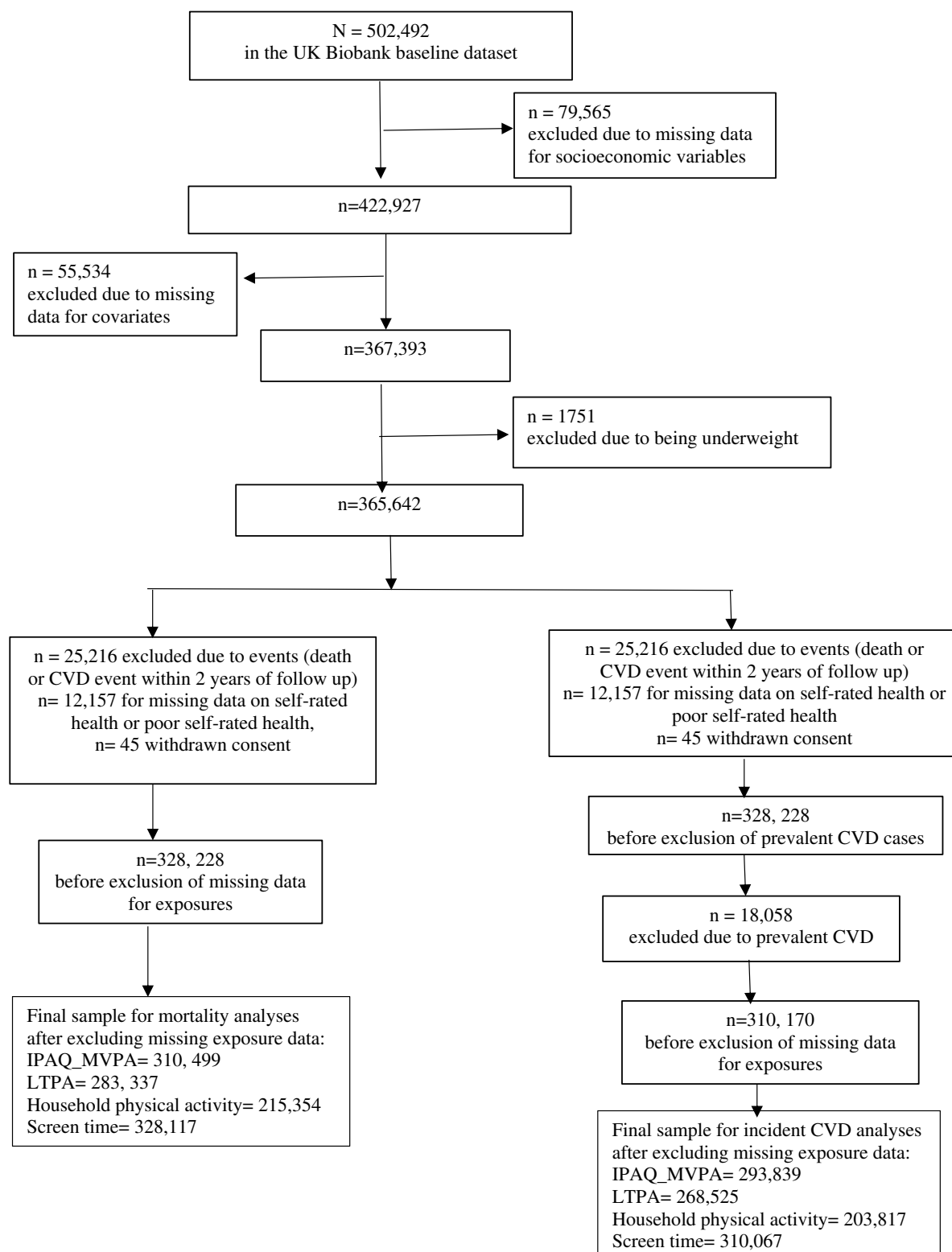


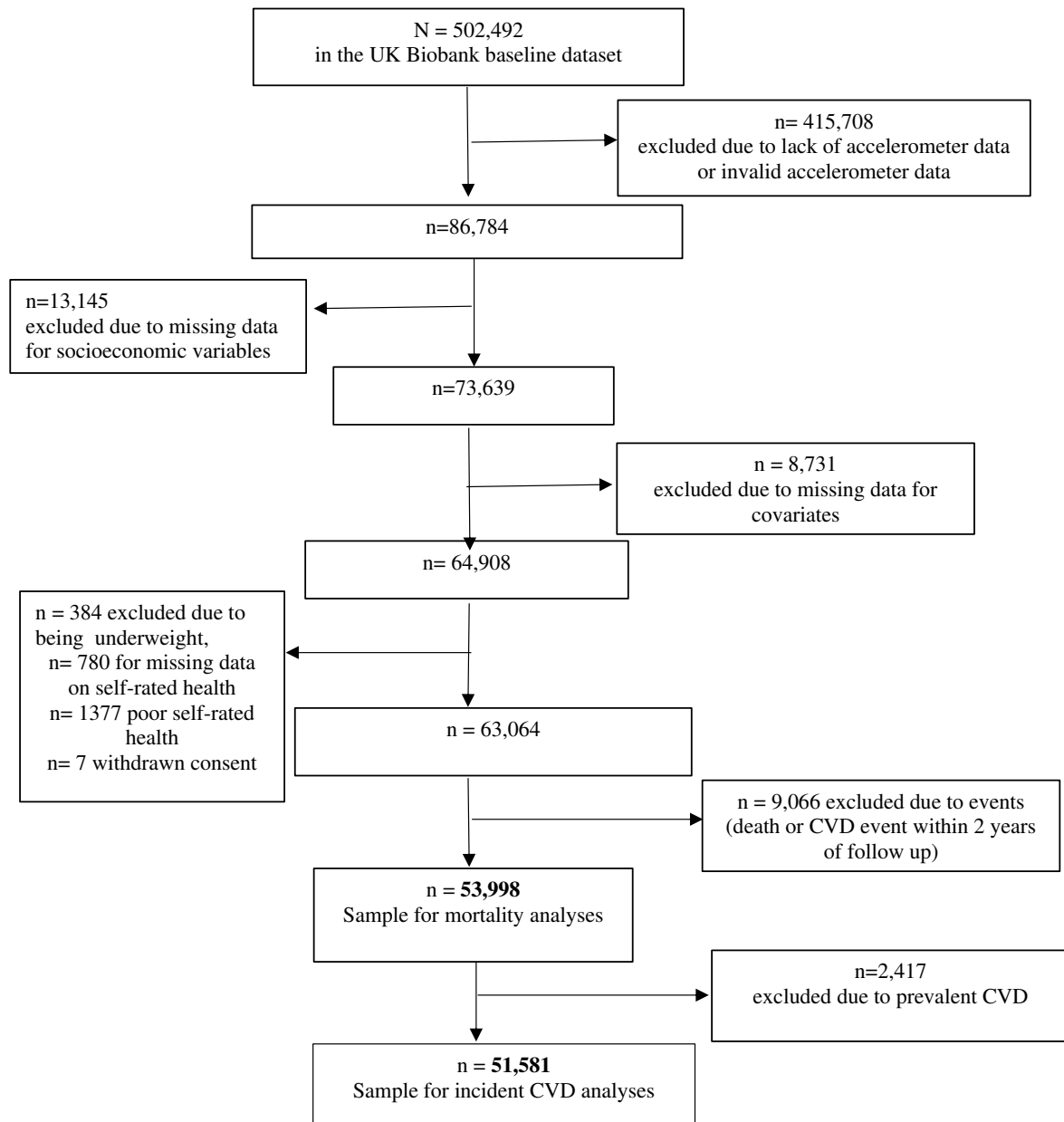
Do associations of physical activity and sedentary behaviour with cardiovascular disease and mortality differ across socioeconomic groups? An analysis of device-measured and self-reported UK Biobank data

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Supplementary Figure S1: Flowchart of sample selection for self-reported exposures

Supplementary Figure S2: Flowchart of sample selection for device-measured exposures



Supplemental Text S1: Description of exposures

Questionnaire-based MVPA: Weekly MVPA was measured using an adapted version of the International Physical Activity Questionnaire (IPAQ) short form. IPAQ collects information on the frequency and duration of walking, moderate and vigorous activities performed over the last seven days^{1, 2}. We calculated total weekly MVPA volume (METs-minutes/week) by multiplying the standardised metabolic equivalent of task (MET) value of each activity (3.3 METs for walking, 4 for moderate and 8 for vigorous activities) by the number of minutes per week². Participants were then categorised into three mutually exclusive groups: low (< 600 metabolic equivalent (MET)-min/week), medium (600 to < 3000 MET-min/week), and high (\geq 3000 MET-min/week) PA³.

Device-measured PA and sitting time: A subsample of the UK Biobank participants (n=103,687) wore an Axivity AX3 triaxial accelerometer on their dominant wrist for a 7-day period between 2013 and 2015⁴. Participants whose accelerometer data could be successfully calibrated were included in this study. We excluded participants with >1% clipped values and implausibly high activity values (average vector magnitude scores of >100 mg). We used previously established procedures^{5, 6} to calibrate data and identify non-wear. Participants with sufficient wear time (at least four valid monitoring days, with at least one of those days being a weekend day) were only included. A previously validated scheme that uses raw acceleration signals to identify and quantify time spent in different intensity activities in 10-second windows was used⁷. Using the total time spent in different activities, we classified participants into tertiles of ACCEL_MVPA and sitting time.

Domain-specific physical activity

Household physical activity was assessed by asking participants the frequency and duration of light (such as home maintenance and gardening) and heavy (such as weeding, lawn mowing, digging and carpentry) do-it-yourself activities they engaged in the last four weeks. We used midpoints to convert categorical frequency and duration responses to continuous variables. For example, “2–3 times a week” was set to 2.5 times, and “between 30 minutes and 1 hour” was set to 45 minutes. Monthly frequencies were converted to weekly frequencies (such as “once in the last 4 weeks” was set to “0.25 times per week” and “2-3 times in the last 4 weeks” was set to “0.63 times per week”). The total weekly household PA volume was then calculated by multiplying the frequency, duration and the MET values (3 METs for Light Do-It-Yourself (DIY) and 6.3 METs for heavy DIY)⁸ and categorised into tertiles in the analytic sample.

Leisure time physical activity: LTPA was calculated using the frequency and duration of walking for pleasure, other exercises, and strenuous sports in the last 4 weeks⁹. We used a similar process as mentioned above to convert categorical responses to continuous scale. We calculated total weekly LTPA volume by multiplying frequency, duration and the MET values

(3.5 METs for walking for pleasure, 4.0 METs for other exercises and 8.0 METs for strenuous sports)¹⁰ and categorised participants into tertiles for the analyses.

Screen time: Participants reported duration (hours per day) spent watching TV and using computers for non-work-related purposes¹¹. Responses of “Do not know” and “Prefer not to answer” were set to missing while “Less than an hour a day” was recorded as 0.5h. We calculated total weekly screen time by multiplying the total daily time spent watching TV and non-occupational computer use by 7 and categorised into tertiles for the analyses. Daily total of screen time was truncated at 16 hours.

