using EndNote X4 reference manager.
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11 **Data charting process**

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14 For each study that met the inclusion criteria, study characteristics and outcomes of interest
15 were extracted using a pre-established data extraction form in Microsoft Excel. Data were
16 extracted by NP and 20% were double checked by LBS, discrepancies over the data
17 extracted (n=1) were resolved through discussion. Extracted data included: Author and year
18 of publication, name and location of study, study type, sample characteristics (i.e. age,
19 gender, ethnicity, sample size), indicator of socioeconomic position, intensity of physical
20 activity assessed (e.g. moderate physical activity), type of sedentary behaviour assessed
21 (e.g. screen time), measures used for physical activity and sedentary behaviour (e.g.
22 questionnaire or device). While data such as sample size, study type and methods used to
23 assess behaviours were extracted and used for appraisal of the studies included,
24 methodological quality or risk of bias of individual studies was not assessed formally, as is
25 standard practice for scoping reviews[29].
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38 **Synthesising associations between indicators of socioeconomic position and physical** 39 **activity and sedentary behaviour**

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42 Identified indicators of socioeconomic position were categorised as community and family
43 level indicators and tabulated to highlight the extent, range and nature of the evidence
44 among children and adolescents respectively. No studies were located that used individual-
45 level markers of child/adolescent socio-economic position. Data were described for each
46 outcome and domain of activity (i.e. moderate activity at lunchtime, vigorous activity after
47 school counts per minute etc.), and for each independent sample (k) or subsample that the
48 study provided data on (i.e. girls and boys, different year groups etc). Tables of results
49 provide summaries at the sample (k) level so that the same samples aren't counted more
50 than once for each association. For example, if one study (e.g. MCS) has 3 articles all
51 examining the association between parent education and device-based physical activity,
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3 these 3 articles are listed as separate references but only counted as k=1 because the data
4 comes from the same sample. Furthermore, if one study provides data for boys and girls
5 separately, this would be counted as k=2.
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10 Indicators of socioeconomic position and behaviour outcomes and domains were extracted
11 as per the reporting in the study and were tabulated according to method of measurement
12 (i.e. device measured or reported behaviour). Most indicators of socioeconomic position are
13 self-explanatory (e.g. maternal education). However, for clarity, the Index of Multiple
14 Deprivation (IMD) is a community level measure of deprivation based on home postcodes.
15 England, Wales and Scotland have their own scales for IMD (e.g. Scottish IMD). The IMD is
16 an overall measure of multiple deprivation experienced by people living in an area based on
17 indices of deprivation including income, employment, health, education, and crime[31].
18 IMD is assessed on a continuum of high to low deprivation. A high IMD score indicates high
19 levels of deprivation (i.e. lower socioeconomic position). Furthermore, Family Affluence
20 Scale (FAS) is a multidimensional household socioeconomic position measure reflecting
21 material affluence. The FAS is often referred to as the “assets approach” to measuring the
22 material conditions in the family of a child or adolescent who might not be able to
23 accurately report information about parental income or occupation[32]. The assets
24 approach requires children and/or adolescents to report on family ownership of goods
25 and/or family’s access to services that are required for an acceptable standard of living[33].
26 The FAS score is created by summing across indicators and high FAS is indicative of higher
27 socioeconomic position.
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45 Associations between indicators of socioeconomic position and behaviour were coded as ‘+’
46 for positive associations (e.g. higher deprivation associated with higher physical activity), ‘-’
47 for inverse associations (e.g. higher maternal education associated with lower sedentary
48 time) and ‘0’ for non-statistically significant association. Significant or non-significant
49 associations were extracted from articles as per stated in the articles (e.g. $p < 0.05$ or $p < 0.01$).
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56 **Patient and public involvement**

57 Patients and the public were not involved in this review.
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RESULTS

The literature searches identified 6761 unique records of which 57 publications (i.e. individual references) were included (Figure 1). These consisted of 37 publications from 20 studies (k=23) of children (5-11 years) and 21 publications from 15 studies (k=23) of adolescents (12-18 years). Two publications from two studies included samples of both children (k=2) and adolescents (k=2).

[INSERT FIGURE 1]

Studies of children (5-11 years)

Table 1 describes the characteristics of the included 19 studies of children. Twelve were cohort studies (63%). One study, the Millennium Cohort Study, was representative of the UK, two studies were representative of England, Ireland and Scotland respectively. There were no studies of children from Wales. Overall, almost half of publications (n=15, 43%) were from two studies: the Millennium Cohort Study (MCS; n=8 articles), and the Sport, Physical Activity and Eating behaviour: Environmental Determinants study (SPEEDY; n=7 articles), which is representative of the East Anglia region of the UK. The South-West region of England was over-represented with over a quarter of all studies (n=5), and 22% (n=8) of publications, of children included in the review conducted in this region. Sixteen studies were cross-sectional (84%), one was longitudinal, and 2 studies used both designs. Sample sizes ranged from 194 to 11,965 participants. Fourteen indicators of socioeconomic position were employed, with articles within studies utilising different and/or multiple indicators. Twelve studies (63%) assessed the English Index of Multiple Deprivation (IMD), and two used the Scottish IMD. Maternal education (26%, 5 studies), family structure (21%, 4 studies), and parent/partner education (21%, 4 studies) were commonly assessed indicators of socioeconomic position. Eighteen studies included a measure of physical activity, of which 12 used device-based measures (67%) and 13 assessed sedentary behaviour, of which 8 were device-based (62%).

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Table 1. Characteristics of studies including children aged 5-11 years

Names of studies including children, by Country/Region	Characteristics of studies							
	[Reference] & independent samples	Sample size range	Study design	Indicators of SES	Physical activity measure	Physical activity outcomes assessed	Sedentary behaviour measure	Sedentary behaviour outcome assessed
UK representative								
Millennium Cohort Study (MCS)	[34] I, II [35] [36] [37] [38] [39] [40]	N=3717 - 11965	Cross-sectional	IMD; Family/household income; Family structure; Maternal education; Maternal occupational status; Access to garden; Housing tenure; Cars in use.	Device-measured; proxy-report	MPM; MVPA; PA; Total activity; No meeting guidelines; Sport/exercise participation; Active transport	Device-measured; proxy-report	Sedentary time; TV viewing; Computer use
England representative								

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Health Survey for England	[41] [42] B, G	N=1110-3822	Cross-sectional	IMD; Family/household income; Head of household occupation/occupational class	self(proxy)-report	Out of school PA	Device-measured; self(proxy)-report	Sedentary time; TV viewing; Non-TV sitting; Total sedentary behaviour
UK Time Use Survey	[43] I	N=1269	Cross-sectional	Maternal employment			self(proxy)-report	TV viewing
East Anglia								
The Sport, Physical activity and Eating behaviour, Environmental Determinants in Young People study (SPEEDY)	[44]	N=316-2064	Longitudinal	Composite SEP score; IMD; Car ownership; Family structure; Parent education; Home ownership	Device-measured	Light PA; MVPA	Device-measured	Sedentary time
	[45]							
	[9]							
	[46]							
	[47]	N=316-2064	Cross-sectional	Composite SEP score; IMD; Car ownership; Family structure; Parent education; Home ownership	Device-measured	MVPA; LPA;	Device-measured; self(proxy)-report	Sedentary time; Screen-time; Total sedentary behaviour; Non-screen-based sedentary behaviour
	[48]							
[49]								

