Extended Data

Extended Data Table 1. Summary of device ownership among cohort participants who provided their device information (n = 12,898). Note: Participants were allowed to report more than one device.

Fitbit Model	Type	Count
Charge 5	Wristband (2021)	2372
Charge 2	Wristband (2016)	2193
Versa 2	Smartwatch (2019)	1799
Charge 4	Wristband (2020)	1353
Sense	Smartwatch (2020)	1345
Charge 3	Wristband (2018)	1034
Versa 3	Smartwatch (2020)	912
Versa 4	Smartwatch (2022)	911
Versa	Smartwatch (2018)	857
Alta HR	Wristband (2017)	839
Inspire 2	Wristband (2020)	818
Luxe	Wristband (2021)	592
Inspire HR	Wristband (2019)	557
Blaze	Smartwatch (2016)	445
Sense 2	Smartwatch (2022)	393
Versa Lite	Smartwatch (2019)	346
Charge HR	Wristband (2015)	274
Inspire 3	Wristband (2022)	254
Google Pixel Watch	Smartwatch (2022)	180
Ionic	Smartwatch (2017)	168
Alta	Wristband (2016)	102
One	Clip (2012)	100
Surge	Smartwatch (2014)	87
Flex	Wristband (2013)	80
Flex 2	Wristband (2016)	75
Inspire	Wristband (2019)	71
Zip	Clip (2012)	56
Charge	Wristband (2014)	43
Ace 2	Wristband (2019)	<20
Force	Wristband (2013)	<20
Ultra	Clip (2011)	<20
Classic	Clip (2009)	<20
Google Pixel Watch 2	Smartwatch (2023)	<20
Ace 3	Wristband (2021)	<20

Extended Data Table 2: Demographics of each group of clusters from the intra-week patterns (columns in Figure 3B).

		Non-habitual low wear	Non-habitual high wear	Daytime Wear	Nighttime Wear	Morning Gap	Night Gap	Other (Membership < 20)
Total N		7,490	5,358	2,047	74	263	126	31
Number of days	Mean days/person	532 ± 319	1348 ± 345	1038 ± 406	1246 ± 445	1300 ± 384	1395 ± 326	1053 ± 311
Age	14-29	1173	546	162	<20	23	<20	<20
	30-39	1415	944	340	<20	45	<20	<20
	40-49	1232	895	359	<20	50	28	<20
	50-64	2253	1770	727	<20	86	44	<20
	65+	1380	1203	435	27	59	34	<20
Sex at birth	Female	5507	3618	1512	35	166	65	<20
	Male	1959	1711	520-530	39	97	61	<20
	Other/Unknown	24	29	<20	0	0	0	<20
Race	Asian	238	172	66	<20	<20	<20	<20
	Black or African American	446	218	180	<20	<20	<20	<20
	White	5888	4525	1591	61	211	99	25
	Other	481	263	94	<20	<20	<20	<20
	Unknown	437	180	116	<20	<20	<20	<20
Ethnicity	Not Hispanic or Latino	6744	4995	1871	67	243	116	<20
	Hispanic or Latino	625	297	153	<20	<20	<20	20-30
	Unknown/Other	121	66	23	<20	<20	<20	0
Income	<50k	1846	898	320	<20	35	<20	<20
	50-75k	1234	737	325	<20	39	22	<20
	75k-100k	1097	847	337	<20	50	30	<20
	100-150k	1447	1225	457	<20	63	<20	<20
	150-200k	661	618	223	<20	27	<20	<20
	>200k	770	765	266	<20	30-35	<20	<20
	Unknown	435	268	119	<20	<20	<20	<20

Extended Data Table 3. Chosen clinical outcomes based on the BRFSS, their corresponding question from BRFSS, and the list of Observational Medical Outcomes Partnership (OMOP) concept IDs used to define each clinical outcome.

