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Association between maternal education and objectively measured physical activity and sedentary time in adolescents

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ABSTRACT

Background Investigating socioeconomic variation in physical activity (PA) and sedentary time is important as it may represent a pathway by which socioeconomic position (SEP) leads to ill health. Findings on the association between children's SEP and objectively assessed PA and/or sedentary time are mixed, and few studies have included international samples.

Objective Examine the associations between maternal education and adolescent's objectively assessed PA and sedentary time.

Methods This is an observational study of 12 770 adolescents (10–18 years) pooled from 10 studies from Europe, Australia, Brazil and the USA. Original PA data were collected between 1997 and 2009. The associations between maternal education and accelerometer variables were examined using robust multivariable regression, adjusted for a priori confounders (ie, body mass index, monitor wear time, season, age and sex) and regression coefficients combined across studies using random effects meta-analyses. Analyses were conducted in March 2014.

Results Adolescents of university educated mothers spent more time sedentary (9.5 min/day, p=0.005) and less time in light activity (10 min/day, p<0.001) compared with adolescents of high school educated mothers. Pooled analysis across two studies from Brazil and Portugal (analysed separately because of the different coding of maternal education) showed that children of higher educated mothers (tertiary vs primary/secondary) spent less time in moderate to vigorous PA (MVPA) (6.6 min/day, p=0.001) and in light PA (39.2 min/day: p<0.001), and more time sedentary (45.9 min/day, p<0.001).

Conclusions Across a number of international samples, adolescents of mothers with lower education may not be at a disadvantage in terms of overall objectively measured PA.

INTRODUCTION

Socioeconomic position (SEP) is an important correlate of health and well-being. Studies show that in adults from developed countries, low SEP, measured through household income and education, is related to poor health and greater all-cause mortality.[1][2] Likewise, populations from developing countries who are socioeconomically disadvantaged in terms of income or education, tend to fare worse in terms of non-communicable diseases,[3] although some epidemiological evidence suggests that the early adoption of unhealthy behaviours by newly socioeconomically advantaged populations may lead to an inverse association between education and health in some countries.[4]

Children growing up in low SEP families in developing countries are more likely to be overweight[5][6] and have greater risk for cardiovascular disease[2][7] and poor psychological health[8] than children of a higher SEP, although the association may differ by country of origin.[9] Socioeconomic variation in physical activity (PA) is important as it may represent an intermediary pathway by which SEP leads to poor health. In PA research, however, SEP is rarely used as a primary variable of interest, and is more frequently included to account for potential confounding effects. Within the relatively small body of literature that has directly examined associations between PA and SEP, findings are equivocal and tend to focus on middle/high income and/or developed countries.[10][11] A systematic review (which included papers from the USA, Asia, Canada, Oceania, Brazil, Europe (and 1 study that included 32 countries)) suggested that higher SEP was associated with higher levels of PA in adolescents.[11] However, 42% of studies reported no association or a negative association. Reasons for these equivocal results are that previous studies[10–13] have used (1) varying indicators of SEP, (2) subjective, self-reported measures of PA, which are known to have inherent biases,[14] (3) varying domains (eg, active travel, leisure time) of PA. That said, a more consistent association has been shown between SEP and indicators of sedentary behaviour, such as self-reported television watching in Europe and the USA.[5][10][15–18] Fewer studies have examined the association between objectively measured total sedentary time and SEP.

Objective measurement tools such as accelerometers, more accurately quantify PA and total sedentary time than self-reporting methods.[14] However, even among studies using objective measures, findings on the association between SEP and PA[17][19–22] and/or sedentary time[15][21][23] are mixed. Given the multiple proxy indicators (eg, maternal

education, paternal education, household income, etc) and composite indicators (eg, National Statistics Socioeconomic classification) of SEP used in published literature, it is difficult to compare results across studies. Interpretation of the accelerometry literature is similarly challenging given the multitude of analytical methods/criteria used to generate outcome variables, such as criteria for establishing wear time versus non-wear, determining what constitutes a valid day/file and choice of intensity cut points. The recently compiled International Children's Accelerometry Database (ICAD)[24] pooled and analysed raw accelerometer data using standardised methods to create comparable outcome variables across studies from Europe, Australia, Brazil and the USA. In addition, separate indicators of maternal education were pooled and recoded to create standardised maternal education categories across studies. Therefore, the ICAD affords the opportunity to investigate, for the first time, cross-sectional associations between maternal education, PA and time spent sedentary across a large number of international samples using standardised SEP and accelerometer data in a meta-analytical approach.

