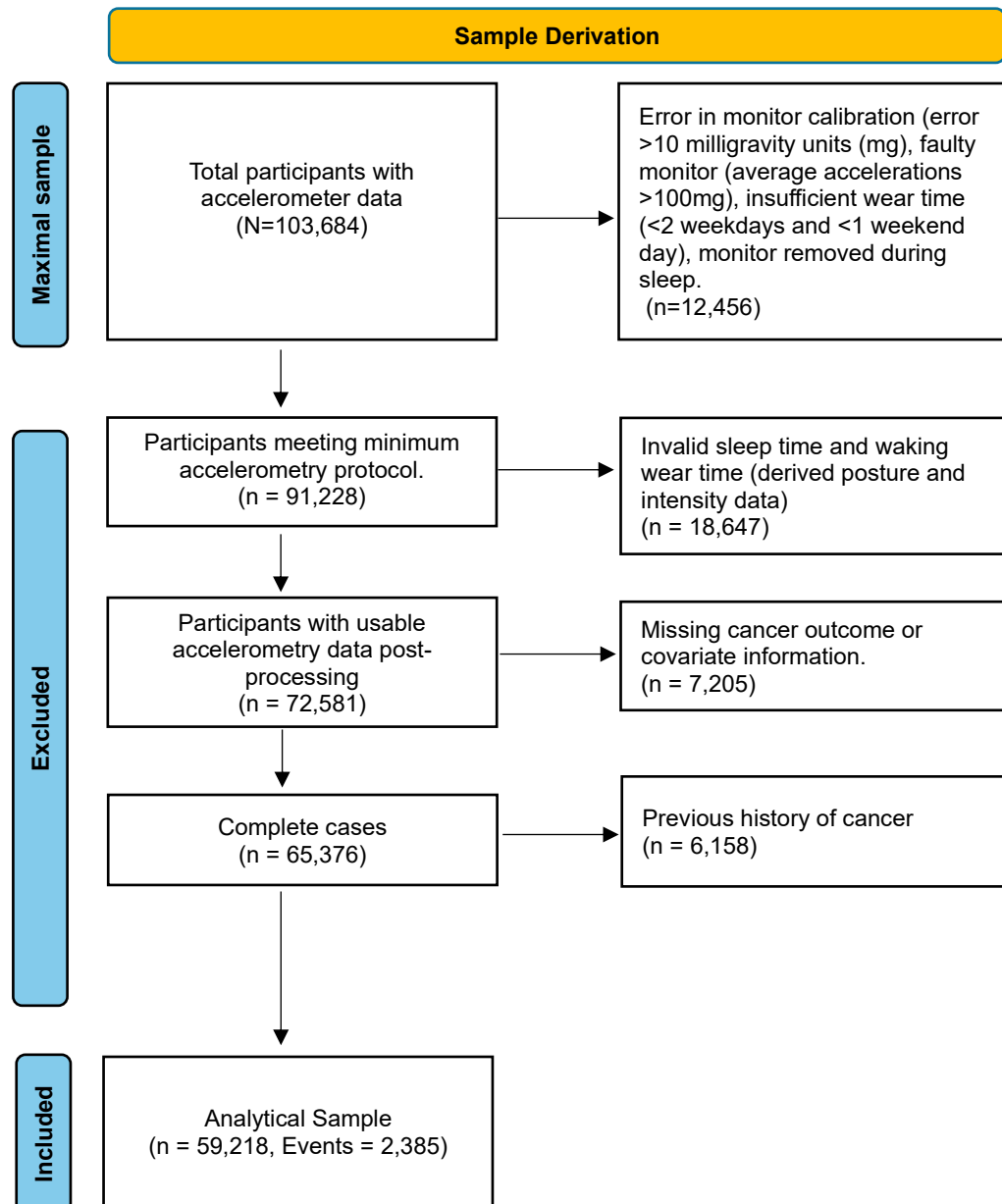


Additional file 1 (Supplementary material): Device-measured movement behaviours and cancer incidence in a population sample of UK adults: Dual 24-hour analyses of intensity and postural compositions

Figure S1. Sample derivation flow chart



Supplementary Text S1. Classification of intensity and posture from processing algorithms.

Sleep classifier

Sleep duration was assessed with an algorithm, using the absence of change in device tilt angle, developed and validated in 3,752 British participants with sleep diary data and 28 patients with polysomnography data. The sleep period time window derived from the algorithm was 11m and 3m longer compared with a sleep diary in men and women, respectively. The mean c-statistic to detect the sleep period time window compared to polysomnography was 0.86 and 0.83 in clinic-based and healthy sleepers, respectively¹.

Physical activity intensity classifier

Physical activity intensity was classified with a previously adopted two-level Random Forest algorithm^{2,3}. The first level classifies activity type, in contiguous 10s bins, and the second level further sorts the activities into intensity bands. This two-level classifier minimises misclassification between the lower intensity bands as activities are first classified by type, clearly delineating Moving activities, standing utilitarian movements (semi-stationary) and sedentary behaviour (SB) before non-sedentary activities are further classified into intensity bands based on degree of acceleration against gravity. Moving activities are then grouped by their acceleration, as light PA (LPA; <100mg), moderate PA (MPA; ≥100mg) and vigorous (≥400mg). The intensity composition therefore encompassed VPA, MPA, LPA, sedentary time (ST) and sleep.

Posture classifier

Stationary behaviour and physical activity were classified using a previously validated Random Forest (RF) activity classifier. The initial probabilities of activity classification from the RF classifier were temporally smoothed using a Hidden Markov Model (HMM) to generate the final sequence of activity predictions.

Physical activity was categorized in 60-second intervals into five classes: Sitting, Standing Stationary, Standing Moving, Walking/Running, and Cycling and has been shown to have a high degree of classification accuracy^{6,374,5}. Sleep and non-wear time were distinguished from active periods based on changes in tilt angle and acceleration standard deviation.

Accelerometer data were calibrated and orientation-corrected according to established procedures (model specificity and accuracy metrics have been previously outlined by Ahmadi et al., 2024).

Matthew N Ahmadi, Pieter Coenen, Leon Straker, Emmanuel Stamatakis, Device-measured stationary behaviour and cardiovascular and orthostatic circulatory disease incidence, International Journal of Epidemiology, Volume 53, Issue 6, December 2024, dyae136, <https://doi.org/10.1093/ije/dyae136>

Supplementary Text S2. Isometric log-ratio '*Pivot*' approach to Compositional data analysis.