Supplemental Text S2: Socioeconomic status

We examined effect modification by two socioeconomic indices: area-level and individual-level SES.

Latent class analysis based on three socioeconomic factors (household income, education level, and employment status) was used to create individual-level SES¹². In the UK Biobank, participants reported their average total before tax household income as less than £18,000, £18,000 to £30,999, £31,000 to £51,999, £52,000 to £100,000 and greater than £100,000, do not know and prefer not to answer. Participants who selected the last two options (14.3%) were excluded from the main analysis. Education was reported as college or university degree; A levels/AS levels or equivalent; O levels/GCSEs or equivalent; CSEs or equivalent; NVQ, HND, HNC, or equivalent; other professional qualifications; none of the above. Participants reported their employment status as paid employment or self-employed, retired, looking after home and/or family, unable to work, unemployed, unpaid or voluntary work or student. In this study, we re-categorised occupational status as employed or unemployed (unable to work or unemployed). Then, we created an overall individual-level SES variable using latent class analysis with these three variables. Since the model with four latent classes failed to converge, we used the model with three latent classes. As shown in table below, “high SES” had a higher proportion of participants with college or university degree and before tax household income of £52,000 or greater. The proportion of unemployed, those with less than high school education (labelled as ‘none’ in UK Biobank) and those with household income less than £18,000 were higher in class labelled “low SES”. Based on the results of latent class analysis, 88020 (25.9%) participants were categorised as ‘low SES’, 126730 (37.2%) as ‘Medium SES’ and 125680 (36.9%) as ‘High SES’. The item response probabilities in the model with three classes are provided in the table S1.

Area-level SES was assessed by the Townsend index score (including measures of unemployment, non-car ownership, non-home ownership and household overcrowding), derived from respondent’s postcode¹³. We categorised Townsend index into tertiles where the lowest score indicated the least socioeconomic deprivation (high area-level SES).

Supplementary Table S1: Prevalence and characteristics of participants in three latent classes

Item	Latent class 1	Latent class 2	Latent class 3
Prevalence	36.9%	25.9%	37.2%
Occupation			
Employed	0.969	0.852	0.974
Unemployed	0.031	0.148	0.026
Education			
None of the above	0.000	0.368	0.109
College or university degree	0.722	0.149	0.154
A/AS levels or equivalent	0.130	0.078	0.138
O/GCSEs level or equivalent	0.091	0.214	0.336
CSEs or equivalent	0.011	0.061	0.092
NVQ/HND/HNC or equivalent	0.020	0.080	0.097
Other professional qualifications	0.026	0.049	0.075
Income			
Less than £18 000	0.006	0.731	0.042
£18 000-30 999	0.133	0.222	0.388
£31 000-51 999	0.295	0.029	0.407
£52 000-100 000	0.416	0.006	0.164
Greater than £100 000	0.151	0.012	0.000
Categorisation	High	Low	Medium

Supplementary Table S2: Covariate definitions

Variable	Definition
Sex	Female, male
Ethnicity	White, not white, not reported
Sleep score ¹⁴	Sleep score was defined as the count of healthy sleep characteristics: morning chronotype, adequate sleep duration (7-8 hours/night), never or rare insomnia, never or rare snoring and infrequent daytime sleepiness; and categorized into three groups (healthy, ≥ 5 ; intermediate, 3-4; and poor: ≤ 2)
Dietary pattern score ¹⁵	Dietary pattern score was created using intake of fruits and vegetables, fish (oily and non-oily), red meat (beef, pork and lamb) and processed meat intake ¹⁵ . Meeting category specific guidelines (>4.5 servings of fruits and vegetables per day, ≥ 2 times per week of fish intake, <2 times of processed meat per week, <5 times of red meat intake per week) was allocated 1 point and total diet score was categorised as poor (0-1), reasonable (2-3) and good (4).
Smoking status	Never, previous, current
Alcohol consumption	Never, previous, current
Body mass index ¹⁶	BMI was calculated as weight (kg) divided by height (m ²) using measurements taken by trained staff and categorised as underweight (<18.5 kg/m ²), normal weight (18.5 to <25 kg/m ²), overweight (25.0 to <30 kg/m ²) and obesity (≥ 30 kg/m ²) ¹⁶
Self-rated health	Self-rated health was assessed by asking "In general how would you rate your overall health?" and categorised as excellent, good, fair, and poor.

Supplementary Table S3: Baseline characteristics of participants by level of device-measured MVPA

	Total (n= 53, 998)	Device-measured MVPA (ACCEL_MVPA)			p-value
		Highest tertile (n= 18,486)	Medium tertile (n= 18,104)	Lowest tertile (n= 17,408)	
Mean age (SD) (years)	55.7 ± 7.8	54.3 ± 7.7	55.6 ± 7.8	57.4 ± 7.6	<0.001
Men	23,701 (43.9%)	8,852 (47.9%)	8,078 (44.6%)	6,771 (38.9%)	<0.001
White ethnicity or race	52,405 (97.0%)	17,923 (97.0%)	17,599 (97.2%)	16,883 (97.0%)	0.290
Household income (£)					<0.001
Less than 18,000	7,290 (13.5%)	2,159 (11.7%)	2,336 (12.9%)	2,795 (16.1%)	
18,000 to 30,999	12,760 (23.6%)	4,025 (21.8%)	4,226 (23.3%)	4,509 (25.9%)	
31,000 to 51,999	15,810 (29.3%)	5,480 (29.6%)	5,328 (29.4%)	5,002 (28.7%)	
52,000 to 100,000	14,070 (26.1%)	5,266 (28.5%)	4,750 (26.2%)	4,054 (23.3%)	
Greater than 100,000	4,068 (7.5%)	1,556 (8.4%)	1,464 (8.1%)	1,048 (6.0%)	
Education					<0.001
None	3,734 (6.9%)	1,120 (6.1%)	1,196 (6.6%)	1,418 (8.1%)	
O/CSE or equivalent	12,893 (23.9%)	4,363 (23.6%)	4,349 (24.0%)	4,181 (24.0%)	
A/NVQ/professional or equivalent	12,656 (23.4%)	4,175 (22.6%)	4,230 (23.4%)	4,251 (24.4%)	
College/University	24,715 (45.8%)	8,828 (47.8%)	8,329 (46.0%)	7,558 (43.4%)	
Employment					0.220
Unemployed	2,172 (4.0%)	761 (4.1%)	691 (3.8%)	720 (4.1%)	
Employed	51,826 (96.0%)	17,725 (95.9%)	17,413 (96.2%)	16,688 (95.9%)	
Townsend Index tertile					0.080
1	18,139 (33.6%)	6,309 (34.1%)	6,092 (33.7%)	5,738 (33.0%)	
2	18,065 (33.5%)	6,208 (33.6%)	6,028 (33.3%)	5,829 (33.5%)	
3	17,794 (33.0%)	5,969 (32.3%)	5,984 (33.1%)	5,841 (33.6%)	
Smoking status					<0.001
Never	30,852 (57.1%)	10,933 (59.1%)	10,388 (57.4%)	9,531 (54.8%)	
Previous	19,480 (36.1%)	6,513 (35.2%)	6,535 (36.1%)	6,432 (36.9%)	
Current	3,666 (6.8%)	1,040 (5.6%)	1,181 (6.5%)	1,445 (8.3%)	
Alcohol status					<0.001
Never	1,449 (2.7%)	441 (2.4%)	458 (2.5%)	550 (3.2%)	
Previous	1,346 (2.5%)	435 (2.4%)	453 (2.5%)	458 (2.6%)	
Current	51,203 (94.8%)	17,610 (95.3%)	17,193 (95.0%)	16,400 (94.2%)	
Sleep pattern					<0.001
Poor	3,206 (5.9%)	895 (4.8%)	1,053 (5.8%)	1,258 (7.2%)	
Intermediate	29,494 (54.6%)	9,594 (51.9%)	9,857 (54.4%)	10,043 (57.7%)	
Healthy	21,298 (39.4%)	7,997 (43.3%)	7,194 (39.7%)	6,107 (35.1%)	
Diet pattern					<0.001
Poor	2,782 (5.2%)	862 (4.7%)	933 (5.2%)	987 (5.7%)	
Reasonable	33,158 (61.4%)	11,364 (61.5%)	11,155 (61.6%)	10,639 (61.1%)	
Good	18,058 (33.4%)	6,260 (33.9%)	6,016 (33.2%)	5,782 (33.2%)	
Body mass index					<0.001
Normal weight	21,642 (40.1%)	9,019 (48.8%)	7,250 (40.0%)	5,373 (30.9%)	
Overweight	22,402 (41.5%)	7,304 (39.5%)	7,706 (42.6%)	7,392 (42.5%)	
Obese	9,954 (18.4%)	2,163 (11.7%)	3,148 (17.4%)	4,643 (26.7%)	
Self-rated health					<0.001
Excellent	12,610 (23.4%)	5,269 (28.5%)	4,230 (23.4%)	3,111 (17.9%)	
Good	33,287 (61.6%)	11,179 (60.5%)	11,320 (62.5%)	10,788 (62.0%)	

Fair	8,101 (15.0%)	2,038 (11.0%)	2,554 (14.1%)	3,509 (20.2%)	
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Device-measured physical activity was measured using the Axivity AX3 triaxial accelerometer worn on participant's dominant wrist for a 7-day period. A previously validated scheme that uses raw acceleration signals to identify and quantify time spent in different intensity activities in 10-second windows was used⁷. Using the total weekly time spent in MVPA, we classified participants into tertiles. Townsend index (including measures of unemployment, non-car ownership, non-home ownership and household overcrowding), derived from respondent's postcode is used as an indicator of area-level SES. We categorised Townsend index into tertiles where the lowest score indicated the least socioeconomic deprivation. Employment status is categorised as employed (includes paid employment or self-employed, retired, paid or voluntary work or student) and unemployed (includes looking after home and/or family, unable to work and unemployed). Sleep pattern is derived using sleep duration, chronotype, insomnia, snoring and dozing. Diet pattern is derived using intake of fruits and vegetables, fish (oily and non-oily), red meat (beef, pork, and lamb) and processed meat intake. BMI is categorised as normal weight (18.5 to <25 kg/m²), overweight (25.0 to <30 kg/m²) and obesity (≥ 30 kg/m²).

Values in the table are frequencies and percentages unless otherwise stated. Difference between groups was tested using one-way ANOVA for age and using chi-square test for other variables.