West Yorkshire								
Unnamed Study 1	[50]	N=160	Cross-sectional	IMD	Device-measured	Light PA; MVPA	Device-measured	Sedentary time
North-East England								
Gateshead Millennium Study	[51]	N=480	Cross-sectional	Maternal education	Device-measured	MVPA	Device-measured	Sedentary time
North-West England								
SportsLinx	[52]	N=6337	Cross-sectional	IMD	self(proxy)-report	Report/exercise participation	self(proxy)-report	TV viewing; video game use
Unnamed Study 2-4	[53]	N=194-223	Cross-sectional	IMD	Device-measured; self(proxy)-report	MVPA; Light PA; Total activity; Active travel		
	[54]							
	[55]							
South-West England								
B-PROACTIV	[56] I BG, II BG	N=685-1026	Cross-sectional and Longitudinal	IMD; Parent education; Family structure	Device-measured	MVPA	self(proxy)-report	Screen-viewing
	[57]							
	[58]	1296	Cross-sectional	IMD; Parent education	Device-measured	MVPA, Active Travel		
Avon Longitudinal Study of Parents and Children (ALSPAC)	[59]a	N=4813	Cross-sectional	Maternal education	Device-measured	PM; Light PA; MVPA	Device-measured	Sedentary time
EarlyBird study	[60]	N=300	Longitudinal	IMD	Device-measured	PM		

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Personal and Environmental Associations with Children's Health study (PEACH)	[61] B, G [59]b [62]	N=552-1307	Cross-sectional	IMD; Car ownership; family/household income; Maternal education; Parent education Free-school meal entitlement	Device-measured	Light PA; MVPA	Device-measured	Sedentary time
International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE)	[63]	N=425	Cross-sectional	Parent education	Device-measured	Light PA; MVPA; Meeting MVPA guidelines		
Ireland								
Growing-up-in-Ireland	[64]	N=8568	Cross-sectional	Head of household occupation/occupational class; Family structure; Maternal education	self(proxy)-report	Light PA; MVPA	self(proxy)-report	TV viewing
	[65]							
Children's Sport Participation and Physical Activity study (CSPPA)	[66] I	N=446	Cross sectional	FAS	Self-report	Light PA		
Scotland								
Growing-up-in-Scotland	[67]	N=774	Cross-sectional	Scottish IMD	Device-measured	Light PA; MVPA	Device-measured	Sedentary time

Unnamed study 5	[68] I, II	N=1700-1906	Repeated cross-sectional	Scottish IMD;	self(proxy)-report	Out of school activity	self(proxy)-report	Screen-time
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Note: B = Boys; G = Girls; I, II = independent samples. For reference 34 I = children aged 5 years, II = children aged 11 years; 43 I = children aged 8-11 years; 56 I = children age 5-6 years, II = children aged 8-9 years; 66 I = primary school aged children; 68 I = children in 2006 II = children in 2010; IMD = Index of Multiple Deprivation; CPM = counts per minute; MPA = moderate physical activity; MVPA = moderate-to-vigorous-physical activity; PA = physical activity; VPA = vigorous physical activity; TV = television

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Socio-economic position and physical activity

Table 2 describes the findings for associations with physical activity in children. Thirteen indicators of socioeconomic position were examined in association with physical activity, and associations were variable, irrespective of the measure of physical activity (self-report vs device), with many samples within studies showing different results depending on the outcome of behaviour assessed.

At the community level, IMD and Scottish IMD were the only measures of socio-economic position found. IMD was examined in association with device-based physical activity in 8 samples from 7 studies, with reported physical activity in 9 samples from 7 studies. Most samples from studies of device-based physical activity reported no association, whereas the samples with reported physical activity showed mixed results. Maternal education and parent/partner education was positively associated with domains of reported activity in two sample, but both of these family level indicators of socioeconomic position showed inconclusive results with device-based activity (Table 2). Family structure was mostly not associated with device-assessed physical activity but showed differing results with reported activity based on the domain assessed.

Studies that examined the association of family/household income (n=1) and maternal employment (n=1) with device measured physical activity reported mixed results that varied by physical activity outcome. Furthermore, one study found an association between higher socioeconomic status (composite score) and lower MVPA and total physical activity. One study found that those children entitled to free school meals had higher levels of school-time physical activity.

Table 2. Synthesis of the evidence on associations between community and family-level indicators of socioeconomic position and physical activity in children (aged 5-11 years)

Indicator of socioeconomic position	Device-based PA						Reported PA					
	n samples [[references] (outcome)]			n samples [[references] (outcome)]			n samples [[references] (outcome)]			n samples [[references] (outcome)]		
	n	Positive association (+)	n	Inverse association (-)	n	No association (0)	n	Positive association (+)	n	Inverse association (-)	n	No association (0)
Community level												
Index of Multiple Deprivation (IMD)	1	[35] (MVPA)	1	[[50] (light PA)]	6	[[53] (MPA and VPA during: school time, out of school, before school, after school, class time, recess time, lunch time), [62] (school-time CPM), [60] B, G, [46], [50] (MVPA)]	4	[[55] [39] (AT), [42] B, G (out of school PA), (AT)]	3	[[62] (weekend S/E), [58] (AT), [39] (S/E)]	2	[[52] (weekday S/E), [54] (PA level)]

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Scottish IMD					1	[67] (CPM, LPA, MVPA)		1	[68] II (out of school PA),			1	[68] I (out of school PA)
Family level													
Maternal education	1	[[37](VPA)]	3	[[59]a (PA, CPM), [59]b (PA), [38] (MVPA, CPM, meets guidelines)]	4	[[51], [35] [59]a (MVPA), [59]b (MVPA, CPM)]		1	[[64] (MPA, VPA)]				
Family structure / parental status	1	[[36](CPM, MVPA, meets guidelines)]			4	[[47] (after school MVPA, weekend MVPA), [69] (CPM), [38] (CPM, MVPA, meets guidelines), [56] I, II B, G (weekday and weekend day MVPA)]		1	[[64] (MPA)]			1	[[64] (VPA)]
Parent/partner Education			1	[[47] (after school MVPA), [9](LPA)]	2	[[47] (weekend MVPA), [48] (weekday		1	[[58] (AT)]				

					and weekend VPA), [9] (MVPA), [63] (LPA, MPA, VPA)]					
Family/household Income	1	[[37] (VPA)]	1	[[40] (MVPA)]	1	[[38] (MVPA, CPM, meets guidelines)]	2	[[34] I, II (S/E)]		
Maternal Employment (unemployed/not in full-time employment)	1	[[36] (CPM, MVPA, meets guidelines)]			1	[[69] (CPM)]		[[64] (MPA)]	1	[[64] (VPA)]
Family Affluence Scale (FAS)					1	[[66] I (meets guidelines)]				
Composite SES score (high SES)			1	[[46] (MVPA and total activity)]						
Free School Meal entitlement	1	[[62] (school-time PA)]								
Home Ownership					2	[[47] (after school and weekend day MVPA), [38] (CPM,				

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					MVPA, meets guidelines]						
Access to a garden				1	[[38] (CPM, MVPA, meets guidelines)]						
Number of cars in use			1		[[38] (CPM, MVPA, meets guidelines)]						

Note: PA = Physical activity; CPM = counts per minute; MVPA = moderate-to-vigorous physical activity; VPA = vigorous physical activity; MPA = moderate physical activity; LPA = light physical activity; S/E = sport/exercise; AT = active travel; B = boys; G = girls. Studies in **bold** represent longitudinal data.

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Socio-economic position and sedentary behaviour

Table 3 presents results for associations with sedentary behaviour in children. Eleven indicators of socioeconomic position were examined, and associations were variable, irrespective of the measure of sedentary behaviour (self-report vs device), with many samples within studies showing different results depending on the behaviour assessed.