The pivot approach^{6,7} to compositional data analysis is established for enabling the modelling of highly collinear movement behaviours in tandem. This involves applying the Isometric log-ratio (ILR) transformation to compositional data of n components, resulting in $n-1$ coordinates which represent all daily movement behaviour in a series of ratios, and which can all be fitted within standard statistical models. This circumvents issues of multicollinearity⁶.

The first ILR-coordinate within each model represents the association of one movement behaviour, relative to all others (i.e. vigorous physical activity (VPA) relative to moderate physical activity (MPA), light physical activity (LPA), sedentary time (ST) and sleep duration) with the outcome and is the only interpreted and reported value in each model. The first ILR coefficient represents the expected difference in the outcome when the ILR-coordinate is increased by one unit. The order of the ratios is then re-pivoted, and the model re-fitted, to investigate the association of a different component, relative to all others, with the outcome. Critically, despite interpretability of the direction and consistency of the model coefficient, the magnitude (presented in ILR-transformed units) should be interpreted through isothermal substitution

Table S1. ICD Codes / Biobank Var numbers		
Variable	Coding	UKB field
Age at baseline	Continuous (years)	34, 52, accelerometer date-timestamp
Sex	Female/Male	31
Smoker status	Never, past, current smoker.	20116
Alcohol Use	Never drinker, Ex-drinker, within UK guideline levels (<15 weekly units), current above guidelines (≥15 weekly units)).	20117, 1558
Diet	Fruits and vegetables servings/day	1309, 1319, 1289, 1299
Physical-activity related cancer event	Physical activity-related cancer at 13 sites (oesophageal adenocarcinoma, liver, lung, kidney, gastric cardia, endometrial, myeloid leukaemia, myeloma, colon, head and neck, rectal, bladder, and breast) using ICD-10 classifications: Bladder: C67; Breast: C50; Colon: C18; Endometrial: C54, C55.9; Gastric cardia: C16.0; Head and neck: C00, C11, C12, C13, C14, C30, C31, C32, C33, C38, C39.0, C39.8, C39.9; Kidney: C64.9, C65.9; Liver: C22.0, C22.1; Lung: C34; Myeloid leukaemia: C92; Myeloma: C90.0; Oesophageal adenocarcinoma: C15; Rectal: C19.9, C20.9; Other digestive: C26.0.	100092

Duration of follow-up (time to event).	Time from accelerometer assessment to incident cancer diagnosis, death, loss to follow-up, or administrative censoring (in years).	100092
Prevalent cancer	Previous cancer at any site (used for exclusion).	20001, 100092
Prevalent CVD	Yes/No Identified by self-report and hospitalisation (ICD-10: I0, I11, I13, I20-I51, I60-I69).	20002, 41259
Education	College/University; A/AS level; O levels; CSE; NVQ/HND/HNC; other. A/AS = Advanced Placement; O level = High school certificate; CSE = Certificate of secondary education; NVQ/HND/HNC = Vocational qualification / Associates degree. A level, typically at age 18 years; O level, typically at age 16 years; CSE, typically at age 16 years;	6138

Cholesterol medication use	Yes/No	6177, 6153
Blood pressure medication use	Yes/No	6177, 6153
Diabetes medication use	Yes/No	6177, 6153
Parental history of cancer	Yes/No Self-reported mother or father diagnosed with cancer	20107, 20110

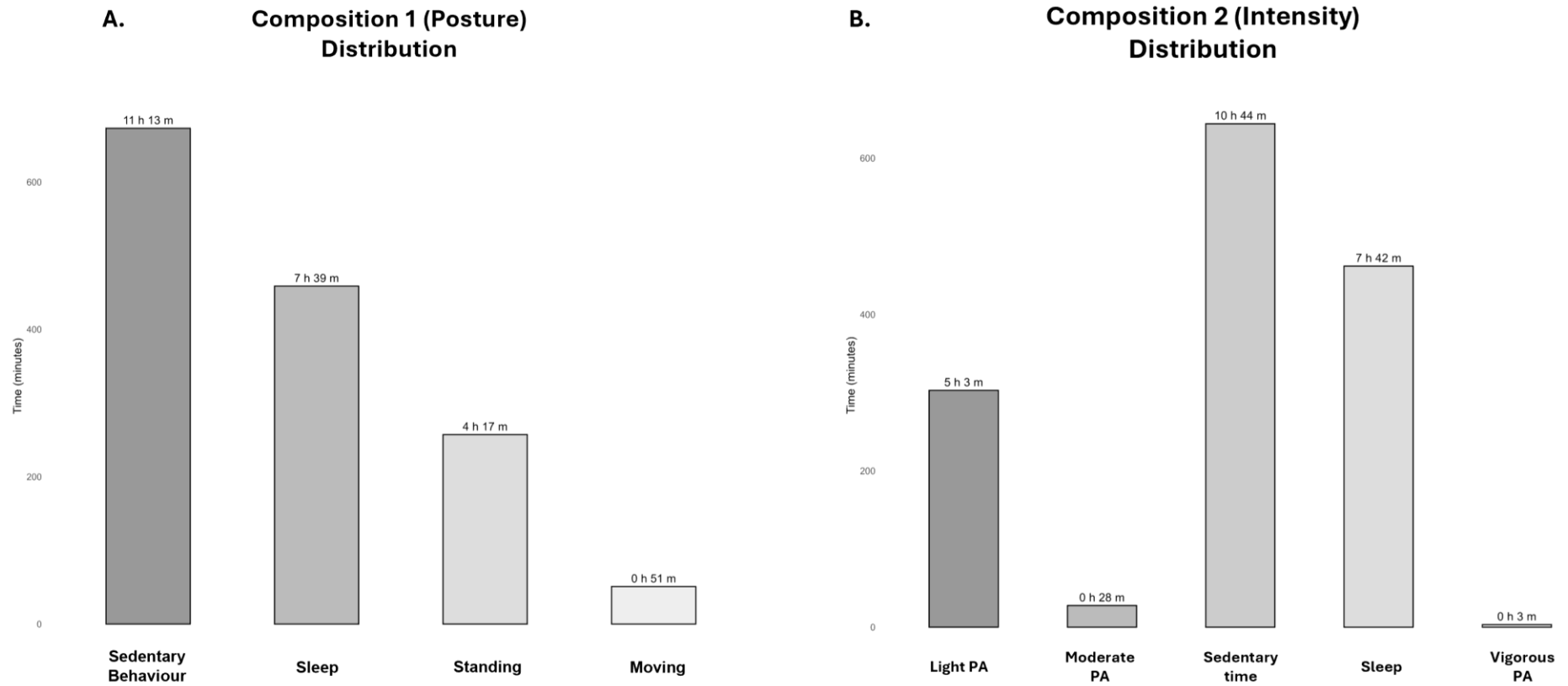
Table S2. Incident cases of physical-activity (PA)-related cancer during the follow-up period.