Supplementary Table S4: Distribution of exposures across individual-level socioeconomic status

	Total	Individual-level SES			p-value
		Low	Medium	High	
Self-reported MVPA (IPAQ_MVPA)	310,499	72,565	117,164	120,770	<0.001
Median (Q1-Q3) MET-minutes /week	2079(970-4170)	2586(1155.6-5118)	2213(990-4530)	1777(876-3306)	
High	113,053 (36.4%)	32,501 (44.8%)	46,120 (39.4%)	34,432 (28.5%)	
Medium	150,763 (48.6%)	30,856 (42.5%)	53,386 (45.6%)	66,521 (55.1%)	
Low	46,683 (15.0%)	9,208 (12.7%)	17,658 (15.1%)	19,817 (16.4%)	
Device-measured MVPA (ACCEL_MVPA)	53,998	8,986	19,257	25,755	<0.001
Median (Q1-Q3) minutes/week	169.5(93.83-280.67)	150(80.17-261.17)	166.8(93-278.33)	178.83(99.83-288.33)	
High	18,486 (34.2%)	2,695 (30.0%)	6,461 (33.6%)	9,330 (36.2%)	
Medium	18,104 (33.5%)	2,884 (32.1%)	6,521 (33.9%)	8,699 (33.8%)	
Low	17,408 (32.2%)	3,407 (37.9%)	6,275 (32.6%)	7,726 (30.0%)	
Household physical activity	215,354	47,192	80,448	87,714	<0.001
Median (Q1-Q3) MET-minutes/week	297.67(102.94-730.35)	283.5(85.05-787.5)	297.67(112.5-741.1)	297.67(118.13-708.75)	
High	69,183 (32.1%)	15,351 (32.5%)	26,268 (32.7%)	27,564 (31.4%)	
Medium	74,394 (34.5%)	14,910 (31.6%)	27,675 (34.4%)	31,809 (36.3%)	
Low	71,777 (33.3%)	16,931 (35.9%)	26,505 (32.9%)	28,341 (32.3%)	
Leisure time physical activity (LTPA)	283,337	64,882	105,453	113,002	<0.001
Median (Q1-Q3) MET-minutes/week	541.88(196.88-1102.5)	499.61(189-1102.5)	499.61(189-1102.5)	573.75(231.52-1143.75)	
High	94,288 (33.3%)	21,186 (32.7%)	33,481 (31.7%)	39,621 (35.1%)	
Medium	95,793 (33.8%)	20,970 (32.3%)	35,277 (33.5%)	39,546 (35.0%)	
Low	93,256 (32.9%)	22,726 (35.0%)	36,695 (34.8%)	33,835 (29.9%)	
Screen time	328,117	81,069	123,520	123,528	<0.001
Median (Q1-Q3) hours/week	24.5(17.5-35)	28(21-35)	24.5(17.5-35)	21(14-28)	
High	99,723 (30.4%)	33,018 (40.7%)	38,388 (31.1%)	28,317 (22.9%)	
Medium	70,873 (21.6%)	17,857 (22.0%)	29,164 (23.6%)	23,852 (19.3%)	
Low	157,521 (48.0%)	30,194 (37.2%)	55,968 (45.3%)	71,359 (57.8%)	
Sitting time	53,998	8,986	19,257	25,755	<0.001
Median (Q1-Q3) hours/week	82.61(74.76-89.94)	84.0(75.66-91.65)	81.76(73.76-89.32)	82.78(75.18-89.76)	
High	17,765 (32.9%)	3,431 (38.2%)	5,891 (30.6%)	8,443 (32.8%)	
Medium	18,078 (33.5%)	2,820 (31.4%)	6,340 (32.9%)	8,918 (34.6%)	
Low	18,155 (33.6%)	2,735 (30.4%)	7,026 (36.5%)	8,394 (32.6%)	

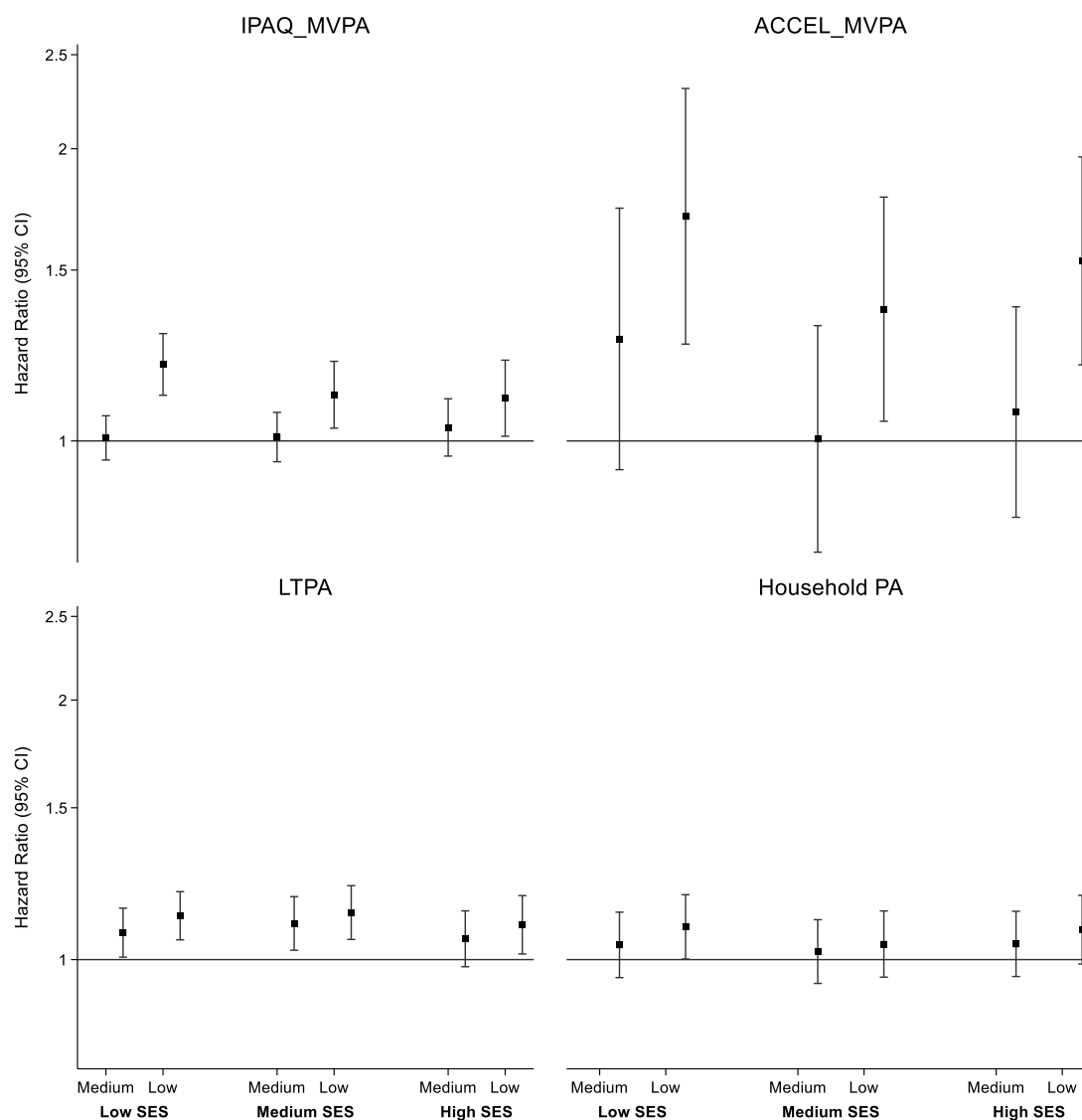
Participants self-reported physical activity measured using the International Physical Activity Questionnaire was categorised as low (< 600 metabolic equivalent (MET)-min/week), medium (600 to < 3000 MET-min/week), and high (\geq 3000 MET-min/week). Device-measured MVPA and sitting time was measured using the Axivity AX3 triaxial accelerometer worn on participant's dominant wrist for a 7-day period. Household physical activity was based on frequency and duration of light (e.g., home maintenance, gardening) and heavy (e.g., weeding, lawn mowing, digging, carpentry) do-it-yourself activities. Leisure-time physical activity was derived from the frequency and duration of walking for pleasure, other exercises, and strenuous sports. Screen time was derived using daily hours spent watching TV and non-occupational and categorised into tertiles. Individual-level SES was created using latent class analysis of three socioeconomic factors (household income, education, and employment status) and categorised into low, medium, and high. Values in the table are frequencies and percentages unless otherwise stated. Difference between groups was tested using chi-square test.

Supplementary Table S5: Association of physical activity and sedentary behaviour with all-cause mortality and incident CVD (main effects)

	All-cause mortality		Incident CVD	
	Events /N	Adjusted HR (95% CI)	Events /N	Adjusted HR (95% CI)
Self-reported MVPA (IPAQ_MVPA)	16,547/310,499		93,712/ 293,839	
High	6,250/113,053	Ref	34,218/106,790	Ref
Medium	7,624 /150,763	1.01 (0.97-1.04)	45,364/142,885	0.99 (0.97-1.00)
Low	2,673/46,683	1.15 (1.10-1.20)	14,130/44,164	0.98 (0.97-1.01)
Device-measured MVPA (ACCEL_MVPA)	1,308/53,998		11,683/51,581	
High	294/18,486	Ref	3,303/17,848	Ref
Medium	380/18,104	1.13 (0.96-1.32)	3,919/17,326	1.11 (1.05-1.17)
Low	634/17,408	1.62 (1.39-1.89)	4,461/16,407	1.14 (1.07-1.21)
Leisure time physical activity (LTPA)	14,420/283,337		85,648/268,525	
High	4,606/94,288	Ref	28,546/89,402	Ref
Medium	4,850/95,793	1.08 (1.04-1.13)	29,068/90,757	1.00 (0.98-1.01)
Low	4,964/93,256	1.14 (1.09-1.18)	28,034/88,366	0.98 (0.97-1.00)
Household physical activity	11,454/215,354		65,024/203,817	
High	3,921/69,183	Ref	20,820/65,337	Ref
Medium	3,764/74,394	1.02 (0.97-1.08)	22,421/70,552	0.99 (0.97-1.01)
Low	3,769/71,777	1.06 (1.01-1.12)	21,783/67,928	1.00 (0.98-1.03)
Screen time	18,023/328,117		98,887/310,067	
High	6,993/99,723	1.12 (1.09-1.17)	29,561/92,596	1.00 (0.98-1.02)
Medium	4,013/70,873	1.05 (1.01-1.09)	21,329/66,765	1.00 (0.99-1.02)
Low	7,017/157,521	Ref	47,997/150,706	Ref
Sitting time	1,308/53,998		11,683/51,581	
High	621/17,765	1.19 (1.02-1.39)	4,628/16,724	1.11 (1.05-1.18)
Medium	393/18,078	1.05 (0.90-1.22)	3,835/17,316	1.03 (0.96-1.09)
Low	294/18,155	Ref	3,220/17,541	Ref

Participants self-reported physical activity measured using the International Physical Activity Questionnaire was categorised as low (< 600 metabolic equivalent (MET)-min/week), medium (600 to < 3000 MET-min/week), and high (\geq 3000 MET-min/week). Device-measured MVPA and sitting time was measured using the Axivity AX3 triaxial accelerometer worn on participant's dominant wrist for a 7-day period. Household physical activity was based on frequency and duration of light (e.g., home maintenance, gardening) and heavy (e.g., weeding, lawn mowing, digging, carpentry) do-it-yourself activities. LTPA was derived from the frequency and duration of walking for pleasure, other exercises, and strenuous sports. Screen time was derived using daily hours spent watching TV and non-occupational and categorised into tertiles. All analyses were adjusted for sex, ethnicity, sleep pattern, dietary score, smoking, alcohol, townsend index and education. For IPAQ_MVPA and LTPA analyses, we additionally adjusted for screen time; screen time analyses were adjusted for IPAQ_MVPA; Household physical activity analyses were adjusted for LTPA and screen time. ACCEL_MVPA analyses were adjusted for sitting time and vice versa and for baseline CVD and cancer. Deaths due to other causes were treated as competing risks in incident CVD analyses.