IMD was not associated with device-based sedentary behaviour in 5 samples of children, including longitudinal data. The results with reported sedentary behaviour were mixed and differed within samples depending on the outcome of sedentary behaviour assessed.

Maternal education was negatively associated with device measured sedentary time in 2 out of 3 samples, whereas parent/partner education showed mixed associations.

Family/household income was not associated with device measured sedentary time in 3 samples but was associated with lower reported sedentary behaviours in 3 samples. Other indicators of socioeconomic position such as composite scores of socioeconomic status, occupational social class, and access to a garden showed mixed results with sedentary behaviour. Car ownership and family structure were consistently unrelated to sedentary behaviour.

Table 3. Synthesis of the evidence on associations between community and family-level indicators of socioeconomic position and sedentary behaviour in children (aged 5-11 years)

Indicator of socioeconomic position	Device-based sedentary time n samples [[references] (outcome)]						Reported sedentary behaviour (summary n samples [[references] (outcome)])					
	n	Positive association (+)	n	Inverse association (-)	n	No association (0)	n	Positive association (+)	n	Inverse association (-)	n	No association (0)
Community level												
Index of Multiple Deprivation (IMD)	3	[[61]B, G (after school ST, weekend ST), [50] (ST)]			5	[[70], [41], [46] (ST), [44] (after school ST, weekend ST), [61]B, G (before school ST, school day ST)]	2	[[52] (weekday VG, weekday TV, weekend VG), [57] (weekday ScrT)]			4	[[41] (TV, non-TV sitting), [52] (weekend TV), [57] (weekday and weekend day ScrT), [57] (weekend ScrT) [39] (TV, C)]
Scottish IMD				1	[67]	2	[68]I, II (ScrT)					
Family level												
Composite SES score	2	[[44](after school ST, weekend ST), [41] (ST)]			1	[[46] (ST)]	1	[[49] (non-screen SB)]	1	[[49] (total SB)]	1	[[49] (screen-based SB)]

Family/household Income				3	[[61]B, G (after school ST, weekend ST, before school ST, school day ST), [41] (ST)]			3	[[41] (TV), [36]I, II (weekday TV viewing, weekday C)]	1	[[41] (non-TV sitting)]
Occupational social class	1	[[36](ST)]		1	[[41] (ST)]			2	[[41], [65] (TV)]	1	[[41] (non-TV sitting)]
Parent/partner Education	2	[[61]B (after school ST, school day ST), [61]G (school day ST)]		3	[[48] (ST), [61]B (weekend ST, before school ST, school day ST) [61]G (after school ST, weekend ST, before school ST, school day ST), [9](ST)]			1	[[57] (weekday and weekend day ScrT)]	1	[[57] (weekday and weekend day ScrT)]
Maternal Employment						1	[[43] I (TV)]				
Maternal education	2	[[59]a, b (ST)]		1	[[51] (ST)]						
Family structure / parental status				2	[[44] (after school ST,						

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						weekend ST), [36](ST)]								
Car ownership					3	[[45] (after school ST and weekend ST), [61]B, G (after school ST, weekend ST, before school ST, school day ST)]								
Access to a garden			2	[[61] B, G (after school ST, weekend ST)]	2	[[61]B, G (before school ST, school day ST)]								

Note: ST = sedentary time; TV = television viewing; ScrT = screen-time; SB = sedentary behaviour; VG = video games use; C = computer use; B=boys; G=girls; studies in **bold** represent longitudinal data.

Studies of adolescents (12-18 years)

Table 4 describes the characteristics of the 15 included studies of adolescents. Eight were cohort studies (54%). Five studies were representative of the UK or England, three studies were representative of Ireland, one of Scotland and two of Wales. Five publications (28%) were from the Health Behaviour in School aged Children Study (HBSC) study, 2 from the Avon Longitudinal Study of Parents and Children (ALSPAC) (11%), 2 from the Health Behaviour in Teens study (11%), with the remaining articles from single studies. All studies conducted cross-sectional or repeated cross-sectional analyses, with one also utilising a longitudinal design. Sample sizes ranged from 286 to 16,421. Nine indicators of socioeconomic position were employed in studies of adolescents. Most frequently assessed was IMD (33%, 5 studies). Twelve studies measured physical activity, of which three (25%) used devices. Ten studies measured sedentary behaviour; 9 used self-report and 1 used a device-based measurement.

Table 4. Characteristics of studies including adolescents aged 12-18 years

Names of studies including adolescents, by region	Characteristics of studies							
	[Reference] reference numbers of articles & independent samples	Sample size range	Study design	Indicators of SES	Physical activity measure	Physical activity outcome assessed	Sedentary behaviour measure	Sedentary behaviour outcome assessed
UK/England representative								
Project STIL (Sedentary Teenagers and Inactive Lifestyles)	[71] B, G	N=1171	Cross-sectional	IMD; Family structure; Parent occupation	self-report	Sport/exercise participation	self-report	TV Viewing; Computer use; Total sedentary behaviour
Health Behaviour in School aged Children study (HBSC)	[72] B, G [73]	N=5148-16,421	Cross-sectional; Repeated cross-sectional	FAS	self-report	MVPA; VPA		
UK Time Use Survey	[43] II							
Programme for International Student assessment (PISA)	[74] B, G	N not specified	Cross-sectional	Family wealth	self-report	MPA; VPA		

Unnamed study 6	[75]	N=3348	Cross-sectional	IMD			Self-report	TV viewing; Streaming
East of England / Anglia								
ROOTS study	[76]	N=825	Cross-sectional	IMD	Device-measured	Light PA; MPA; PAEE	Device-measured	Sedentary time
East of England Healthy Hearts Study (EEHHS)	[77]	N=6240	Cross-sectional	IMD	self-report	PA	self-report	Screen-time
Midlands								
Unnamed study 7-8	[78]	N=611	Cross-sectional	IMD	self-report	Active travel		
	[79]	N=381 B, G	Cross-sectional	Family structure			self-report	Sedentary behaviour
Greater London								
Health Behaviour in Teens study (HBTs)	[80] B, G	N=5863	Longitudinal	Area deprivation (Townsend Index)	self-report	VPA	self-report	Screen-time
	[81] B, G	N=4320	Cross-sectional	Area deprivation (Townsend Index); Family structure	self-report	VPA	self-report	Screen-time
South-West England								
Avon Longitudinal Study of Parents and Children (ALSPAC)	[82]	N=5595-6406	Cross-sectional	Head of household occupation; Maternal education	Device-measured;	MVPA; Total activity; Inactivity	self-report	TV Viewing
	[83]				self-report			

1	Unnamed study 9	[84] G	N=286	Cross-sectional	Head of household occupation	self-report	VPA		
2	Ireland								
3	Young Hearts study 2000	[85]	N=2016	Cross-sectional	Maternal occupation	self-report	PA	self-report	Screen-time
4	Health Behaviour in School aged Children study (HBSC)	[72] B, G	N=975-4098	Cross-sectional; Repeated cross-sectional	FAS	self-report	MVPA; VPA		
5		[73]							
6	Children's Sport Participation and Physical Activity study (CSPPA)	[66] II	N=1508	Cross sectional	FAS	Self-report	PA		
7	Scotland								
8	Health Behaviour in School aged Children study (HBSC)	[86] B, G	N=19073	Cross-sectional	FAS	self-report	VPA		
9	Wales								
10	Health Behaviour in School aged Children study (HBSC)	[87]	N=7376-9194	Cross-sectional	FAS	self-report	MVPA; PA; VPA	self-report	Screen-time
11		[88]							