PA-related Cancer site	Cases in follow-up period
Breast	823
Colon	355
Lung	301
Bladder	269
Endometrial	119
Head and neck	112
Oesophageal adenocarcinoma	111
Myeloma	94
Liver	65
Myeloid leukaemia	57
Rectal	39
Gastric cardia	24
Kidney	16

Table S3. Competing risk, causes of death.

Cause of death	Deaths (n)
Cardiovascular disease	451
Other cancer*	400
Respiratory disease	157
Neurological disease	103
Accidents/trauma/external causes	59
Infectious disease	57
Gastrointestinal/liver disease	55
Frailty/nonspecific causes	51
Metabolic/endocrine disease	43
Other	37
Renal/genitourinary disease	34
Rectal Cancer	33
Haematological/immune disease	29
Kidney Cancer	16
Musculoskeletal disease	12
Gastric cardia Cancer	11
Bladder Cancer	na [¶]
Endometrial Cancer	na [¶]
[¶] Omitted for disclosure control, due to insufficient bin-width. *Other (Non-physical activity-related) cancers (>5% prevalence): Pancreatic (22%), prostate (14%), brain (12%), ovarian (10.2), lymphoma (8.2%).	

Figure S2. Raw sample means of (left (A): composition 1 (Posture); right (B): composition 2 (Intensity)



Abbreviations: Hours (h); minutes (m); physical activity (PA).

Table S4. Association of Coordinates of composition 1 (posture) and sleep with risk of physical activity (PA)-related cancers (Fine-Gray Cox Proportional Hazards Model)

	Age and Sex-adjusted				Fully adjusted				Fully adjusted + BMI*			
	HR	95% CI		p-value	HR	95% CI		p-value	HR	95% CI		p-value
Moving (vs all other postures)	0.957	0.937	0.978	<0.001	0.962	0.942	0.983	<0.001	0.966	0.945	0.987	0.001
Standing (vs all other postures)	0.911	0.872	0.953	<0.001	0.917	0.877	0.959	<0.001	0.928	0.887	1.109	0.001
Sedentary Behaviour (vs all other postures)	1.095	1.026	1.169	0.006	1.084	1.016	1.158	0.015	1.057	0.989	1.130	0.102
Sleep (vs all other postures)	1.047	0.969	1.131	0.241	1.045	0.968	1.129	0.259	1.056	0.977	1.141	0.169

Coefficients are in ILR transformed units and represent the relative association of each behavioural component relative to all other components. While direction of association can be interpreted, magnitude should be interpreted from isotemporal substitution analysis.. Bold: Significant at $p < 0.05$. HR: Hazard Ratio. CI: Confidence interval BMI: Body mass index. * $n=59,129, 2383$ events.

Table S5 Predicted Hazard Ratio (HR) from theoretical isotemporal substitution around sample average of Moving whilst holding other components constant at sample average.

Reallocation of time between behaviours	+3 min			+5 min			+10 min			+15 min			+30 min			+45 min			+60 min			+90 min		
	HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI	
Reallocating Sedentary behaviour to Moving (centred at the average day: 51m moving, 11h 13min sedentary behaviour)	1.00	0.99	1.00	0.99	0.99	1.00	0.98	0.98	0.99	0.98	0.97	0.99	0.96	0.94	0.98	0.94	0.92	0.97	0.93	0.90	0.96	0.91	0.87	0.95
Reallocating Standing to Moving (centred at the average day: 51m moving, 4h 17 min standing)	1.00	1.00	1.00	1.00	0.99	1.00	0.99	0.98	1.00	0.99	0.98	1.00	0.99	0.96	1.01	0.98	0.95	1.02	0.99	0.95	1.03	1.00	0.94	1.06
Reallocating Sleep to Moving (centred at the average day: 51m moving, 7h 39 min sleep)	1.00	0.99	1.00	0.99	0.99	1.00	0.98	0.98	0.99	0.98	0.97	0.99	0.96	0.94	0.98	0.95	0.91	0.98	0.93	0.89	0.97	0.91	0.86	0.96
Reallocating Moving to Sedentary behaviour (centred at the average day: 51m moving, 11h 13min sedentary behaviour)	1.01	1.00	1.01	1.01	1.00	1.01	1.02	1.01	1.03	1.03	1.01	1.03	1.08	1.04	1.12	1.19	1.08	1.30	-	-	-	-	-	-
Reallocating Moving to Standing (centred at the average day: 51m moving, 4h 17 min standing)	1.00	1.00	1.01	1.00	1.00	1.01	1.01	1.00	1.02	1.02	1.00	1.02	1.05	1.01	1.09	1.14	1.04	1.25	-	-	-	-	-	-
Reallocating Moving to Sleep (centred at the average day: 51m moving, 7h 39 min sleep)	1.01	1.00	1.01	1.01	1.00	1.01	1.02	1.01	1.03	1.03	1.01	1.03	1.07	1.03	1.12	1.18	1.08	1.30	-	-	-	-	-	-

Abbreviations: HR: Hazard Ratio; CI: Confidence interval; min: minutes. h: Hours. Omitted estimates are outside of limits of prediction/theoretical reallocation.

Table S6 Predicted Hazard Ratio (HR) from Isotemporal substitution around sample average of standing whilst holding other components constant at sample average.