Figure S3: Sensitivity analysis: Association of physical activity with all-cause mortality across individual-level socioeconomic status: further adjustment for body mass index



Small squares denote point estimates of the hazard ratio, and the bars indicate 95% confidence interval. Y axis is in log-scale. Reference: High physical activity, SES= Socioeconomic status, IPAQ_MVPA: Self-reported moderate vigorous physical activity (MVPA), ACCEL_MVPA: Device-measured MVPA, LTPA: Leisure-time physical activity. Individual-level SES was created using latent class analysis of three socioeconomic factors (household income, education, and employment status) and categorised into low, medium, and high.

IPAQ_MVPA: Participants physical activity measured using the International Physical Activity Questionnaire was categorised as low (< 600 metabolic equivalent (MET)-min/week), medium (600 to < 3000 MET-min/ week), and high (\geq 3000 MET-min/week).

Low SES: High IPAQ_MVPA (2,882/32,501), Medium IPAQ_MVPA (2,751/30,856; 1.01 (0.96-1.06)), Low IPAQ_MVPA (997/9,208; 1.20 (1.11-1.29))

Medium SES: High (2,088/46,120), Medium (2,447/53,386; 1.01 (0.95-1.07)), Low (892/17,658; 1.11(1.03-1.21)) High SES: High (1,280/34,432), Medium (2,426/66,521; 1.03(0.96-1.10)), Low (784/19,817; 1.11(1.01-1.21))

ACCEL_MVPA: Device-measured total physical activity was measured using the Axivity AX3 triaxial accelerometer worn on participant's dominant wrist for a 7-day period. Total minutes spent on MVPA (a sum of moderate and vigorous activities) was extracted and categorised into tertile-based thirds. 'Low' indicated the first tertile, 'Medium' indicated second tertile and 'High' indicated third tertile.

Low SES: High ACCEL_MVPA (70/2,695), Medium ACCEL_MVPA (109/2,884; 1.27(0.93-1.74)), Low ACCEL_MVPA (194/3,407; 1.70(1.26-2.30))

Medium SES: High (103/6,461), Medium (129/6,521; 1.00(0.77-1.31)), Low (211/6,275; 1.37(1.05-1.78))

High SES: High (121/9,330), Medium (142/8,699; 1.07(0.83-1.37)), Low (229/7,726; 1.53(1.20-1.96))

LTPA was calculated using the frequency and duration of walking for pleasure, other exercises, and strenuous sports in the last 4 weeks and categorised into tertile-based thirds.

Low SES: High LTPA (1,811 /21,186), Medium LTPA (1,816/ 20,970; 1.07(1.01-1.15)), Low LTPA (2,041/ 22,726; 1.12(1.05-1.20))

Medium SES: High (1,430/ 33,481), Medium (1,606/ 35,277; 1.10(1.02-1.18)), Low (1,671/ 36,695; 1.13(1.05-1.22))

High SES: High (1,365/ 39,621), Medium (1,428/ 39,546; 1.06(0.98-1.14)), Low (1,252/ 33,835; 1.10(1.01-1.19))

Household physical activity was assessed by asking participants the frequency and duration of light and heavy do-it-yourself activities in the last four weeks and categorised into tertile-based thirds.

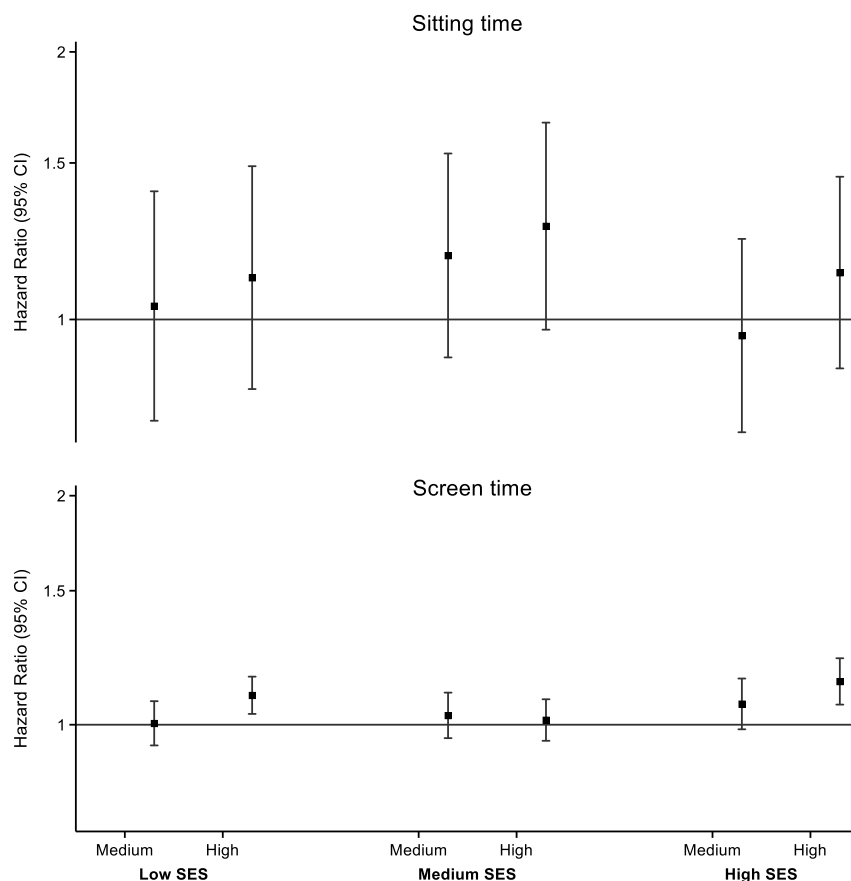
Low SES: High household physical activity (1,419/ 15,351), Medium household physical activity (1,323/14,910; 1.04(0.95-1.13)), Low household physical activity (1,578/ 16,931; 1.09(1.00-1.19))

Medium SES: High (1,349/ 26,268), Medium (1,266/ 27,675; 1.02(0.94-1.11)), Low (1,185/ 26,505; 1.04(0.95-1.14))

High SES: High (1,153/ 27,564), Medium (1,175/ 31,809; 1.04(0.96-1.14)), Low (1,006/ 28,341; 1.08(0.99-1.19))

All analyses were adjusted for sex, ethnicity, sleep score, dietary pattern score, smoking, alcohol consumption and body mass index. IPAQ_MVPA and LTPA analyses were additionally adjusted for screen time (derived using daily hours of TV viewing and non-occupational computer use), ACCEL_MVPA for device-measured sitting time and household physical activity analyses for LTPA and screen time.

Figure S4: Sensitivity analysis: Association of sedentary behaviour with all-cause mortality across individual-level socioeconomic status: further adjustment for body mass index



Small squares denote point estimates of the hazard ratio, and the bars indicate 95% confidence interval. Y axis is in log-scale. 'Low' indicated the first tertile, 'Medium' indicated second tertile and 'High' indicated third tertile. Reference: Lowest/first tertile

SES= Socioeconomic status. Individual-level SES was created using latent class analysis of three socioeconomic factors (household income, education, and employment status) and categorised into low, medium, and high.

Sitting time: Device-measured sitting time was measured using the Axivity AX3 triaxial accelerometer worn on participant's dominant wrist for a 7-day period. Total minutes of sitting time was extracted and categorised into tertile-based thirds.

Low SES: Low sitting time (79/2,735), Medium sitting time (107/2,820; 1.03(0.77-1.39)), High sitting time (187/3,431; 1.11(0.83-1.49))

Medium SES: Low (101/7,026), Medium (140/6,340; 1.18 (0.91-1.54)), High (202/5,891; 1.27(0.97-1.66)) High SES: Low (114/8,394), Medium (146/8,918; 0.96 (0.75-1.23)), High (232/8,443; 1.13 (0.88-1.45))

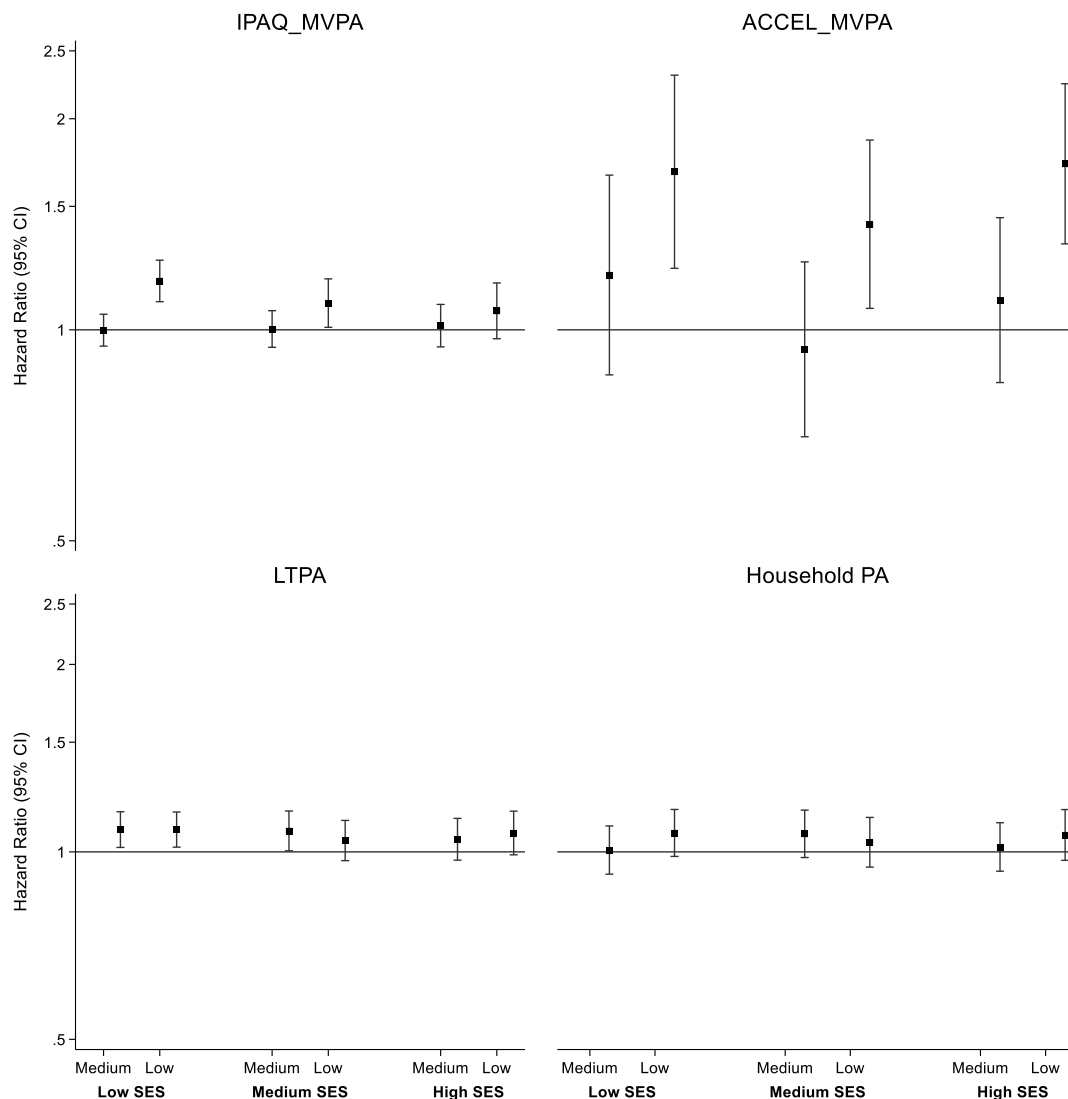
Screen time: Screen time was derived using daily hours spent watching TV and non-occupational and categorised into tertile-based thirds.