Active Project	[89] B, G	N=270	Cross-sectional	Welsh IMD	Device-measured	MVPA;		
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For reference 43 II = adolescents age 14-18 years; 66 II = post primary school age

IMD = Index of Multiple Deprivation; CPM = counts per minute; MPA = moderate physical activity; MVPA = moderate-to-vigorous-physical activity; PA = physical activity; VPA = vigorous physical activity; PAEE = physical activity energy expenditure; TV = television

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Socio-economic position and physical activity

Nine indicators of socioeconomic position were examined in association with physical activity. At the community level, IMD, Welsh IMD and area deprivation measured by the Townsend Index were assessed and there were no consistent results with either self-report or device assessed activity (Table 5). Head of Household Occupation was unrelated to reported physical activity in 4 out of 5 samples. Higher affluence (assessed with FAS) was positively associated with reported physical activity in 8 samples (from 2 studies), but unrelated in one study. The association between other indicators of socioeconomic position showed varied and inconclusive associations with adolescent physical activity.

Socio-economic position and sedentary behaviour

Eight indicators of socioeconomic position were examined in association with adolescent sedentary behaviour. At the community level, area deprivation was associated with reported activity in a cross-sectional and longitudinal sample. IMD showed mixed results with reported sedentary behaviour (Table 6). At the family level, Head of Household Occupation showed mixed results with reported sedentary behaviour that varied across samples according to outcome assessed. Family structure (living in single parent households) was associated with higher levels of reported sedentary behaviour in 4 samples, and not associated with reported sedentary behaviour in two samples.

Table 5. Synthesis of the evidence on associations between community and family-level indicators of socio-economic position and physical activity in adolescents (aged 12-18 years)

Indicator of socioeconomic status	Device-based PA n samples [[references] (outcome)]					Reported physical activity n samples [[references] (outcome)]						
	n	Positive association (+)	n	Inverse association (-)	n	No association (0)	n	Positive association (+)	n	Inverse association (-)	n	No association (0)
Community level												
Index of Multiple Deprivation (IMD)			1	[[76] (LPA)]	1	[[76] (MVPA, PAEE)]			3	[[78] (AT), [71] B weekday /E, [71] G weekday /E, weekend /E]	2	[[71] B (weekend S/E), [77] (PA level)]
Welsh IMD	1	[[89]G (MVPA)]			1	[[89]B (MVPA)]						
Area deprivation (Townsend Index)									1	[[81] G (VPA), [80] G (VPA)]	1	[[81] B (VPA), [80] B (VPA)]
Family level												
Maternal education					1	[[82] (MVPA, CPM)]			1	[[83] (inactivity)]		
Head of Household Occupation /					1	[[82] (MVPA, CPM)]	1	[[85] (PA)]			4	[[71] B, G (weekday S/E,

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occupational/social class										weekend S/E), [83] (inactivity), [84] (VPA)]
Family/household Income									1	[[83] (inactivity)]
Family Affluence Scale (FAS) / family wealth							8	[[72]UK, Ir, [73] UK, Ir, [87], [86] B, G (VPA), [87], [88] (PA), [72] UK, Ir (PA guidelines), [74] B, G (out of school MPA and VPA)	1	[[66] II (meets guidelines)]
Family structure / parental status (single parents)									4	[[81] B, G (VPA), [71] B, G (weekday and weekend S/E)]
Parent/partner Education			1	[[82] (CPM)]	1	[[82] (MVPA)]				

Note: UK = United Kingdom; Ir = Ireland

Table 6. Synthesis of the evidence on associations between community and family-level indicators of socio-economic position and sedentary behaviour in adolescents (aged 12-18 years)

Indicator of socioeconomic position	Device-based sedentary time n samples [[references] (outcome)]					Reported sedentary behaviour n samples [[references] (outcome)]					
	n	Positive association (+)	n	Inverse association (-)	No association (0)	n	Positive association (+)	n	Inverse association (-)	No association (0)	
Community level											
Index of Multiple Deprivation (IMD)			1	[[76] (ST)]		2	[[77] (ScrT), [75] (TV, streaming)]			2	[[71] B, G (TV, total SB, C)]
Area Deprivation (Townsend Index)						2	[[81] B, G, [80] B, G (ScrT)]				
Family level											
Maternal education								1	[[83] (TV)]		
Family/household Income								1	[[83] (TV)]		
Head of Household Occupation / occupational/social class						3	[[71] B (weekend TV and C), [71] G (weekday total SB), [85] (weekend ScrT)]	2	[[71] G (weekend TV), [85] weekday ScrT]]	4	[[71] B, G (weekday TV C, weekend total SB), [71] B (weekday total SB), [71] G (weekend C), [83], [84] (TV)]
Family Affluence Scale (FAS) / family wealth										1	[[87] (ScrT)]

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Family structure / parental status (single parents)						4	[[81] B, G (ScrT), [71] (total SB, weekend TV weekday C), [79] B (weekday total SB)]		3	[[71] B, G (weekday TV, weekend C), [71] G (total SB, weekend TV, weekday C), [79] G (weekday SB), [79] B, G (weekend SB)]
Maternal Employment						1	[[43] II (TV viewing)]			

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DISCUSSION

The purpose of this scoping review was to examine the extent, range and nature of the evidence on the association between socioeconomic position and young people's physical activity and sedentary behaviour in the UK. Of the 57 included publications, almost 65% reported data for children. Across childhood and adolescence, the majority of reported analyses were cross-sectional, with only 3 longitudinal analyses among samples of children and only one among adolescents. Considerable variation in the characterisation and measurement of the exposures / outcomes examined in this review combined to provide a mixed picture with regard to the association of socioeconomic position with physical activity and sedentary behaviour in young people living in the UK.

A substantial proportion of the evidence base is derived from studies that recruited country or regionally representative samples. In studies of children the coverage of data comes mostly from the Millennium Cohort Study (MCS), the Sport, Physical activity and Eating behaviour, Environmental Determinants in Young People study (SPEEDY) representing East Anglia, and the South-West region of England respectively. While Scotland and Ireland were represented in studies of children, Wales was not represented. In studies of adolescents, data were found for all four home countries of the UK. Much of the data was from the Health Behaviours in School-aged Children study (HBSC) where consistent associations were found between family affluence and reported physical activity.

The prevalence of children living at different socio-economic positions varies by country within the UK. Recent evidence suggests that 30% of all children in England and Wales live in poverty, compared to around 24% in Ireland and Scotland[90]. The limited data available across the nations and the variation in exposures and outcome measures used in the studies included in this scoping review precludes any conclusions about whether the associations between socioeconomic position and physical activity and sedentary behaviour are different. Future research is needed in the home countries that aims to improve the understanding of associations within countries so that policies can be targeted where most needed.

