

Supplementary Tables

Contents

- eTable 1.** The descriptions and sources of selected covariates, genotyping process and sample quality control in UK Biobank.
- eTable 2.** The descriptions and sources of information for outcomes in UK Biobank.
- eTable 3.** 118 single-nucleotide polymorphisms list of morning person identified in UK Biobank.
- eTable 4.** 12 single-nucleotide polymorphisms list of evening person identified in UK Biobank.
- eTable 5.** 27 single-nucleotide polymorphisms list of short sleep duration identified in UK Biobank.
- eTable 6.** 8 single-nucleotide polymorphisms list of long sleep duration identified in UK Biobank.
- eTable 7.** 78 single-nucleotide polymorphisms list of continuous sleep duration identified in UK Biobank.
- eTable 8.** 57 single-nucleotide polymorphisms list of insomnia identified in UK Biobank.
- eTable 9.** Multivariable Cox regression analysis for the pan-cancer incidence associated with sleep traits.
- eTable 10.** Multivariable Cox regression analysis for the all-cause mortality among cancer patients associated with sleep traits.
- eTable 11.** Multivariable Cox regression analysis for the cancer mortality associated with sleep traits among cancer patients during the follow-up years.
- eTable 12.** Multivariable Cox regression analysis for the cancer mortality among cancer patients associated with sleep traits in the 5 years.
- eTable 13.** Associations between morning/evening person unweighted GRS and potential confounders in UK Biobank.
- eTable 14.** Associations between short/long sleep duration unweighted GRS and potential confounders in UK Biobank.
- eTable 15.** Associations between insomnia unweighted GRS and potential confounders in UK Biobank.
- eTable 16.** Mendelian randomization estimates for genetically predicted morning person and evening person with adjustment for other confounders.
- eTable 17.** Mendelian randomization estimates for genetically predicted short sleep duration and long sleep duration with adjustment for other confounders.
- eTable 18.** Mendelian randomization estimates for genetically predicted insomnia with adjustment for other sleep traits confounders.
- eTable 19.** Mendelian randomization estimates for genetically predicted short sleep duration and long sleep duration with adjustment for other confounders after excluding the disturbed participants.
- eTable 20.** Mendelian randomization estimates for genetically predicted insomnia with adjustment for other confounders after excluding the disturbed participants.
- eTable 21.** Non-linear Mendelian randomization results between genetically predicted continuous sleep durations and pan-cancer incidence and mortality among cancer patients using piecewise linear method.

eTable 22. Non-linear Mendelian randomization results between genetically predicted continuous sleep durations and pan-cancer incidence and mortality among cancer patients using piecewise linear method (participants with insomnia symptoms were excluded).

eTable 23. Analysis for mortality of cancer associated with sleep traits.

eTable 24. The analysis of cumulative hazard and survival probability of sleep traits on overall cancer patients in 5 years (non-cancer deaths were excluded) among the UKB cohort.

eTable 25. The analysis of cumulative hazard and survival probability of sleep traits on overall cancer patients (non-cancer deaths were excluded) in the UKB cohort.

eTable 26. Multivariable Cox regression analysis for pan-cancer incidence and mortality associated with sleep traits among cancer patients after removing participants who reported currently working night shifts.

eTable 27. Scatter plot of individual SNP-sleep traits and SNP effect on pan-cancer incidence associations with overlay of causal estimate from each MR test using.

eTable 28. Scatter plot of individual SNP-sleep traits and SNP effect on all-cause mortality of cancer patient associations with overlay of causal estimate from each MR test using.

eTable 29. Scatter plot of individual SNP-sleep traits and SNP effect on 5-year cancer mortality of cancer patient associations with overlay of causal estimate from each MR test using.

eTable 30. Scatter plot of individual SNP-sleep traits and SNP effect on cancer mortality of cancer patient associations with overlay of causal estimate from each MR test using.

eTable 31. Radial MR plots for sleep traits in pan-cancer incidence.

eTable 32. Radial MR plots for sleep traits in all-cause mortality of cancer patients.

eTable 33. Radial MR plots for sleep traits in 5-year cancer mortality among cancer patients.

eTable 34. Radial MR plots for sleep traits in 5-year cancer mortality among cancer patients.

eTable 35. Associations of outlying SNPs for definite morning chronotype in several diseases identified from radial curves with other traits using a phenome-wide association study approach.

eTable 36. Sensitivity analysis for morning/evening chronotype and pan-cancer incidence and all-cause mortality of cancer patients using the Weighted median and MR-Egger methods.

eTable 37. Sensitivity analysis for short/long sleep duration and pan-cancer incidence and all-cause mortality of cancer patients using the Weighted median and MR-Egger methods.

eTable 38. Sensitivity analysis for insomnia and pan-cancer incidence and all-cause mortality of cancer patients using the

eTable 1. The descriptions and sources of selected covariates, genotyping process and sample quality control in UK Biobank.

Field ID	Description	Category
31	Sex	Baseline characteristics
21022	Age at recruitment	Baseline characteristics
21001	Body mass index (BMI)	Body size measures
189	Townsend deprivation index at recruitment	Baseline characteristics
2100	Seen a psychiatrist for nerves, anxiety, tension or depression	Mental health
20116	Smoking status	Smoking
6142	Current employment status	Employment
3426	Job involves night shift work	Employment
826	Job involves shift work	Employment
20117	Alcohol drinker status	Alcohol
1180	Morning/evening person (chronotype)	Sleep
1160	Sleep duration	Sleep
1200	Insomnia	Sleep
191	Date lost to follow-up	Ongoing characteristics
53	Date of attending assessment centre	Reception
54	UK Biobank assessment centre	Reception
22027	Outliers for heterozygosity or missing rate	Genotyping process and sample QC
22019	Sex chromosome aneuploidy	Genotyping process and sample QC
22021	Genetic kinship to other participants	Genotyping process and sample QC
22009	Genetic principal components	Genotyping process and sample QC

eTable 2. The descriptions and sources of information for outcomes in UK Biobank.

Field ID	Description	Category
84	Cancer year/age first occurred	Medical conditions
40005	Date of cancer diagnosis	Cancer register
40006	Type of cancer: ICD10	Cancer register
	Overall cancer (The definition of total cancer excludes in situ, benign, uncertain, or non-well-defined cancers; ICD-10 code: C0, C1, C2, C3, C4, C5, C6, C70, C71, C72, C73, C74, C75, C76, C8, C9)	
40008	Age at cancer diagnosis	Cancer register
40000	Date of death	Death register
40001	Underlying (primary) cause of death: ICD10	Death register
40023	Records in death dataset	Death register

ICD: International Classification of Disease

eTable 3. 118 single-nucleotide polymorphisms list of morning person identified in UK Biobank.

SNP	EA	NEA	EA_Freq	Beta	P	N
rs1989147	T	C	0.1824	0.0812	9.65E-25	248094
rs10927823	G	A	0.3305	-0.0374	1.98E-08	248094
rs10917509	T	C	0.3655	0.0358	1.47E-08	248094
rs12752290	C	T	0.5529	-0.0383	7.12E-10	248094
rs12140153	G	T	0.0783	-0.0675	2.66E-08	248094
rs12040629	A	G	0.1588	0.0835	5.04E-24	248094
rs1335720	A	G	0.759	0.0400	1.79E-08	248094
rs12032173	G	T	0.1971	-0.0431	3.05E-08	248094
rs9436119	A	G	0.365	0.0525	3.55E-16	248094
rs1144566	T	C	0.0268	0.3121	1.76E-62	248094
rs7522067	G	A	0.3578	-0.0428	1.21E-11	248094
rs7581403	C	T	0.3108	-0.0364	3.76E-08	248094
rs62124718	G	A	0.8973	-0.0569	1.86E-08	248094
rs905667	G	A	0.4928	-0.0375	1.51E-09	248094
rs1504155	C	A	0.4976	-0.0359	3.09E-09	248094
rs112067664	T	G	0.0975	0.0695	1.53E-11	248094
rs78986478	G	C	0.9026	-0.0692	1.58E-11	248094
rs1160648	C	T	0.4138	-0.0338	4.39E-08	248094
rs359246	G	A	0.4848	-0.0376	6.37E-10	248094
rs10201530	T	C	0.5789	0.0401	6.50E-11	248094
rs34509802	A	G	0.1784	0.0506	5.00E-10	248094
rs35125029	G	A	0.3697	-0.0537	1.43E-17	248094
rs6433478	C	T	0.4698	-0.0353	1.29E-08	248094
rs13427590	T	C	0.4857	0.0676	1.16E-28	248094
rs4416211	T	A	0.4925	-0.0346	1.41E-08	248094
rs113223463	C	T	0.1051	-0.0962	1.07E-21	248094
rs55886641	T	C	0.8903	0.0923	3.20E-21	248094
rs62260792	A	G	0.0766	0.0725	2.34E-10	248094
rs82825	A	G	0.8276	0.0475	3.61E-09	248094
rs7626335	C	A	0.3307	-0.0411	2.02E-10	248094
rs4077419	C	A	0.5601	-0.0469	4.86E-14	248094
rs56242353	T	G	0.12	0.0655	5.96E-12	248094
rs1449403	A	G	0.12	0.0545	6.02E-09	248094
rs9290069	G	A	0.5098	-0.0381	3.54E-10	248094
rs3850174	T	A	0.2581	-0.0386	4.55E-08	248094
rs9863471	G	C	0.7514	-0.0400	1.44E-08	248094
rs1488137	G	T	0.5275	-0.0407	2.31E-11	248094
rs4698679	C	T	0.7282	-0.0379	3.68E-08	248094
rs4579124	A	G	0.7313	0.0403	3.90E-09	248094
rs876684	C	A	0.371	-0.0386	9.96E-10	248094
rs11731618	G	T	0.8107	-0.0456	3.09E-09	248094
rs35166798	A	G	0.8841	0.0527	3.45E-08	248094

rs893191	T	A	0.6015	-0.0354	1.34E-08	248094
rs780405	G	A	0.2491	-0.0473	1.78E-11	248094
rs12514961	C	T	0.6387	-0.0360	1.76E-08	248094
rs1998528	A	G	0.3499	0.0370	5.64E-09	248094
rs62385532	A	G	0.2881	0.0709	6.71E-26	248094
rs766406	G	T	0.6536	-0.0343	7.06E-08	248094
rs2653349	A	G	0.1941	0.0738	5.40E-22	248094
rs1931805	T	C	0.4966	0.0321	1.30E-07	248094
rs12195792	A	T	0.278	0.0471	3.77E-12	248094
rs76223855	C	T	0.9857	-0.2708	4.50E-23	248094
rs10237162	T	C	0.719	0.0495	2.53E-13	248094
rs1450870	C	T	0.3849	-0.0375	1.75E-09	248094
rs6969081	A	T	0.6235	0.0462	1.60E-13	248094
rs10258689	G	A	0.1969	-0.0764	1.66E-23	248094
rs56269620	G	A	0.6423	-0.0512	5.24E-16	248094
rs184416329	T	C	0.2014	0.0416	4.91E-08	248094
rs73208648	T	G	0.2016	0.0414	6.08E-08	248094
rs6968240	A	C	0.3957	0.0331	1.65E-07	248094
rs4129572	C	T	0.407	-0.0354	1.08E-08	248094
rs7463166	G	A	0.6355	-0.0471	8.25E-14	248094
rs35231275	T	A	0.3249	-0.0375	3.97E-08	248094
rs2736304	C	T	0.4575	-0.0354	6.17E-09	248094
rs16878810	C	G	0.7056	0.0383	9.83E-09	248094
rs7842982	G	T	0.6186	-0.0382	1.38E-09	248094
rs62501026	C	T	0.8461	-0.0609	4.95E-13	248094
rs13251387	G	A	0.3988	-0.0345	2.79E-08	248094
rs72673538	C	G	0.2848	0.0501	1.32E-13	248094
rs148724076	T	A	0.829	-0.0448	3.23E-08	248094
rs4279559	G	A	0.8292	-0.0442	3.76E-08	248094
rs11787046	T	A	0.7197	-0.0389	2.57E-08	248094
rs73581580	G	A	0.1208	-0.0733	3.29E-12	234925
rs4948548	G	A	0.7296	-0.0440	1.17E-10	248094
rs1351525	A	T	0.2965	0.0435	6.99E-11	248094
rs10742179	A	G	0.2673	0.0385	2.12E-08	248094
rs1222208	A	C	0.7849	0.0403	4.63E-08	248094
rs1402954	T	C	0.0991	0.0791	8.32E-15	248094
rs10838193	G	A	0.3273	-0.0352	4.83E-08	248094
rs11039155	G	A	0.1409	-0.0564	1.52E-10	248094
rs3107024	C	T	0.403	-0.0375	1.54E-09	248094
rs1278402	A	G	0.7416	0.0380	3.88E-08	248094
rs12786007	G	A	0.6965	-0.0419	2.09E-10	248094
rs627858	G	A	0.6796	-0.0369	1.19E-08	248094
rs12310956	A	G	0.6239	0.0571	1.25E-19	248094
rs6582579	T	A	0.4797	-0.0604	4.74E-23	248094

rs1650008	G	A	0.4775	-0.0376	1.04E-09	248094
rs10877962	T	C	0.3972	0.0494	2.74E-15	248094
rs10778534	C	T	0.626	-0.0381	1.31E-09	248094
rs1697497	G	T	0.2089	-0.0410	4.41E-08	248094
rs4445791	A	G	0.5023	0.0374	9.04E-10	248094
rs1407571	A	T	0.6743	0.0362	2.48E-08	248094
rs9573980	A	G	0.9652	0.1498	6.99E-19	248094
rs1890256	T	C	0.2554	0.0407	5.21E-09	248094
rs11158627	T	C	0.6399	0.0371	4.46E-09	248094
rs10851460	A	G	0.2421	0.0405	1.20E-08	248094
rs7174381	C	A	0.7095	-0.0375	4.34E-08	248094
rs1873958	A	G	0.4121	0.0414	2.27E-11	248094
rs12927162	A	G	0.7386	0.0656	1.76E-21	248094
rs55872725	T	C	0.4128	0.0440	8.80E-13	248094
rs2398144	C	A	0.4051	-0.0414	1.82E-11	248094
rs1013982	A	G	0.6404	0.0375	6.13E-09	248094
rs35712131	C	T	0.4485	-0.0340	3.60E-08	248094
rs1061032	T	G	0.1039	0.0647	1.89E-10	248094
rs11545787	G	A	0.2441	-0.0705	2.78E-22	248094
rs11650615	G	C	0.7147	-0.0395	4.20E-09	248094
rs10853329	T	C	0.3062	0.0450	1.18E-10	248094
rs1788784	G	A	0.3446	-0.0427	2.69E-11	248094
rs4419127	A	G	0.657	0.0600	6.23E-21	248094
rs203179	C	T	0.5477	-0.0366	1.81E-09	248094
rs4800994	T	C	0.179	0.0582	3.82E-13	248094
rs9964420	C	A	0.2871	-0.0640	7.78E-21	248094
rs2425674	C	G	0.4273	0.0335	4.88E-08	248094
rs133075	T	G	0.5634	0.0364	3.10E-09	248094
rs3747463	C	T	0.3609	-0.0316	1.08E-09	248094
rs213462	C	A	0.55	-0.0363	1.08E-12	248094
rs7060620	T	A	0.8143	-0.0449	2.92E-12	248094
rs727656	A	G	0.6256	0.0282	3.94E-08	248094

SNP, single-nucleotide polymorphisms; Chr, chromosome; EA, effect allele; NEA, non-effect allele; EA_freq, effect allele frequency.

eTable 4. 12 single-nucleotide polymorphisms list of evening person identified in UK Biobank.