Clinical Outcome	BRFSS Question	OMOP
Heart attack	(Ever told) (you had) heart attack, also called a myocardial infarction?	4329847
Angina	(Ever told) (you had) angina or coronary heart disease?	317576, 321318, 36712983
Stroke	(Ever told) (you had) a stroke.	197303, 36684840, 37395574, 37395575, 381316, 4045734, 40479572, 40480946, 40481354, 40481389, 40482266, 40482301, 40484101, 40484910, 4090122, 4110196, 4112022, 4116269, 42535112, 42535113, 42535114, 42535416, 42535417, 42535419, 42535459, 42535460, 42535461, 42535511, 42535512, 42539166, 42539195, 42539262, 43530623, 43530742, 43531610, 443465, 443525, 443551, 44782753, 44782781, 761785, 761789, 761790, 761792, 761793, 761794, 761795, 761796, 761797, 761798, 762340, 762344, 764721, 765568
Asthma	(Ever told) (you had) asthma?	317009
Skin cancer, not melanoma	(Ever told) (you had) skin cancer that is not melanoma?	138102, 435506
Cancer	(Ever told) (you had) melanoma or any other types of cancer?	443392
Chronic obstructive pulmonary disease (COPD)	(Ever told) (you had) C.O.P.D. (chronic obstructive pulmonary disease), emphysema or chronic bronchitis?	255573, 255841, 261325
Depressive disorder	(Ever told) (you had) a depressive disorder (including depression, major depression, dysthymia, or minor depression)?	433440, 440383
Kidney disease	Not including kidney stones, bladder infection or incontinence, were you ever told you had kidney disease?	198124
Arthritis	(Ever told) (you had) some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia? (Arthritis diagnoses include: rheumatism, polymyalgia rheumatica; osteoarthritis (not osteoporosis); tendonitis, bursitis, bunion, tennis elbow; carpal tunnel syndrome, tarsal tunnel syndrome; joint infection, etc.)	134453, 138845, 192885, 255348, 255891, 257628, 380094, 40405599, 4147145, 4180167, 42535223, 42535408, 42535409, 4291025, 4316217, 4344158, 440674, 443744, 760925, 762150, 762151, 80180, 80809, 81379
Type 2 diabetes mellitus	(Ever told) (you had) diabetes? (If 'Yes' and respondent is female, ask 'Was this only when you were pregnant?'. If Respondent says pre-diabetes or borderline diabetes, use response code 4.)	201826

Extended Data Table 4. Logistic regression and chi-square test results for associations between wear behavior and clinical outcomes. When level of wear was analyzed as a continuous variable, odds ratios from logistic regression are reported with their 95% confidence intervals in brackets. For categorical analyses, chi-square test statistics (χ^2), degrees of freedom (df), and p-values are provided. Significant results are highlighted in bold. The notation "S" indicates cases where Monte Carlo simulations were used to estimate p-values when applicable. COPD = Chronic Obstructive Pulmonary Disease, T2D = Type 2 Diabetes Mellitus.

