

The Fragile Families and Child Wellbeing Study

Sleep Actigraphy Data

Year 15 Follow-Up Wave

Public Use Version

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FILE OVERVIEW

The Fragile Families Sleep Actigraphy Dataset contains participant-level data that correspond to daily mean sleep actigraphy measures across approximately one week of data collection at Year 15. At Year 15, a randomly selected sub-sample (N=1,090) participating in Year 15 Home Visits was asked to wear an accelerometer on their non-dominant wrist for seven consecutive days to track their sleep.

The participants were instructed to wear the watch all the time, day or night, except when the watch could be damaged (participating in contact sports or exposed to extreme temperatures). The watch is water resistant, but participants were asked to take the device off while bathing or swimming.

While this data set includes all N=4898 family identifiers, sleep variables in the data are present only for the n=923 participants who provided at least one valid day of sleep actigraphy and are missing for n=3975 of the original N=4898. Please see the "Categorical (Flag) Variables" section for more information on sampling and excluded participants; see the "Data Methods" section for more information on data scoring and valid day criteria.

FILE LAYOUT

The file contains 4,898 observations (one per family) and is sorted by the family identifier *idnum*.

VARIABLE NAMING CONVENTION

Actigraphy variable names are up to 31 characters long. The first 2 characters contain the variable prefix "a6" to indicate these are actigraphy variables from the sixth wave of data collection (Year 15). The remaining characters indicate the type of variable measure, which include: timing and duration variables, data calculated across the full week, data calculated on weekdays (or weekends) only, 24-hour level measures or nighttime-only measures, and whether the variable was calculated by taking the count, mean, or standard deviation. Variable definitions are written out fully in the variable label in Stata, and detailed in the variable definitions in the "Detailed description of sleep variable categories" and "Data Dictionary" sections of this document. Below are some of the most common or crucial variable abbreviations.

<u>Position</u>	<u>Character</u>	<u>Indicates</u>
1	a	Actigraphy
2	6	Sixth wave (Year 15)
4-31	wk	Data during weekdays (includes Sun. night sleep – Fri. day)
4-31	wknd	Data during weekends (includes Fri. night – Sun. day)
4-31	mn	Mean
4-31	sd	Standard Deviation
4-31	dec	Decimal time
4-31	_c_	Decimal time is midnight-centered (e.g, midnight is 0, 1 AM is 1)
4-31	mins	Variable unit is in minutes

CATEGORICAL (FLAG) VARIABLES

There are two categorical flag variables in the data set (*a6_wavestatus*, *a6_napper*). All other variables are continuous.