<i>Reallocation of time between behaviours</i>	+3 min			+5 min			+10 min			+15 min			+30 min			+45 min			+60 min			+90 min		
	HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI	
Reallocating Sedentary behaviour to Standing (centred at the average day: 4h 17 min standing, 11h 13min sedentary behaviour)	1.00	1.00	1.00	1.00	0.99	1.00	0.99	0.99	1.00	0.99	0.98	0.99	0.97	0.96	0.99	0.96	0.95	0.98	0.95	0.93	0.97	0.93	0.90	0.96
Reallocating Moving to Standing (centred at the average day: 51m moving, 4h 17 min standing)	1.00	1.00	1.01	1.00	1.00	1.01	1.01	1.00	1.02	1.02	1.00	1.03	1.05	1.01	1.09	1.14	1.04	1.25	-	-	-	-	-	-
Reallocating Sleep to Standing (centred at the average day: 4h 17 min standing, 7h 39 min sleep)	1.00	1.00	1.00	1.00	0.99	1.00	0.99	0.99	1.00	0.99	0.98	1.00	0.98	0.96	0.99	0.96	0.94	0.99	0.95	0.92	0.99	0.93	0.89	0.98
Reallocating Standing to Sedentary behaviour (centred at the average day: 4h 17 min standing, 11h 13min sedentary behaviour)	1.00	1.00	1.00	1.00	1.00	1.01	1.01	1.00	1.01	1.01	1.01	1.02	1.03	1.02	1.04	1.04	1.02	1.06	1.06	1.03	1.09	1.10	1.05	1.14
Reallocating Standing to Moving (centred at the average day: 51m moving, 4h 17 min standing)	1.00	1.00	1.00	1.00	0.99	1.00	0.99	0.98	1.00	0.99	0.98	1.00	0.99	0.96	1.01	0.98	0.95	1.02	0.99	0.95	1.03	1.00	0.94	1.06
Reallocating Standing to Sleep (centred at the average day: 4h 17 min standing, 7h 39 min sleep)	1.00	1.00	1.00	1.00	1.00	1.01	1.01	1.00	1.01	1.01	1.00	1.02	1.03	1.01	1.04	1.04	1.01	1.07	1.06	1.02	1.09	1.09	1.03	1.15

Abbreviations: HR: Hazard Ratio; CI: Confidence interval; min: minutes. h: Hours. Omitted estimates are outside of limits of prediction/theoretical reallocation. **Bold:** Significant at p<0.05

Table S7 Predicted Hazard Ratio (HR) from Isotemporal substitution around sample average of Sedentary Behaviour postures whilst holding other components constant at sample average.

<i>Reallocation of time between behaviours</i>	+3 min			+5 min			+10 min			+15 min			+30 min			+45 min			+60 min			+90 min		
	HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI	
Reallocating Standing to Sedentary behaviour (centred at the average day: 4h 17 min standing, 11h 13min sedentary behaviour)	1.00	1.00	1.00	1.00	1.00	1.01	1.01	1.00	1.01	1.03	1.02	1.04	1.04	1.02	1.06	1.06	1.03	1.09	-	-	-	-	-	-
Reallocating Moving to Sedentary behaviour (centred at the average day: 51m moving, 11h 13min sedentary behaviour)	1.01	1.00	1.01	1.01	1.00	1.01	1.02	1.01	1.03	1.03	1.01	1.03	1.08	1.04	1.12	1.19	1.08	1.30	-	-	-	-	-	-
Reallocating Sleep to Sedentary behaviour (centred at the average day: 11h 13min sedentary behaviour, 7h 39 min sleep)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.00	0.99	1.01	1.00	0.99	1.02	1.00	0.98	1.02	1.00	0.97	1.03	1.00	0.96	1.05
Reallocating Sedentary behaviour to Standing (centred at the average day: 4h 17 min standing, 11h 13min sedentary behaviour)	1.00	1.00	1.00	1.00	0.99	1.00	0.99	0.99	1.00	0.99	0.98	0.99	0.97	0.96	0.99	0.96	0.95	0.98	0.95	0.93	0.97	0.93	0.90	0.96
Reallocating Sedentary behaviour to Moving (centred at the average day: 51m moving, 11h 13min sedentary behaviour)	1.00	0.99	1.00	0.99	0.99	1.00	0.98	0.98	0.99	0.98	0.97	0.99	0.96	0.94	0.98	0.94	0.92	0.97	0.93	0.90	0.96	0.91	0.87	0.95

Reallocating Standing to Sleep (centred at the average day: 11h 13min sedentary behaviour, 7h 39 min sleep)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.99	1.01	1.00	0.98	1.01	1.00	0.98	1.02	1.00	0.97	1.02	0.99	0.95	1.04
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Abbreviations: HR: Hazard Ratio; CI: Confidence interval; min: minutes. h: Hours. Omitted estimates are outside of limits of prediction/theoretical reallocation. **Bold:** Significant at p<0.05

Table S8. Association of Coordinates of composition 2 (intensity) and sleep with risk of physical activity (PA)-related cancers (Fine-Gray Cox Proportional Hazards Model)

	Age and Sex-adjusted				Fully adjusted			Fully adjusted + BMI				
	HR	95% CI		p-value	HR	95% CI		p-value	HR	95% CI		p-value
Vigorous PA (vs all other behaviours)	0.922	0.878	0.968	0.001	0.932	0.887	0.978	0.004	0.945	0.899	0.993	0.026
Moderate PA (vs all other behaviours)	0.971	0.903	1.043	0.415	0.973	0.905	1.046	0.454	0.978	0.91	1.051	0.546
Light PA (vs all other behaviours)	0.781	0.642	0.95	0.013	0.792	0.651	0.965	0.02	0.802	0.659	0.976	0.027
Sleep (vs all other behaviours)	1.169	0.948	1.442	0.145	1.165	0.945	1.437	0.152	1.201	0.973	1.483	0.088
Sedentary time (vs all other behaviours)	1.225	0.993	1.51	0.058	1.195	0.969	1.475	0.096	1.123	0.907	1.39	0.286

Coefficients are in ILR transformed units and represent the relative association of each behavioural component relative to all other components. While direction of association can be interpreted, magnitude should be interpreted from isotemporal substitution analysis.. Bold: Significant at $p < 0.05$. HR: Hazard Ratio; CI: Confidence interval. BMI: Body mass index.. * $n=59,129, 2383$ events.

Table S9. Predicted HR from Isotemporal substitution around sample average of VPA whilst holding other components constant at sample average.