SNP	EA	NEA	EA_freq	Beta	P-value	N
rs141175086	C	T	0.998	0.64933	1.65E-05	73,778
rs2050122	C	T	0.804	0.03342	4.12E-04	73,778
rs76681500	G	A	0.841	0.04139	3.07E-05	73,778
rs10157197	A	G	0.398	0.04532	2.33E-10	73,778
rs1144566	C	T	0.970	0.06446	3.58E-03	73,778
rs11895698	T	C	0.143	0.02119	1.53E-02	73,778
rs11708779	G	A	0.648	0.01703	2.01E-02	73,778
rs148750727	T	G	0.995	0.27416	1.40E-05	73,778
rs372229746	A	G	0.448	0.02531	3.24E-03	73,778
rs17311976	C	T	0.193	0.03342	9.49E-05	73,778
rs542675489	C	CA	0.596	0.01284	7.66E-02	73,778
rs4821940	C	T	0.552	0.01284	1.02E-01	73,779

SNP, single-nucleotide polymorphisms; Chr, chromosome; EA, effect allele; NEA, non-effect allele; EA_freq, effect allele frequency.

eTable 5. 27 single-nucleotide polymorphisms list of short sleep duration identified in UK Biobank.

SNP	EA	NEA	EA_freq	Beta	P-value	N
rs11763750	G	A	0.814346	0.035	5.10E-09	411,934
rs1229762	T	C	0.664501	0.037	1.00E-12	411,934
rs12518468	C	T	0.328456	0.031	8.50E-09	411,934
rs12567114	G	A	0.7246	0.036	4.10E-09	411,934
rs12661667	T	C	0.263495	0.028	2.80E-08	411,934
rs12963463	C	T	0.299425	0.029	1.90E-11	411,934
rs13107325	T	C	0.074528	0.075	2.50E-13	411,934
rs1380703	G	A	0.383531	0.035	1.60E-11	411,934
rs142180737	C	T	0.009491	0.154	4.40E-09	411,934
rs1607227	G	T	0.704938	0.031	1.50E-09	411,934
rs17005118	A	G	0.264936	0.03	2.50E-09	411,934
rs17388803	C	A	0.105648	0.053	6.50E-10	411,934
rs2014830	C	T	0.698128	0.03	2.70E-08	411,934
rs205024	C	T	0.616724	0.031	2.70E-08	411,934
rs2186122	T	A	0.561566	0.024	4.80E-09	411,934
rs2820313	G	A	0.341112	0.031	2.30E-09	411,934
rs2863957	C	A	0.781508	0.054	2.60E-18	411,934
rs3776864	A	C	0.66721	0.031	1.70E-08	411,934
rs4585442	G	A	0.311023	0.031	8.10E-10	411,934
rs5757675	G	T	0.259528	0.034	2.70E-09	411,934
rs59779556	T	G	0.553827	0.025	2.00E-08	411,934
rs60882754	A	T	0.938985	0.055	1.80E-08	411,934
rs7524118	C	T	0.708376	0.03	4.90E-08	411,934
rs75539574	A	C	0.914664	0.045	8.40E-11	411,934
rs7939345	T	G	0.207569	0.035	4.00E-08	411,934
rs9321171	C	T	0.540122	0.031	4.20E-08	411,934
rs9367621	T	A	0.43104	0.024	1.60E-08	411,934

SNP, single-nucleotide polymorphisms; SE, standard error; EA, effect allele; NEA, non-effect allele; EA_freq, effect allele frequency.

eTable 6. 8 single-nucleotide polymorphisms list of long sleep duration identified in UK Biobank.

SNP	EA	NEA	EA_freq	Beta	P-value	N
rs10899257	A	G	0.144473	0.067659	4.60E-08	339,926
rs17688916	T	A	0.796267	0.07139	1.10E-11	339,926
rs17817288	A	G	0.518127	0.039221	8.90E-09	339,926
rs3751046	G	A	0.147342	0.069526	2.00E-08	339,926
rs549961083	T	C	0.001432	0.533565	9.60E-09	339,926
rs6737318	G	A	0.221841	0.076035	3.40E-13	339,926
rs7534398	A	T	0.201382	0.046884	2.10E-08	339,926
rs75458655	T	C	0.022973	0.184818	5.40E-12	339,926

SNP, single-nucleotide polymorphisms; SE, standard error; EA, effect allele; NEA, non-effect allele; EA_freq, effect allele frequency.

eTable 7. 78 single-nucleotide polymorphisms list of continuous sleep duration identified in UK Biobank.

SNP	EA	NEA	EA_freq	Beta	P-value	N
rs10173260	C	T	0.606235	0.77	2.90E-08	446,118
rs10421649	A	T	0.55697	0.798	6.90E-09	446,118
rs10483350	G	A	0.195418	1.042	1.50E-09	446,118
rs1057703	G	T	0.146608	1.164	1.10E-09	446,118
rs10761674	C	T	0.477334	0.74	4.20E-08	446,118
rs10973207	T	G	0.157677	1.226	6.00E-11	446,118
rs11190970	G	A	0.798661	0.923	4.60E-08	446,118
rs112230981	A	G	0.94984	1.892	2.20E-09	446,118
rs113113059	T	C	0.78	0.968	8.40E-09	446,118
rs11567976	T	C	0.570908	0.768	2.10E-08	446,118
rs11602180	C	T	0.836621	1.095	2.30E-09	446,118
rs11614986	A	G	0.820952	0.983	2.70E-08	446,118
rs11621908	C	T	0.917141	1.446	5.60E-09	446,118
rs11643715	G	C	0.290942	0.834	3.20E-08	446,118
rs11885663	T	C	0.247809	0.973	8.60E-10	446,118
rs12246842	A	G	0.459815	0.804	3.90E-09	446,118
rs12567114	A	G	0.275802	0.89	4.30E-09	446,118
rs12607679	T	C	0.737717	1.208	8.30E-15	446,118
rs12611523	A	G	0.545244	0.758	3.10E-08	446,118
rs1263056	A	G	0.519099	0.768	2.00E-08	446,118
rs12791153	T	A	0.081089	1.413	1.90E-08	446,118
rs13088093	G	T	0.336317	0.976	7.00E-12	446,118
rs13109404	T	G	0.928024	1.872	1.40E-12	446,118
rs151014368	A	G	0.206258	0.966	9.10E-09	446,118
rs1517572	C	A	0.580536	0.879	1.50E-10	446,118
rs1553132	G	A	0.258433	0.87	2.50E-08	446,118
rs17427571	A	G	0.684313	0.83	1.30E-08	446,118
rs174560	C	T	0.314215	0.815	2.80E-08	446,118
rs17732997	C	G	0.569098	0.776	1.20E-08	446,118
rs1776776	T	C	0.873832	1.198	4.90E-09	446,118
rs180769	T	C	0.424698	0.763	2.30E-08	446,118
rs1939455	G	T	0.879446	1.226	1.20E-08	446,118
rs1991556	G	A	0.773765	0.994	1.00E-09	446,118
rs205024	T	C	0.383735	0.83	3.90E-09	446,118
rs2072727	T	C	0.43617	0.795	7.90E-09	446,118
rs2079070	C	G	0.264613	1.053	7.50E-12	446,118

rs2139261	G	C	0.748584	1.122	8.50E-11	446,118
rs2192528	A	G	0.480065	0.802	2.70E-09	446,118
rs2231265	G	A	0.772289	0.897	2.70E-08	446,118
rs269054	A	T	0.422076	0.819	2.10E-09	446,118
rs3095508	C	A	0.593529	0.921	3.10E-11	446,118
rs330088	C	T	0.547012	0.868	2.70E-10	446,118
rs34354917	C	A	0.710472	0.825	3.90E-08	446,118
rs34556183	A	G	0.719606	1.015	2.30E-11	446,118
rs34731055	T	C	0.18089	1.168	3.70E-11	446,118
rs35531607	C	T	0.474083	0.77	1.50E-08	446,118
rs365663	A	G	0.545963	0.878	1.00E-10	446,118
rs374153	C	T	0.158085	1.057	9.10E-09	446,118
rs4128364	C	T	0.339025	0.876	1.40E-09	446,118
rs4538155	T	C	0.647426	0.779	3.60E-08	446,118
rs4592416	G	A	0.464407	0.881	9.30E-11	446,118
rs460692	C	T	0.137484	1.263	3.60E-10	446,118
rs4767550	G	A	0.414138	0.858	6.30E-10	446,118
rs55658675	C	T	0.644938	0.788	2.00E-08	446,118
rs56372231	T	C	0.334093	1.017	2.20E-12	446,118
rs61796569	T	C	0.269583	0.927	1.50E-09	446,118
rs61985058	T	C	0.143176	1.116	1.30E-08	446,118
rs62120041	T	C	0.933902	1.567	9.60E-09	446,118
rs6575005	T	C	0.757854	0.934	4.40E-09	446,118
rs7115226	A	C	0.073525	1.594	1.70E-09	446,118
rs72804080	G	A	0.149928	1.068	2.90E-08	446,118
rs73219758	G	A	0.708064	0.984	5.60E-11	446,118
rs7503199	C	T	0.734267	0.885	1.00E-08	446,118
rs75539574	C	A	0.085792	2.175	6.90E-19	446,118
rs7556815	A	G	0.219144	2.443	1.30E-49	446,118
rs7616632	T	G	0.522135	0.792	4.30E-09	446,118
rs7644809	T	C	0.421606	0.784	1.60E-08	446,118
rs7806045	T	C	0.754703	0.887	1.40E-08	446,118
rs7915425	T	C	0.174682	1.144	2.00E-10	446,118
rs7951019	G	T	0.032227	2.213	1.20E-08	446,118
rs80193650	G	A	0.162466	1.01	4.10E-08	446,118
rs8038326	A	G	0.72691	0.955	2.80E-10	446,118
rs8050478	G	A	0.500253	0.96	1.70E-12	446,118
rs915416	C	G	0.289947	1.156	9.90E-15	446,118

rs9345234	C	A	0.578016	0.781	1.80E-08	446,118
rs9382445	T	C	0.62305	0.872	4.80E-10	446,118
rs9903973	C	T	0.46702	0.766	2.60E-08	446,118
rs9940646	C	G	0.577569	1.017	1.20E-13	446,118

SNP, single-nucleotide polymorphisms; SE, standard error; EA, effect allele; NEA, non-effect allele; EA_freq, effect allele frequency.

eTable 8. 57 single-nucleotide polymorphisms list of insomnia identified in UK Biobank.

SNP	EA	NEA	EA_freq	Beta	p-value	N
rs11184946	T	C	0.417	0.01284	2.90E-10	237,627
rs6664467	G	A	0.863	0.02119	4.50E-08	237,627
rs4751	T	G	0.425	0.01284	1.60E-08	237,627
rs2644128	G	C	0.550	0.01703	1.00E-12	237,627
rs12405761	A	C	0.571	0.01703	2.60E-11	237,627
rs2613503	A	C	0.802	0.01703	2.80E-07	237,627
rs11804386	A	G	0.332	0.01703	2.60E-08	237,627
rs62158170	A	G	0.784	0.02119	5.70E-13	237,627
rs4577309	A	G	0.468	0.01284	3.70E-09	237,627
rs12713372	C	T	0.566	0.00860	1.20E-05	237,627
rs35881094	G	T	0.426	0.02119	3.00E-15	237,627
rs2192338	C	G	0.780	0.02119	1.20E-07	237,627
rs113851554	T	G	0.058	0.07918	1.30E-41	237,627
rs72826719	A	G	0.049	0.04139	2.20E-12	237,627
rs9845387	C	A	0.959	0.04139	2.10E-08	237,627
rs6785034	A	G	0.422	0.01284	9.60E-05	237,627
rs4683301	T	A	0.600	0.01703	4.60E-08	237,627
rs10865954	T	C	0.334	0.01703	1.70E-09	237,627
rs4688760	T	C	0.690	0.02119	1.00E-12	237,627
rs55946513	C	T	0.934	0.02119	7.30E-06	237,627
rs11097861	G	A	0.715	0.01703	1.70E-09	237,627
rs1841625	G	A	0.432	0.01284	3.60E-08	237,627
rs28061	A	G	0.692	0.01703	2.10E-08	237,627
rs1592757	C	G	0.357	0.01703	4.60E-10	237,627
rs7711696	T	G	0.305	0.02119	9.90E-12	237,627
rs1430205	T	C	0.458	0.01284	3.60E-08	237,627
rs6932158	C	T	0.491	0.01284	2.80E-08	237,627
rs314280	G	A	0.548	0.01703	3.50E-10	237,627
rs10947690	G	A	0.261	0.01703	3.50E-08	237,627
rs3824081	T	C	0.475	0.01703	1.10E-08	237,627
rs10280045	G	C	0.574	0.01703	1.00E-10	237,627
rs302165	G	A	0.216	0.01703	2.40E-06	237,627
rs6593005	G	A	0.741	0.01284	8.60E-09	237,627
rs17151854	T	G	0.154	0.02531	2.40E-08	237,627
rs11793831	G	T	0.583	0.01703	1.50E-06	237,627
rs11793074	A	G	0.853	0.01703	2.30E-07	237,627
rs10156602	A	G	0.638	0.01703	3.40E-12	237,627
rs2296580	G	T	0.702	0.02119	8.70E-12	237,627
rs11191595	A	C	0.937	0.04139	1.50E-09	237,627
rs10838708	G	A	0.541	0.01284	2.50E-09	237,627

rs68094047	T	C	0.250	0.01703	3.30E-09	237,627
rs324017	A	C	0.295	0.02119	1.10E-10	237,627
rs2956278	G	A	0.215	0.02119	1.30E-08	237,627
rs2147141	G	C	0.543	0.01703	8.20E-08	237,627
rs1923770	T	A	0.383	0.02119	2.30E-12	237,627
rs1031654	C	A	0.202	0.02119	2.00E-09	237,627
rs4886140	G	A	0.668	0.01703	3.10E-10	237,627
rs11635495	C	T	0.515	0.01703	6.80E-09	237,627
rs4886860	G	C	0.234	0.02119	6.10E-12	237,627
rs1544637	T	C	0.488	0.01284	3.00E-08	237,627
rs3104778	A	G	0.589	0.01284	4.20E-08	237,627
rs2062113	T	C	0.430	0.01703	1.90E-10	237,627
rs17139246	C	T	0.389	0.01284	4.10E-08	237,627
rs17669584	G	A	0.195	0.01703	3.60E-08	237,627
rs11651809	G	C	0.296	0.02119	2.10E-15	237,627
rs1942262	A	G	0.292	0.01703	1.10E-13	237,627
rs11673344	G	A	0.380	0.01703	9.00E-10	237,627

SNP, single-nucleotide polymorphisms; SE, standard error; EA, effect allele; NEA, non-effect allele; EA_freq, effect allele frequency.

eTable 9. Multivariable Cox regression analysis for the pan-cancer incidence associated with sleep traits.