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3 Socioeconomic position of young people is typically inferred based on characteristics
4 measured at the parental (e.g. maternal education, occupational status), household (e.g.
5 housing tenure, household income) or neighbourhood (e.g. area deprivation) level. The
6 pathways through which these different indicators may influence children's health in
7 general are complex [91] and the magnitude of the observed inequalities is known to vary
8 by indicator[92]. Across the included literature, 17 indicators of socioeconomic position
9 were used. This heterogeneity may explain the lack of consistent associations found in this
10 review and others[19, 23]. Furthermore, the evidence presented here also highlights that
11 the same indicator of socioeconomic position may have different associations with
12 subcomponents/domains of physical activity and sedentary behaviour. For example, higher
13 maternal education and higher household income was shown to be associated with higher
14 levels of vigorous physical activity but with lower levels of moderate physical activity in
15 children[37]. Similar findings have been seen in the adult literature, for example in a recent
16 study of over 40,000 British adults, lower educational attainment was associated with
17 higher active travel and occupational activity, but lower weekly leisure-time physical
18 activity[93]. Furthermore, while the longitudinal evidence was scant in this review, the
19 evidence that does exist confirms the findings from the cross-sectional data. For example,
20 Salway et al. found that children from more deprived background saw higher increases in
21 screen-time from age 6 to 9 years, compared with those from less deprived
22 backgrounds[57]. In this same study, there were no associations between household
23 education and screen-time, but the longitudinal analyses showed that those from
24 households of higher education had less increases in screen-time from age 6 to 9 years
25 compared with those from households with lower education[57]. In addition, we did not
26 observe clear evidence that associations between specific markers of socioeconomic
27 position and physical activity were opposite in sedentary behaviour, consistent with
28 previous evidence that the correlations between these two behaviours are low[94]. This
29 exemplifies the importance of specificity in the definition of the socio-economic exposure
30 and the domain of the outcome of interest in observational research and in the design and
31 delivery of interventions.
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3 In the present review, the most common indicator of socioeconomic position used was IMD.
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5 IMD provides a measure of the level of deprivation experienced by people living in a small
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7 area (approximately 1500 residents) based on indices of deprivation including income,
8
9 employment, health, education, and crime[31]. While census data collected on IMD is key
10
11 for targeting services to help tackle deprivation, it is not a direct or necessarily meaningful
12
13 measure of deprivation at the individual/household level[95]. This scoping review suggests
14
15 that further evidence is needed to assess the relationship between individual or household
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17 measures of socio-economic position and physical activity and sedentary behaviours in
18
19 children. Nonetheless, area-level markers of socioeconomic position may still be insightful
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21 for examining potential neighbourhood socioeconomic position influences on physical
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23 activity or sedentary behaviour and for geographical targeting of interventions. Social
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25 Scientists argue that area-based measures of socioeconomic position may be more relevant
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27 for adolescents than household measures because of the growing amount of time that they
28
29 spend outside of the household and engaging with their community[96, 97]. In the present
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31 review, the IMD was not associated with device measured physical activity or sedentary
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33 behaviour but showed positive, negative, and null associations with self- or proxy reported
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35 physical activity tend to collect information on purposeful bouts of more organised activity
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37 that can be recalled. Thus, questionnaires are likely to pick up sports participation and
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39 leisure time activity that arguably could be more closely associated with area level
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41 deprivation. For example, recalled bouts of sports/exercise may be more closely linked to
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43 facilities, green space, play parks, and perceived safety which have previously been shown
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45 to be related to structured activity[98]. The inability of device-based assessment to capture
46
47 specific activity types means that such associations may have been obscured in studies that
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49 used this methodology.

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51 The evidence presented here is characterized by substantial variability in the markers of
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53 socioeconomic position used across different studies, but they are generally similar to those
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55 seen in the literature for adults. Collection of common indicators used in adult studies (such
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57 as income, employment and education) can be problematic in this younger population, as
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59 many young people cannot accurately describe their parent's education, income or details
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3 of their current employment, and collection of data from parents could result in high levels
4 of missing data. It has thus been suggested that assessing material circumstances, such as
5 number of assets in the home as used in the Family Affluence Scale (FAS) might be valuable
6 because these circumstances are easier to recall[99]. In addition, multidimensional
7 measures, like the FAS, have their strength in capturing an overall measure of
8 socioeconomic position rather than looking at single domains. This can be important when
9 the study is interested in the overall concept of socioeconomic position as opposed to the
10 constituent parts[100, 101]. In the present review, FAS was only used in two studies of
11 adolescents. One of these was the HBSC study which showed, consistently (across 5
12 publications), that higher affluence was associated with higher self-reported MVPA, VPA,
13 and meeting physical activity guidelines. Data (not included in the review) from the HBSC
14 study reveals this same trend across other European countries and for other health
15 behaviours, such as fruit and vegetable consumption (i.e. higher affluence associated with
16 higher consumption), and health outcomes, such as obesity[102]. Advantages of the FAS
17 include that it is relatively straightforward for young people to complete and that it
18 recognises that socioeconomic position is a complex concept that cannot be fully described
19 or have its complete meaning defined in any single measure. It further recognises that as
20 young people age, they start spending more time outside of the home, and thus may
21 become more influenced by their community/neighbourhood environment. However,
22 limited research is available on its validity and comparison with other measures of socio-
23 economic position[103].

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42 The majority of the device-based measures of physical activity and sedentary behaviour
43 characterised behaviour at daily or weekly level, which may mask socio-economic variations
44 in behaviour that occur within these periods. For example, emerging literature shows that
45 physical activity and sedentary behaviours are most varied out of school (e.g. structure day
46 hypothesis[104]), and that weekend activity behaviour is more susceptible to seasonal
47 variation than weekday activity[105]. One study in the present review for example, found
48 that IMD was associated with higher levels of after school sedentary time and sedentary
49 time on weekends, but not associated with before school or school day sedentary time[61].
50 However, limited research is available on whether this also holds true for physical
51 activity. Future research that explores socio-economic patterning of physical activity and
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3 sedentary behaviour within specific periods of the day or week will allow for more precise
4 targeting of behaviour change interventions.
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8 Finally, there may be a different association between socioeconomic position and intensity
9 of physical activity, although the evidence base is scarce. One large-scale study in 7-year-
10 olds showed that children from less affluent families (and certain ethnic minorities groups)
11 spent less time in vigorous physical activity[37]. Vigorous physical activity, compared with
12 lower intensity physical activity, has a stronger association with adiposity[106], and this
13 socioeconomic disparity in inactivity intensity may partly help explain inequalities in obesity
14 prevalence.
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20 21 **Future research**

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23 Future research which has at the heart of its aim to understand the relationship between
24 socioeconomic position and health behaviour outcomes should consider using
25 multidimensional, simple to report measures of socioeconomic position in studies of
26 children and adolescents including individual, community/neighbourhood measures of
27 socioeconomic position. Consistency in the domains of socioeconomic position reported and
28 physical activity and sedentary behaviour levels would allow harmonisation of data across
29 studies and country-specific meta-analyses. There is a need to have a better theoretical
30 understanding of how measures of socioeconomic position apply to children, and how their
31 influence would operate on physical activity and sedentary behaviours to understand
32 whether there are specific domains of socioeconomic position that would be more
33 appropriate to focus on in these types of studies.
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44 National surveys, such as Health Survey for England, need to make informed decisions
45 regarding the socioeconomic position indicators and ensure that the same measure is
46 included over time to assess secular trends, whilst adding new measures as knowledge
47 evolves on how to best measure socioeconomic position. There is also a need to consider
48 routine inclusion of device measured physical activity, alongside questionnaires, within
49 health surveys to capture varied types and intensity of activities. Lastly, the relative
50 importance of different domains of socio-economic position likely vary with age, with
51 neighbourhood and community measures becoming more important in adolescence when
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3 children spend more time outside of the home. This information should be used to inform
4 the refinement of relevant and valid indicators of socioeconomic position.
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10 **Strengths and Limitations of the review**