Low SES: Low screen time (2,488/30,194), Medium screen time (1,628/17,857; 1.00(0.94-1.07)), High screen time (3,493/33,018; 1.09(1.03-1.16))

Medium SES: Low (2,278/55,968), Medium (1,401/ 29,164; 1.03(0.96-1.10)), High (2,096/ 38,388; 1.01(0.95-1.08)) High SES: Low (2,251/ 71,359), Medium (984/23,852; 1.06(0.99-1.15)), High (1,404/28,317; 1.14(1.06-1.22))

All analyses were adjusted for sex, ethnicity, sleep score, dietary pattern score, smoking, alcohol consumption and body mass index. Sitting time analyses were additionally adjusted for device-measured MVPA and screen time analyses for self-reported MVPA.

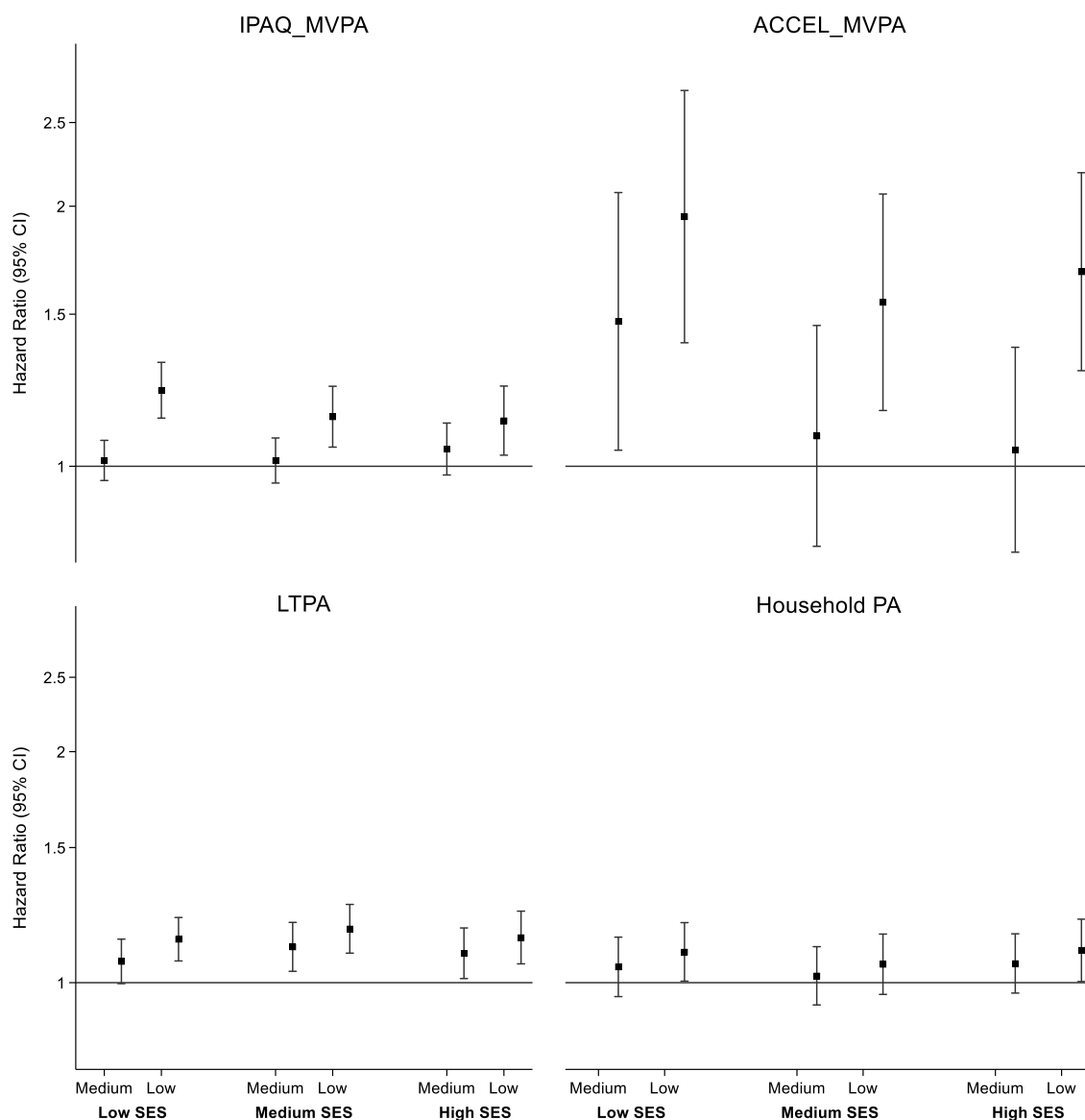
Figure S5: Sensitivity analyses: Association of physical activity with all-cause mortality across individual-level socioeconomic status: additional adjustment for self-rated health



Small squares denote point estimates of the hazard ratio, and the bars indicate 95% confidence interval. Y axis is in log-scale. Reference: High physical activity. SES= Socioeconomic status, IPAQ_MVPA: Self-reported moderate vigorous physical activity (MVPA), ACCEL- MVPA: Device-measured MVPA, LTPA: Leisure-time physical activity. Individual-level SES was created using latent class analysis of three socioeconomic factors (household income, education, and employment status) and categorised into low, medium, and high. IPAQ_MVPA was measured using the International Physical Activity Questionnaire was categorised as low (< 600 metabolic equivalent (MET)-min/week), medium (600 to < 3000 MET-min/week), and high (\geq 3000 MET- min/week). ACCEL_MVPA: Device-measured total PA was measured using the Axivity AX3 triaxial accelerometer worn on participant's dominant wrist for a 7-day period. Total minutes spent on MVPA (ACCEL- MVPA: a sum of moderate and vigorous activities) was extracted and categorised into tertile-based thirds. 'Low' indicated the first tertile, 'Medium' indicated second tertile and 'High' indicated third tertile. LTPA was calculated using the frequency and duration of walking for pleasure, other exercises, and strenuous sports in the last 4 weeks and categorised into tertile-based thirds. Household physical activity was assessed by asking participants the frequency and duration of light and heavy do-it-yourself activities in the last four weeks and categorised into tertile-based thirds.

All analyses were adjusted for sex, ethnicity, sleep score, dietary pattern score, smoking, alcohol consumption and self-rated health. IPAQ_MVPA and LTPA analyses were additionally adjusted for screen time (derived using daily hours of TV viewing and non-occupational computer use), ACCEL_MVPA for device-measured sitting time and household physical activity analyses for LTPA and screen time. Participants with poor self-rated health were not excluded from this sample.

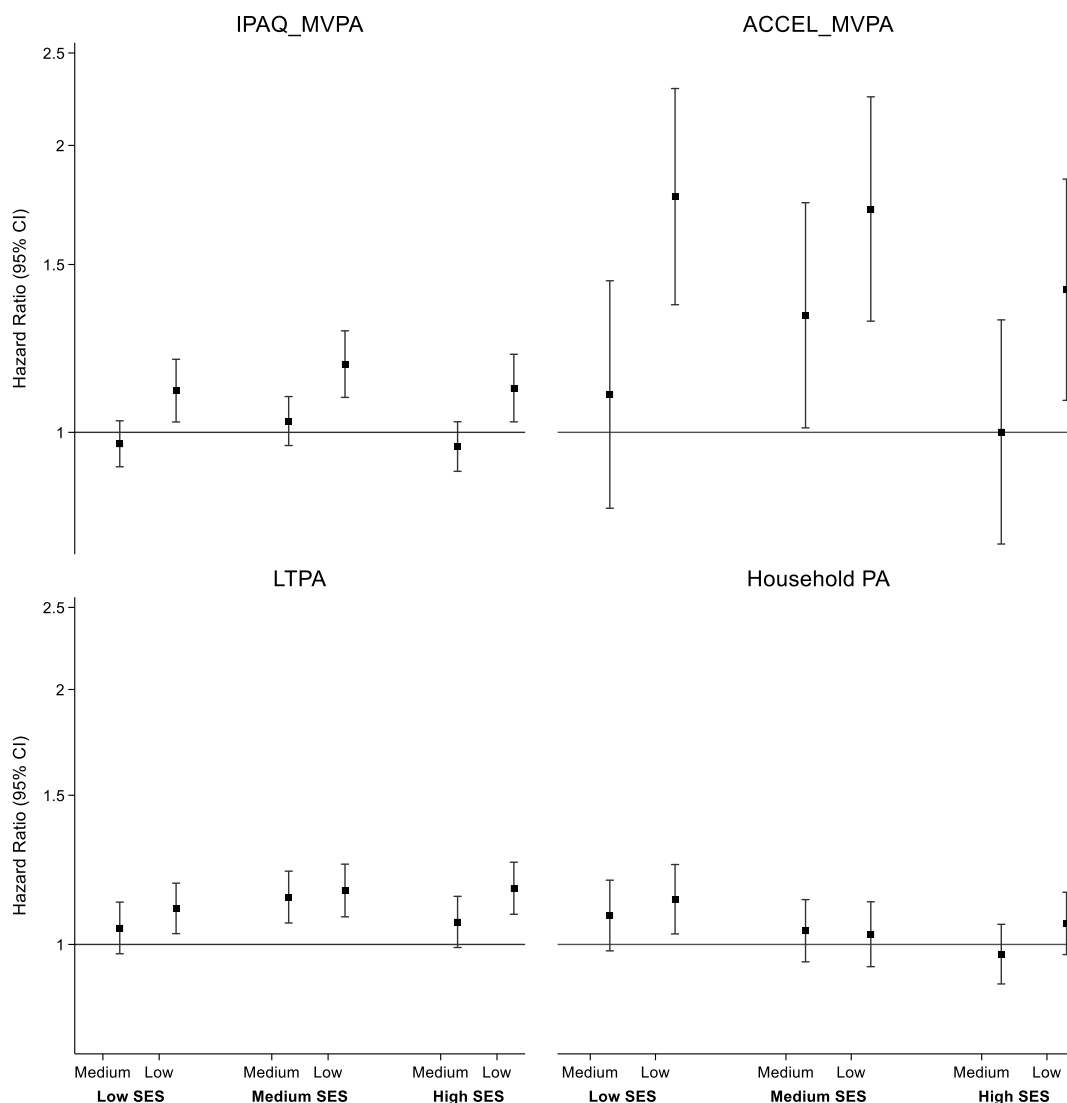
Figure S6: Sensitivity analyses: Association of physical activity with all-cause mortality across individual-level socioeconomic status: initial 3 years of follow-up and any events within it excluded