[illegible]

Reallocating Vigorous PA to Sleep (centred at the average day: 3 min VPA, 7h 42 min sleep)	1.17	1.05	1.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Abbreviations: PA: Physical Activity; HR: Hazard Ratio; CI: Confidence interval; min: minutes. h: Hours. Omitted estimates are outside of limits of prediction/theoretical reallocation. Bold: Significant at p<0.05																					

Table S10. Predicted HR from Isotemporal substitution around sample average of LPA whilst holding other components constant at sample average.																								
Reallocation of time between behaviours	+3 min			+5 min			+10 min			+15 min			+30 min			+45 min			+60 min			+90 min		
	HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI	
Reallocating Sedentary time to Light PA (centred at the average day: 5h 3min LPA, 10h 44 min sedentary time)	1.00	0.99	1.00	1.00	0.99	1.00	0.99	0.98	1.00	0.99	0.98	1.00	0.97	0.95	0.99	0.96	0.93	0.99	0.95	0.91	0.99	0.92	0.87	0.99
Reallocating Moderate PA to Light PA (centred at the average day: 5h 3min LPA, 28 min MPA)	1.00	0.99	1.02	1.00	0.97	1.04	1.01	0.96	1.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reallocating Vigorous PA to Light PA (centred at the average day: 3 min VPA, 5h 3min LPA)	1.16	1.05	1.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reallocating Sleep to Light PA (centred at the average day: 5h 3min LPA, 7h 42 min sleep)	1.00	0.99	1.00	1.00	0.99	1.00	0.99	0.98	1.00	0.99	0.97	1.00	0.97	0.95	1.00	0.96	0.92	0.99	0.94	0.90	0.99	0.92	0.86	0.99
Reallocating Light PA to Sedentary time (centred at the average day: 5h 3min LPA, 10h 44 min sedentary time)	1.00	1.00	1.01	1.00	1.00	1.01	1.01	1.00	1.02	1.01	1.00	1.03	1.03	1.01	1.05	1.05	1.01	1.08	1.06	1.01	1.12	1.10	1.02	1.19
Reallocating Light PA to Moderate PA (centred at the average day: 5h 3min LPA, 28 min MPA)	1.00	0.99	1.01	1.00	0.99	1.01	1.00	0.98	1.02	1.00	0.97	1.03	1.00	0.95	1.06	1.01	0.94	1.09	1.02	0.93	1.12	1.04	0.91	1.18
Reallocating Light PA to Vigorous PA (centred at the average day: 3 min VPA, 5h 3min LPA)	0.96	0.93	0.99	0.96	0.93	0.99	0.95	0.91	0.99	0.92	0.87	0.98	0.88	0.79	0.98	0.87	0.77	0.99	0.87	0.76	1.00	0.87	0.74	1.02

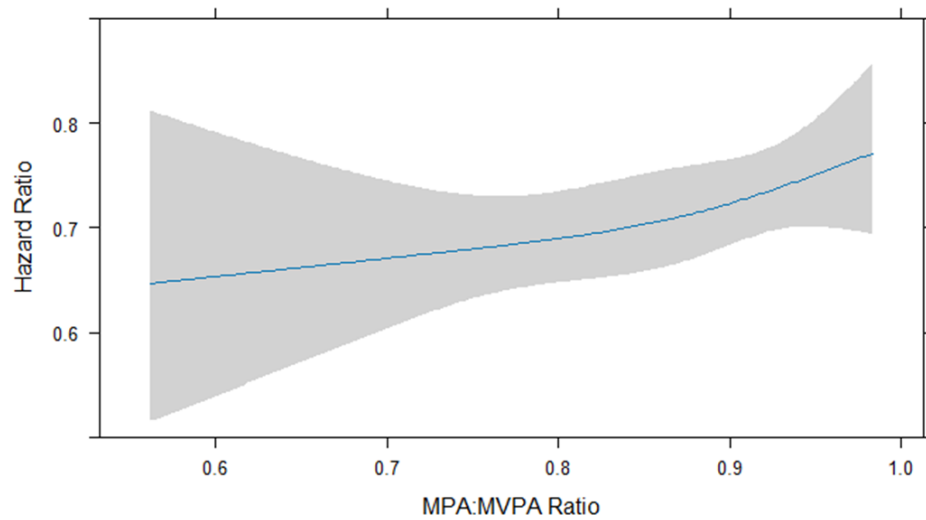
Reallocation	1.00	1.00	1.01	1.00	1.00	1.01	1.01	1.00	1.02	1.02	1.00	1.03	1.03	1.01	1.06	1.05	1.01	1.09	1.06	1.01	1.12	1.10	1.02	1.19
(centred at the average day: 5h 3min LPA, 7h 42 min sleep)	1.00	1.00	1.01	1.00	1.00	1.01	1.01	1.00	1.02	1.02	1.00	1.03	1.03	1.01	1.06	1.05	1.01	1.09	1.06	1.01	1.12	1.10	1.02	1.19

Abbreviations: PA: Physical Activity; HR: Hazard Ratio; CI: Confidence interval; min: minutes. h: Hours. Omitted estimates are outside of limits of prediction/theoretical reallocation. **Bold:** Significant at p<0.05

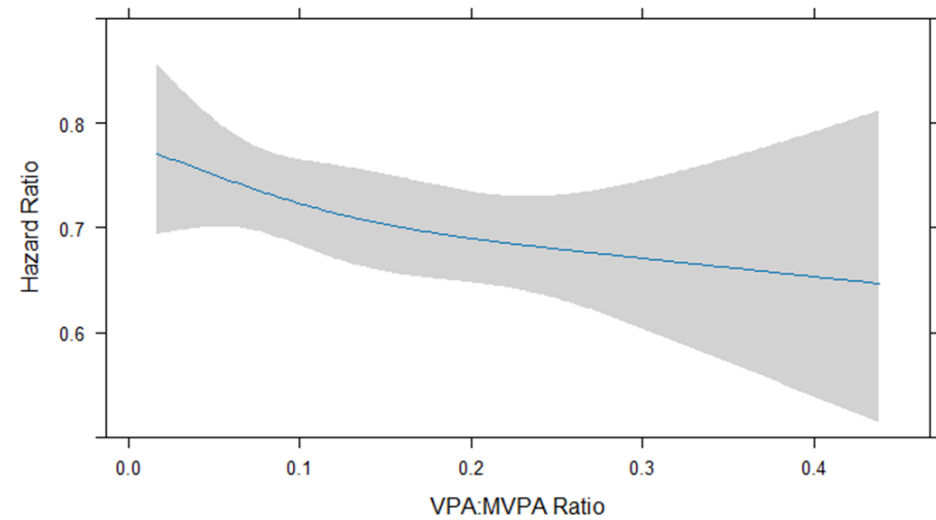
Table S11 Association of Coordinates of daily-movement behaviours (intensities, including MVPA) and sleep with risk of PA-related cancers (Fine-Gray Cox Proportional Hazards Model) (including all events).