METHODS
Study design
The ICAD (http://www.mrc-epid.cam.ac.uk) has been described in detail elsewhere along with dates of data collection.[24] In brief, the eligibility criteria for inclusion in the ICAD were (1) PA data in the form of raw accelerometer (.dat) files from a version of a waist-worn Actigraph accelerometer (eg, 7164, 71256, GT1M1) on children aged 3–18 years, (2) accompanying data, at a minimum, of gender, age and measured height and weight. Formal data sharing agreements were established, and all partners consulted with their individual research boards to confirm sufficient ethical approval had been attained for contributing data.

Participants
For the present study, the analytical sample (n=12 770) was restricted to children aged 10–18 years. This age range was chosen as it yields the largest number of participants with maternal education information. Data were taken from 10 studies, across eight countries: Australia (N=2: 2001/2004/2006; 2002–2003/2006), Brazil (2006–2007), Denmark (1997–1998 and 2003–2004), Estonia (1998–1999), Portugal (1999–2000), Switzerland (2005–2006), the UK (N=2: 2003–2007; 2006–2009) and the USA (2002–2006). Where longitudinal data was available, only baseline data was used.

Maternal education
Owing to the variation in national education systems and categories used to record educational level (see online supplementary table S1), raw maternal education variables were standardised to enable comparisons across studies. To maintain meaningful interpretation, the studies were divided into two groups for analysis, and maternal education was standardised separately for each group. For eight of the studies, the raw education variables were recoded into the following three categories: (1) 'high school'—no education, or completed some/all of high school, (2) 'college'—completed some/all of college education (including vocational training), (3) 'university'—completed some/all of a university degree (including graduate school). The reason for selecting these categories (rather than including a 'not completed high school' category, commonly seen in other literature) is because three studies did not collect data on not completing high school, and when they did few were placed

into this category. Where data was collected on not completing high school (5 studies), different criteria/cut-offs were used. The raw education variable for the remaining two studies (Pelotas study of Brazilian children and The Portugal European Youth Heart Study (EYHS) of children from Madeira) recorded school attainment in years of education, and thus, no distinction could be made between vocational and university training. These studies were analysed separately on an educational scale defined as (1) primary school education and (2) secondary school/tertiary education. Online supplementary table S1 also indicates the number of years of education for each education category by study.

Assessment of PA and sedentary time
Detailed description of the assessment of PA is available elsewhere.[24] Briefly, all available accelerometer data from the ICAD project were reanalysed, to provide comparable PA and sedentary outcomes across studies, using specifically developed and commercially available software (KineSoft, V.3.3.20, Loughborough, UK; http://www.kinesoft.org). Data files were reintegrated to 60 s epochs and non-wear time was defined as 60 min of consecutive zeros allowing 2 min of non-zero interruptions.[25] All children with ≥ 1 day with ≥500 min of wear time between 7:00 and midnight were included, in keeping with previous analyses.[26] A more thorough discussion of the appropriateness of using a single day of wear is available elsewhere.[27] Raw accelerometer-derived PA data were expressed as average counts per minute (CPM; ie, total counts per valid day, divided by monitor wear time per day). Time spent sedentary was defined as all minutes <100 CPM,[28] and MVPA time as minutes >3000 CPM,[28 29] corresponding to about 4.6 metabolic equivalents.[28]

Anthropometry
Height and weight was measured using standardised techniques within studies. Body mass index (BMI) was calculated as weight (kg)/height (m)^2 and participants were categorised into normal weight, overweight and obese groups according to age-specific and sex-specific thresholds.[30]

Statistical analysis
Descriptive results are expressed as mean and SD for continuous variables and percentages for categorical variables. Two-way analysis of variance (ANOVA) was used to explore possible interactions between sex and maternal education in relation to each PA outcome. Associations between CPM, light activity, moderate-to-vigorous PA (MVPA), and sedentary time were analysed using Pearson correlation. Robust linear regression was used to estimate the mean difference in PA outcomes between the maternal education categories within each study. Models were adjusted a priori for age, sex, season and monitor wear time, with the exception of CPM models, in which wear time is inherent in the derived variable. A binary classification was used as an indicator of season (based on daylight). Data collected in the Northern hemisphere were classified as either summer (data collected May–October) or winter (data collected November–April), and inverted for Southern hemisphere data.