	Level of Wear		**Non-habitual vs. Habitual**			**Non-habitual**		**Habitual**							
						Level of Wear		Level of Wear		Wear Patterns			Wear Subpatterns		
Clinical outcomes	**Odds ratio**	**p-value**	**χ^2**	**p-value**	**DoF**	**Odds ratio**	**p-value**	**Odds ratio**	**p-value**	**χ^2**	**p-value**	**DoF**	**χ^2**	**p-value**	**DoF**
Angina	0.97 [0.90, 1.05]	0.4422	0.47	0.4950	1	0.95 [0.87, 1.03]	0.2157	1.12 [0.93, 1.35]	0.2189	1.89	0.5947	3	9.48	0.7360	S
Arthritis	1.03 [0.98, 1.07]	0.2442	0.37	0.5446	1	1.02 [0.97, 1.07]	0.4175	1.08 [0.98, 1.20]	0.1380	1.76	0.6248	3	17.31	0.1853	13
Asthma	**0.91 [0.86, 0.97]**	**0.0019**	0.20	0.6540	1	**0.91 [0.86, 0.97]**	**0.0048**	0.90 [0.78, 1.03]	0.1299	0.55	0.9077	3	14.37	0.3453	S
Cancer	**1.10 [1.04, 1.16]**	**0.0018**	0.12	0.7270	1	**1.10 [1.03, 1.17]**	**0.0046**	1.12 [0.97, 1.29]	0.1386	3.57	0.3120	3	19.91	0.0961	S
COPD	0.94 [0.84, 1.05]	0.2989	0.81	0.3671	1	0.94 [0.84, 1.07]	0.3479	0.96 [0.72, 1.29]	0.7849	4.59	0.2024	S	16.48	0.2213	S
Depression	**0.83 [0.79, 0.87]**	**<0.0001**	**15.84**	**<0.0001**	**1**	**0.83 [0.79, 0.88]**	**<0.0001**	0.90 [0.79, 1.03]	0.1227	0.39	0.9413	3	**33.74**	**0.0026**	**S**
Heart attack	0.93 [0.81, 1.08]	0.3543	0.04	0.8377	1	0.91 [0.77, 1.07]	0.2356	1.16 [0.81, 1.67]	0.4112	**12.54**	**0.0122**	**S**	**28.79**	**0.0288**	**S**
Kidney disease	0.95 [0.89, 1.01]	0.0776	0.01	0.9229	1	**0.92 [0.86, 0.99]**	**0.0263**	1.11 [0.95, 1.29]	0.1994	1.89	0.5955	3	19.61	0.1014	S
Skin cancer (not melanoma)	1.03 [0.99, 1.07]	0.2091	**5.27**	**0.0217**	**1**	1.02 [0.97, 1.06]	0.4964	1.09 [0.98, 1.20]	0.1073	1.48	0.6877	3	10.62	0.6428	13
Stroke	0.91 [0.67, 1.22]	0.5212	0.24	0.6257	1	0.93 [0.66, 1.30]	0.6607	0.74 [0.37, 1.49]	0.3977	5.18	0.1566	S	13.18	0.3734	S
T2D	**0.93 [0.87, 1.00]**	**0.0471**	0.04	0.8425	1	**0.92 [0.86, 1.00]**	**0.0391**	1.00 [0.93, 1.35]	0.9892	4.40	0.2217	2	15.91	0.2400	S

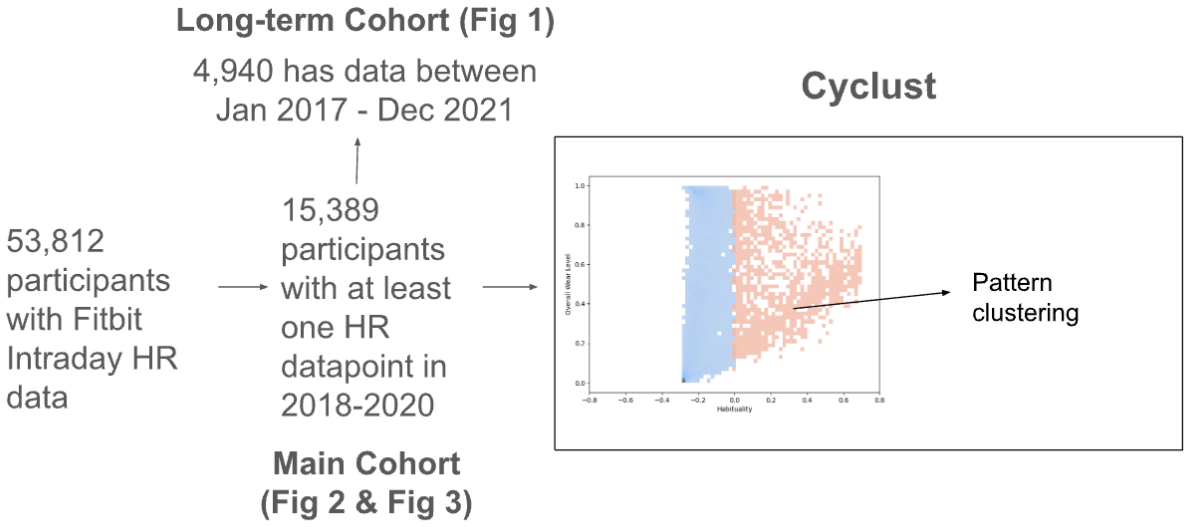
Extended Data Table 5. Prevalence of clinical outcomes across wear behavior groups. This table presents the prevalence rates (%) of key clinical outcomes across wear behavior groups (e.g., inconsistent vs. consistent wear) and further subgroups (e.g., high vs. low wear levels and wear patterns such as Daytime Wear, Nighttime Wear, Morning Gap, and Night Gap). Weekday-weekend uniformity is described as the row number, counted from the bottom of Figure 3B, where 1 represents the pattern with the lowest difference between weekday and weekend wear patterns, and 5 represents the highest difference. We denote the combination of wear pattern and weekday-weekend uniformity as "abbreviated wear pattern" - "weekday-weekend uniformity." For example, "D-1" denotes the Daytime Wear pattern with the lowest weekday-weekend uniformity. COPD = Chronic Obstructive Pulmonary Disease, T2D = Type 2 Diabetes Mellitus.