Small squares denote point estimates of the hazard ratio, and the bars indicate 95% confidence interval. Y axis is in log-scale. Reference: High physical activity. SES= Socioeconomic status, IPAQ_MVPA: Self-reported moderate vigorous physical activity (MVPA), ACCEL_MVPA: Device-measured MVPA, LTPA: Leisure-time physical activity. Individual-level SES was created using latent class analysis of three socioeconomic factors (household income, education, and employment status) and categorised into low, medium, and high. IPAQ_MVPA was measured using the International Physical Activity Questionnaire was categorised as low (< 600 metabolic equivalent (MET)-min/week), medium (600 to < 3000 MET-min/week), and high (\geq 3000 MET-min/week). ACCEL_MVPA: Device-measured total physical activity was measured using the Axivity AX3 triaxial accelerometer worn on participant's dominant wrist for a 7-day period. Total minutes spent on MVPA (ACCEL_MVPA: a sum of moderate and vigorous activities) was extracted and categorised into tertile-based

thirds. 'Low' indicated the first tertile, 'Medium' indicated second tertile and 'High' indicated third tertile. LTPA was calculated using the frequency and duration of walking for pleasure, other exercises, and strenuous sports in the last 4 weeks and categorised into tertile-based thirds. Household physical activity was assessed by asking participants the frequency and duration of light and heavy do-it-yourself activities in the last four weeks and categorised into tertile-based thirds.

All analyses were adjusted for sex, ethnicity, sleep score, dietary pattern score, smoking and alcohol consumption. IPAQ_MVPA and LTPA analyses were additionally adjusted for screen time (derived using daily hours of TV viewing and non-occupational computer use), ACCEL_MVPA for device-measured sitting time and household physical activity analyses for LTPA and screen time.

Figure S7: Association of physical activity with all-cause mortality across area-level socioeconomic status

Small squares denote point estimates of the hazard ratio, and the bars indicate 95% confidence interval. Y axis is in log-scale. Reference: High physical activity. SES= Area-level socioeconomic status, IPAQ_MVPA: Self-reported moderate vigorous physical activity. (MVPA), ACCEL_MVPA: Device-measured MVPA, LTPA: Leisure-time physical activity. Townsend index, derived from respondent's postcode, was used as an indicator of area-level SES and categorised into tertiles with the lowest score indicating highest SES.

IPAQ_MVPA: Participants physical activity measured using the International Physical Activity Questionnaire was categorised as low (< 600 metabolic equivalent (MET)-min/week), medium (600 to < 3000 MET-min/ week), and high (\geq 3000 MET-min/week).

Low SES: High IPAQ_MVPA (1,915/36,884), Medium IPAQ_MVPA (2,455/52,896; 0.97(0.92-1.03)), Low IPAQ_MVPA (847/16,539; 1.11(1.02-1.19))

Medium SES: High (1,994/38,274), Medium (2,476/50,534; 1.03(0.97-1.09)), Low (868/15,760; 1.18(1.09-1.28)) High SES: High (2,341/37,895), Medium (2,693/47,333; 0.97(0.91-1.02)), Low (958/14,384; 1.11(1.02-1.21))

ACCEL_MVPA: Device-measured total physical activity was measured using the Axivity AX3 triaxial accelerometer worn on participant's dominant wrist for a 7-day period. Total minutes spent on MVPA (a sum of

moderate and vigorous activities) was extracted and categorised into tertile-based thirds. 'Low' indicated the first tertile, 'Medium' indicated second tertile and 'High' indicated third tertile.

Low SES: High ACCEL_MVPA (95/5,969), Medium ACCEL_MVPA (124/5,984; 1.09 (0.83-1.44)) and Low ACCEL_MVPA (240/5,841; 1.78 (1.36-2.29))

Medium SES: High (93/6,208), Medium (136/6,028; 1.33 (1.01-1.74)) and Low (203/5,829; 1.71 (1.31-2.25))

High SES: High (106/6,309), Medium (120/6,092; 1.00 (0.76-1.31)) and Low (191/5,738; 1.41 (1.08-1.84))

LTPA was calculated using the frequency and duration of walking for pleasure, other exercises, and strenuous sports in the last 4 weeks and categorised into tertile-based thirds.

Low SES: High LTPA (1,507/27,169), Medium LTPA (1,637/ 29,129; 1.04 (0.97-1.12)) and Low LTPA (1,873/ 31,824; 1.10 (1.03-1.18))

Medium SES: High (1,488/32,248), Medium (1,629/32,571; 1.14 (1.06-1.22)) and Low (1,570/31,120; 1.16(1.08-1.24))

High SES: High (1,611/34,871), Medium (1,584/34,093;1.06(0.99-1.14)) and Low (1,521/30,312; 1.16(1.08-1.25))

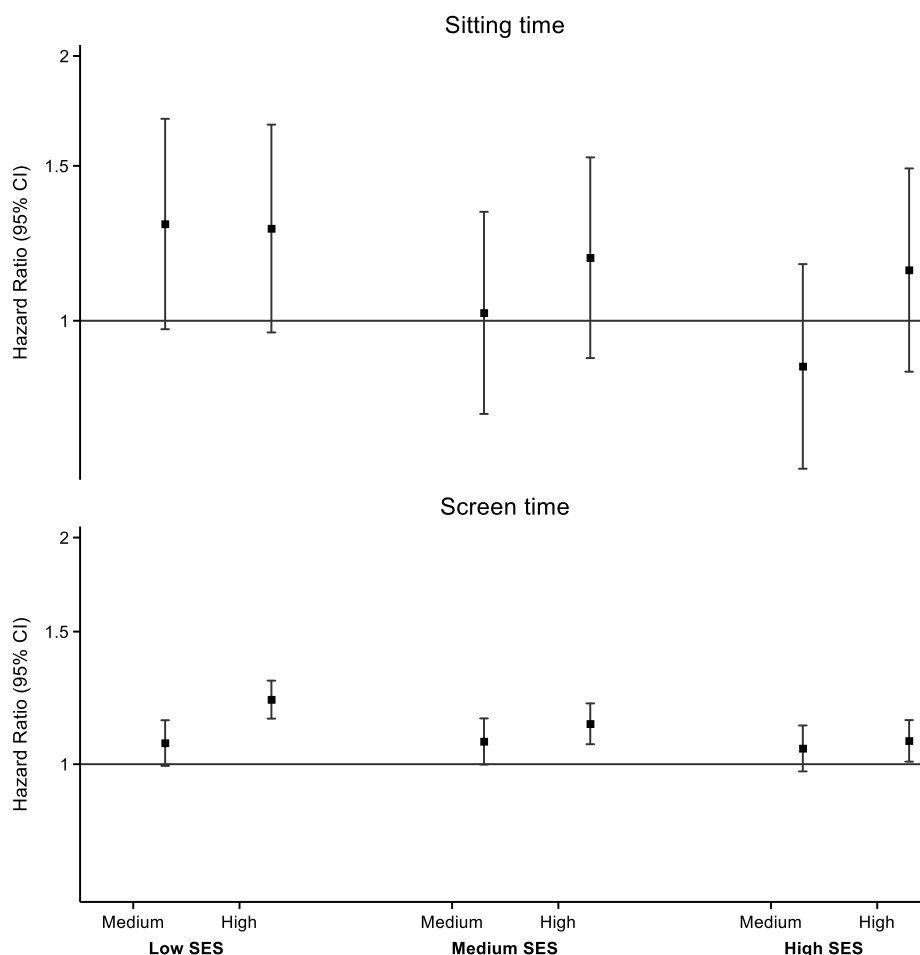
Household physical activity was assessed by asking participants the frequency and duration of light and heavy do-it-yourself activities in the last four weeks and categorised into tertile-based thirds.

Low SES: High household physical activity (1,062/ 17,428), Medium household physical activity (1,173/ 20,702;1.08 (0.98-1.19)) and low household physical activity (1,395/ 23,204; 1.13(1.03-1.24))

Medium SES: High (1,391/ 24,692), Medium (1,283/ 25,932; 1.04(0.95-1.13)) and Low (1,210/ 24,508; 1.03(0.94-1.12))

High SES: High (1,468/ 27,063), Medium (1,308/ 27,760; 0.97(0.90-1.06)) and Low (1,164/ 24,065; 1.06(0.97-1.15))

All analyses were adjusted for sex, ethnicity, sleep score, dietary pattern score, smoking and alcohol consumption. IPAQ_MVPA and LTPA analyses were additionally adjusted for screen time (derived using daily hours of TV viewing and non-occupational computer use), ACCEL_MVPA for device-measured sitting time and household physical activity analyses for LTPA and screen time.

Figure S8: Association of sedentary behaviour with all-cause mortality across area-level socioeconomic status

Small squares denote point estimates of the hazard ratio, and the bars indicate 95% confidence interval. Y axis is in log-scale. 'Low' indicated the first tertile, 'Medium' indicated second tertile and 'High' indicated third tertile. Reference: Lowest/first tertile. SES= Socioeconomic status, Sitting time: Device-measured sitting time. Townsend index, derived from respondent's postcode, was used as an indicator of area-level SES and categorised into tertiles with the lowest score indicating highest SES.

Sitting time: Device-measured sitting time was measured using the Axivity AX3 triaxial accelerometer worn on participant's dominant wrist for a 7-day period. Total minutes of sitting time was extracted and categorised into tertile-based thirds.