Reprocessing the raw accelerometer data allowed measurement of the dependent and independent variables on the same scales, and thus, comparison of mean differences in PA between maternal education categories. Mean differences of the studies were combined to estimate an overall mean difference (ie, a combined estimate), and 95% CI between maternal education categories for each accelerometer outcome in turn by using

random effects meta-analysis models weighted by the inverse of the variances (precision) of the mean differences. Heterogeneity among the study estimates was assessed by visual inspection of forest plots and by the I^2 statistic.[31] Heterogeneity between studies may be reduced through modelling relative rather than absolute differences in accelerometer outcomes between maternal educational categories. To explore this, analyses were repeated using within-study standardisation of the accelerometer outcomes. Last, in addition to controlling for the aforementioned confounders the analyses were repeated when (1) adjusting for BMI status (normal weight/overweight/obese) to assess whether the observed difference in PA and sedentary time between maternal education categories was independent of BMI status, (2) mutually adjusting for MVPA and sedentary time (ie, when MVPA was modelled as the main exposure, the analysis was adjusted for sedentary time and vice versa) to establish if differences in MVPA and sedentary time between maternal education categories were independent of each other. All analyses were conducted using Stata/SE V.11.2 in March 2014. Significance testing was two sided, and p values were used to assess the strength of evidence against the null hypotheses.

RESULTS

Ten ICAD studies representing 16 275 youths aged 10–18 years, met the inclusion criteria for the present analysis. Of this sample, 12 770 (78.5%) had at least 1 day of ≥500 min of valid accelerometer wear time and a self-reported measure of maternal education, and thus, formed the study population.

The mean age of included participants was 12.4 years (SD=1.4) and 66.9% were female. The average number of monitored days for these participants was 5.3, with a daily monitor wear time of 790 min (SD=78). Seventy-five per cent of the participants were normal weight, 18.2% overweight and 6.8% obese. Participant characteristics by maternal grouping and study are summarised in table 1.

Table 1 shows the average daily PA (CPM, minutes spent in light and MVPA), and time sedentary by study. After controlling for monitor wear, girls spent 55 more minutes sedentary compared to boys (mean: 406 min/day (SD=92.1) vs 351 min/day (SD=87.5), p<0.001). Girls accumulated 34 min less light activity (mean: 356 min/day (SD=74.7) vs 390 min/day (SD=71.5), p<0.001) and 20 min less in MVPA (mean: 22.6 min/day (SD=15.5) vs 42.1 min/day (SD=23.6), p<0.001) per day than boys. Two-way ANOVAs provided no evidence of interactions between sex and maternal education when considering their relationship with each PA outcome in turn. Consequently, data for boys and girls were combined, and models adjusted for sex. Inspection of forest plots and the I^2 statistic with 'high school' as the reference group (figure 1) indicated that moderate to high levels of heterogeneity ($I^2 > 25\%$[32]) were present in estimates of the mean difference in PA outcomes by maternal education. Random-effects meta-analysis was used, due to these differences in the effect of maternal education across studies.

Maternal education defined as high school, college and university: eight studies

For all PA outcomes (CPM, sedentary, light and MVPA), and after controlling for confounders (age, season, sex and monitor wear time (where appropriate)), no significant differences were found in the combined estimate (ie, overall mean difference across studies between maternal education categories) for children of college versus high school educated mothers (see online supplementary figure S1). However, significant differences in PA were found between children of university educated mothers

compared with high school educated mothers. Adjustment for sedentary time in addition to the previously mentioned confounders resulted in a higher pooled estimate of MVPA (2.2 min, p<0.001) and lower heterogeneity ($I^2 = 0\%$) in children of university versus high school educated mothers.

Across all three maternal education groups, the only pooled estimates that were significant at the 0.05 level were time spent sedentary (9.5 min/day, p=0.005) and in light activity (−10.0 min/day, p<0.001) for children of university compared to high school educated mothers. For these pooled estimates there was a high level of heterogeneity within the study-specific estimates (sedentary: $I^2 = 76.8\%$; light: $I^2 = 71.9\%$), but high consistency in the point estimates either above or below the line representing 'no effect' (see online supplementary figure S1). Repeating the main analysis adjusting for BMI status as well as other confounders had no substantive impact on the results (see figure 1).