Sleep traits	Basic model#		Fully adjusted model*		Additional adjusted model§	
	Hazard ratio (95%)	P value	Hazard ratio (95%)	P value	Hazard ratio (95%)	P value
Chronotype						
Definite morning	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
More morning	1.00 (0.98-1.02)	0.94	1.00 (0.98-1.02)	0.93	1.00 (0.98-1.02)	0.81
More evening	1.01 (0.99-1.03)	0.42	1.00 (0.97-1.02)	0.88	1.00 (0.97-1.02)	0.76
Definite evening	1.06 (1.03-1.10)	<0.001	1.04 (1.00-1.07)	0.03	1.03 (1.00-1.07)	0.05
Sleep duration						
Normal (6-8 h)	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
Extreme short (≤ 4)	0.95 (0.87-1.03)	0.23	0.94 (0.87-1.02)	0.16	0.93 (0.85-1.02)	0.10
Shorter (5 h)	0.97 (0.94-1.02)	0.23	0.97 (0.93-1.01)	0.15	0.96 (0.91-1.00)	0.05
Longer (9 h)	1.05 (1.01-1.08)	0.008	1.04 (1.01-1.08)	0.02	1.04 (1.01-1.08)	0.02
Extreme long (≥ 10 h)	1.09 (1.03-1.16)	0.004	1.07 (1.01-1.14)	0.02	1.08 (1.01-1.14)	0.02
Insomnia symptom						
Never	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
sometimes	1.01 (0.99-1.03)	0.23	1.01 (0.99-1.03)	0.34	1.01 (0.99-1.03)	0.37
Usually	1.03 (1.01-1.06)	0.01	1.03 (1.00-1.05)	0.03	1.03 (1.01-1.06)	0.01

Basic model: Adjusted for age, sex, assessment centre, top 10 genetic principal components and genotyping array.

* Fully adjusted model: Adjusted for age, sex, assessment centre, top 10 genetic principal components, genotyping array, body mass index, employment status, Townsend deprivation index, smoking status, drinking status and mental health issue.

§ Additional adjusted model: Adjusted for age, sex, assessment centre, top 10 genetic principal components, genotyping array, body mass index, employment status, Townsend deprivation index, smoking status, drinking status, mental health issue and other sleep traits.

Statistical significance was defined as $P < 0.05$.

eTable 10. Multivariable Cox regression analysis for the all-cause mortality among cancer patients associated with sleep traits.

Sleep traits	Basic model#		Fully adjusted model*		Additional adjusted model§	
	Hazard ratio (95%)	P value	Hazard ratio (95%)	P value	Hazard ratio (95%)	P value
Chronotype						
Definite morning	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
More morning	0.93 (0.89-0.98)	0.003	0.96 (0.91-1.00)	0.05	0.96 (0.92-1.00)	0.07
More evening	1.02 (0.97-1.07)	0.37	0.99 (0.94-1.03)	0.54	0.99 (0.94-1.04)	0.70
Definite evening	1.20 (1.12-1.28)	<0.001	1.07 (1.00-1.14)	0.06	1.07 (1.00-1.14)	0.05
Sleep duration						
Normal (6-8 h)	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
Extreme short (≤ 4)	1.61 (1.40-1.86)	<0.001	1.24 (1.07-1.43)	0.004	1.25 (1.07-1.46)	0.005
Shorter (5 h)	1.37 (1.27-1.48)	<0.001	1.23 (1.14-1.33)	<0.001	1.19 (1.10-1.30)	<0.001
Longer (9 h)	1.14 (1.07-1.22)	<0.001	1.04 (0.97-1.11)	0.23	1.03 (0.96-1.11)	0.35
Extreme long (≥ 10 h)	1.71 (1.55-1.88)	<0.001	1.37 (1.24-1.52)	<0.001	1.37 (1.23-1.52)	<0.001
Insomnia symptom						
Never	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
sometimes	1.06 (1.01-1.10)	0.02	1.03 (0.98-1.07)	0.22	1.04 (0.99-1.09)	0.13
Usually	1.17 (1.11-1.23)	<0.001	1.07 (1.02-1.12)	0.002	1.06 (1.00-1.11)	0.05

Basic model: Adjusted for age, sex, assessment centre, top 10 genetic principal components and genotyping array.

* Fully adjusted model: Adjusted for age, sex, assessment centre, top 10 genetic principal components, genotyping array, body mass index, employment status, Townsend deprivation index, smoking status, drinking status and mental health issue.

§ Additional adjusted model: Adjusted for age, sex, assessment centre, top 10 genetic principal components, genotyping array, body mass index, employment status, Townsend deprivation index, smoking status, drinking status, mental health issue and other sleep traits.

Statistical significance was defined as $P < 0.05$.

eTable 11. Multivariable Cox regression analysis for the cancer mortality associated with sleep traits among cancer patients during the follow-up years.

Sleep traits	Basic model [#]		Fully adjusted model [*]		Additional adjusted model [§]	
	Hazard ratio (95%)	P value	Hazard ratio (95%)	P value	Hazard ratio (95%)	P value
Chronotype						
Definite morning	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
More morning	0.95 (0.90-1.00)	0.07	0.97 (0.91-1.02)	0.22	0.97 (0.91-1.02)	0.25
More evening	1.03 (0.97-1.09)	0.38	0.99 (0.93-1.05)	0.76	1.00 (0.94-1.06)	0.93
Definite evening	1.19 (1.10-1.29)	<0.001	1.07 (0.99-1.16)	0.10	1.07 (0.99-1.17)	0.09
Sleep duration						
Normal (6-8 h)	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
Short (< 6 h)						
Extreme short (≤4)	1.54 (1.29-1.85)	<0.001	1.24 (1.03-1.49)	0.02	1.24 (1.02-1.52)	0.03
Shorter (5 h)	1.32 (1.20-1.45)	<0.001	1.21 (1.10-1.33)	<0.001	1.19 (1.07-1.32)	0.001
Long (> 8 h)						
Longer (9 h)	1.11 (1.02-1.20)	0.01	1.03 (0.95-1.11)	0.55	1.02 (0.94-1.12)	0.60
Extreme long (≥10 h)	1.56 (1.37-1.77)	<0.001	1.29 (1.14-1.47)	<0.001	1.31 (1.14-1.50)	<0.001
Insomnia						
Never	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
sometimes	1.05 (1.00-1.11)	0.07	1.03 (0.98-1.09)	0.28	1.05 (0.99-1.11)	0.11
Usually	1.14 (1.07-1.21)	<0.001	1.06 (1.00-1.12)	0.05	1.05 (0.99-1.12)	0.11

[#] Basic model: Adjusted for age, sex, assessment centre, top 10 genetic principal components and genotyping array.

^{*} Fully adjusted model: Adjusted for age, sex, assessment centre, top 10 genetic principal components, genotyping array, body mass index, employment status, Townsend deprivation index, smoking status, drinking status and mental health issue.

[§] Additional adjusted model: Adjusted for age, sex, assessment centre, top 10 genetic principal components, genotyping array, body mass index, employment status, Townsend deprivation index, smoking status, drinking status, mental health issue and other sleep traits.

Statistical significance was defined as $P < 0.05$.

eTable 12. Multivariable Cox regression analysis for the cancer mortality among cancer patients associated with sleep traits in the 5 years.

Sleep traits	Basic model [#]		Fully adjusted model [*]		Additional adjusted model [§]	
	Hazard ratio (95%)	P value	Hazard ratio (95%)	P value	Hazard ratio (95%)	P value
Chronotype						
Definite morning	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
More morning	0.96 (0.90-1.02)	0.21	0.99 (0.92-1.05)	0.67	0.99 (0.93-1.05)	0.72
More evening	1.06 (0.99-1.13)	0.09	1.03 (0.96-1.10)	0.43	1.04 (0.97-1.11)	0.30
Definite evening	1.18 (1.07-1.30)	<0.001	1.07 (0.98-1.18)	0.14	1.07 (0.98-1.18)	0.14
Sleep duration						
Normal (6-8 h)	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
Short (< 6 h)						
Extreme short (≤4)	1.70 (1.39-2.08)	<0.001	1.35 (1.10-1.66)	0.004	1.36 (1.09-1.69)	0.007
Shorter (5 h)	1.28 (1.15-1.43)	<0.001	1.18 (1.06-1.32)	0.003	1.18 (1.05-1.33)	0.006
Long (> 8 h)						
Longer (9 h)	1.08 (0.99-1.19)	0.10	1.02 (0.93-1.12)	0.69	1.02 (0.92-1.13)	0.71
Extreme long (≥10 h)	1.55 (1.34-1.78)	<0.001	1.34 (1.16-1.55)	<0.001	1.36 (1.17-1.59)	<0.001
Insomnia						
Never	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
sometimes	1.02 (0.95-1.08)	0.64	1.00 (0.94-1.06)	0.98	1.02 (0.95-1.09)	0.58
Usually	1.12 (1.05-1.20)	0.001	1.05 (0.98-1.13)	0.14	1.05 (0.97-1.13)	0.21

[#] Basic model: Adjusted for age, sex, assessment centre, top 10 genetic principal components and genotyping array.

^{*} Fully adjusted model: Adjusted for age, sex, assessment centre, top 10 genetic principal components, genotyping array, body mass index, employment status, Townsend deprivation index, smoking status, drinking status and mental health issue.

[§] Additional adjusted model: Adjusted for age, sex, assessment centre, top 10 genetic principal components, genotyping array, body mass index, employment status, Townsend deprivation index, smoking status, drinking status, mental health issue and other sleep traits.

Statistical significance was defined as $P < 0.05$.

eTable 13. Associations between morning/evening person unweighted GRS and potential confounders in UK Biobank.

Instrument	Confounder	Coefficients	SE	N	P value
Morning person					
Morning person scores	Sex	-0.022	0.024	377,364	0.3630
Morning person scores	Age	0.002	0.002	377,364	0.2881
Morning person scores	Townsend deprivation index	-0.005	0.004	377,364	0.2046
Morning person scores	Mental health issues	0.044	0.037	377,364	0.2334
Morning person scores	Body mass index	-0.010	0.002	377,364	<1.0E-04*
Morning person scores	Previous smoking	-0.004	0.026	377,364	0.8820
Morning person scores	Current smoking	0.007	0.040	377,364	0.8692
Morning person scores	Shift work	-0.016	0.054	377,364	0.7658
Morning person scores	Night shift work	0.023	0.054	377,364	0.6751
Morning person scores	Previous alcohol drinker	-0.006	0.086	377,364	0.9462
Morning person scores	Current alcohol drinker	0.029	0.061	377,364	0.6343
Morning person scores	Short sleep duration	-0.026	0.059	377,364	0.6559
Morning person scores	Long sleep duration	0.008	0.050	377,364	0.8664
Morning person scores	Sometimes insomnia symptom	-0.007	0.029	377,364	0.8112
Morning person scores	Usually insomnia symptom	0.053	0.033	377,364	0.1104
Evening person					
Evening person scores	Sex	0.000	0.006	377,364	0.9880
Evening person scores	Age	0.000	0.000	377,364	0.5911
Evening person scores	Townsend deprivation index	0.002	0.001	377,364	0.0308
Evening person scores	Mental health issues	-0.003	0.009	377,364	0.7535
Evening person scores	Body mass index	-0.001	0.001	377,364	0.1801
Evening person scores	Previous smoking	-0.005	0.006	377,364	0.4129
Evening person scores	Current smoking	-0.023	0.010	377,364	0.0218
Evening person scores	Shift work	0.019	0.014	377,364	0.1698
Evening person scores	Night shift work	-0.009	0.014	377,364	0.4954
Evening person scores	Previous alcohol drinker	0.037	0.021	377,364	0.0886
Evening person scores	Current alcohol drinker	-0.004	0.015	377,364	0.7982
Evening person scores	Short sleep duration	0.032	0.015	377,364	0.0290
Evening person scores	Long sleep duration	0.006	0.013	377,364	0.6234
Evening person scores	Sometimes insomnia symptom	0.008	0.007	377,364	0.2946
Evening person scores	Usually insomnia symptom	-0.010	0.008	377,364	0.2362

Coefficients are in terms of an average-SNP increase in the allele score per unit/level increase in confounder. SE, standard error. P-value threshold of 0.05/15=3.3E-03 and P<0.05 as supporting evidence.

eTable 14. Associations between short/long sleep duration unweighted GRS and potential confounders in UK Biobank.

Instrument	Confounder	Coefficients	SE	N	P value
Short sleep duration					
Short sleep duration scores	Sex	0.037	0.011	377,364	5.0E-04*
Short sleep duration scores	Age	-0.001	0.001	377,364	0.2482
Short sleep duration scores	Townsend deprivation index	0.002	0.002	377,364	0.2123
Short sleep duration scores	Body mass index	0.006	0.001	377,364	<1.0E-04*
Short sleep duration scores	Shift work	0.018	0.024	377,364	0.4434
Short sleep duration scores	Night shift work	0.034	0.024	377,364	0.1546
Short sleep duration scores	Previous alcohol drinker	0.002	0.038	377,364	0.9635
Short sleep duration scores	Current alcohol drinker	-0.067	0.027	377,364	0.0117
Short sleep duration scores	Previous smoking	0.006	0.011	377,364	0.6022
Short sleep duration scores	Current smoking	0.035	0.018	377,364	0.0505
Short sleep duration scores	Mental health issue	0.026	0.016	377,364	0.1093
Short sleep duration scores	Morning Chronotype	-0.028	0.013	377,364	0.0301
Short sleep duration scores	Evening Chronotype	0.024	0.020	377,364	0.2193
Short sleep duration scores	Sometimes insomnia symptom	0.089	0.013	377,364	<1.0E-04*
Short sleep duration scores	Usually insomnia symptom	0.178	0.015	377,364	<1.0E-04*
Long sleep duration					
Long sleep duration scores	Sex	-0.004	0.005	377,364	0.4179
Long sleep duration scores	Age	0.000	0.000	377,364	0.9789
Long sleep duration scores	Townsend deprivation index	-0.000	0.001	377,364	0.8954
Long sleep duration scores	Body mass index	-0.008	0.000	377,364	<1.0E-04*
Long sleep duration scores	Shift work	-0.015	0.011	377,364	0.1549
Long sleep duration scores	Night shift work	0.012	0.011	377,364	0.2542
Long sleep duration scores	Previous alcohol drinker	0.010	0.017	377,364	0.5704
Long sleep duration scores	Current alcohol drinker	-0.010	0.012	377,364	0.4052
Long sleep duration scores	Previous smoking	-0.010	0.005	377,364	0.0484
Long sleep duration scores	Current smoking	-0.007	0.008	377,364	0.3937
Long sleep duration scores	Mental health issues	-0.014	0.007	377,364	0.0627
Long sleep duration scores	Morning chronotype	0.009	0.006	377,364	0.1408
Long sleep duration scores	Evening chronotype	0.040	0.009	377,364	<1.0E-04*
Long sleep duration scores	Sometimes insomnia symptom	-0.015	0.006	377,364	0.0118
Long sleep duration scores	Usually insomnia symptom	0.003	0.007	377,364	0.6603

Coefficients are in terms of an average-SNP increase in the allele score per unit/level increase in confounder. SE, standard error. P-value threshold of 0.05/15=3.3E-03 and P<0.05 as supporting evidence.

eTable 15. Associations between insomnia unweighted GRS and potential confounders in UK Biobank.