	Age and Sex-adjusted				Fully adjusted			
	HR	95% CI		p-value	HR	95% CI		p-value
Moderate-to-Vigorous PA (vs all other behaviours)	0.950	0.923	0.979	0.001	0.956	0.928	0.985	0.003
Light PA (vs all other behaviours)	0.891	0.813	0.975	0.012	0.897	0.819	0.983	0.019
Sleep (vs all other behaviours)	1.073	0.974	1.182	0.155	1.072	0.973	1.181	0.162
Sedentary time (vs all other behaviours)	1.101	0.999	1.213	0.052	1.088	0.987	1.199	0.090
Coefficients are in ILR transformed units and represent the relative association of each behavioural component relative to all other components. While direction of association can be interpreted, magnitude should be interpreted from isotemporal substitution analysis.. Bold: Significant at p<0.05. HR: Hazard Ratio. CI: Confidence interval.								

Figure S3. Association of ratio variables (proportion of vigorous physical activity (VPA) and moderate physical activity (MPA) within moderate-to-vigorous physical activity (MVPA)) with risk of PA-related cancers (Age, sex, MVPA and sedentary-behaviour-adjusted Fine-Gray Cox Proportional Hazards Model, with knots placed at the 10th, 50th and, 90th percentile).



Adjusted to: MVPA= 34m; SB=10h 36m; Sex=Male; Age=62y



Adjusted to: MVPA= 34m; SB=10h 36m; Sex=Male; Age=62y

Table S12. E-values of posture model		
Exposure	E-value	(Lower-limit)
Moving (vs other postures)	1.242	(1.151)
Standing (vs other postures)	1.318	(1.204)
Sedentary Behaviour (vs other postures)	1.305	(1.116)
Sleep (vs other postures)	Null	-
Point estimate (and upper limit of the confidence interval in brackets) that an unmeasured confounder must have with both the exposure and outcome (conditional on the measured covariates) to render the exposure-outcome association null.		

Table S13. E-values of Intensity model		
Exposure	E-value	(Lower-limit)
Vigorous Physical Activity (vs other movement behaviours)	1.282	(1.143)
Moderate Physical Activity (vs other movement behaviours)	Null	-
Light Physical Activity (vs other movement behaviours)	1.628	(1.187)
Sedentary time (vs other movement behaviours)	Null	-
Sleep (vs other movement behaviours)	Null	-
Point estimate (and upper limit of the confidence interval in brackets) that an unmeasured confounder must have with both the exposure and outcome (conditional on the measured covariates) to render the exposure-outcome association null.		

Table S14. Association of Coordinates of daily-movement behaviours (postures) and sleep with risk of physical activity (PA)-related cancers (Fine-Gray Cox Proportional Hazards Model) with removal of first 1 year of events.

	Age and Sex-adjusted				Fully adjusted			
	HR	95% CI	p-value		HR	95% CI	p-value	
Moving (vs all other postures)	0.960	0.939	0.981	<0.001	1.034	0.941	0.987	0.002
Standing (vs all other postures)	0.917	0.875	0.961	<0.001	0.923	0.881	0.968	<0.001
Sedentary Behaviour (vs all other postures)	1.088	1.015	1.164	0.017	1.075	1.003	1.151	0.040
Sleep (vs all other postures)	1.045	0.961	1.134	0.285	1.044	0.963	1.132	0.300
Coefficients are in ILR transformed units and represent the relative association of each behavioural component relative to all other components. While direction of association can be interpreted, magnitude should be interpreted from isotemporal substitution analysis.. Bold: Significant at p<0.05. HR: Hazard Ratio.								

Table S15. Association of Coordinates of daily-movement behaviours (intensities) and sleep with risk of physical activity (PA)-related cancers (Fine-Gray Cox Proportional Hazards Model) with removal of first 1 year of events.

[illegible]

Table S16. Association of Coordinates of daily-movement behaviours (postures) and sleep with risk of physical activity (PA)-related cancers (Fine-Gray Cox Proportional Hazards Model) with removal of first 2 years events).

[illegible]

Table S17. Association of Coordinates of daily-movement behaviours (intensities) and sleep with risk of physical activity (PA)-related cancers (Fine-Gray Cox Proportional Hazards Model) (after removal of first 2 years of events).

[illegible]

Figure S4. Difference in composition 2 (intensity) of individuals with physical activity-related cancer incidence within first 1 year follow-up, relative to sample average.

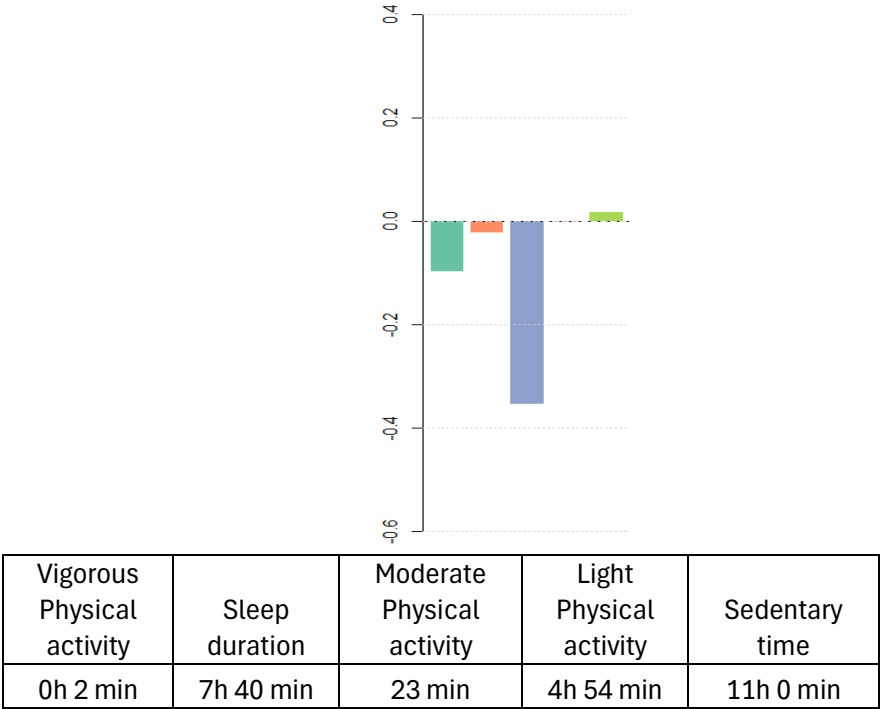
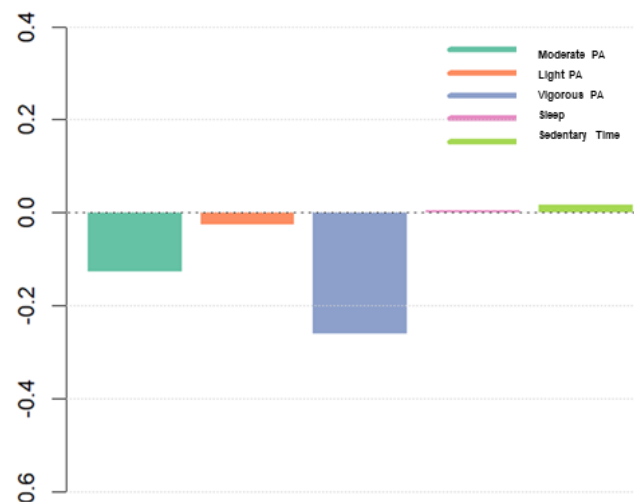