Maternal education defined as primary, secondary and tertiary: two studies

Findings within this group were similar to those observed within the main set of studies (see online supplementary figure S2). After controlling for confounders children of higher educated mothers (secondary/tertiary vs primary educated) on average participated in less MVPA (−6.6 min/day, p=0.001), light PA (−39.2 min/day, p<0.001) and CPM (−85.4 min/day, p<0.001) and spent more time sedentary (45.9 min/day, p<0.001). Repeating the main analyses adjusting for BMI status in addition to other confounders did not alter the results (figure 2).

DISCUSSION

Pooled analyses from the eight studies from the UK, Australia, Denmark, Estonia, the USA and Switzerland showed that adolescents of university educated mothers spent approximately 10 more minutes sedentary and approximately 10 less minutes in light activity per day compared with adolescents of high school educated mothers. In the two studies from Brazil and Portugal that were categorised based on primary/secondary and tertiary maternal education, pooled analyses revealed that adolescents of tertiary educated mothers were less active (approximately 40 min less light activity and approximately 7 min less MVPA/day), and more sedentary (approximately 46 min/day), when compared with adolescents of primary/secondary educated mothers. Although 7 min more MVPA per day by children of the primary educated mothers does not appear behaviourally significant, when considering the relatively low time spent in MVPA in this sample, the difference is quite large (approximately 25% of their total MVPA average). The lack of significance in PA and/or sedentary time between children of college educated mothers and the other groups (ie, high school and university) is somewhat to be expected. There was likely little discriminatory difference in education between these neighbouring categories, as a mother could be placed into a higher category based on a short attendance at higher education. For example, a mother who completed a few weeks on a vocational course and then withdrew would still be placed in the 'college' category.

Results from the present work support a small number of studies from developed countries that have used objective measurements of PA and total time sedentary to explore the association with SEP. The Gateshead Millennium Study in England found an inverse association between SEP and children's PA[22] and The Health Survey for England (HSE) showed that children grouped into the high SEP category spent approximately 17 more minutes sedentary per day.[15] Likewise, a previous

Table 1 Characteristics of study populations (mean (SD)) by study and maternal education group