Low SES: Low sitting time (84/5,653), Medium sitting time (141/5,750; 1.29(0.98-1.70)) and High sitting time (234/6,391; 1.27(0.97-1.67))

Medium SES: Low (102/6,198), Medium (132/6,089; 1.02(0.78-1.33)) and High (198/5,778; 1.18(0.91-1.53))

High SES: Low (108/6,304), Medium (120/6,239; 0.89(0.68-1.16)) and 189/5,596; 1.14(0.87-1.49))

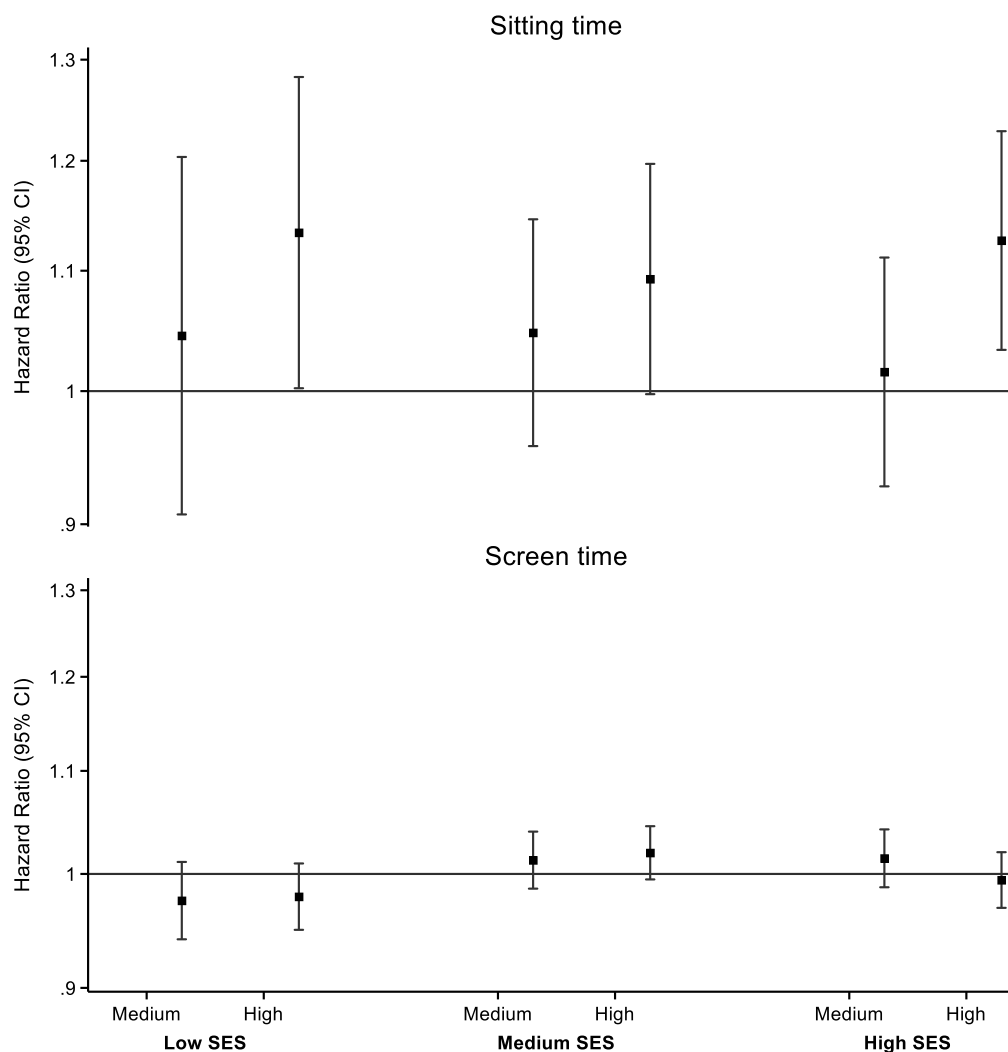
Screen time: Screen time was derived using daily hours spent watching TV and non-occupational computer use and categorised into tertile-based thirds.

Low SES: Low screen time (2,483/49,887), Medium screen time (1,360/21,838; 1.07(0.99-1.14)) and High screen time (2,831/35,167; 1.22(1.15-1.29))

Medium SES: Low (2,268/53,110), Medium (1,343/24,184; 1.07(1.00-1.15)) and High (2,182/32,880; 1.13(1.06-1.20))

High SES: Low (2,266/54,524), Medium (1,310/24,851; 1.05(0.98-1.12)) and High (1,980/31,676; 1.07(1.01-1.14))

All analyses were adjusted for sex, ethnicity, sleep score, dietary pattern score, smoking and alcohol consumption. Sitting time analyses were additionally adjusted for device-measured MVPA and screen time analyses for self-reported MVPA.

Figure S9: Association of sedentary behaviour with incident CVD across individual-level socioeconomic status

Small squares denote point estimates of the sub-hazard ratio, and the bars indicate 95% confidence interval. Y axis is in log-scale. 'Low' indicated the first tertile, 'Medium' indicated second tertile and 'High' indicated third tertile. Reference: Lowest/first tertile. SES= Socioeconomic status, Sitting time: Device-measured sitting time. Individual-level SES was created using latent class analysis of three socioeconomic factors (household income, education, and employment status) and categorised into low, medium, and high.

Sitting time: Device-measured sitting time was measured using the Axivity AX3 triaxial accelerometer worn on participant's dominant wrist for a 7-day period. Total minutes of sitting time was extracted and categorised into tertile-based thirds.

Low SES: Low sitting time (628/2,568), Medium sitting time (773/2,629; 1.04(0.91-1.20)), High sitting time (1,055/3,122; 1.13(1.00-1.28))

Medium SES: Low (1,336/6,798), Medium (1,485/6,065; 1.05(0.96-1.14)), High (1,645/5,551; 1.09(1.00-1.20))

High SES: Low (1,256/ 8,175), Medium (1,577/8,622; 1.01(0.93-1.11)), High (1,928/8,051; 1.13(1.03-1.23))

Screen time: Screen time was derived using daily hours spent watching TV and non-occupational and categorised into tertile-based thirds.

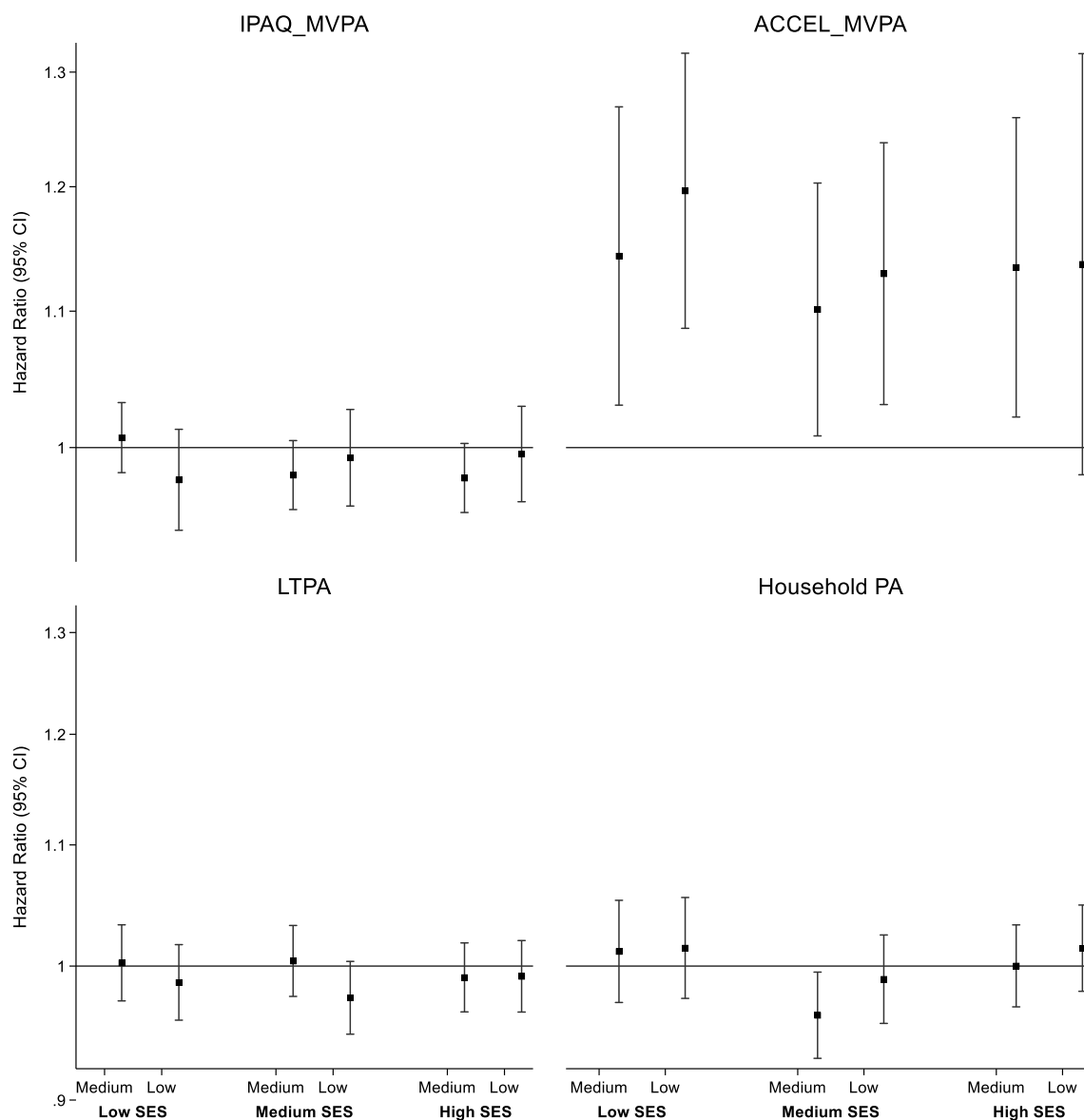
Low SES: Low screen time (9,097/27,939), Medium screen time (5,214/16,256; 0.98(0.94-1.01)), High screen time (9,564/29,632; 0.98(0.95-1.01))

Medium SES: Low (16,935/53,632), Medium (8,816/27,693; 1.01(0.97-1.04)), High (11,490/36,063; 1.02(0.99-1.04))

High SES: Low (21,965/69,135), Medium (7,299/22,816; 1.01(0.99-1.04)), High (8,507/26,901; 0.99(0.97-1.02))

All analyses were adjusted for sex, ethnicity, sleep score, dietary pattern score, smoking and alcohol consumption. Sitting time analyses were additionally adjusted for device-measured MVPA and screen time analyses for self-reported MVPA. Deaths due to other causes were treated as competing risks.

Figure S10: Association of physical activity with incident CVD across area-level socioeconomic status



Small squares denote point estimates of the sub-hazard ratio, and the bars indicate 95% confidence interval. Y axis is in log-scale. Reference: High physical activity. SES= Area-level socioeconomic status, IPAQ_MVPA: Self-reported moderate vigorous physical activity (MVPA), ACCEL_MVPA: Device-measured MVPA, LTPA: Leisure-time physical activity. Townsend index, derived from respondent's postcode, was used as an indicator of area-level SES and categorised into tertiles with the lowest score indicating highest SES.

IPAQ_MVPA: Participants physical activity measured using the International Physical Activity Questionnaire was categorised as low (< 600 metabolic equivalent (MET)-min/week), medium (600 to < 3000 MET-min/ week), and high (\geq 3000 MET-min/week).