Figure S5. Difference in composition 2 (intensity) of individuals with physical activity-related cancer incidence excluding first 2 year follow-up, relative to sample average.



Vigorous Physical activity*	Sleep duration	Moderate Physical activity	Light Physical activity	Sedentary time
0h 3 min	7h 44 min	25 min	4h 55 min	10h 54 min

MANOVA Pillai's trace test of multivariate differences in compositional centre between PA-related cancer in first 2y follow-up compared to outside of 2y follow-up ($p=0.2405$)

*Significant t-test on difference in compositional average VPA between PA-related cancer in first 2y follow-up compared to outside of 2y follow-up ($p<0.0177$).

Table S18. Association of Coordinates of daily-movement behaviours (intensities, including moderate-to-vigorous physical activity (MVPA) and sleep with risk of physical activity (PA)-related cancers (Fine-Gray Cox Proportional Hazards Model) (after removal of first 2 years of events).

	Age and Sex-adjusted				Fully adjusted			
	HR	95% CI		p-value	HR	95% CI		p-value
Moderate-to-Vigorous PA (vs all other behaviours)	0.946	0.914	0.977	0.001	0.952	0.92	0.985	0.0038
Light PA (vs all other behaviours)	0.881	0.772	1.006	0.0159	0.888	0.805	0.979	0.0232
Sleep (vs all other behaviours)	1.09	0.98	1.22	0.1139	1.08	0.97	1.21	0.1719
Sedentary time (vs all other behaviours)	1.098	0.973	1.241	0.0967	1.096	0.983	1.211	0.1028
Coefficients are in ILR transformed units and represent the relative association of each behavioural component relative to all other components. While direction of association can be interpreted, magnitude should be interpreted from isotemporal substitution analysis.. Bold: Significant at p<0.05. HR: Hazard Ratio.								

Figure S6. Associations of each composition 1 (posture) component (relative to all other movement behaviour) with physical activity (PA)-related cancer, stratified by site.

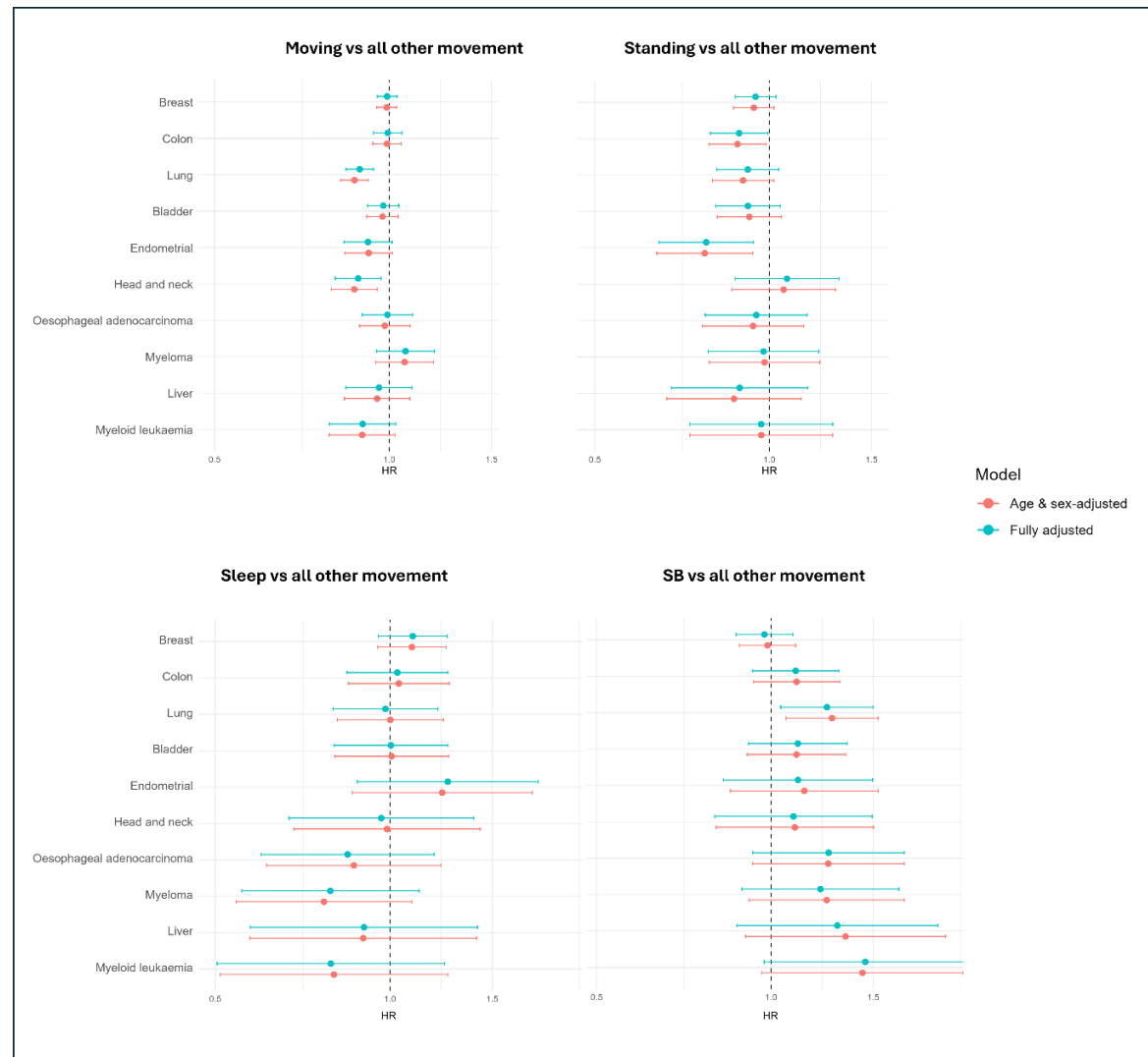


Figure S7. Associations of each composition 2 (intensity) component (relative to all other movement behaviour) with physical activity (PA)-related cancer, stratified by site.