Study	Maternal education group	N	Age (year)	BMI (kg/m^2)	% NW/OW/OB	Days of monitoring	Summer sample (%)	Monitor wear time (min/day)	CPM	Sedentary (min/day)	Light activity (min/day)	MVPA (min/day)
ALSPAC*	High School	2972	11.7 (0.2)	19.2(3.4)	77, 18, 5	6.1	52	769(59)	596 (196)	348 (71)	390 (67)	34.8 (20.6)
(UK)	College	691	11.7 (0.2)	19.1 (3.5)	79, 17, 4	6.1	51	773 (59)	591 (192)	353 (72)	391 (66)	34.5 (20.8)
	University	1195	11.7 (0.2)	18.6 (2.9)	84, 14, 2	6.2	52	779 (58)	577 (180)	370 (69)	380 (64)	34.7 (19.7)
CLAN	High School	461	11.5 (0.6)	19.9 (3.9)	71, 21, 8	5.5	26	781 (69)	673 (213)	335 (69)	413 (64)	38.7 (20.6)
(Australia)	College	83	11.5 (0.6)	20.4 (3.8)	66, 25, 9	5.6	28	791 (70)	651 (201)	339 (69)	419 (61)	36.5 (19.0)
	University	267	11.5 (0.6)	19.1 (3.3)	75, 22, 3	5.5	32	779 (69)	651 (202)	348 (72)	397 (61)	37.7 (19.7)
EYHS	High School	184	13.8 (2.5)	20 (3.4)	85, 14, 2	3.8	32	783 (75)	505 (312)	408 (133)	356 (112)	25.8 (24.8)
(Denmark)	College	182	13.5 (2.6)	19.6 (3.1)	85, 14, 1	4.1	27	792 (66)	485 (247)	413 (121)	363 (106)	25.3 (20.9)
	University	149	13 (2.7)	19 (2.9)	88, 12, 0	4.3	22	789 (61)	511 (264)	405 (128)	365 (112)	27.0 (22.8)
EYHS	High School	102	14.7 (1.9)	19.8 (2.7)	93, 7, 0	3.9	41	806 (65)	555 (241)	394 (104)	384 (91)	38.8 (25.7)
(Estonia)	College	105	14.8 (1.8)	20.1 (3)	88, 11, 1	3.8	29	811 (60)	578 (256)	375 (106)	409 (88)	38.0 (27.4)
	University	114	14.7 (1.8)	19.9 (2.8)	93, 5, 2	3.9	57	815 (53)	544 (228)	403 (96)	379 (83)	39.2 (26.1)
HEAPS	High School	426	11.3 (0.6)	19.8 (3.4)	65, 27, 8	4.9	31	760 (77)	659 (224)	325 (73)	404 (65)	37.1 (22.2)
(Australia)	College	77	11.3 (0.6)	20.7 (3.6)	56, 34, 10	5.0	29	778 (84)	629 (205)	342 (76)	406 (66)	35.4 (20.3)
	University	276	11.2 (0.6)	19.1 (3.2)	76, 17, 6	4.9	30	765 (76)	670 (193)	325 (68)	407 (66)	40.0 (20.8)
PEACH	High School	379	10.9 (0.4)	18.5 (3.2)	76, 20, 4	5.1	42	740 (74)	560 (170)	362.2 (70)	355 (60)	26.3 (16.3)
(UK)	University	173	10.9 (0.4)	17.6 (2.5)	88, 10, 2	5.8	66	757 (59)	552 (135)	382 (64)	351 (56)	27.9 (14.9)
Pelotas	Primary	370	13.3 (0.3)	20.3 (3.7)	77, 19, 4	3.8	52	932 (78)	420 (161)	516 (91)	391 (93)	23.5 (18.0)
(Brazil)	Secondary/Tertiary	86	13.7 (2.6)	20.7 (4.0)	73, 17, 10	3.8	48	917 (84)	339 (127)	557 (99)	342 (90)	17.3 (11.9)
EYHS	Primary	324	13.8 (2.6)	20.4 (3.6)	81, 14, 5	3.7	32	789 (76)	546 (235)	387 (104)	372 (94)	30.5 (23.5)
(Portugal)	Secondary/Tertiary	23	13.9 (2.7)	20.7 (3.6)	83, 13, 4	4.0	29	799 (66)	420 (178)	438 (90)	340 (92)	20.7 (20.0)
Project TAAG	High School	1250	13.4 (1.1)	22.8 (5.5)	62, 21, 17	4.8	2	788 (82)	391 (150)	447 (84)	328 (73)	16.0 (12.2)
(USA)	College	708	13.4 (1.0)	22.7 (5.5)	61, 23, 16	4.8	2	790 (79)	405 (146)	446 (77)	330 (73)	17.5 (12.5)
	University	1951	13.3 (1.0)	21.3 (4.6)	73, 18, 9	5.0	3	795 (79)	404 (143)	452 (83)	328 (71)	18.4 (13.0)
KISS	High School	56	11.3 (0.5)	18.4 (3)	78, 20, 2	6.3	100	908 (90)	683 (172)	399 (78)	465 (75)	50.0 (22.7)
(Switzerland)	College	104	11.2 (0.5)	18.2 (2.7)	85, 13, 2	6.7	89	919 (66)	628 (197)	436 (87)	444.5 (65)	45.2 (24.3)
	University	62	10.9 (0.5)	17.7 (2.7)	89, 10, 2	6.6	100	905 (82)	654 (164)	425 (83)	441 (57)	46.4 (20.0)