Instrument	Confounder	Coefficients	SE	N	P value
Insomnia symptom scores	Sex	0.084	0.016	377,364	<1.0E-04*
Insomnia symptom scores	Age	-0.005	0.001	377,364	2.0E-04*
Insomnia symptom scores	Townsend deprivation index	0.004	0.003	377,364	0.1436
Insomnia symptom scores	Body mass index	0.004	0.002	377,364	0.0192
Insomnia symptom scores	Shift work	-0.026	0.037	377,364	0.4778
Insomnia symptom scores	Night shift work	0.023	0.037	377,364	0.5265
Insomnia symptom scores	Previous alcohol drinker	0.222	0.058	377,364	1.0E-04*
Insomnia symptom scores	Current alcohol drinker	0.081	0.041	377,364	0.0500
Insomnia symptom scores	Previous smoking	0.051	0.018	377,364	0.0039
Insomnia symptom scores	Current smoking	0.085	0.027	377,364	0.0019*
Insomnia symptom scores	Mental health issues	0.052	0.025	377,364	0.0387
Insomnia symptom scores	Morning chronotype	0.032	0.020	377,364	0.1103
Insomnia symptom scores	Evening chronotype	-0.041	0.031	377,364	0.1796
Insomnia symptom scores	Short sleep duration	0.183	0.040	377,364	<1.0E-04*
Insomnia symptom scores	Long sleep duration	-0.051	0.034	377,364	0.1376

Coefficients are in terms of an average-SNP increase in the allele score per unit/level increase in confounder. SE, standard error. P-value threshold of 0.05/15=3.3E-03 and P<0.05 as supporting evidence.

eTable 16. Mendelian randomization estimates for genetically predicted morning person and evening person with adjustment for other confounders.

Instrument	Outcomes	Basic adjustment*			Further adjusted #			Additional adjusted§		
		OR	95% CI	P value	OR	95% CI	P value	OR	95% CI	P value
Morning person										
	Pan-cancer incidence	0.91	(0.85, 0.97)	4.76E-03**	0.91	(0.85, 0.97)	6.83E-03**	0.92	(0.86-0.98)	0.02*
	All-cause mortality of cancer patients	0.63	(0.54, 0.74)	2.44E-08**	0.65	(0.55, 0.76)	1.72E-07**	0.65	(0.55-0.77)	2.29E-07**
	5-year cancer mortality	0.72	(0.61, 0.85)	8.54E-05**	0.72	(0.61, 0.86)	1.95E-04**	0.72	(0.61-0.85)	1.41E-04**
	Cancer mortality	0.69	(0.59, 0.82)	1.03E-05**	0.70	(0.60, 0.83)	3.03E-05**	0.71	(0.60-0.83)	3.12E-05**
Evening person										
	Pan-cancer incidence	1.29	(1.08, 1.53)	4.82E-03**	1.12	(0.94,1.33)	0.20	1.09	(0.92-1.30)	0.33
	All-cause mortality of cancer patients	2.97	(2.01, 4.40)	5.18E-08**	1.51	(1.02, 2.23)	0.04*	1.47	(0.99-2.21)	0.05*
	5-year cancer mortality	2.33	(1.46, 3.73)	4.12E-04**	1.46	(0.91, 2.35)	0.12	1.46	(0.90-2.36)	0.12
	Cancer mortality	2.65	(1.69, 4.16)	2.10E-05**	1.51	(0.96, 2.36)	0.07	1.50	(0.95-2.37)	0.08

* Adjusted for age, sex, assessment centers, top 10 genetic principal components and genotyping array. [#] Further adjusted for the GRS association factors. [§] Additionally adjusted for other sleep traits. Odds ratios are per category increase in chronotype (from definite evening, intermediate evening, intermediate morning, and definite morning), per category increase in sleep duration (from extreme short, shorter, normal, longer, and extreme long), and per category increase in insomnia risk (from no, some, and frequent insomnia symptoms). * p<0.05 and ** p< bonferroni-corrected threshold of 0.05/groups.

eTable 17. Mendelian randomization estimates for genetically predicted short sleep duration and long sleep duration with adjustment for other confounders.

Instrument	Outcomes	Basic adjustment*			Further adjusted #			Additional adjusted§		
		OR	95% CI	P value	OR	95% CI	P value	OR	95% CI	P value
Short sleep duration										
	Pan-cancer incidence	0.85	(0.76, 0.94)	2.21E-03**	0.84	(0.75, 0.93)	1.28E-03**	0.77	(0.68-0.88)	1.17E-04**
	All-cause mortality of cancer patients	1.59	(1.23,2.05)	3.47E-03**	1.40	(1.09, 1.82)	9.64E-03**	1.14	(0.84-1.56)	0.40
	5-year cancer mortality	1.23	(0.90, 1.69)	0.20	1.18	(0.86, 1.62)	0.30	0.96	(0.66-1.39)	0.83
	Cancer mortality	1.32	(1.00, 1.77)	0.05*	1.24	(0.93, 1.65)	0.14	1.03	(0.73-1.45)	0.85
Long sleep duration										
	Pan-cancer incidence	1.73	(1.32, 2.27)	7.65E-05**	1.58	(1.22,2.06)	6.02E-04**	1.63	(1.25-2.13)	3.07E-04**
	All-cause mortality of cancer patients	4.40	(2.96, 6.54)	2.38E-13**	3.43	(2.32, 5.05)	5.16E-10**	3.53	(2.39-5.23)	2.69E-10**
	5-year cancer mortality	2.72	(1.44, 5.14)	2.00E-03**	2.27	(1.22, 4.22)	9.62E-03**	2.28	(1.22-4.28)	0.01*
	Cancer mortality	3.11	(1.85, 5.22)	1.74E-05**	2.57	(1.55,4.25)	2.55E-04**	2.65	(1.59-4.40)	1.76E-04**

* Adjusted for age, sex, assessment centers, top 10 genetic principal components and genotyping array. # Further adjusted for the GRS association factors. § Additionally adjusted for other sleep traits. Odds ratios are per category increase in chronotype (from definite evening, intermediate evening, intermediate morning, and definite morning), per category increase in sleep duration (from extreme short, shorter, normal, longer, and extreme long), and per category increase in insomnia risk (from no, some, and frequent insomnia symptoms). * p<0.05 and ** p< bonferroni-corrected threshold of 0.05/groups.

eTable 18. Mendelian randomization estimates for genetically predicted insomnia symptom with adjustment for other sleep traits confounders.

Instrument	Outcomes	Basic adjustment*			Further adjusted [#]			Additional adjusted [§]		
		OR	95% CI	P value	OR	95% CI	P value	OR	95% CI	P value
Insomnia symptom										
	Pan-cancer incidence	1.04	(1.01, 1.08)	0.01*	1.03	(1.00, 1.07)	0.06	1.05	(1.01-1.08)	0.01*
	All-cause mortality of cancer patients	1.22	(1.14, 1.31)	9.45E-09**	1.15	(1.07, 1.23)	1.34E-04**	1.13	(1.05-1.21)	1.57E-03**
	5-year cancer mortality	1.17	(1.07, 1.28)	6.38E-04**	1.11	(1.01, 1.22)	0.02*	1.09	(0.98-1.20)	0.10
	Cancer mortality	1.18	(1.09, 1.28)	2.64E-05**	1.13	(1.04, 1.22)	3.34E-03**	1.11	(1.01-1.21)	0.02*

* Adjusted for age, sex, assessment centers, top 10 genetic principal components and genotyping array. # Further adjusted for the GRS association factors. § Additionally adjusted for other sleep traits. Odds ratios are per category increase in chronotype (from definite evening, intermediate evening, intermediate morning, and definite morning), per category increase in sleep duration (from extreme short, shorter, normal, longer, and extreme long), and per category increase in insomnia risk (from no, some, and frequent insomnia symptoms). * p<0.05 and ** p< bonferroni-corrected threshold of 0.05/groups.

eTable 19. Mendelian randomization estimates for genetically predicted short sleep duration and long sleep duration with adjustment for other confounders after excluding the disturbed participants.

Instrument	Outcomes	Basic adjustment*			Further adjusted #			Additional adjusted§		
		OR	95% CI	P value	OR	95% CI	P value	OR	95% CI	P value
Short sleep duration (Participants with insomnia symptoms were excluded)										
	Pan-cancer incidence	0.82	(0.61,1.10)	0.18	0.79	(0.59, 1.07)	0.13	0.79	(0.58-1.07)	0.13
	All-cause mortality of cancer patients	1.00	(0.45,2.24)	1.00	0.87	(0.40, 1.91)	0.74	0.91	(0.42-1.98)	0.82
	5-year cancer mortality	0.99	(0.42, 2.35)	0.98	1.06	(0.45, 2.49)	0.89	1.06	(0.45-2.50)	0.89
	Cancer mortality	1.11	(0.52, 2.38)	0.78	1.08	(0.52, 2.27)	0.83	1.09	(0.52-2.27)	0.82
Long sleep duration (Participants with evening preference were excluded)										
	Pan-cancer incidence	1.59	(1.19, 2.12)	1.52E-03**	1.50	(1.14,1.99)	3.97E-03**	1.56	(1.18-2.06)	1.66E-03**
	All-cause mortality of cancer patients	3.14	(2.04, 4.84)	2.12E-07**	2.52	(1.65, 3.87)	2.15E-05**	2.65	(1.73-4.07)	7.71E-06**
	5-year cancer mortality	2.32	(1.16, 4.65)	0.02*	1.89	(0.96, 3.74)	0.07	1.96	(0.99-3.89)	0.05*
	Cancer mortality	2.01	(1.14, 3.55)	0.02*	1.71	(0.98, 2.99)	0.06	1.77	(1.01-3.09)	0.05*

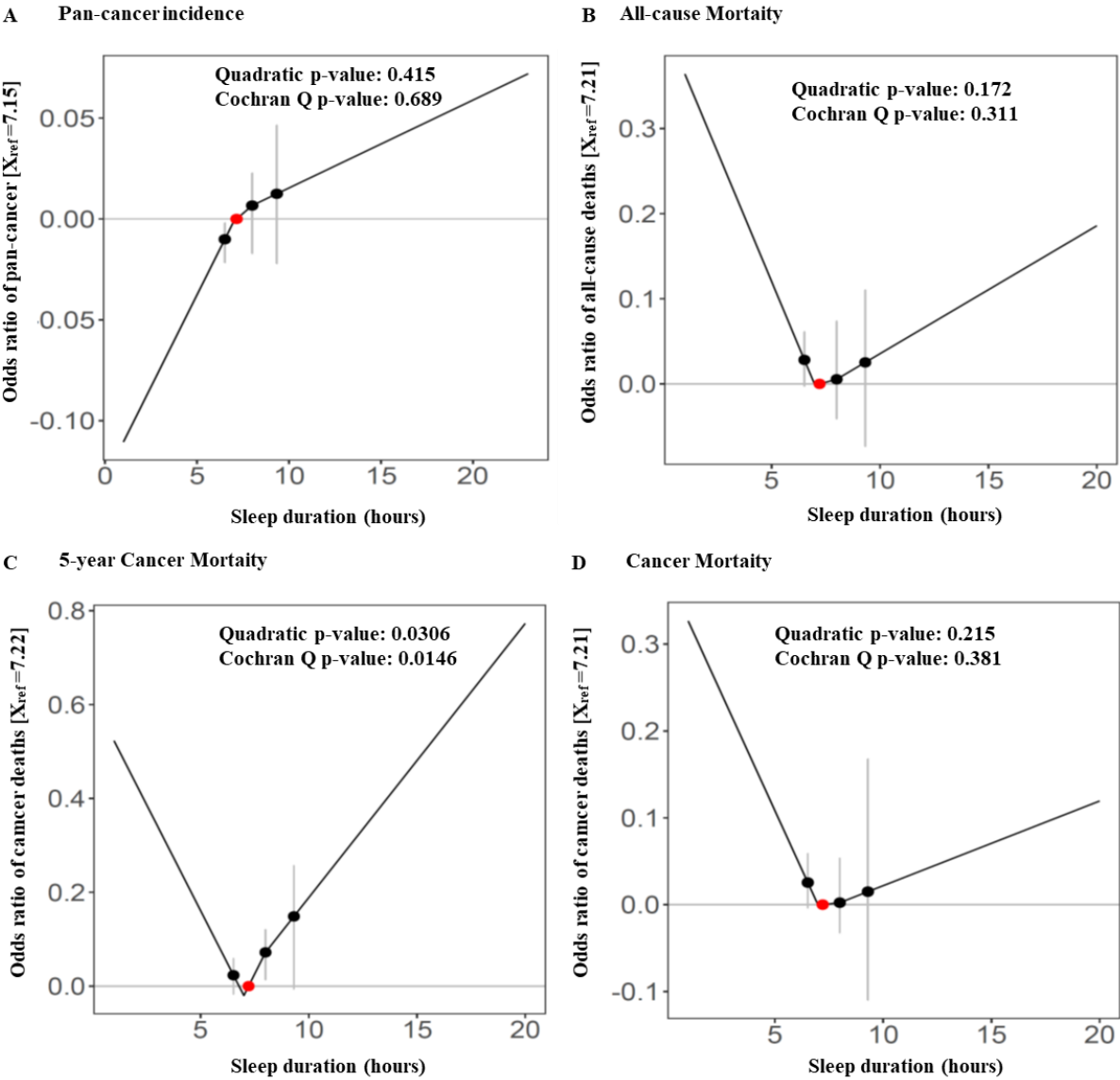
* Adjusted for age, sex, assessment centers, top 10 genetic principal components and genotyping array. [#] Further adjusted for the GRS association factors. [§] Additionally adjusted for other sleep traits. Odds ratios are per category increase in chronotype (from definite evening, intermediate evening, intermediate morning, and definite morning), per category increase in sleep duration (from extreme short, shorter, normal, longer, and extreme long), and per category increase in insomnia risk (from no, some, and frequent insomnia symptoms). * p<0.05 and ** p< bonferroni-corrected threshold of 0.05/groups.

eTable 20. Mendelian randomization estimates for genetically predicted insomnia with adjustment for other confounders after excluding the disturbed participants.