a6_wavestatus

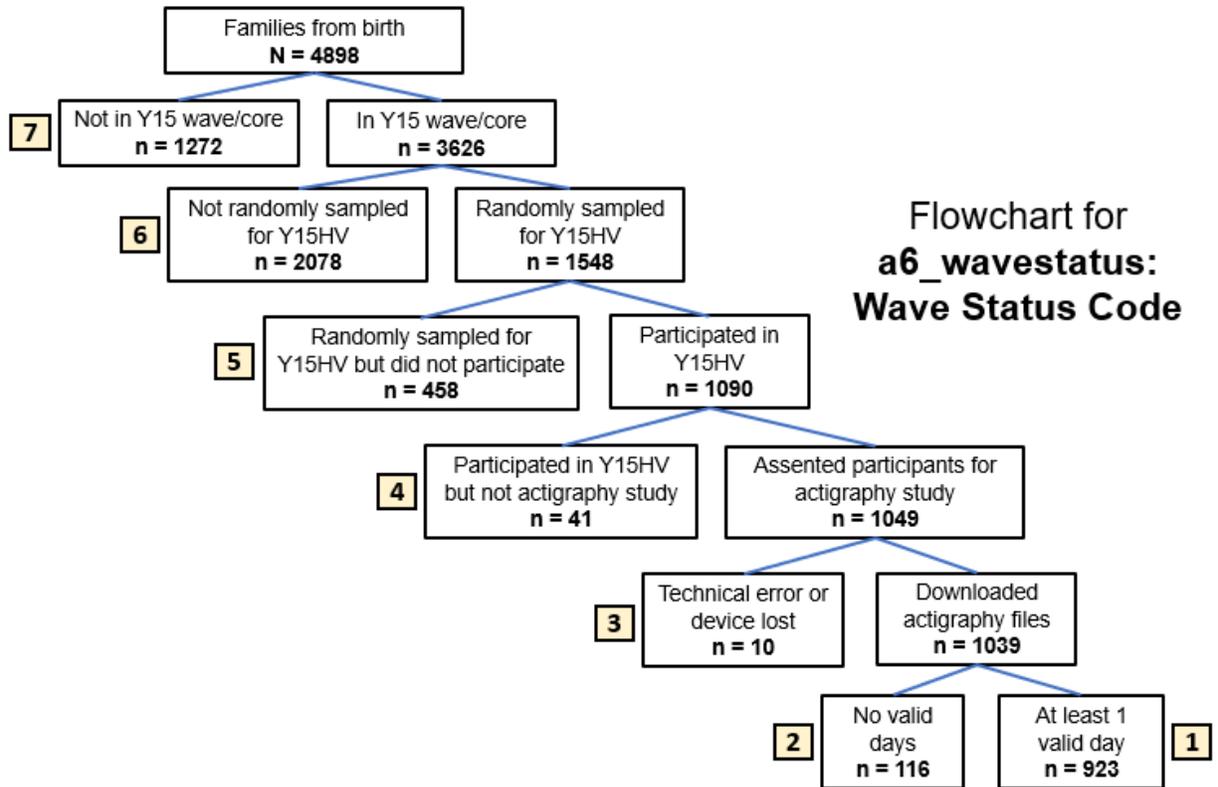
Variable “*a6_wavestatus: missing_ACT*” was created for the user to better understand which participants had non-missing values in this data set, as well as the reasons for missing data or exclusion from the actigraphy study sample. Participants who were selected to participate in the Year 15 Home Visit (Y15HV) were also asked to participate in the sleep actigraphy study. For more information about the Year 15 Home Visit, please see the [Year 15 User Guide](#). After the processing and scoring of the sleep actigraphy data, there were a total of n=923 participants who provided at least 1 valid day of data.

a6_wavestatus values and short description		
Value	Value label	Frequency
1	Non-missing; provided at least 1 valid day of actigraphy	923
2	Provided no valid days of actigraphy	116
3	Technical error or device lost	10
4	Participated in Y15HV but did not consent/assent to actigraphy study	41
5	Randomly sampled for Y15HV but did not participate	458
6	Not randomly sampled for Y15HV	2078
7	Not in Y15 wave/core	1272

Expanded description of a6_wavestatus values

Value 1 corresponds to the sample of participants in this data set who provided at least 1 valid day of sleep actigraphy. It is recommended to remove all other observations/participants in this data set (*a6_wavestatus* values 2-7) before analyzing the data, as remaining participants have missing values for all actigraphy variables. Value 2 corresponds to participants who did not provide at least 1 valid day of sleep actigraphy data, typically due to a participant not wearing the device for the instructed amount of time per day (see “Data Methods” for scoring rules). Value 3 corresponds to a subset of participant actigraphy data files that were unable to be retrieved, which includes: the participant lost the device, or there was a device or software error during data collection. Value 4 corresponds to the sample of participants that participated in the Year 15 Home Visit but did not agree to participate in the actigraphy study. Value 5 corresponds to participants who were randomly sampled to participate in the Year 15 Home Visit, but did not participate. Value 6 corresponds to the sample of age 15 participants who were not randomly sampled for the Year 15 Home Visit. Value 7 corresponds to the participants who were not in the age 15 wave or core (attrition from original birth cohort N).