	Non-habitual (N=7874)			Habitual (N=1566)																	
Clinical Outcomes		**Low Wear (N=4633)**	**High Wear (N=3241)**		**Daytime Wear (N=1295)**					**Nighttime Wear (N=34)**			**Night Gap (N=71)**				**Morning Gap (N=166)**					
						D-1 (N=282)	**D-2 (N=482)**	**D-3 (N=468)**	**D-4 (N=63)**		**N-1 (N=24)**	**N-2 (N=10)**		**NG-1 (N=26)**	**NG-2 (N=32)**	**NG-3 (N=13)**		**MG-1 (N=13)**	**MG-2 (N=70)**	**MG-3 (N=31)**	**MG-4 (N=24)**	**MG-5 (N=28)**
Angina	7.07	7.6	7.07	7.6	7.18	8.16	8.51	5.77	3.17	8.82	8.33	10.00	9.86	7.69	12.5	7.69	9.64	15.38	10.00	12.9	8.33	3.57
Arthritis	37.5	36.65	37.5	36.65	36.45	40.78	39.42	30.98	34.92	47.06	50.00	40.00	38.03	34.62	40.62	38.46	35.54	23.08	41.43	41.94	20.83	32.14
Asthma	14.72	15.2	14.72	15.2	15.21	17.02	12.24	17.31	14.29	17.65	25.00	0.00	16.9	11.54	21.88	15.38	13.86	15.38	8.57	22.58	16.67	14.29
Cancer	13.72	13.35	13.72	13.35	12.66	14.54	13.28	11.32	9.52	20.59	20.83	20.00	15.49	23.08	15.62	0.00	16.27	0.00	21.43	16.13	25.00	3.57
COPD	3.49	3.00	3.49	3.00	2.70	2.84	2.28	2.99	3.17	2.94	4.17	0.00	7.04	11.54	6.25	0.00	3.61	7.69	1.43	9.68	0.00	3.57
Depression	23.22	18.58	23.22	18.58	18.61	17.38	13.07	24.15	25.40	14.71	16.67	10.00	18.31	26.92	12.5	15.38	19.28	15.38	20.00	35.48	4.17	14.29
Heart attack	1.97	1.85	1.97	1.85	1.31	1.42	1.45	1.28	0.00	2.94	4.17	0.00	4.23	0.00	9.38	0.00	4.82	7.69	7.14	3.23	0.00	3.57
Kidney Disease	11.87	11.75	11.87	11.75	11.27	14.18	9.96	10.9	11.11	14.71	20.83	0.00	15.49	3.85	25.00	15.38	13.25	0.00	12.86	22.58	8.33	14.29
Skin cancer, not melanoma	35.42	38.51	35.42	38.51	38.92	39.36	41.49	36.97	31.75	38.24	45.83	20.00	40.85	46.15	40.62	30.77	34.34	38.46	38.57	38.71	25.00	25.00
Stroke	0.44	0.57	0.44	0.57	0.54	0.71	0.41	0.43	1.59	2.94	4.17	0.00	1.41	3.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T2D	9.72	9.51	9.72	9.51	9.19	10.28	7.26	10.47	9.52	14.71	16.67	10.00	15.49	7.69	21.88	15.38	8.43	7.69	7.14	16.13	0.00	10.71