Instrument	Outcomes	Basic adjustment*			Further adjusted [#]			Additional adjusted [§]		
		OR	95% CI	<i>P</i> value	OR	95% CI	<i>P</i> value	OR	95% CI	<i>P</i> value
Insomnia symptom (Participants with short sleep duration were excluded)										
	Pan-cancer incidence	1.04	(1.01, 1.08)	0.02*	1.03	(1.00, 1.07)	0.06	1.04	(1.00-1.07)	0.04*
	All-cause mortality of cancer patients	1.17	(1.09, 1.26)	2.52E-05**	1.12	(1.03, 1.20)	5.16E-03**	1.13	(1.05-1.22)	1.79E-03**
	5-year cancer mortality	1.12	(1.01, 1.23)	0.03*	1.07	(0.97, 1.18)	0.17	1.07	(0.98-1.19)	0.13
	Cancer mortality	1.14	(1.05, 1.24)	2.37E-03**	1.10	(1.01, 1.20)	0.03*	1.11	(1.02-1.21)	0.02*

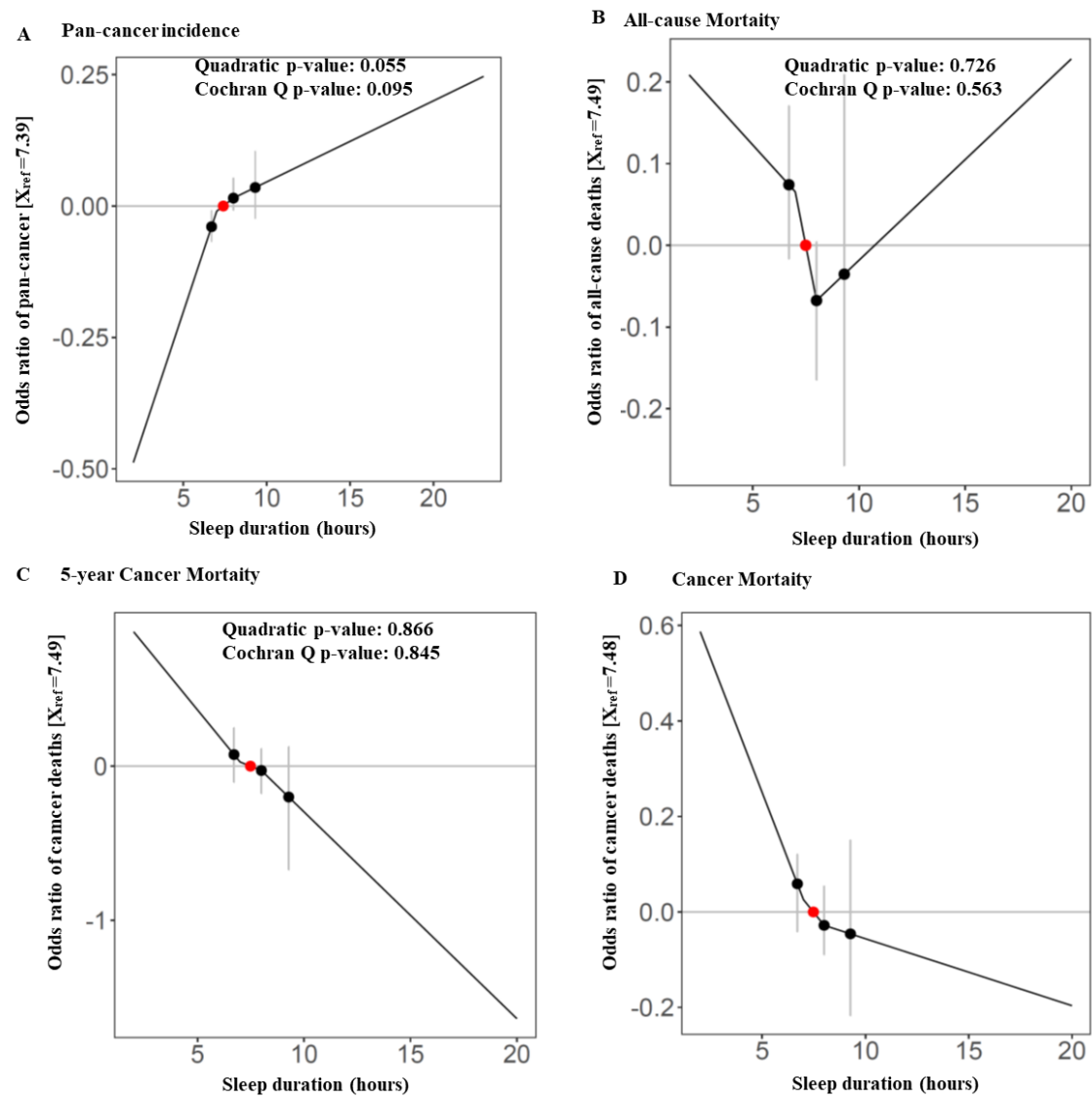
* Adjusted for age, sex, assessment centers, top 10 genetic principal components and genotyping array. [#] Further adjusted for the GRS association factors. [§] Additionally adjusted for other sleep traits. Odds ratios are per category increase in chronotype (from definite evening, intermediate evening, intermediate morning, and definite morning), per category increase in sleep duration (from extreme short, shorter, normal, longer, and extreme long), and per category increase in insomnia risk (from no, some, and frequent insomnia symptoms). * p<0.05 and ** p< bonferroni-corrected threshold of 0.05/groups.

eTable 21. Non-linear Mendelian randomization results between genetically predicted continuous sleep durations and pan-cancer incidence and mortality among cancer patients using piecewise linear method.



Localized average causal effects (LACE) for Pan-cancer incidence/mortality were estimated with piecewise linear method. Black dots (black vertical lines) mean the LACE (95% confidence interval) in each stratum; read dots represent reference point. P quadratic/Cochran Q = P-value for non-linearity from quadratic/Cochran Q test. A, Pan-cancer incidence; B, All-cause mortality of cancer patients; C, 5-year cancer mortality; D, Cancer mortality.

eTable 22. Non-linear Mendelian randomization results between genetically predicted continuous sleep durations and pan-cancer incidence and mortality among cancer patients using piecewise linear method (participants with insomnia symptoms were excluded).

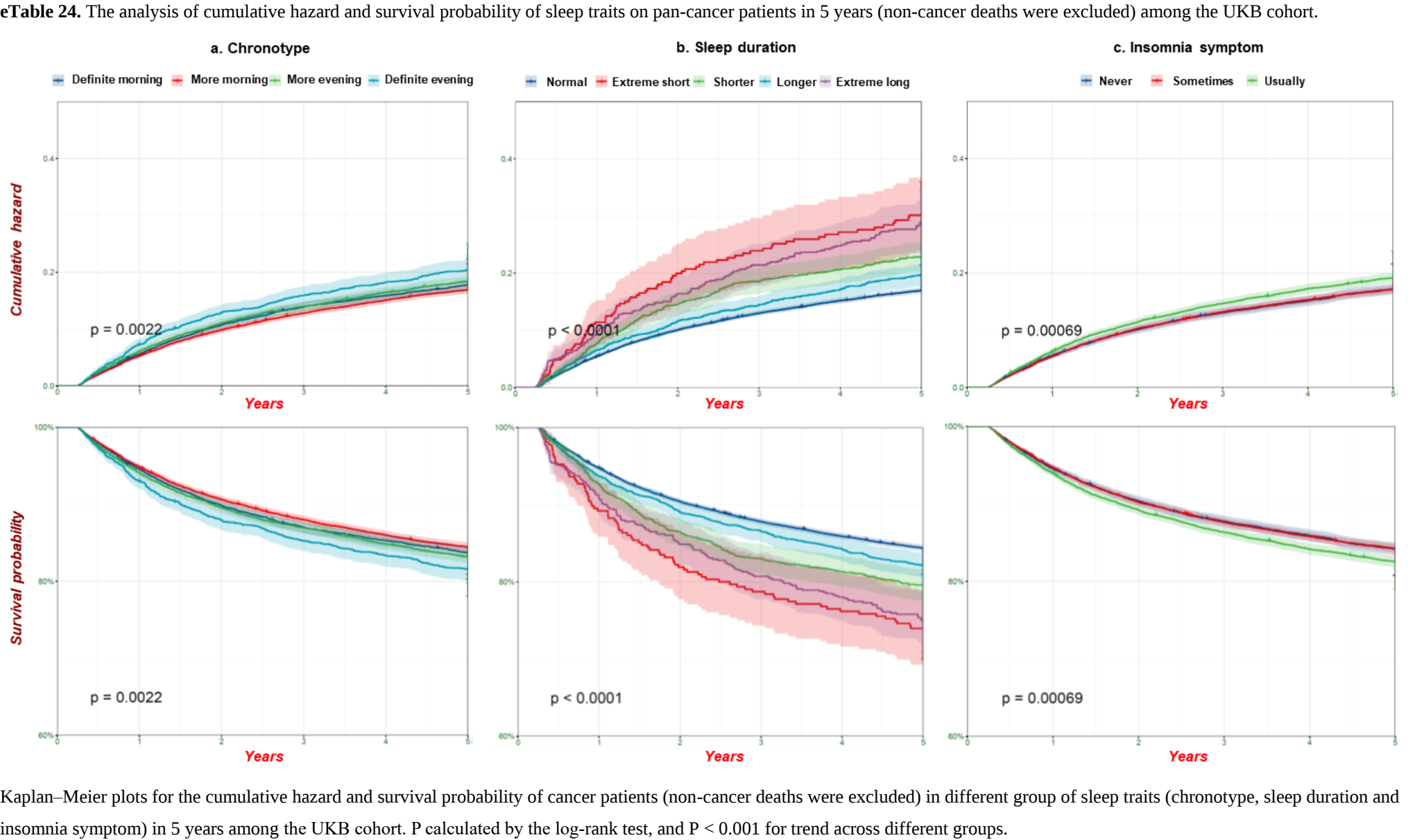


Localized average causal effects (LACE) for Pan-cancer incidence/mortality were estimated with piecewise linear method. Black dots (black vertical lines) mean the LACE (95% confidence interval) in each stratum; read dots represent reference point. P quadratic/Cochran Q = P-value for non-linearity from quadratic/Cochran Q test. A, Pan-cancer incidence; B, All-cause mortality of cancer patients; C, 5-year cancer mortality; D, Cancer mortality.

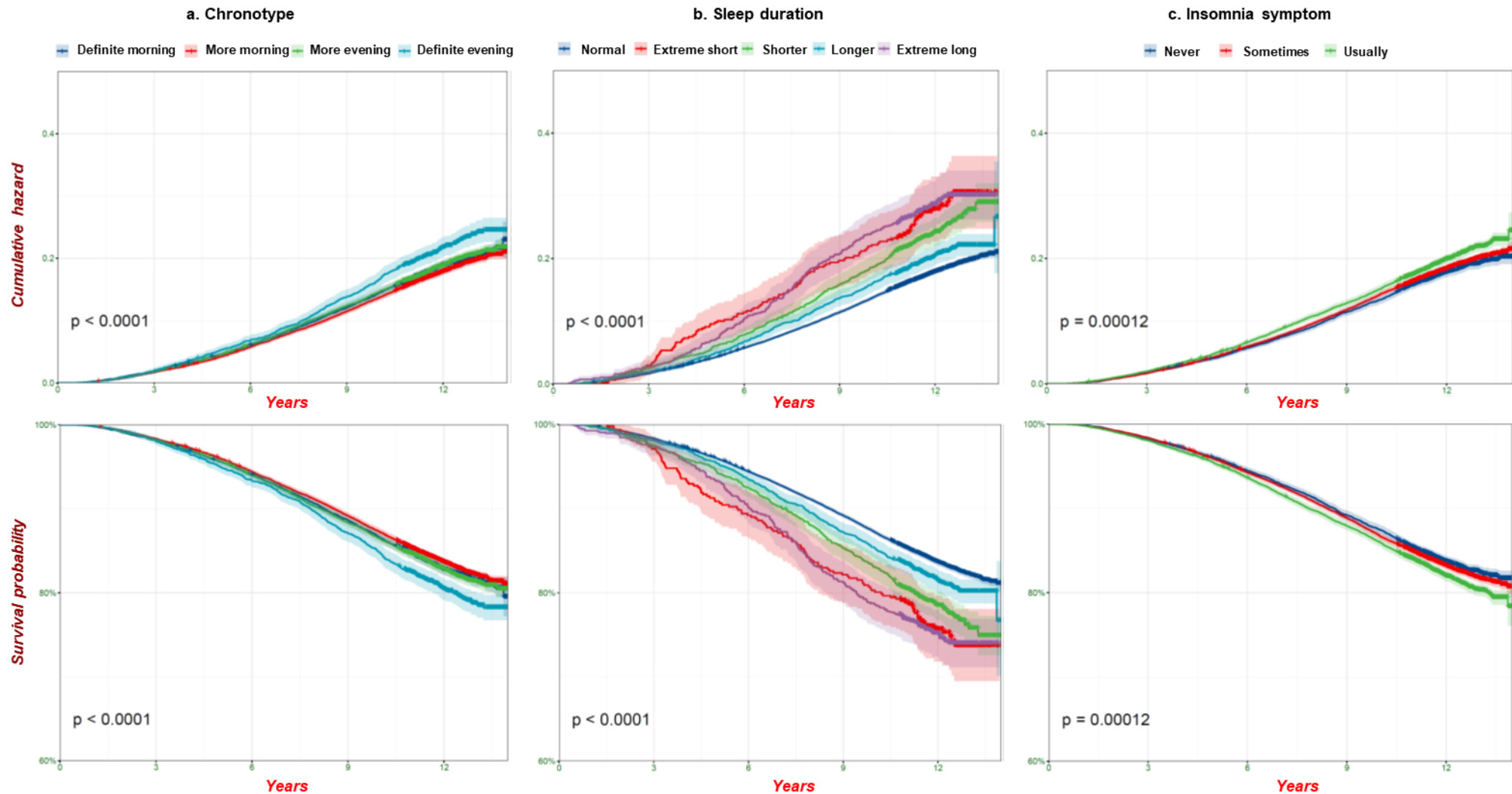
eTable 23. Analysis for mortality of cancer associated with sleep traits.

Sleep traits	All-cause mortality of cancer patients [§]		Cancer mortality ^{&}		In 5-year cancer mortality	
	No. (Deaths)	%	No. (Deaths)	%	No. (Deaths)	%
Chronotype	50,252 (11,800)	23.5%	46,435 (7,986)	17.2%	30,565 (6,046)	19.8%
Definite morning	13,999 (3,346)	23.9%	12,886 (2,233)	17.3%	8,522 (1,690)	19.8%
More morning	18,049 (3,985)	22.1%	16,799 (2,738)	16.3%	11,053 (2,078)	18.8%
More evening	13,827 (3,288)	23.8%	12,766 (2,227)	17.4%	8,371 (1,701)	20.3%
Definite evening	4,377 (1,181)	27.0%	3,984 (788)	19.8%	2,619 (577)	22.0%
Sleep duration	56,081 (13,179)	23.5%	51,811 (8,912)	17.2%	34,044 (6,737)	19.8%
Normal (6-8 h)	48,281 (10,882)	22.5%	44,859 (7,463)	16.6%	29,400 (5,624)	19.1%
Extreme short (≤ 4)	553 (189)	34.2%	482 (118)	24.5%	315 (95)	30.2%
Shorter (5 h)	2,328 (694)	29.8%	2,082 (448)	21.5%	1,379 (332)	24.1%
Longer (9 h)	3,778 (996)	26.4%	3,423 (641)	18.7%	2,276 (490)	21.5%
Extreme long (≥ 10 h)	1,141 (418)	36.6%	965 (242)	25.1%	674 (196)	29.1%
Insomnia symptom	56,313 (13,270)	23.6%	52,012 (8,972)	17.2%	34,179 (6,785)	19.9%
Never	13,102 (2,930)	22.4%	12,174 (2,002)	16.4%	7,902 (1,523)	19.3%
Sometimes	26,810 (6,199)	23.1%	24,839 (4,231)	17.0%	16,334 (3,164)	19.4%
Usually	16,401 (4,141)	25.2%	14,999 (2,739)	18.3%	9,943 (2,098)	21.1%

[§] Mean (SD) of follow-up years: 11.05 (2.65); [&] Mean (SD) of follow-up years: 11.36 (2.35).



eTable 25. The analysis of cumulative hazard and survival probability of sleep traits on pan-cancer patients (non-cancer deaths were excluded) in the UKB cohort.