Additionally, for user interpretation, a participant attrition flowchart figure (below) was created to correspond to *a6_wavestatus* values. Yellow boxes with numbers next to a Wave Status category on the figure represent each of 1-7 values in the Wave Status Code variable (labeled *missing_ACT*).



a6_napper

Variable “a6_napper: Actigraphic Nap Flag (has at least 1 nap)” indicates whether a participant had at least one nap calculated across the valid days in their sleep actigraphy. This variable is missing for any participants who do not have actigraphy data ($2 \leq a6_wavestatus \leq 7$).

a6_napper value and short description		
Value	Value label	Frequency
0	No naps	432
1	Has at least 1 nap	491

DATE VARIABLES

There are two date variables in this data set that contain information relating to when participants wore the sleep actigraphy device: *a6_year* (range: 2014-2016), *a6_month* (range: 1-12). For participants who provided at least 1 valid day of sleep data ($n=923$; $a6_wavestatus=1$), variables *a6_year* and *a6_month* are non-missing and indicate the year and month of the first valid day of sleep data for each individual. Variable *a6_month* is useful to data users who are interested in analyzing data within a subset of participants that participated in the study during specific times of the year (e.g. summer vs. school year).

MISSING DATA CODES

Unlike other Fragile Families and Child Wellbeing Study data and documentation, where missing data were given negative values and labels, missing data values in the sleep actigraphy data set are

represented in the data as “.” to avoid confusion. This decision is due to some variables containing true negative values, such as midnight-centered sleep timing (e.g. *nightslp_start_dec_c_mn*). Additionally, there are several types of missing values in this data set for participants who are in the n=923 sample, as some weekday/weekend/standard deviation variables cannot be calculated due to a participant not having more than 1 valid day in the full week, weekday, or weekend variable categories. When using this data set, it is recommended to first filter the data on only participants who provide at least 1 valid day of sleep actigraphy (*a6_wavestatus* = 1; N=923). The remainder of participants ($2 \leq a6_wavestatus \leq 7$) have no sleep actigraphy data.

DATA METHODS

Actigraphy device, software, and initial processing

Sleep actigraphy data were collected at 30-second epochs with a wrist-worn accelerometer (Actiwatch Spectrum; Philips-Respironics, Murrysville, PA) worn on a participant’s non-dominant wrist, day and night, for one week. Data collection occurred from 2014 to 2016 and during all months of the year, including summer months. Following the study period, the devices were mailed by the participant to a data coordinating center (Westat). Staff at Westat downloaded the actigraphy recording from each device using Philips Actiware software version 6.0.4 and shared via Secure File Transfer Protocol with staff in the Sleep, Health, and Society Collaboratory (SHSC) at Penn State. Staff in the SHSC exported the 30-second epoch data from Actiware 6.0.4 to CSVs in preparation for scoring. The medium sensitivity wake threshold option in the software (40 counts per minute) was selected in calculating sleep variables.

Scoring Methods

At least two independent, trained scorers reviewed and visually scored each recording using a standard validated algorithm (see 2013 Marino et al. Sleep; DOI: [10.5665/sleep.3142](https://doi.org/10.5665/sleep.3142)) in a graphical user interface. Scorers determined cut-point times, validity of days, and set sleep intervals, without using information from a sleep diary.

The cut-point selected for each recording determines the “start” and “end” of a 24-hour day. The preferred cut-point is at noon for each recording; however, the cut-point can be shifted (as close to noon as possible) to select a time that intersects the minimum number of sleep periods and off-wrist periods in a recording. Scorers determined sleep intervals using a decrease in activity levels and the aid of light levels for sleep onset and sleep offset. A nighttime sleep interval was split into two intervals (night sleep and nap) if there was an awakening ≥ 1 hour during this interval. Sleep intervals were not scored if the duration of an interval was less than 30 minutes; therefore, any nap or nighttime sleep duration must be greater or equal to 30 minutes.