*See online supplementary material.
ALSPAC, Avon Longitudinal Study of Parents and Children; BMI, body mass index; CLAN, Children Living In Active Neighbourhoods; CPM, counts per minute; EYHS, European Youth Heart Study; HEAPS, Healthy Eating and Play Study; KISS, Kinder-Sportstudie Study; MVPA, moderate-to-vigorous physical activity; NW, normal weight; OB, obese; OW, overweight; PEACH, Personal And Environmental Associations With Children's Health; Pelotas, Pelotas 1993 birth cohort; Project TAAG, Project Trial of Activity for Adolescent Girls.
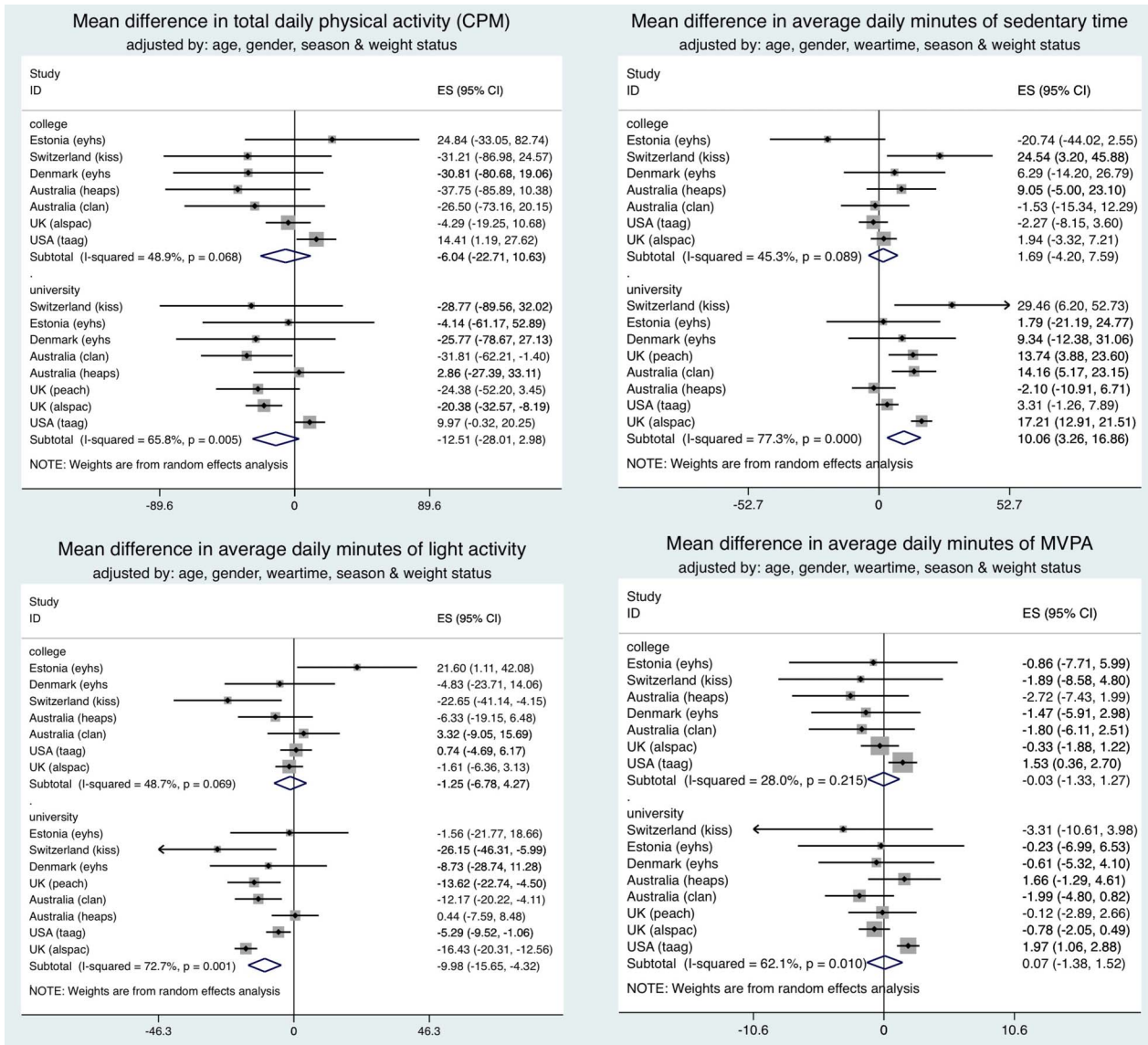
Figure 1 Forest plot showing mean differences, after adjustment for body mass index status, in physical activity variables between studies where maternal education defined as: high school (reference group), college and university.

analysis[23] from EYHS found a positive association between children's sedentary time and SEP in Portuguese and Estonian samples, but not in the Danish and Norwegian. The results from this study contrast evidence based on self-reported PA and/or sedentary behaviours. Previous data suggest that children of low SEP report greater engagement in sedentary pursuits such as TV watching and other screen-based activities.[5 10 15–18] This supports the notion that self-reporting tools and objective measurement of overall PA are not measuring the same construct. In fact within the same sample there appears to be a different association between SEP and self-reporting sedentary behaviours and objectively measured sedentary time. The aforementioned paper from the HSE[15] revealed that low SEP was associated with high television watching, but lower total accelerometer assessed sedentary time. Likewise, although the association with total PA and SEP is inconsistent,[17 19 22] studies have shown that children of higher SEP participate in more self-reported organised sports.[18 33] Whereas, two separate studies of Brazilian adolescents indicated that lower SEP youth were more likely to

self-report greater PA levels and, in particular, active transport.[34 35] These studies suggest that how children from different SEPs accrue sedentary time and PA may be different.