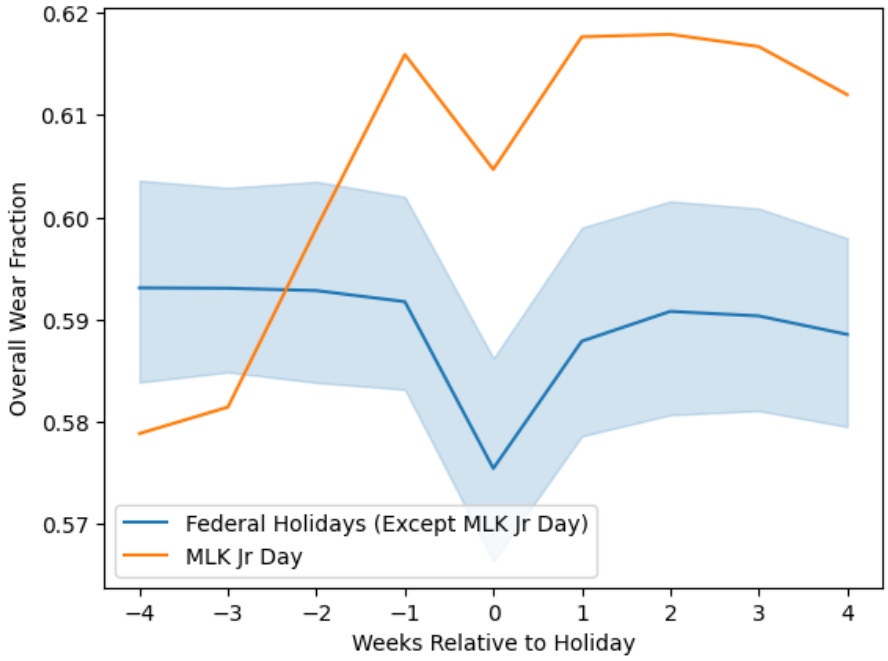
Extended Data Table 6. Results of Chi-Square tests examining the association between sub-patterns within each wear pattern (Daytime Wear, Nighttime Wear, Night Gap, and Morning Gap) and various clinical outcomes. Significant results after multiple testing corrections are bolded, and "S" denotes the use of Monte Carlo simulations to estimate p-values where applicable. COPD = Chronic Obstructive Pulmonary Disease, T2D = Type 2 Diabetes Mellitus.

Clinical Outcomes	Daytime wear			Nighttime Wear			Night Gap			Morning Gap		
	χ^2	p-value	DoF	χ^2	p-value	DoF	χ^2	p-value	DoF	χ^2	p-value	DoF
Angina	4.59	0.2045	3	0.02	1.0000	S	0.46	0.8689	S	2.11	0.7382	S
Arthritis	10.22	0.0168	3	0.28	0.7191	S	0.22	0.8953	2	4.90	0.2976	4
Asthma	5.65	0.1299	3	3.04	0.1507	S	1.12	0.6119	S	3.80	0.4364	S
Cancer	2.38	0.4971	3	0.00	1.0000	S	3.53	0.1956	S	8.55	0.0685	S
COPD	0.55	0.9089	3	0.43	1.0000	S	1.82	0.5025	S	5.75	0.2140	S
Depression	**21.43**	**<0.0001**	**3**	0.25	1.0000	S	2.09	0.4011	S	9.35	0.0529	4
Heart attack	0.94	0.8758	S	0.43	1.0000	S	3.82	0.2166	S	2.54	0.6503	S
Kidney Disease	3.29	0.3491	3	2.44	0.2936	S	4.90	0.0849	S	4.87	0.2944	S
Skin cancer, not melanoma	3.48	0.3231	3	1.99	0.2630	S	0.85	0.6537	2	2.93	0.5699	4
Stroke	1.69	0.6579	S	0.43	1.0000	S	1.76	0.5456	S	-	-	-
T2D	3.48	0.3234	3	0.25	1.0000	S	2.20	0.3157	S	4.94	0.2866	S