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12 Strengths of the review include the systematic methodology and reporting in accordance
13 with PRISMA-SCR guidelines. The present review also examined and reported the results of
14 children and adolescents separately allowing the complete extent, range, and nature of the
15 evidence to be synthesised. Meta-analytic synthesis would have enabled more precise
16 quantification of the direction and magnitude of reported associations, but this was deemed
17 inappropriate due to heterogeneity in the exposure and outcome measures used and is also
18 outside of the scope of a scoping review of this nature. We recognise the value of
19 qualitative research on this topic and acknowledge that a mixed-studies review may have
20 provided additional insight. However, given the volume of research on this topic, a more
21 focussed quantitative research review was undertaken as a starting point.
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32 **CONCLUSIONS**

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34 A large number of indicators of socioeconomic position have been studied in relation to
35 physical activity and sedentary behaviour among children and adolescents in the UK, and
36 the evidence is mixed. It is clear that physical activity and sedentary behaviours of children
37 and adolescents in the UK are complex and influenced by multiple indicators of
38 socioeconomic position that are, in most cases, different across age stages, outcomes
39 examined, and measurement tools. Greater consistency in the use and measures of
40 socioeconomic position as well as outcomes of behaviour are required for robust country-
41 specific meta-analyses. More longitudinal studies that adopt devices (such as
42 accelerometers) to measure physical activity and sedentary time in addition to
43 questionnaire-based measures are required.
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19 **AUTHOR CONTRIBUTIONS**

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21 Activities undertaken by the authors were as follows: conceptualisation of the design of the
22 study: NP, LBS, EvS and AJA; establishment of research question/s NP and LBS, development
23 of search strategy: NP and AJA. Background framing: NP, PG, EvS, KK, AJA and LBS. Database
24 search and record screening: NP and LBS. Extraction of primary studies from the included
25 reviews: NP and LBS. Interpretation of the results: NP, PG, EvS, KK, AJA and LBS. Drafting
26 manuscript: NP. Final approval of the version to be published: NP, PG, EvS, KK, AJA and LBS.
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29 **Data sharing statement**

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31 All relevant data are within the paper and supporting materials
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34 **COMPETING INTERESTS**

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36 No competing interests
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38

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40
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55 **FIGURE 1** Flow diagram of search strategy
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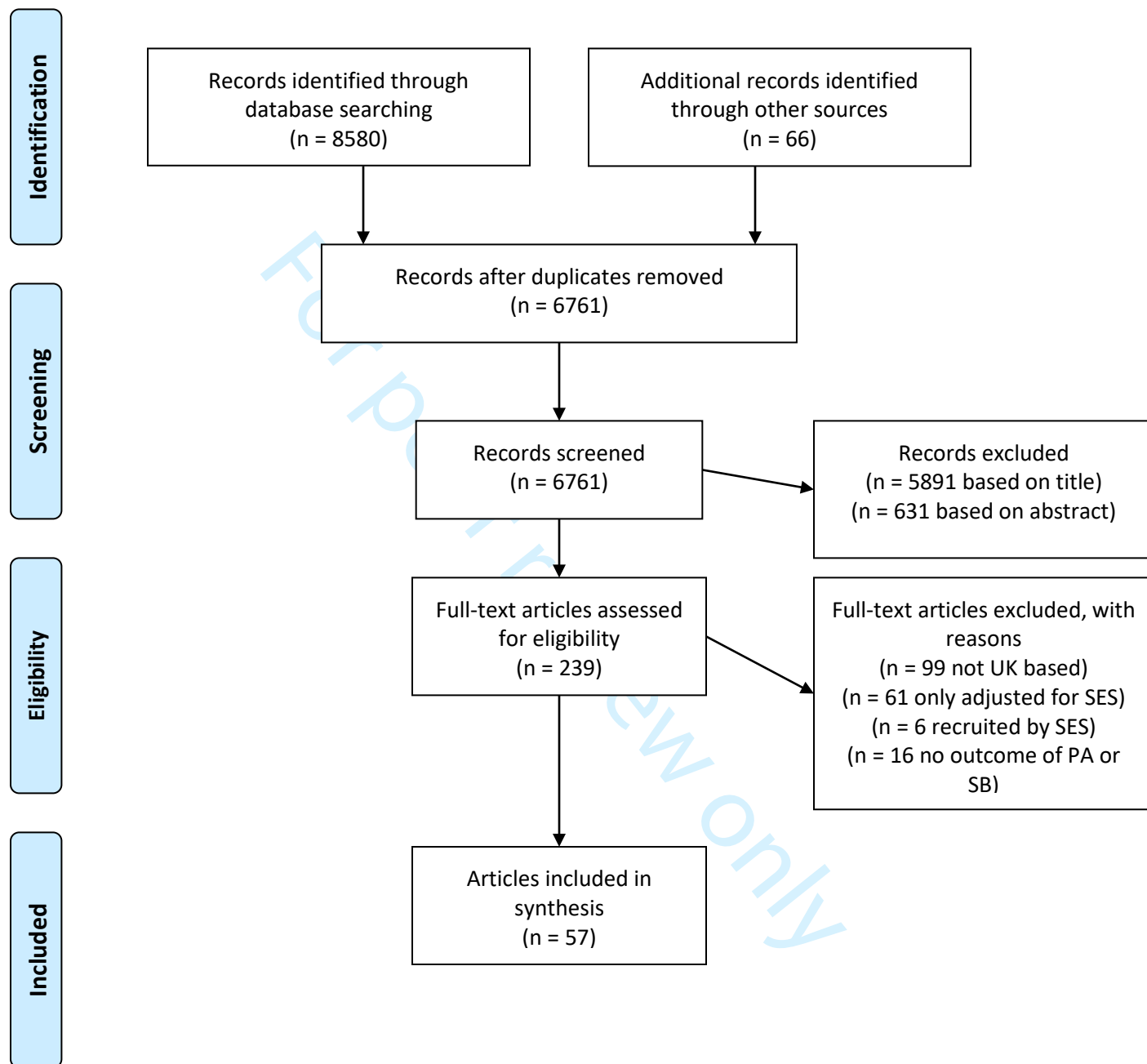
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Supplementary Figure 1. Flow diagram of search strategy



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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Supplementary File 1: Pubmed Search

Search number	Query	Sort By	Filters	Search Details	Results	Time
13	#4 AND #5 AND #7 AND #10	Publication Date		("Demographic"[Title/Abstract] OR "family"[Title/Abstract] OR "education level"[Title/Abstract] OR "SES"[Title/Abstract] OR "socioeconomic status"[Title/Abstract] OR "social position"[Title/Abstract] OR "socioeconomic position"[Title/Abstract] OR "SEP"[Title/Abstract] OR "employment"[Title/Abstract] OR "income"[Title/Abstract] OR "occupational status"[Title/Abstract] OR "occupational class"[Title/Abstract] OR "depriv*"[Title/Abstract] OR "affluence"[Title/Abstract] OR "maternal education"[Title/Abstract] OR "parent education"[Title/Abstract] OR "car ownership"[Title/Abstract]) AND ("adolescent"[MeSH Terms] OR "child"[MeSH Terms:noexp]) AND ("child"[MeSH Terms:noexp] OR "adolescent"[MeSH Terms]) AND (("physical*"[Title/Abstract] OR "activ*"[Title/Abstract] OR "physical activity"[Title/Abstract] OR "sport"[Title/Abstract] OR "cycling"[Title/Abstract])	2,481	10:45:04