Maternal education was chosen as the SEP indicator in the present pooled analysis because it was the most common indicator across the studies. The wider adoption of maternal education as an indicator of SEP by contributing studies reflects the fact that it is relatively easy to measure and garners a high response rate. Although composite measures of SEP often show stronger associations with health outcomes and behaviours,[36] conclusions based on univariate indicators, such as maternal education, may offer clearer direction for policymakers. However, although maternal education is a strong determinant of parental employment and income[37] the meaning of maternal education levels likely varies between countries, and potentially populations within a country, where education can be either compulsory or a choice. Furthermore, mothers play different cultural and societal roles depending on the country/population, while in some cultures paternal education may be more important.
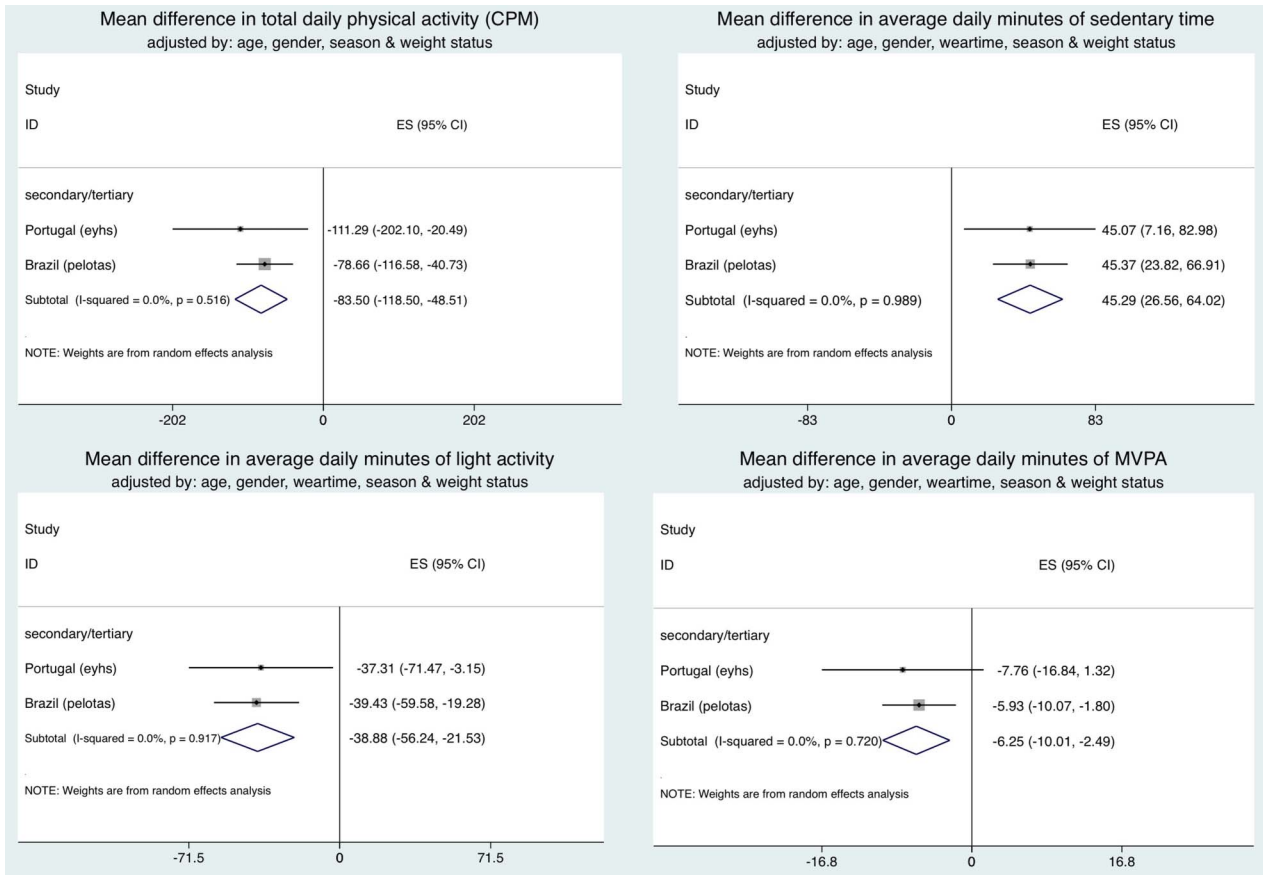
Figure 2 Forest plot showing mean differences, after adjustment for body mass index status, in physical activity variables between studies where maternal education defined as: primary (reference group), secondary and tertiary.