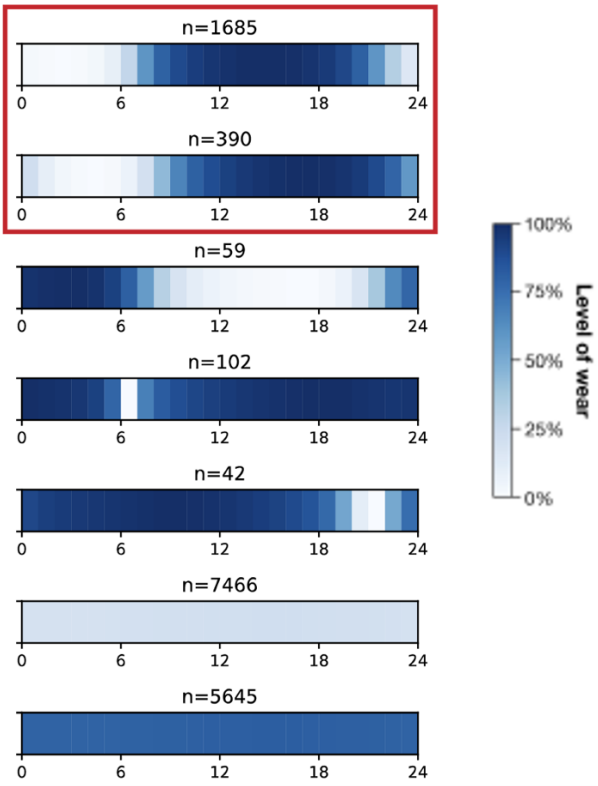
Extended Data Figure 1. Inclusion criteria for main cohort and long-term cohort. The flow diagram describes the inclusion criteria applied to define the Main Cohort and the Long-Term Cohort used for visualization and clustering.



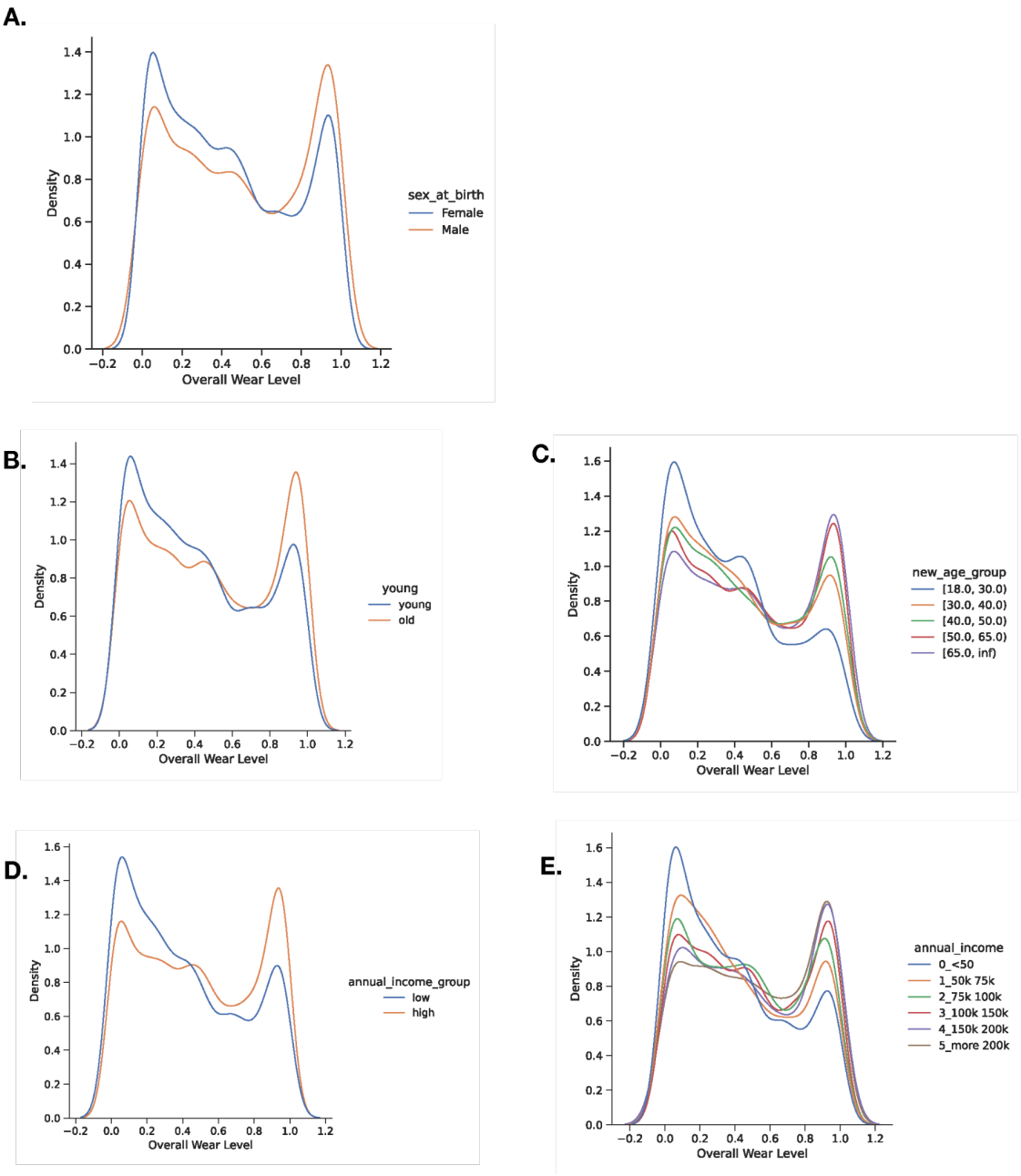
Extended Data Figure 2: Mean overall wear fraction of the long-term cohort (N=4,940) on federal holidays, and on the same day of the week in the 4 weeks preceding and following each holiday. Federal holidays included Martin Luther King Jr. Day, Presidents Day, Memorial Day, Independence Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving, and Christmas. On each holiday, the population has a tendency to wear their devices less than on the same day of the week in the vicinity of the holiday. Only MLK Jr day has a different trend, but being in early January, this is attributable to the increase in wear at the beginning of every year.