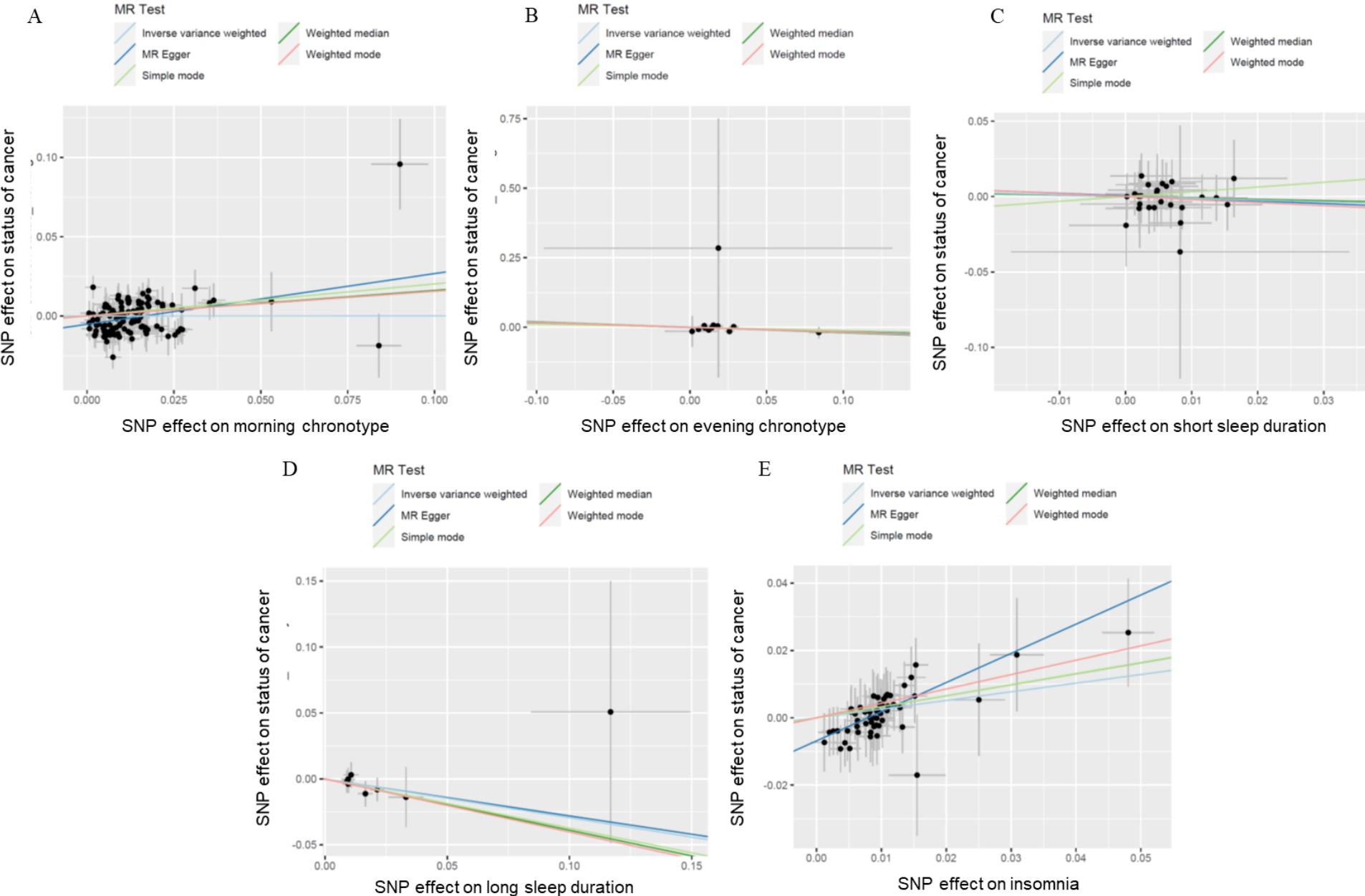
Kaplan–Meier plots for the cumulative hazard and survival probability of cancer patients (non-cancer deaths were excluded) in different group of sleep traits (chronotype, sleep duration and insomnia symptom) in the UKB cohort. P calculated by the log-rank test, and $P < 0.001$ for trend across different groups.

eTable 26. Multivariable Cox regression analysis for pan-cancer incidence and mortality associated with sleep traits among cancer patients after removing participants who reported currently working night shifts.

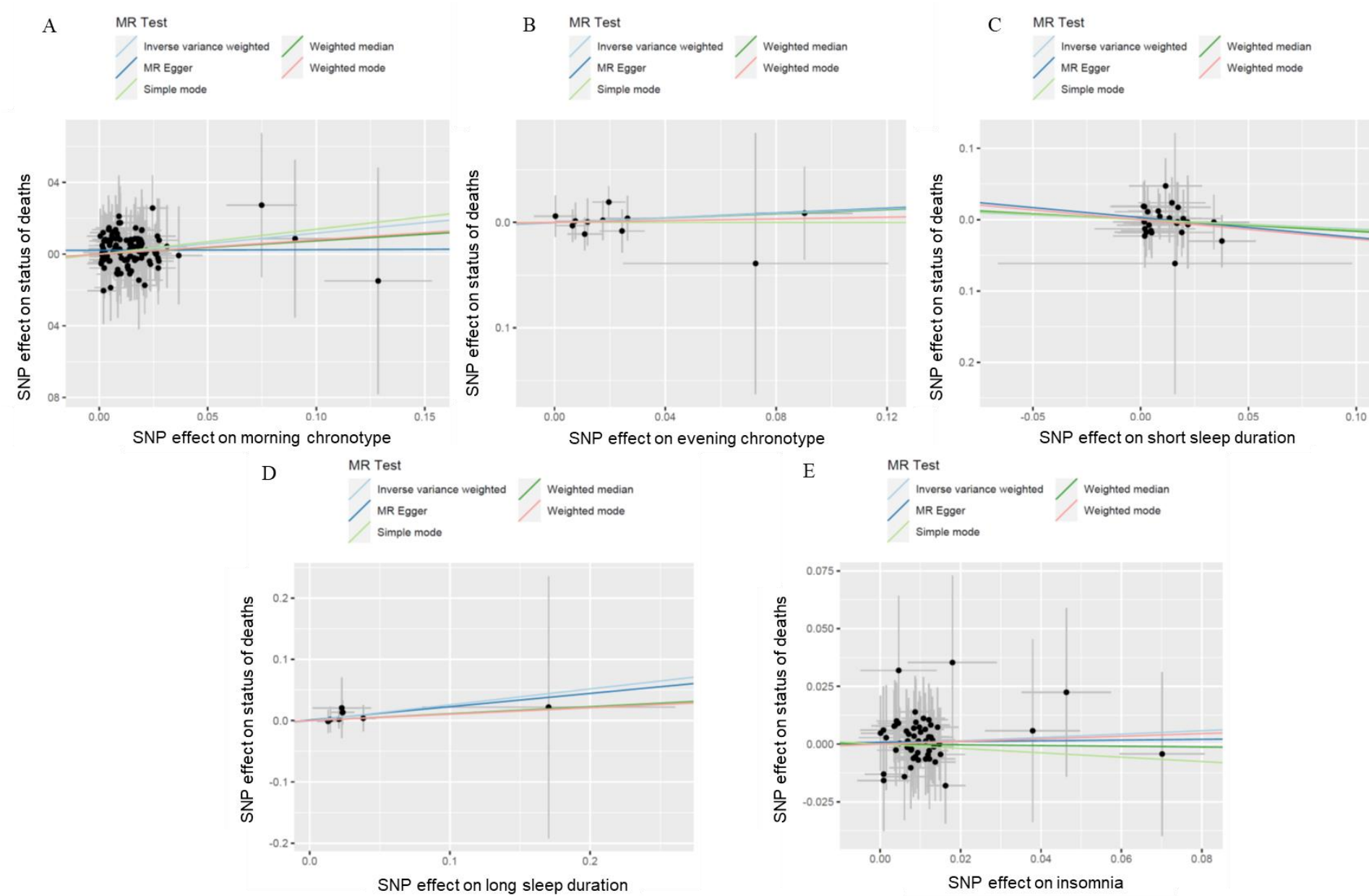
Sleep traits	Pan-cancer incidence		All-cause mortality		5-year cancer mortality		Cancer mortality	
	Hazard ratio (95%)	P value	Hazard ratio (95%)	P value	Hazard ratio (95%)	P value	Hazard ratio (95%)	P value
Chronotype								
Definite morning	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
More morning	1.00 (0.98-1.02)	0.87	0.96 (0.92-1.01)	0.14	1.00 (0.94-1.07)	0.97	0.98 (0.92-1.03)	0.40
More evening	0.99 (0.97-1.02)	0.55	0.99 (0.94-1.04)	0.57	1.03 (0.96-1.11)	0.36	0.99 (0.94-1.06)	0.85
Definite evening	1.04 (1.00-1.08)	0.03	1.07 (1.00-1.15)	0.05	1.07 (0.97-1.18)	0.18	1.07 (0.99-1.17)	0.10
Sleep duration								
Normal (6-8 h)	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
Extreme short (≤ 4)	0.92 (0.83-1.01)	0.07	1.23 (1.05-1.45)	0.01	1.31 (1.04-1.65)	0.02	1.23 (1.00-1.51)	0.05
Shorter (5 h)	0.96 (0.92-1.01)	0.08	1.20 (1.10-1.31)	<0.001	1.19 (1.06-1.35)	<0.001	1.21 (1.09-1.34)	<0.001
Longer (9 h)	1.04 (1.00-1.07)	0.05	1.04 (0.97-1.11)	0.31	1.03 (0.93-1.14)	0.59	1.03 (0.94-1.12)	0.50
Extreme long (≥ 10 h)	1.08 (1.02-1.15)	0.02	1.38 (1.24-1.53)	<0.001	1.37 (1.17-1.59)	<0.001	1.31 (1.14-1.50)	<0.001
Insomnia								
Never	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref	1.00 (ref)	Ref
sometimes	1.01 (0.99-1.03)	0.44	1.04 (0.99-1.09)	0.12	1.02 (0.96-1.09)	0.51	1.05 (0.99-1.11)	0.12
Usually	1.03 (1.01-1.06)	0.02	1.06 (1.01-1.12)	0.02	1.06 (0.98-1.14)	0.12	1.06 (0.99-1.13)	0.09

Adjusted for age, sex, assessment centre, top 10 genetic principal components, genotyping array, body mass index, employment status, Townsend deprivation index, smoking status, drinking status, mental health issue and other sleep traits. Statistical significance was defined as $P < 0.05$.

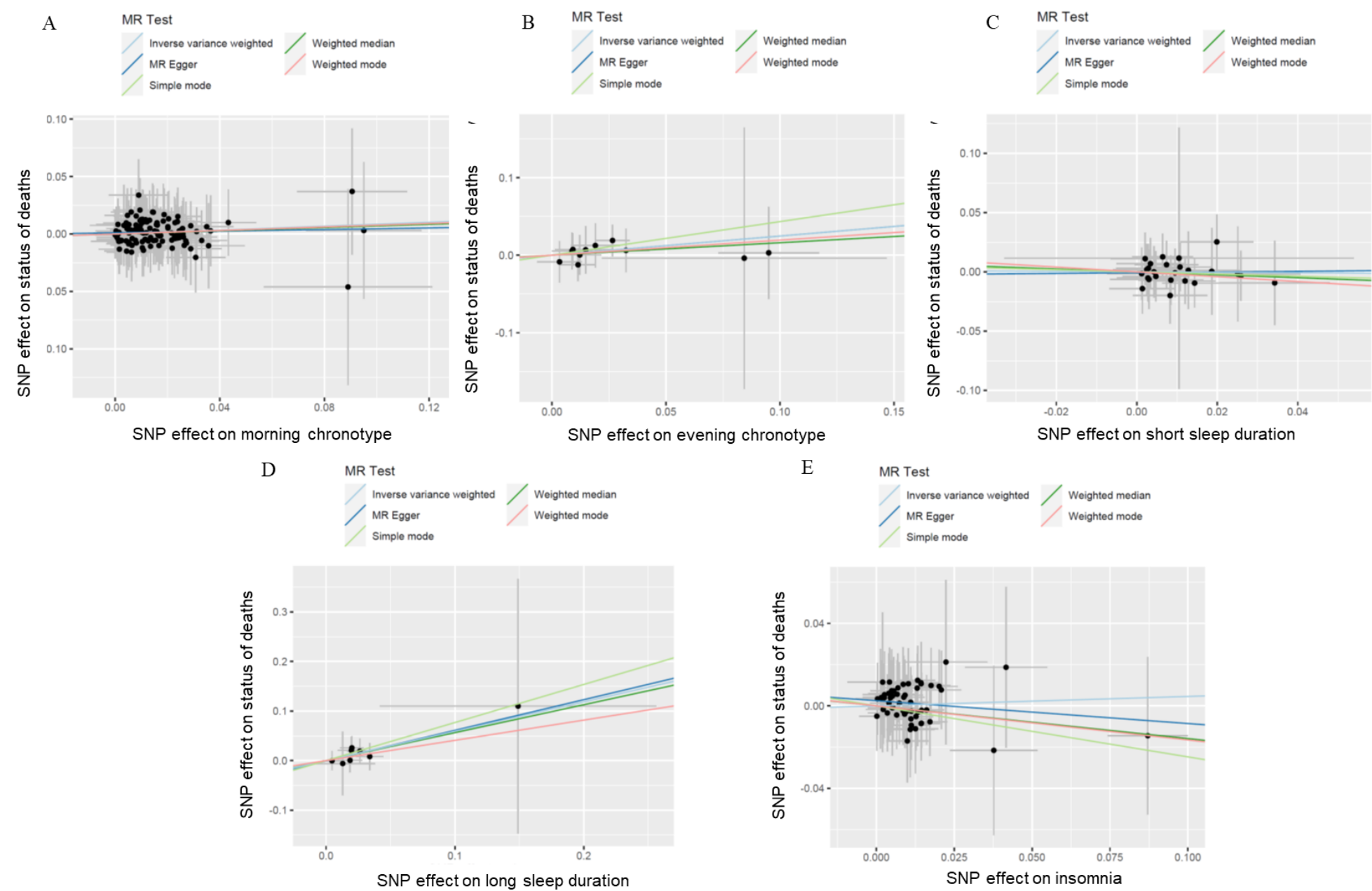
eTable 27. Scatter plot of individual SNP-sleep traits and SNP effect on pan-cancer incidence associations with overlay of causal estimate from each MR test using.