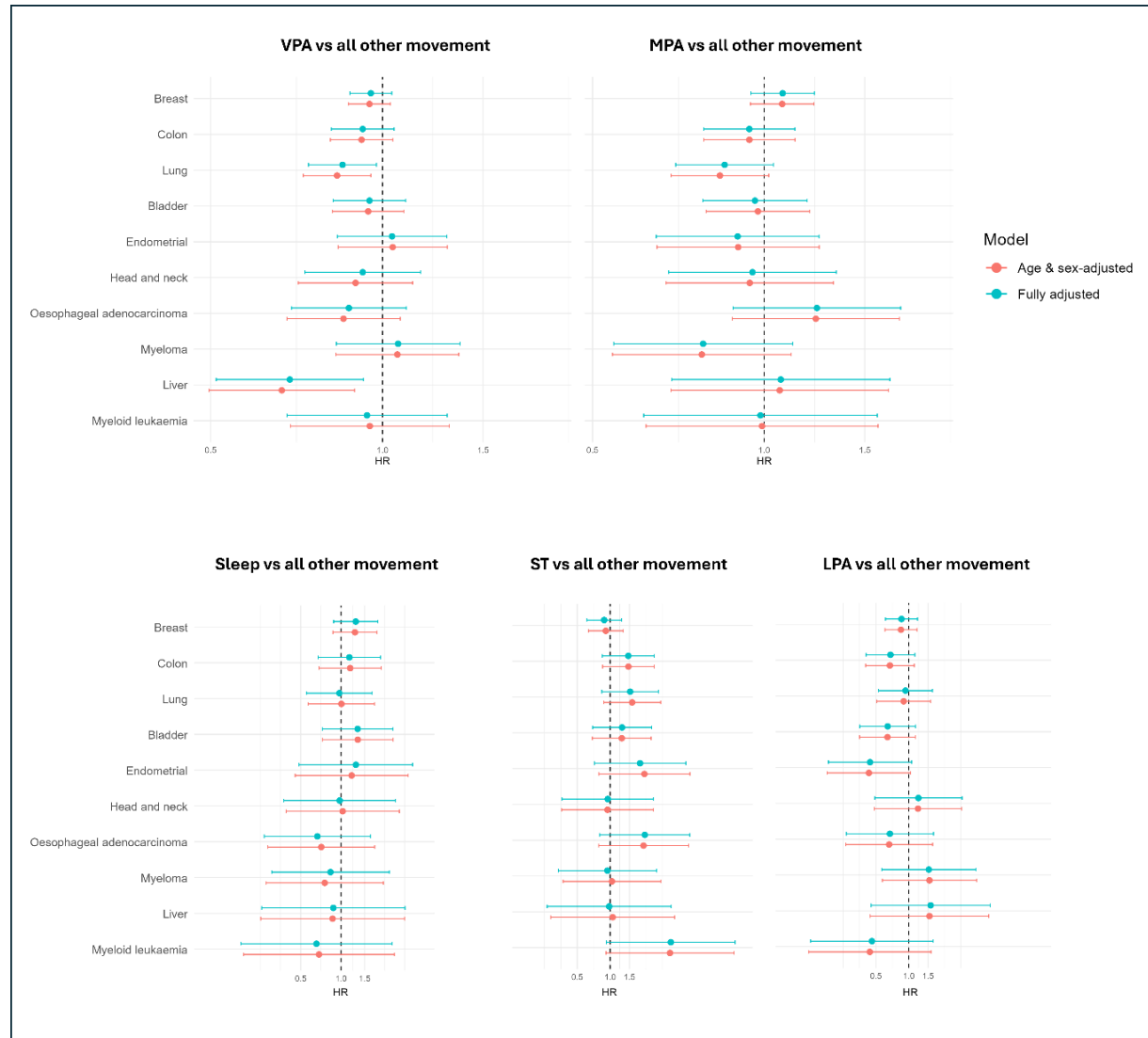


Table S19. Included and excluded participant characteristics at baseline.

		Included Sample n=59,218		Excluded Sample n=22,666		p-value
Age (years)	Mean (SD)	61.7	(7.8)	62.9	(7.8)	<0.001
Sex (female)	n, %	32,452	55%	13,549	60%	<0.001
Ethnicity (White)	n, %	56,988	96%	21,632	95%	<0.001
Education	n, %					0.007
College/University degree		25,737	43%	9,997	44%	
A/AS-level		7,966	13%	2,943	13%	
NVQ/HND/HNC		3,235	6%	1,151	5%	
CSE		2,335	4%	832	4%	
O-levels		12,116	21%	4,622	20%	
Other		7,829	13%	3,121	14%	
Smoking history	n, %					<0.001
Current		3,925	7%	1,633	7%	
Never		34,092	56%	12,621	56%	
Ex		21,201	37%	8,412	37%	
Medication Use (Cholesterol lowering, Blood pressure-lowering, Insulin)	n, %	13,549	23%	5,687	25%	<0.001
Alcohol	n, %					<0.001
Above guidelines		22,409	38%	8,423	37%	
Ex		1,545	3%	627	3%	
Within guidelines		33,647	57%	12,944	57%	
Never		1,617	3%	672	3%	
Family history of Cancer		15,353	26%	6,424	29%	<0.001
Diet Quality (Fruit/Vegetable consumption) index	Median (Q1,Q3)	7	(5-10)	7	(5-10)	0.1953
Previous history of CVD		5,366	9%	2,372	10%	<0.001
PA-related Cancer Incidence		2,385	4%	-	-	-
			(7.4-			
Follow up in years	Median (Q1,Q3)	8.0	8.5)	-	-	-
Competing risk	Median (Q1,Q3)	1,552	3%	-	-	-
Previous history of Cancer		-	-	7,633	34%	-

Comparisons of categorical variables with chi-squared tests and continuous variables with Wilcoxon signed-rank tests. Totals in excluded sample may vary due to missingness. (CVD: Cardiovascular disease; PA: Physical activity). Excluded sample were missing Physical activity measures, cancer outcomes and/or covariates.