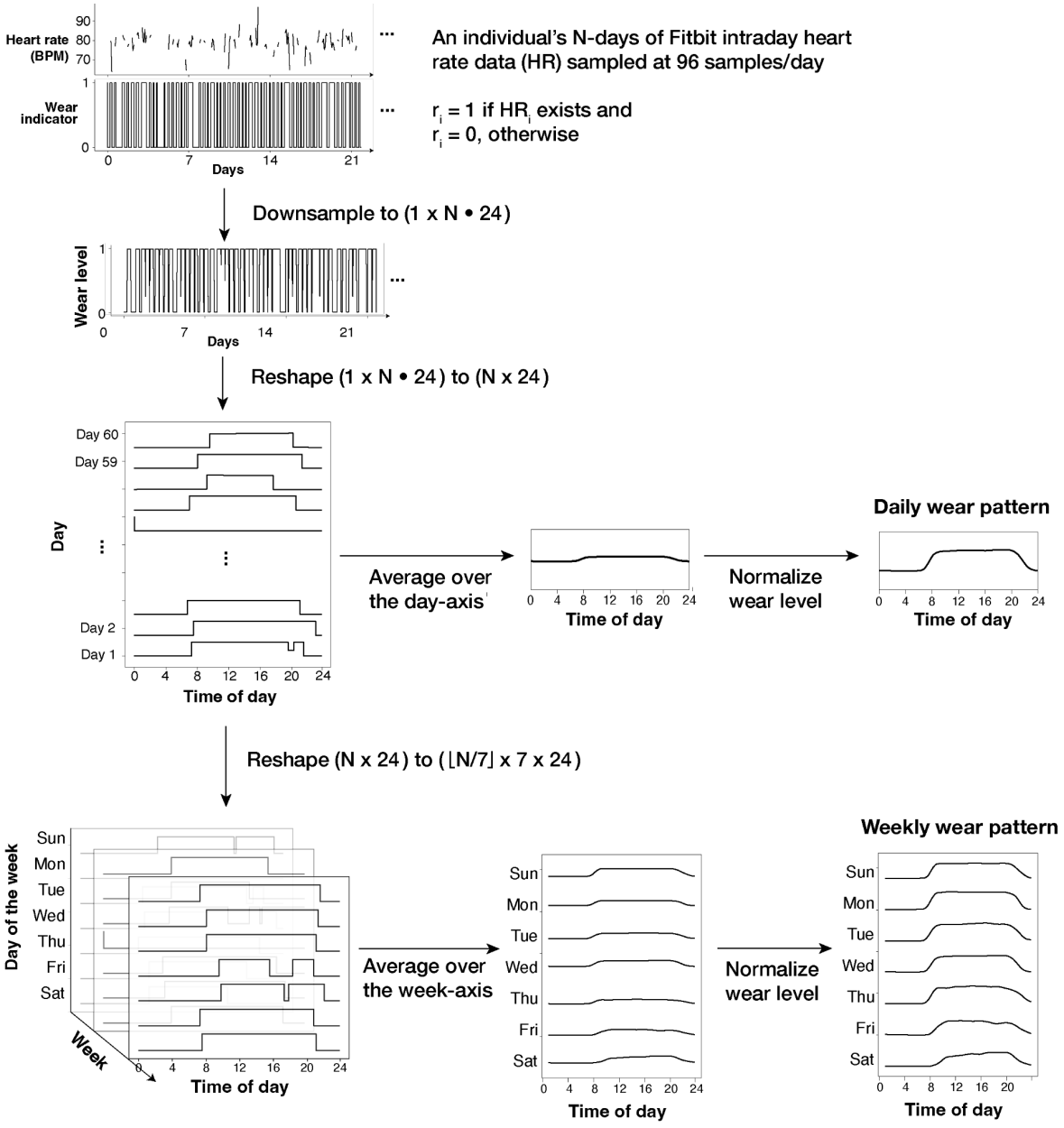
Extended Data Figure 3: Grouping similar patterns that were originally separated by the unsupervised agglomerative clustering algorithm. The final clusters presented in Figure 2B are a result of merging each of the boxed clusters together and recalculating the centroid. It should be noted that the non-habitual groups present in Figure 2B were excluded from this analysis.