After individual scoring was completed, the scorers adjudicated each recording for interrater agreement by verifying number of valid days, cut-point, number of sleep intervals (night sleep and naps), and differences greater than 15 minutes in duration and wake after sleep onset (WASO) for each sleep interval.

Valid Days

The accelerometer had an on-wrist detection feature that allowed scorers to view when participants

were not wearing the device. A sleep actigraphy day was determined invalid and no sleep interval was set if there were ≥ 4 total hours of off-wrist time, with the exception of the first and last day (device should be worn at least 2 hours before sleep onset on the first day), constant false activity due to battery failure, or an off-wrist period of ≥ 60 minutes within 10 minutes of the scored beginning or end of the night sleep period for that day. Participants with at least 1 valid day have non-missing data for most variables in this file. For analyses, is it recommended to use data for participants who have at least 3 valid days. A greater number of valid days for an individual provides better mean estimates of that individual's regular sleep patterns. However, each study may wish to consider appropriate sensitivity analyses to justify any specific cut-off choices. Variable "a6_vday_n" displays the number of valid days for each participant.

Sleep Variable Categories

Variables 5 (a6_vday_n) to 28 (a6_napper) reflect measures across the entire week of a participant's scored actigraphy recording. The next set of variables (29 – 49) reflect actigraphy measures for only weekdays in a participant's scored actigraphy (Monday – Friday), which includes Sunday night into Monday morning sleep. The remaining set of variables (50 – 70) reflect actigraphy measures for only weekend days in a participant's scored actigraphy (Saturday – Sunday), which includes Friday night into Saturday morning sleep.

Nighttime sleep measures, such as timing, duration, TST (total sleep time), WASO (wake after sleep onset), and sleep maintenance efficiency only include data from what is considered the participant's "nighttime sleep interval". The nighttime sleep interval duration was calculated as the number of minutes between sleep onset and sleep offset during the sleep interval, which was defined as the sleep interval with the longest duration between the hours of 10PM and 8AM in a 24-hour cut-point day. All other sleep intervals within the 24-hour cut-point day were considered naps and were not included in the nighttime sleep variable measures.

All variables, with the exception of the flag variables and date variables, can fall into 1 of 9 categories of sleep measures detailed below. Variables can be counts/sums, means, or standard deviations. Variable categories are indicated by "nighttime" or "24-hr/daily" or both. Exact variable names are listed below each category and exclude the "a6_" prefix in this section.

Detailed description of sleep variable categories

1. Number of Valid days

The number of valid days (integer) across the participant's entire recording, or only during weekdays, or only during weekends.

- Variables: vday_n, vday_wk_n, vday_wknd_n

2. Sleep onset timing (nighttime)

Sleep onset was defined as the nighttime sleep duration start time: the time of the last 30-second epoch of activity >10 counts followed by 5 consecutive epochs ≤ 10 , indicating the first epoch of sleep. Sleep onset timing variables were constructed as midnight-centered decimal time. For example, the time "0.00" indicates midnight/12:00AM, "-1.20" indicates 10:48PM (or 1.2 hours before midnight), and "2.45" indicates 2:27AM (or 2.45 hours after midnight).