Low SES: High IPAQ_MVPA (11,430/35,638), Medium IPAQ_MVPA (14,320/44,687; 1.01(0.98-1.03)), Low IPAQ_MVPA (4,246/13,453; 0.98(0.94-1.01))

Medium SES: High (11,603/36,145), Medium (15,185/47,988; 0.98(0.96-1.01)), Low (4,805/14,973; 0.99 (0.96-1.03))
High SES: High (11,185/ 35,007), Medium (15,859/50,210; 0.98(0.96-1.00)), Low (5,079/15,738; 0.99(0.96-1.03))

ACCEL_MVPA: Device-measured total physical activity was measured using the Axivity AX3 triaxial accelerometer worn on participant's dominant wrist for a 7-day period. Total minutes spent on MVPA (a sum of moderate and vigorous activities) was extracted and categorised into tertile-based thirds. 'Low' indicated the first tertile, 'Medium' indicated second tertile and 'High' indicated third tertile.

Low SES: High ACCEL_MVPA (1,044/ 5,778), Medium ACCEL_MVPA (1,269/5,734; 1.14(1.03-1.27)), Low ACCEL- MVPA (1,504/5,489; 1.20(1.09-1.32))

Medium SES: High (1,099/ 6,005), Medium (1,314/ 5,755; 1.10(1.00-1.20)), Low (1,533/5,507; 1.13(1.03-1.24))

High SES: High (1,160/ 6,065), Medium (1,336/5,837; 1.13(1.02-1.26)), Low (1,424/5,411; 1.14(0.98-1.32))

LTPA was calculated using the frequency and duration of walking for pleasure, other exercises, and strenuous sports in the last 4 weeks and categorised into tertile-based thirds.

Low SES: High LTPA (8,233/25,665), Medium LTPA (8,816/ 27,464; 1.00(0.97-1.03)), Low LTPA (9,549/29,984; 0.99(0.96- 1.02))

Medium SES: High (9,776/30,552), Medium (9,942/30,876; 1.00(0.98-1.03)), Low (9,310/29,585; 0.97(0.95-1.00))

High SES: High (10,537/33,185), Medium (10,310/32,417; 0.99(0.96-1.02)), Low (9,175/28,797; 0.99(0.96-1.02))

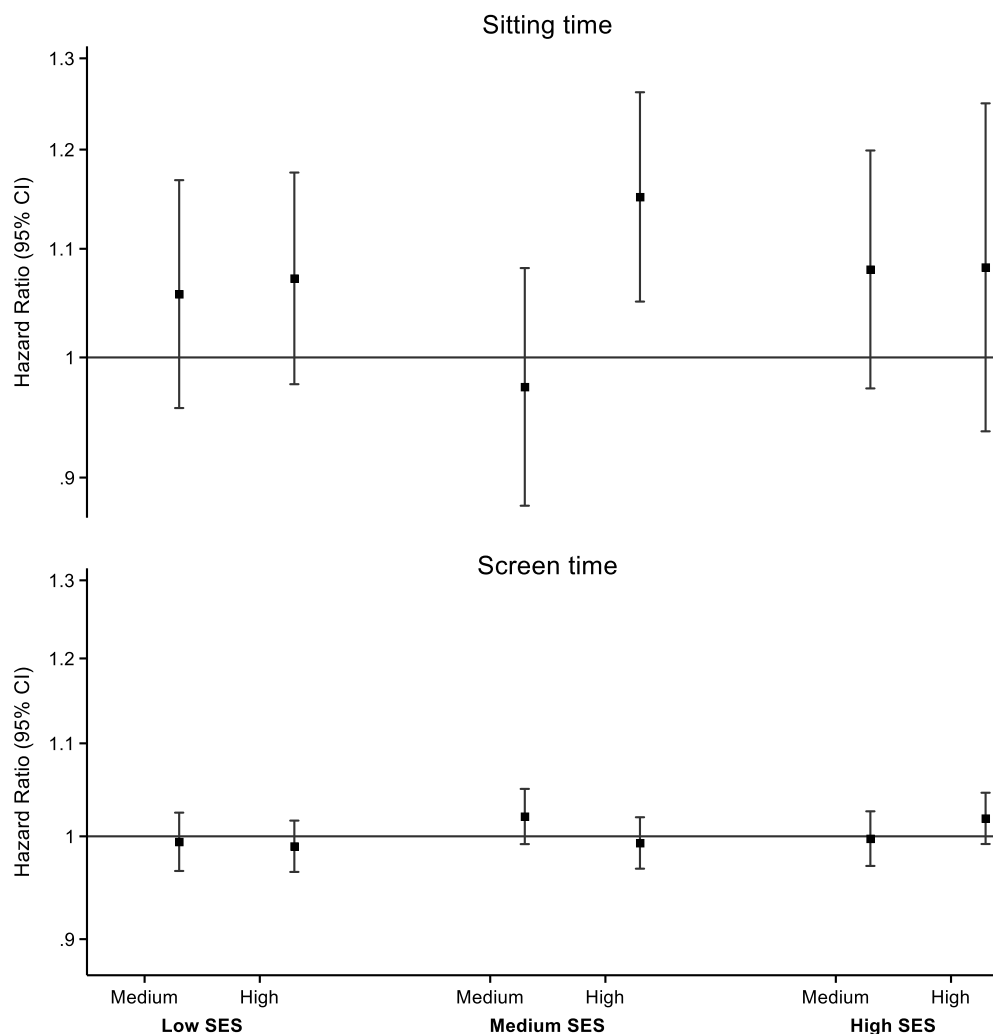
Household physical activity was assessed by asking participants the frequency and duration of light and heavy do-it-yourself activities in the last four weeks and categorised into tertile-based thirds.

Low SES: High household physical activity (5,178/16,437), Medium High household physical activity (6,287/19,567; 1.01(0.97-1.05)), Low High household physical activity (6,985/21,844; 1.01(0.97-1.06))

Medium SES: High (7,539/23,329), Medium (7,721/24,594; 0.96(0.93-0.99)), Low (7,461/23,235; 0.99(0.96-1.02))

High SES: High (8,103/25,571), Medium (8,413/26,391; 1.00(0.97-1.03)), Low (7,337/22,849; 1.01(0.98-1.05))

All analyses were adjusted for sex, ethnicity, sleep score, dietary pattern score, smoking and alcohol consumption. IPAQ_MVPA and LTPA analyses were additionally adjusted for screen time (derived using daily hours of TV viewing and non-occupational computer use), ACCEL_MVPA for device-measured sitting time and household physical activity analyses for LTPA and screen time. Deaths due to other causes were treated as competing risks.

Figure S11: Association of sedentary behaviour with incident CVD across area-level socioeconomic status

Small squares denote point estimates of the sub-hazard ratio, and the bars indicate 95% confidence interval. Y axis is in log-scale. 'Low' indicated the first tertile, 'Medium' indicated second tertile and 'High' indicated third tertile. Reference: Lowest/first tertile. SES= Socioeconomic status. Townsend index, derived from respondent's postcode, was used as an indicator of area-level SES and categorised into tertiles with the lowest score indicating highest SES.

Sitting time: Device-measured sitting time was measured using the Axivity AX3 triaxial accelerometer worn on participant's dominant wrist for a 7-day period. Total minutes of sitting time was extracted and categorised into tertile-based thirds.

Low SES: Low sitting time (965/5,471), Medium sitting time (1,204/5,498; 1.06(0.96-1.17)), High sitting time (1,648/6,032; 1.07(0.98-1.18))

Medium SES: Low (1,112/5,989), Medium (1,276/5,846; 0.97(0.88-1.08)), High (1,558/5,432; 1.15(1.05-1.26))

High SES: Low (1,143/6,081), Medium (1,355/5,972; 1.08(0.98-1.20)), High (1,422/5,260; 1.08(0.94-1.25))

Screen time: Screen time was derived using daily hours spent watching TV and non-occupational and categorised into tertile-based thirds.

Low SES: Low screen time (15,286/47,591), Medium screen time (6,542/20,448; 0.99(0.96-1.02)), High screen time

(10,357/ 32,372; 0.99(0.96-1.02))

Medium SES: Low (16,168/50,815), Medium (7,359/22,822; 1.02(0.99-1.05)), High (9,673/30,657; 0.99(0.97-1.02)) High SES: Low (16,543/ 52,300), Medium (7,428/23,495; 1.00(0.97-1.02)), High (9,531/29,567; 1.02 (0.99-1.04))

All analyses were adjusted for sex, ethnicity, sleep score, dietary pattern score, smoking and alcohol consumption. Sitting time analyses were additionally adjusted for device-measured MVPA and screen time analyses for self-reported MVPA. Deaths due to other causes were treated as competing risks.

Supplementary Table S6: E-values [point estimate (CI)]

Association of physical activity with all-cause mortality across individual-level SES*

	Low SES	Medium SES	High SES
Self-reported MVPA (IPAQ_MVPA)			
Low	1.74 (1.51)	1.56 (1.31)	1.54 (1.28)
Device-measured MVPA (ACCEL_MVPA)			
Low	3.00 (1.99)	2.30 (1.51)	2.64 (1.86)
Leisure time physical activity (LTPA)			
Medium	1.37 (1.11)	1.49 (1.24)	1.34 (1.00)
Low	1.54 (1.34)	1.62 (1.40)	1.51 (1.28)

Association of sedentary behaviour with all-cause mortality across individual-level SES*

	Low SES	Medium SES	High SES
Screen time			
High	1.43 (1.24)		1.67 (1.46)

Association of physical activity with all-cause mortality across area-level SES*

	Low SES	Medium SES	High SES
Self-reported MVPA (IPAQ_MVPA)			
Low	1.46 (1.16)	1.64 (1.40)	1.46 (1.16)
Device-measured MVPA (ACCEL_MVPA)			
Low	2.96 (2.06)	2.81 (1.95)	2.17 (1.37)
Leisure time physical activity (LTPA)			
Low	1.43 (1.21)	1.59 (1.37)	1.59 (1.37)
Household physical activity			
Low	1.51 (1.21)		

Association of sedentary behaviour with all-cause mortality across area-level SES*

	Low SES	Medium SES	High SES
Screen time			
High	1.74 (1.56)	1.51 (1.31)	1.34 (1.11)

Association of physical activity with incident CVD across individual-level SES*

	Low SES	Medium SES	High SES
Self-reported MVPA (IPAQ_MVPA)			
Medium			1.17 (1.09)
Low			1.17 (1.00)
Device-measured MVPA (ACCEL_MVPA)			
Medium			1.40 (1.20)
Low		1.42 (1.20)	1.44 (1.25)
Leisure time physical activity (LTPA)			
Low	1.20 (1.09)		

Association of sedentary behaviour with incident CVD across individual-level SES*

	Low SES	Medium SES	High SES
Sitting time			
High			1.40 (1.17)

Association of physical activity with incident CVD across area-level SES*

	Low SES	Medium SES	High SES
Device-measured MVPA (ACCEL_MVPA)			
Medium	1.42 (1.17)		1.40 (1.13)
Low	1.53 (1.32)	1.40 (1.17)	

Association of sedentary behaviour with incident CVD across area-level SES*

	Low SES	Medium SES	High SES
Sitting time			
High		1.44 (1.22)	

*E-values are provided only for statistically significant associations in main analysis.

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