Extended Data Figure 4: Kernel density estimation (KDE) plot of overall wear levels stratified by demographic characteristics. The curves are normalized by subgroup. (A) Displays wear level distributions across male vs female. (B) Compares wear levels between younger (<50 years) and older (≥50 years) individuals. (C) Shows wear level distributions across all age groups. (D) Examines wear levels by annual income, aggregated into low-income (<$75K) and high-income (≥$75K) groups. (E) Displays wear level distributions across all detailed income brackets.



Extended Data Figure 5: Algorithm steps for extracting daily and weekly wear patterns. First, a binary indicator vector for whether the watch is worn is generated at a 15 minute resolution, then downsampled to hour-level fractional wear. Next the vector is reshaped into a matrix such that each day occupies one row in the matrix. For the daily wear pattern, this matrix is aggregated along the day axis to get the average wear level at each hour of the day, then normalized to mean 0 and standard deviation 1. For the weekly wear pattern, the matrix is further reshaped into a tensor which is a stack of matrices that each represent one week of days. The tensor is then aggregated along the week axis to get the average wear level at every given hour of the day on every day of the week.



Extended Data Figure 6. Weekday-weekend consistency. The circadian and weekly consistency metrics are defined as the difference between the maximum and minimum values in an individual's intra-day or intra-week pattern vector (prior to normalization), respectively. Examples include: **(A)** an individual with high average wear level (more wear than non-wear days) but low consistency due to the differences in their timing and duration of wear; **(B)** an individual with low average wear levels (more non-wear than wear days) and low consistency; **(C)** an individual with high average wear levels and high consistency from wearing their device at consistent times; and **(D)** an individual with high weekly consistency from consistently wearing their device at similar times across all days of the week.