				OR "bicycling"[Title/Abstract] OR "walking"[Title/Abstract] OR "physical education"[Title/Abstract] OR "exercise"[Title/Abstract] OR "energy expenditure"[Title/Abstract] OR "physical inactivity"[Title/Abstract] OR "physical fitness"[Title/Abstract] OR "active travel"[Title/Abstract] OR "commuting"[Title/Abstract] OR "motor activity"[Title/Abstract] OR "play"[Title/Abstract] AND ("child"[MeSH Terms:noexp] OR "adolescent"[MeSH Terms])) AND (("sedentar*"[Title/Abstract] OR "sedentary behavio*"[Title/Abstract] OR "Computer"[Title/Abstract] OR "tv viewing"[Title/Abstract] OR "sitting"[Title/Abstract] OR "Television"[Title/Abstract] OR "Screen- Time"[Title/Abstract] OR "Screen- Based"[Title/Abstract] OR "Screen- Based"[Title/Abstract] OR "inactiv*"[Title/Abstract] OR "sedentary time"[Title/Abstract] OR "sitting time"[Title/Abstract] OR "Screen- Time"[Title/Abstract]) AND ("child"[MeSH Terms:noexp] OR "adolescent"[MeSH		
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				<p>Terms]) AND ("child"[MeSH Terms:noexp] OR "adolescent"[MeSH Terms])) AND (("child"[Title/Abstract] OR "children"[Title/Abstract] OR "childhood"[Title/Abstract] OR "kids"[Title/Abstract] OR "adolescen*"[Title/Abstract] OR "young person"[Title/Abstract] OR "young people"[Title/Abstract] OR "teen*"[Title/Abstract] OR "youth*"[Title/Abstract] OR "boy"[Title/Abstract] OR "girl*"[Title/Abstract]) AND ("child"[MeSH Terms:noexp] OR "adolescent"[MeSH Terms]) AND ("child"[MeSH Terms:noexp] OR "adolescent"[MeSH Terms]))</p>		
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12	#4 AND #5 AND #7 AND #10	Publication Date	Child: 6-12 years	("Demographic"[Title/Abstract] OR "family"[Title/Abstract] OR "education level"[Title/Abstract] OR "SES"[Title/Abstract] OR "socioeconomic status"[Title/Abstract] OR "social position"[Title/Abstract] OR "socioeconomic position"[Title/Abstract] OR "SEP"[Title/Abstract] OR "employment"[Title/Abstract] OR "income"[Title/Abstract] OR "occupational status"[Title/Abstract] OR "occupational class"[Title/Abstract] OR "depriv*"[Title/Abstract] OR "affluence"[Title/Abstract] OR "maternal education"[Title/Abstract] OR "parent education"[Title/Abstract] OR "car ownership"[Title/Abstract]) AND ("adolescent"[MeSH Terms] OR "child"[MeSH Terms:noexp]) AND ("child"[MeSH Terms:noexp] OR "adolescent"[MeSH Terms]) AND (("physical*"[Title/Abstract] OR "activ*"[Title/Abstract] OR "physical activity"[Title/Abstract] OR "sport"[Title/Abstract] OR "cycling"[Title/Abstract] OR "bicycling"[Title/Abstract] OR "walking"[Title/Abstract] OR "physical	1,869	10:44:59
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1				education"[Title/Abstract]		
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4				OR "energy		
5				expenditure"[Title/Abstract]		
6				OR "physical		
7				inactivity"[Title/Abstract]		
8				OR "physical		
9				fitness"[Title/Abstract]		
10				OR "active		
11				travel"[Title/Abstract] OR		
12				"commuting"[Title/Abstract]		
13				OR "motor		
14				activity"[Title/Abstract]		
15				OR "play"[Title/Abstract]		
16				AND ("child"[MeSH		
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18				"adolescent"[MeSH		
19				Terms])) AND		
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22				behavio*"[Title/Abstract]		
23				OR		
24				"Computer"[Title/Abstract]		
25				OR "tv		
26				viewing"[Title/Abstract]		
27				OR		
28				"sitting"[Title/Abstract]		
29				OR		
30				"Television"[Title/Abstract]		
31				OR "Screen-		
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33				"Screen-		
34				Based"[Title/Abstract] OR		
35				"Screen-		
36				Based"[Title/Abstract] OR		
37				"inactiv*"[Title/Abstract]		
38				OR "sedentary		
39				time"[Title/Abstract] OR		
40				"sitting		
41				time"[Title/Abstract] OR		
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11	#4 AND #5 AND #7 AND #10	Publication Date	Child: 6-12 years, Adolescent: 13-18 years	("Demographic"[Title/Abstract] OR "family"[Title/Abstract] OR "education level"[Title/Abstract] OR "SES"[Title/Abstract] OR "socioeconomic status"[Title/Abstract] OR "social position"[Title/Abstract] OR "socioeconomic position"[Title/Abstract] OR "SEP"[Title/Abstract] OR "employment"[Title/Abstract] OR "income"[Title/Abstract] OR "occupational status"[Title/Abstract] OR "occupational class"[Title/Abstract] OR "depriv*"[Title/Abstract] OR "affluence"[Title/Abstract] OR "maternal education"[Title/Abstract] OR "parent education"[Title/Abstract] OR "car ownership"[Title/Abstract]) AND ("adolescent"[MeSH Terms] OR "child"[MeSH Terms:noexp]) AND ("child"[MeSH Terms:noexp] OR "adolescent"[MeSH Terms]) AND (("physical*"[Title/Abstract] OR "activ*"[Title/Abstract] OR "physical activity"[Title/Abstract] OR "sport"[Title/Abstract] OR "cycling"[Title/Abstract] OR "bicycling"[Title/Abstract] OR "walking"[Title/Abstract] OR "physical	2,481	10:44:09
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8				OR "physical		
9				fitness"[Title/Abstract]		
10				OR "active		
11				travel"[Title/Abstract] OR		
12				"commuting"[Title/Abstract]		
13				OR "motor		
14				activity"[Title/Abstract]		
15				OR "play"[Title/Abstract]		
16				AND ("child"[MeSH		
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24				"Computer"[Title/Abstract]		
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9	child[tiab] OR children[tiab] OR childhood[tiab] OR kids[tiab] OR adolescen*[tiab]] OR young person[tiab] OR young people[tiab] OR teen*[tiab] OR youth*[tiab] OR boy*[tiab] OR girl*[tiab]	Publicati on Date	Child: 6- 12 years, Adolesce nt: 13-18 years	"child"[Title/Abstract] OR "children"[Title/Abstract] OR "childhood"[Title/Abstrac t] OR "kids"[Title/Abstract] OR "adolescen*"[Title/Abstra ct] OR "young person"[Title/Abstract] OR ("young"[All Fields] OR "youngs"[All Fields]) AND ("people s"[All Fields] OR "peopled"[All Fields] OR "peopling"[All Fields] OR "persons"[MeSH Terms] OR "persons"[All Fields] OR "people"[All Fields] OR "peoples"[All Fields])) OR "teen*"[Title/Abstract] OR "youth*"[Title/Abstract] OR "boy"[Title/Abstract] OR "girl*"[Title/Abstract]	1,536,7 26	10:42: 06
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8	United kingdom[tiab] OR UK[tiab] OR Wales[tiab] OR England[tiab] OR Scotland[tiab] OR Northern Ireland[tiab]	Publication Date	Child: 6-12 years, Adolescent: 13-18 years	"united kingdom"[Title/Abstract] OR "UK"[Title/Abstract] OR "Wales"[Title/Abstract] OR "England"[Title/Abstract] OR "Scotland"[Title/Abstract] OR "northern ireland"[Title/Abstract]	35,254	10:40:35