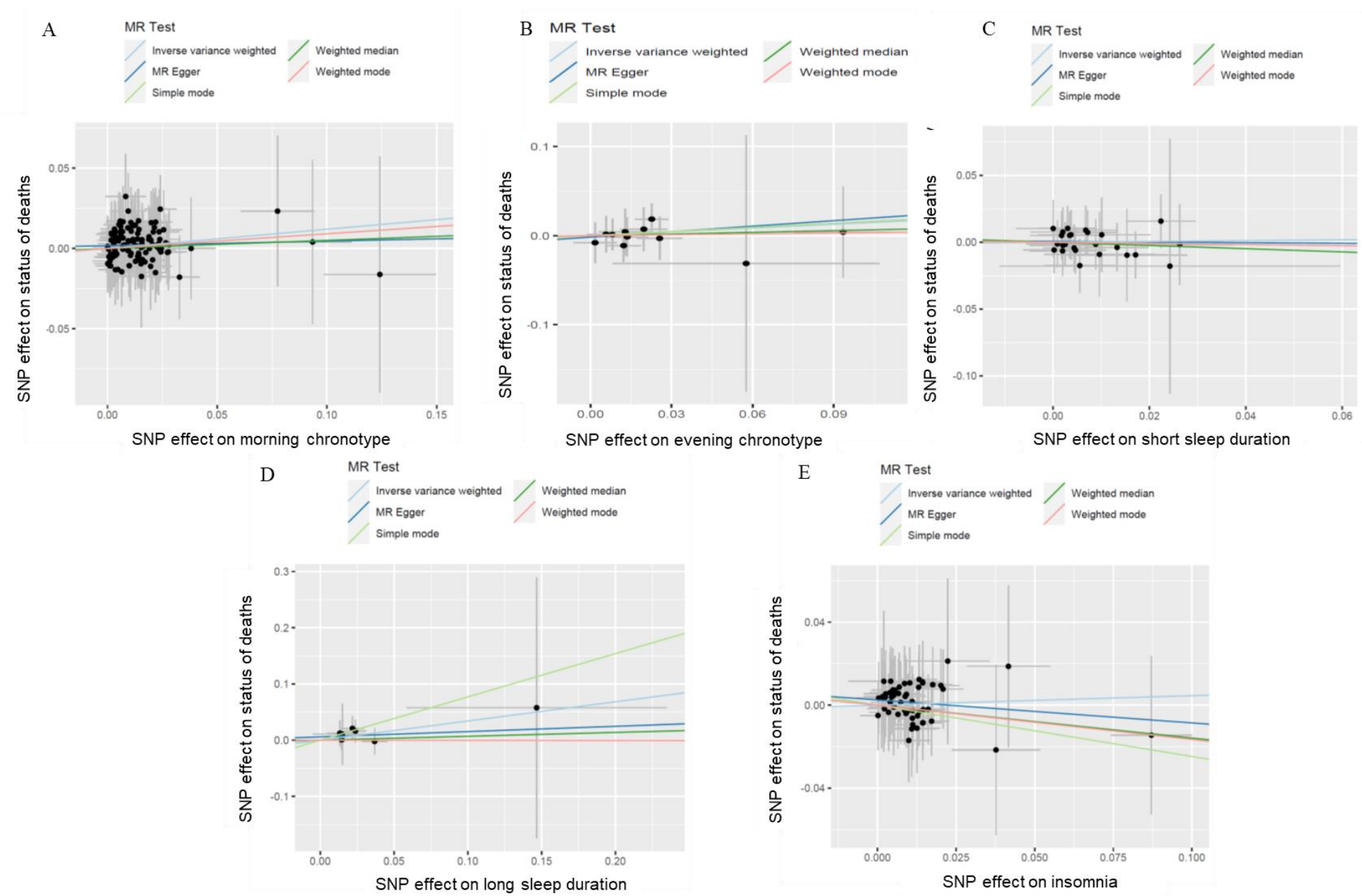
eTable 28. Scatter plot of individual SNP-sleep traits and SNP effect on all-cause mortality of cancer patient associations with overlay of causal estimate from each MR test using.



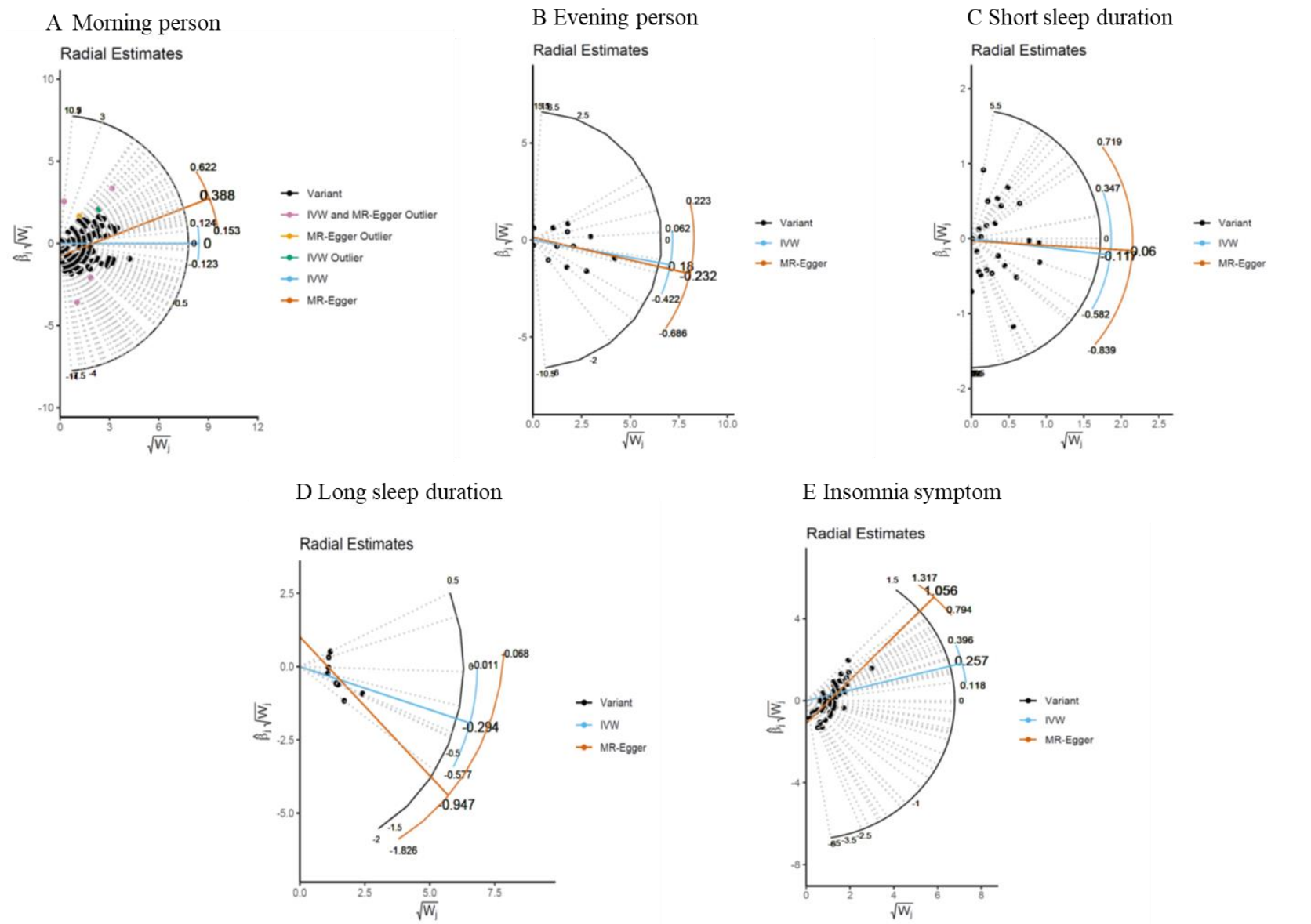
eTable 29. Scatter plot of individual SNP-sleep traits and SNP effect on 5-year cancer mortality of cancer patient associations with overlay of causal estimate from each MR test using.



eTable 30. Scatter plot of individual SNP-sleep traits and SNP effect on cancer mortality of cancer patient associations with overlay of causal estimate from each MR test using.



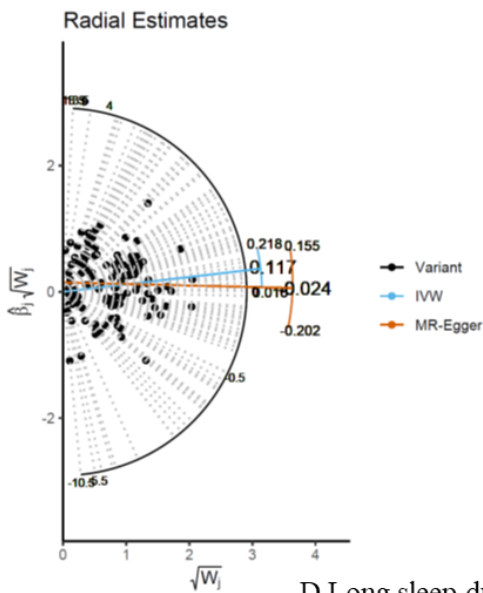
eTable 31. Radial MR plots for sleep traits in pan-cancer incidence.



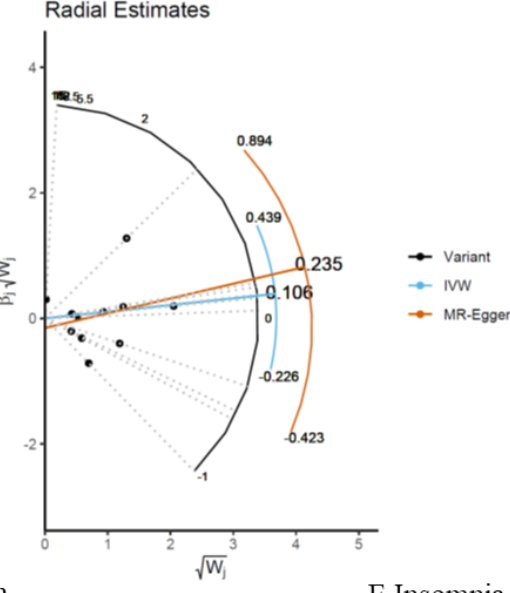
Radial curve means the ratio estimate for each SNP, the overall IVW (in blue) and MR Egger estimate (in orange) identified seven and six outlying genetic variants for morning person.

eTable 32. Radial MR plots for sleep traits in all-cause mortality among cancer patients.