The data in ICAD comes from middle-high income/developed countries with generally high national levels of education. Of the 10 studies included, 8 were from developed countries and were ranked in the top 50% for tertiary education, with two (Brazil and Portugal) in the bottom 50%.[38] Association between PA and SEP may be dependent on the level of development of the country.[3] For example, in developing countries, an active lifestyle may be a necessity for those in lower SEPs, whereas in developed countries, technological advances have resulted in an erosion of lifestyle-embedded PA across all social strata, and a healthy 'active' lifestyle may require more deliberate effort. However, evidence from developing countries in rapid transition appear to support the findings from this study. For example, in rural South Africa, adolescents whose mothers had a secondary school education or higher, reported significantly more self-reported sedentary time and significantly less walking for transport than children whose mothers had no education.[39] In the older group, however, higher maternal education was associated with nearly 3 h more school and club MVPA per week.[39] Thus, future research needs to explore, across countries of varying development, the association between SEP and specific behaviours, such as active commuting, technology-driven sedentary pursuits, PE participation, sports participation, etc. Further effort is also needed to determine the impact of these behaviours on overall objectively measured PA and time spent sedentary, and how they relate to health outcomes to inform intervention and policy changes.

Strengths and limitations

Strengths include the large sample size and the meta-analysis of 10 individual studies, providing more robust estimates of observed associations. Physical activity and time spent sedentary were objectively measured, reducing possible misclassification, and raw data files were cleaned, processed and analysed in a standardised manner.[24] Limitations include the lack of data from low income/developing countries, the cross-sectional nature of the data and lack of consideration of important potential mediators (eg, time spent in after-school sports clubs, birth weight and birth order).[22] Our intensity threshold for MVPA (3000 CPM) was higher compared with some previous studies in youths.[40] However, when reanalysing our data using a lower threshold, the observations were materially unchanged (data not shown). Of the 10 studies included in the analyses, only one study (Project TAAG) relied on adolescent, rather than parent-reported maternal education. It is likely that adolescent-reported maternal education is less accurate than parental reported; however, validity studies have shown fair agreement between the two.[41] Some previous studies examining the association between PA/sedentary behaviour and maternal education have included a lower educational category (eg, primary school only, or 1–2 years of high school). Owing to original maternal educational coding used, this was not possible in the pooled analyses. This reduces the ability to directly compare our results with some previous studies. Last, maternal education was the sole SEP indicator considered, and it is likely that other measures of SEP have a different association with youth PA and sedentary behaviour.

CONCLUSION

Greater maternal education appears to be associated with lower objectively assessed PA and increased time spent sedentary in adolescents from developed countries. From a public health perspective, these results are a potential good news story as they highlight that children from low SEP may not be disadvantaged in terms of overall daily PA. Future work pooling standardised accelerometer data across countries needs to prioritise the inclusion of lower income/developing countries to fully understand the association between maternal education and PA/time spent sedentary.

What is already known on this subject

Socioeconomic differences in physical activity and time spent sedentary may be a mechanism linking socioeconomic position and ill health. Studies that have investigated the relationship between socioeconomic position and physical activity and sedentary behaviour have reported inconsistent findings.

What this study adds

In a pooled analysis of 12 770 youths across 10 studies from Europe, Australia, Brazil and the USA, those children whose mothers reported a higher level of education (proxy for socioeconomic position (SEP)) had lower levels of objectively measured physical activity and greater time spent sedentary. This finding suggests that children from low SEP may not be disadvantaged in terms of overall daily physical activity. Future research needs to explore, across countries of varying development, the association between SEP and specific behaviours, such as active commuting, technology-driven sedentary pursuits and sports participation, and the impact these have on overall objectively measured physical activity and time spent sedentary.

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