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7	Sedentar*[tiab] OR Sedentary behavio*[tiab] OR Computer[tiab] OR 'TV viewing'[tiab] OR sitting[tiab] OR Television[tiab] OR Screen- Time[tiab] OR Screen- Based[tiab] OR screen based[tiab] OR inactiv*[tiab] OR sedentary time[tiab] OR 'sitting time'[tiab] OR screen time[tiab] AND (child[Filter] OR adolescent[Filter])	Publicati on Date	Child: 6- 12 years, Adolesce nt: 13-18 years	("sedentar*"[Title/Abstra ct] OR "sedentary behavio*"[Title/Abstract] OR "Computer"[Title/Abstrac t] OR "tv viewing"[Title/Abstract] OR "sitting"[Title/Abstract] OR "Television"[Title/Abstrac t] OR "Screen- Time"[Title/Abstract] OR "Screen- Based"[Title/Abstract] OR "Screen- Based"[Title/Abstract] OR "Screen- Based"[Title/Abstract] OR "inactiv*"[Title/Abstract] OR "sedentary time"[Title/Abstract] OR "sitting time"[Title/Abstract] OR "Screen- Time"[Title/Abstract]) AND ("child"[MeSH Terms:noexp] OR "adolescent"[MeSH Terms])	45,677	10:39: 13
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5	physical*[tiab] OR activ*[tiab] OR 'physical activity'[tiab] OR sport[tiab] OR cycling[tiab] OR bicycling[tiab] OR walking[tiab] OR physical education[tiab] OR exercise[tiab] OR 'energy expenditure'[tiab] OR 'physical inactivity'[tiab] OR 'physical fitness'[tiab] OR 'active travel'[tiab] OR commuting[tiab]] OR 'motor activity'[tiab] OR play[tiab]	Publicati on Date	Child: 6- 12 years, Adolesce nt: 13-18 years	"physical*" [Title/Abstract] OR "activ*" [Title/Abstract] OR "physical activity" [Title/Abstract] OR "sport" [Title/Abstract] OR "cycling" [Title/Abstract] OR "bicycling" [Title/Abstract] OR "walking" [Title/Abstract] OR "physical education" [Title/Abstract] OR "exercise" [Title/Abstract] OR "energy expenditure" [Title/Abstra ct] OR "physical inactivity" [Title/Abstract] OR "physical fitness" [Title/Abstract] OR "active travel" [Title/Abstract] OR "commuting" [Title/Abstra ct] OR "motor activity" [Title/Abstract] OR "play" [Title/Abstract]	399,685	10:34: 55
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4	Demographic[tiab] OR family[tiab] OR 'education level'[tiab] OR SES[tiab] OR 'socioeconomic status'[tiab] OR 'social position'[tiab] OR OR 'socioeconomic position'[tiab] OR OR SEP[tiab] OR 'employment'[tiab] OR income[tiab] OR OR 'occupational status'[tiab] OR 'occupational class'[tiab] OR depriv*[tiab] OR OR affluence[tiab] OR OR 'maternal education'[tiab] OR OR 'parent education'[tiab] OR OR 'car ownership'[tiab] AND (adolescent[Filter] OR child[Filter])	Publicati on Date	Child: 6- 12 years, Adolesce nt: 13-18 years	("Demographic"[Title/Abstract] OR "family"[Title/Abstract] OR "education level"[Title/Abstract] OR "SES"[Title/Abstract] OR "socioeconomic status"[Title/Abstract] OR "social position"[Title/Abstract] OR "socioeconomic position"[Title/Abstract] OR "SEP"[Title/Abstract] OR "employment"[Title/Abstract] OR "income"[Title/Abstract] OR "occupational status"[Title/Abstract] OR "occupational class"[Title/Abstract] OR "depriv*"[Title/Abstract] OR "affluence"[Title/Abstract] OR "maternal education"[Title/Abstract] OR "parent education"[Title/Abstract] OR "car ownership"[Title/Abstract]) AND ("adolescent"[MeSH Terms] OR "child"[MeSH Terms:noexp])	237,586	10:31: 26
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3	Demographic[tiab] OR family[tiab] OR education level[tiab] OR SES[tiab] OR socioeconomic status[tiab] OR social position[tiab] OR socioeconomic position[tiab] OR SEP[tiab] OR employment[tiab] OR income[tiab] OR occupational status[tiab] OR occupational class[tiab] OR deprivation[tiab] OR affluence[tiab] OR maternal education[tiab] OR parent education[tiab]	Publicati on Date	Adolesce nt: 13-18 years, Child: 6- 12 years	"Demographic"[Title/Abstract] OR "family"[Title/Abstract] OR "education level"[Title/Abstract] OR "SES"[Title/Abstract] OR "socioeconomic status"[Title/Abstract] OR "social position"[Title/Abstract] OR "socioeconomic position"[Title/Abstract] OR "SEP"[Title/Abstract] OR "employment"[Title/Abstract] OR "income"[Title/Abstract] OR "occupational status"[Title/Abstract] OR "occupational class"[Title/Abstract] OR "deprivation"[Title/Abstract] OR "affluence"[Title/Abstract] OR "maternal education"[Title/Abstract] OR "parent education"[Title/Abstract]	236,113	10:29: 06
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2	Demographic[tiab] OR family[tiab] OR education level[tiab] OR SES[tiab] OR socioeconomic status[tiab] OR social position[tiab] OR socioeconomic position[tiab] OR SEP[tiab] OR employment[tiab] OR income[tiab] OR occupational status[tiab] OR occupational class[tiab] OR deprivation[tiab] OR affluence[tiab] OR maternal education[tiab] OR parent education[tiab]	Publicati on Date	Child: 6- 12 years	"Demographic"[Title/Abstract] OR "family"[Title/Abstract] OR "education level"[Title/Abstract] OR "SES"[Title/Abstract] OR "socioeconomic status"[Title/Abstract] OR "social position"[Title/Abstract] OR "socioeconomic position"[Title/Abstract] OR "SEP"[Title/Abstract] OR "employment"[Title/Abstract] OR "income"[Title/Abstract] OR "occupational status"[Title/Abstract] OR "occupational class"[Title/Abstract] OR "deprivation"[Title/Abstract] OR "affluence"[Title/Abstract] OR "maternal education"[Title/Abstract] OR "parent education"[Title/Abstract]	131,288	10:29: 01
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1	Demographic[tiab] OR family[tiab] OR education level[tiab] OR SES[tiab] OR socioeconomic status[tiab] OR social position[tiab] OR socioeconomic position[tiab] OR SEP[tiab] OR employment[tiab] OR income[tiab] OR occupational status[tiab] OR occupational class[tiab] OR deprivation[tiab] OR affluence[tiab] OR maternal education[tiab] OR parent education[tiab]	Publicati on Date		"Demographic"[Title/Abstract] OR "family"[Title/Abstract] OR "education level"[Title/Abstract] OR "SES"[Title/Abstract] OR "socioeconomic status"[Title/Abstract] OR "social position"[Title/Abstract] OR "socioeconomic position"[Title/Abstract] OR "SEP"[Title/Abstract] OR "employment"[Title/Abstract] OR "income"[Title/Abstract] OR "occupational status"[Title/Abstract] OR "occupational class"[Title/Abstract] OR "deprivation"[Title/Abstract] OR "affluence"[Title/Abstract] OR "maternal education"[Title/Abstract] OR "parent education"[Title/Abstract]	1,325,6 19	10:28: 50
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Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	



SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med.* 2018;169:467–473. doi: 10.7326/M18-0850.



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