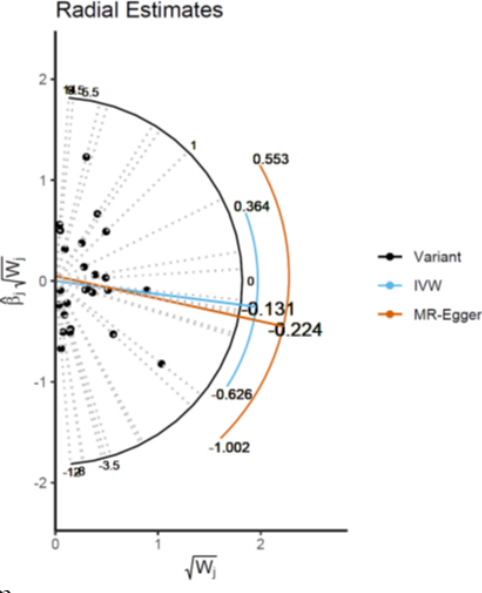
A Morning person



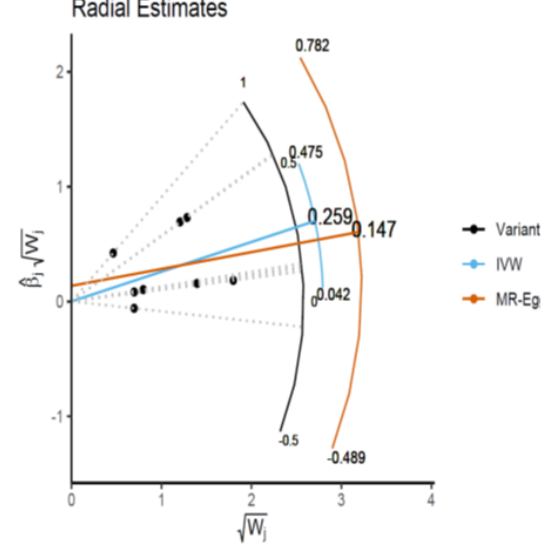
B Evening person



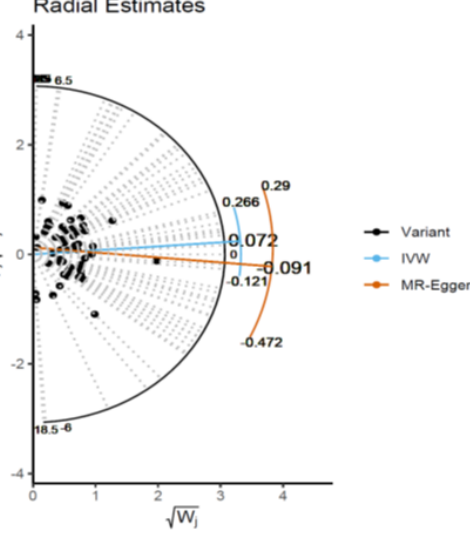
C Short sleep duration



D Long sleep duration

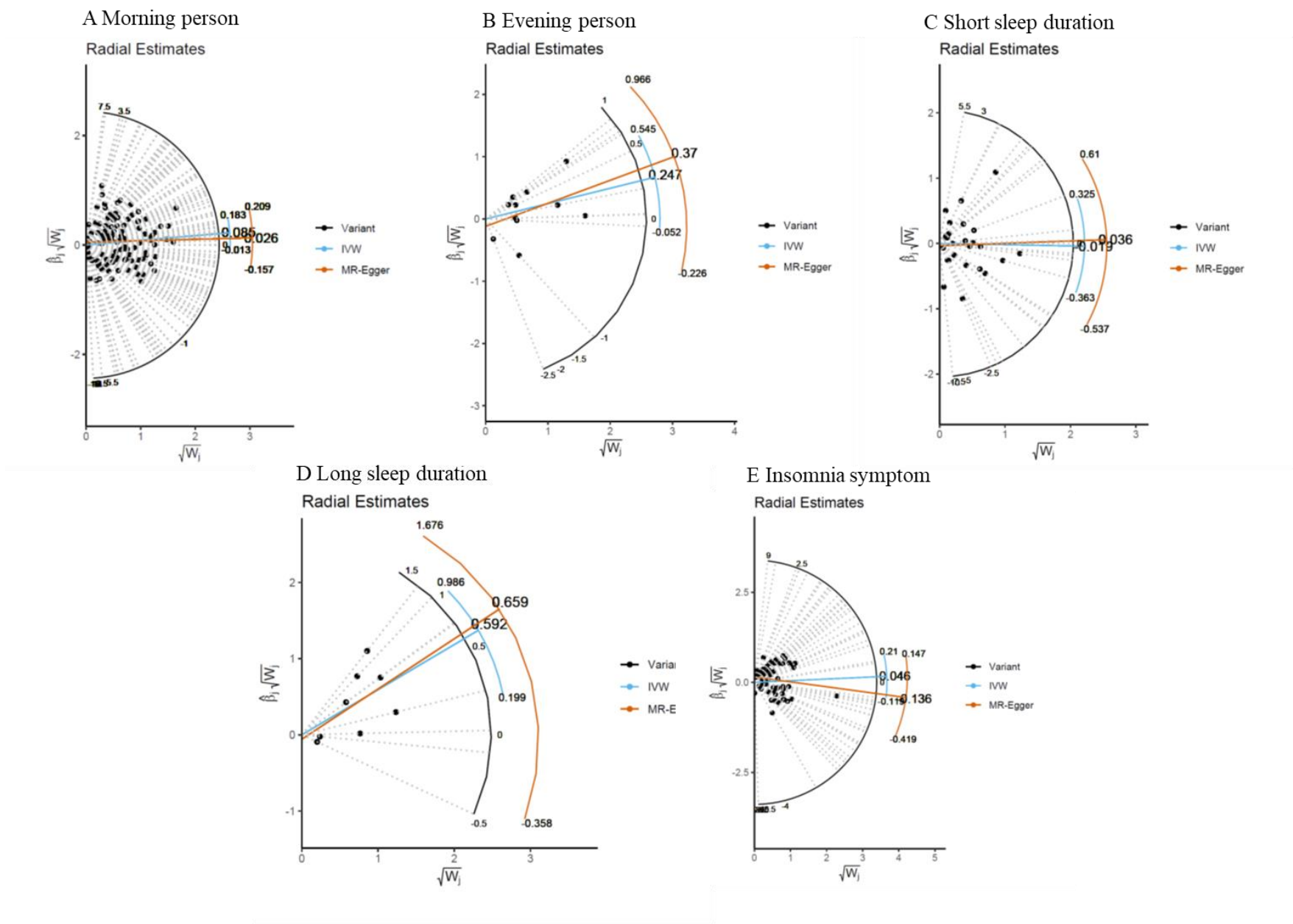


E Insomnia symptom

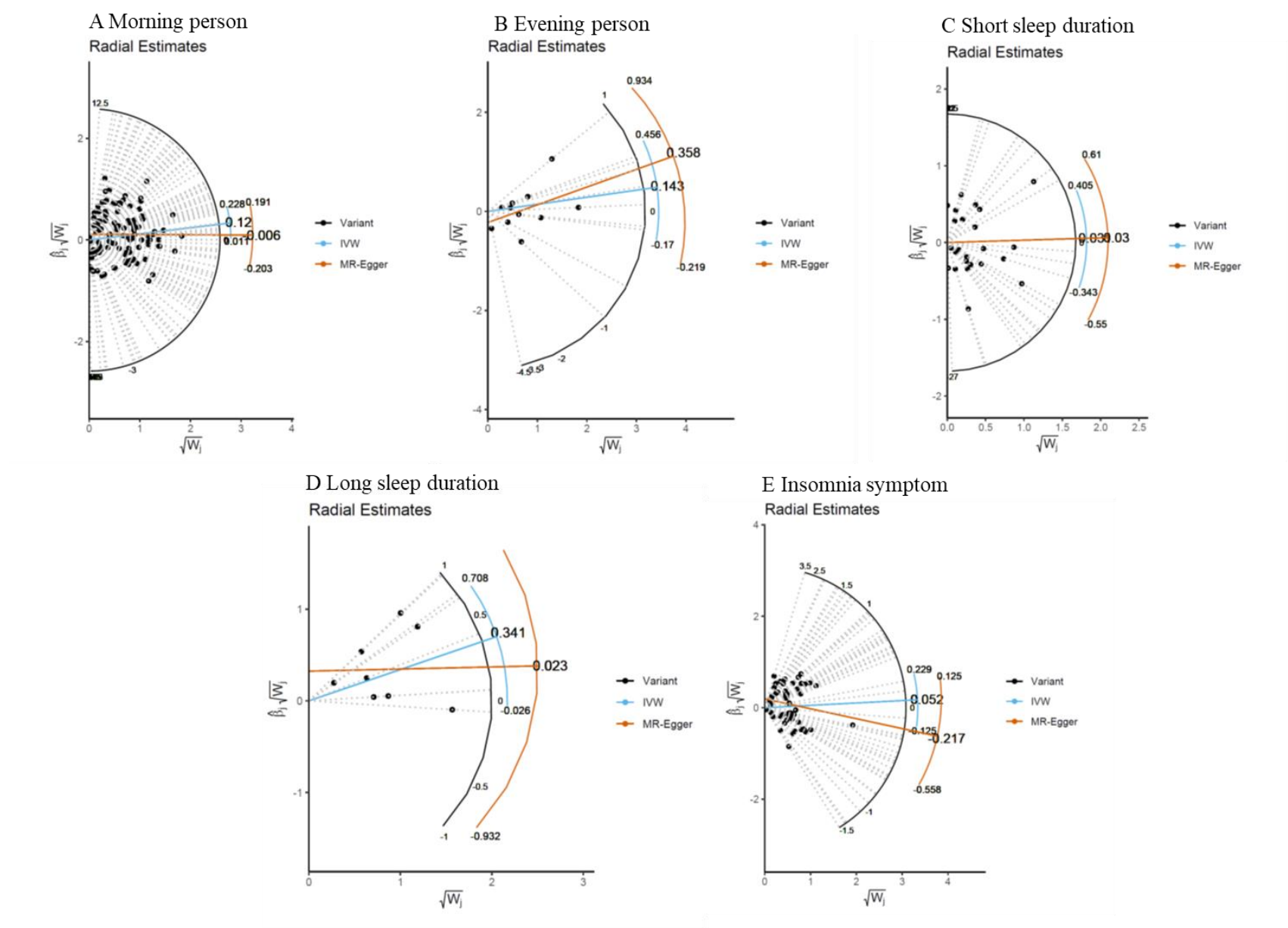


Radial curve means the ratio estimate for each SNP. No outlying genetic variants were found in these cancers.

eTable 33. Radial MR plots for sleep traits in 5-year cancer mortality among cancer patients.

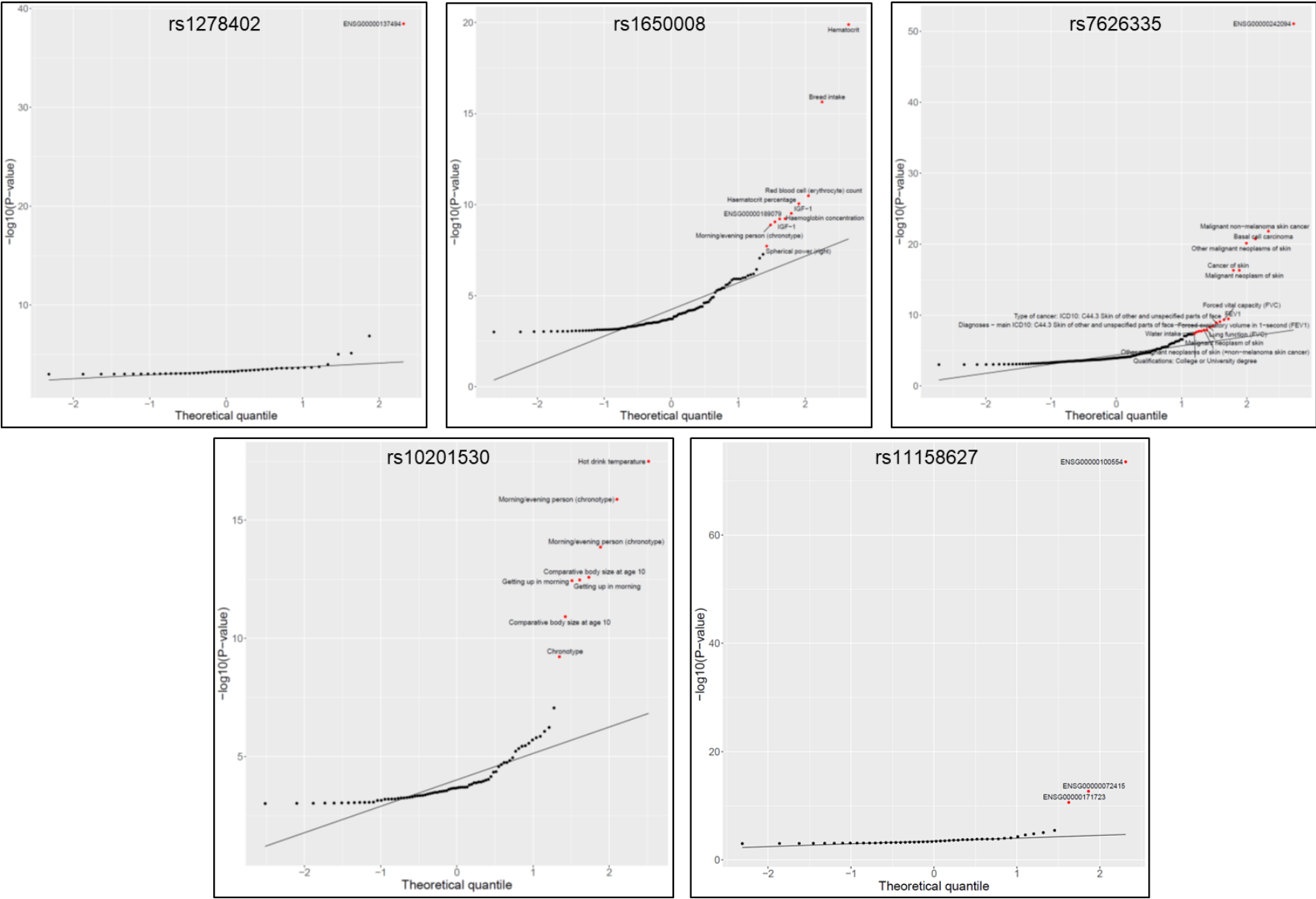


eTable 34. Radial MR plots for sleep traits in 5-year cancer mortality among cancer patients.

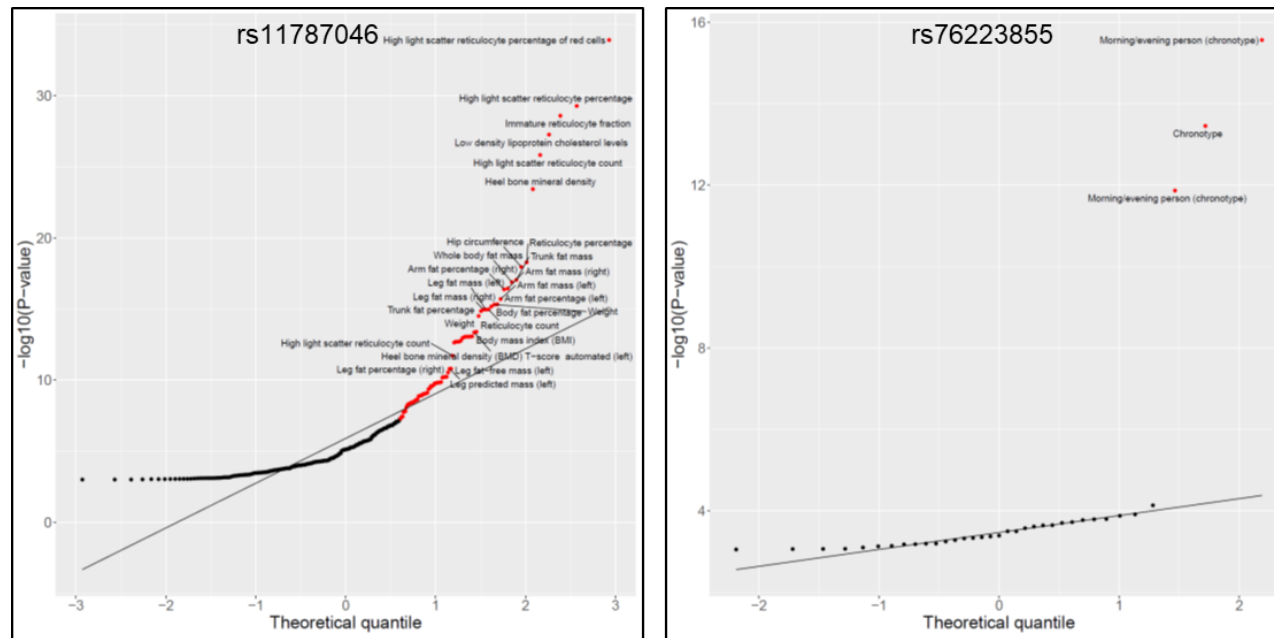


Radial curve means the ratio estimate for each SNP. No outlying genetic variants were found in these cancers.

eTable 35. Associations of outlying SNPs for definite morning chronotype in several diseases identified from radial curves with other traits using a phenome-wide association study approach.



To be continued...



Associations of outliers for morning chronotype in severe diseases with other traits were assessed by a phenome-wide association study approach in MR-Base (<http://www.mrbase.org/>). $P < 5.0\text{E-}08$ are annotated.

eTable 36. Sensitivity analysis for morning/evening chronotype and pan-cancer incidence and all-cause mortality of cancer patients using the Weighted median and MR-Egger methods.

Outcomes	Weighted median		MR-Egger			
	Beta (se)	P value	Beta (se)	P value	Intercept*	P value
Morning chronotype						
Pan-cancer incidence	0.161 (0.087)	0.064	0.320 (0.104)	0.003	-0.005 (0.001)	<0.001
All-cause mortality of cancer patients	0.074 (0.148)	0.619	0.003 (0.174)	0.984	0.002 (0.003)	0.408
5-year Cancer mortality	0.070 (0.178)	0.696	0.035 (0.217)	0.871	0.051 (0.067)	0.451
Cancer mortality	0.050 (0.166)	0.761	0.028 (0.202)	0.889	0.114 (0.075)	0.134
Evening chronotype						
Pan-cancer incidence	-0.196 (0.181)	0.279	-0.146 (0.235)	0.548	-0.001 (0.005)	0.862
All-cause mortality of cancer patients	0.101 (0.402)	0.803	0.114 (0.452)	0.807	-0.001 (0.009)	0.983
5-year Cancer mortality	0.161 (0.470)	0.732	0.247 (0.574)	0.677	-0.118 (0.215)	0.560
Cancer mortality	0.063 (0.472)	0.894	0.206 (0.527)	0.706	-0.224 (0.222)	0.339

* MR-Egger intercept was used to quantify the effect of directional pleiotropy. Values that significantly differ from zero indicated potential pleiotropy, which suggested exposure-associated genetic variables may influence the outcome through other pathways rather than through exposure.

eTable 37. Sensitivity analysis for short/long sleep duration and pan-cancer incidence and all-cause mortality of cancer patients using the Weighted median and MR-Egger methods.

Outcomes	Weighted median		MR-Egger			
	Beta (se)	P value	Beta (se)	P value	Intercept*	P value
Short sleep duration						
Pan-cancer incidence	-0.090 (0.651)	0.890	-0.172 (0.806)	0.833	0.001 (0.006)	0.935
All-cause mortality of cancer patients	-0.164 (0.793)	0.836	-0.279 (0.767)	0.719	0.003 (0.011)	0.799
5-year Cancer mortality	-0.124 (0.603)	0.837	0.295 (0.624)	0.962	-0.034 (0.136)	0.803
Cancer mortality	-0.121 (0.632)	0.849	-0.023 (0.639)	0.971	0.001 (0.124)	0.996
Long sleep duration						
Pan-cancer incidence	-0.389 (0.294)	0.185	-0.278 (0.524)	0.615	-0.001 (0.008)	0.973
All-cause mortality of cancer patients	0.114 (0.394)	0.773	0.217 (0.838)	0.804	0.001 (0.020)	0.959
5-year Cancer mortality	0.564 (0.606)	0.352	0.618 (0.913)	0.524	-0.057 (0.324)	0.866
Cancer mortality	0.069 (0.499)	0.890	0.094 (0.941)	0.924	0.324 (0.363)	0.407

* MR-Egger intercept was used to quantify the effect of directional pleiotropy. Values that significantly differ from zero indicated potential pleiotropy, which suggested exposure-associated genetic variables may influence the outcome through other pathways rather than through exposure.

eTable 38. Sensitivity analysis for insomnia and pan-cancer incidence and all-cause mortality of cancer patients using the Weighted median and MR-Egger methods.

Outcomes	Weighted median		MR-Egger			
	Beta (se)	P value	Beta (se)	P value	Intercept*	P value
Insomnia symptom						
Pan-cancer incidence	0.327 (0.147)	0.026	0.867 (0.235)	<0.001	-0.007 (0.002)	0.005
All-cause mortality of cancer patients	-0.015 (0.312)	0.961	0.016 (0.369)	0.966	0.001 (0.004)	0.854
5-year Cancer mortality	-0.159 (0.306)	0.603	-0.111 (0.324)	0.734	0.149 (0.095)	0.122
Cancer mortality	-0.145 (0.318)	0.649	-0.171 (0.385)	0.659	0.194 (0.106)	0.073

* MR-Egger intercept was used to quantify the effect of directional pleiotropy. Values that significantly differ from zero indicated potential pleiotropy, which suggested exposure-associated genetic variables may influence the outcome through other pathways rather than through exposure.