- Variables: *nightslp_start_dec_c_mn*, *nightslp_start_dec_c_sd*,
nightslp_start_dec_c_wk_mn, *nightslp_start_dec_c_wk_sd*,
nightslp_start_dec_c_wknd_mn, *nightslp_start_dec_c_wknd_sd*
3. Sleep offset timing (nighttime)
Sleep offset was defined as the nighttime sleep duration end time: the time of the first 30-second epoch with activity count >10 preceded by 5 consecutive 30-second epochs ≤ 10, indicating the last epoch of sleep. Sleep offset timing variables were constructed as midnight-centered decimal time; however, in our data set, mean nighttime sleep offset was never before midnight.
- Variables: *nightslp_end_dec_mn*, *nightslp_end_dec_sd*, *nightslp_end_dec_wk_mn*,
nightslp_end_dec_wk_sd, *nightslp_end_dec_wknd_mn*, *nightslp_end_dec_wknd_sd*
4. Sleep midpoint timing (nighttime)
Sleep midpoint was defined as the time halfway between sleep onset and sleep offset during the nighttime sleep duration interval. Sleep midpoint timing variables were constructed as midnight-centered decimal time.
- Variables: *nightslp_mid_dec_c_mn*, *nightslp_mid_dec_c_sd*,
nightslp_mid_dec_c_wk_mn, *nightslp_mid_dec_c_wk_sd*,
nightslp_mid_dec_c_wknd_mn, *nightslp_mid_dec_c_wknd_sd*
5. Sleep duration (nighttime and 24-hr/daily)
Sleep duration is calculated as the total number of minutes between sleep onset and sleep offset in a sleep interval, including any wake time (minutes of WASO). Nighttime sleep duration (*nightsleepdur*) includes the number of minutes between sleep onset and sleep offset during the nighttime sleep interval only. 24-hour/daily sleep duration (*dailysleepdur*) includes the number of minutes in the nighttime sleep interval (*nightsleepdur*) plus any nap minutes within a 24-hr cut-point day.
- Variables: *dailysleepdur_mins_mn*, *dailysleepdur_mins_sd*, *nightsleepdur_mins_mn*,
nightsleepdur_mins_sd, *dailysleepdur_mins_wk_mn*, *dailysleepdur_mins_wk_sd*,
nightsleepdur_mins_wk_mn, *nightsleepdur_mins_wk_sd*,
dailysleepdur_mins_wknd_mn, *dailysleepdur_mins_wknd_sd*,
nightsleepdur_mins_wknd_mn, *nightsleepdur_mins_wknd_sd*
6. Total sleep time (nighttime and 24-hr/daily)
Total sleep time (TST) is calculated as the total number of minutes that are considered sleep between sleep onset and sleep offset in a sleep interval, and does not include any wake time (WASO). Nighttime TST (*nighttst*) includes the number of minutes of sleep between sleep onset and sleep offset during the nighttime sleep interval only. 24-hour/daily TST (*dailytst*) includes the number of minutes of sleep in the nighttime sleep interval (*nighttst*) plus any nap minutes within a 24-hr cut-point day.
- Variables: *dailytst_mins_mn*, *dailytst_mins_sd*, *nighttst_mins_mn*, *nighttst_mins_sd*,
dailytst_mins_wk_mn, *dailytst_mins_wk_sd*, *nighttst_mins_wk_mn*,
nighttst_mins_wk_sd, *dailytst_mins_wknd_mn*, *dailytst_mins_wknd_sd*,
nighttst_mins_wknd_mn, *nighttst_mins_wknd_sd*
7. Wake after sleep onset - WASO (nighttime)
WASO represents the number of minutes of wake between sleep onset and sleep offset during the nighttime sleep interval. The calculation of this variable is: $restwaso = nightsleepdur -$

nighttst. WASO is typically used as a measure of sleep quality; increased WASO indicates lower sleep quality.

- Variables: *restwaso_mins_mn*, *restwaso_mins_sd*, *restwaso_mins_wk_mn*, *restwaso_mins_wk_sd*, *restwaso_mins_wknd_mn*, *restwaso_mins_wknd_sd*

8. Sleep maintenance efficiency (nighttime)

Sleep maintenance efficiency (*smeff*) was defined as the percentage of minutes (unit: 0-100) of total sleep time (*nighttst*) between sleep onset and sleep offset in the nighttime sleep duration interval (*nightsleepdur*). The calculation of this variable is: $smeff = (nighttst / nightsleepdur) * 100$. Sleep maintenance efficiency is typically used as a measure of sleep quality; higher sleep maintenance efficiency indicates better quality sleep.

- Variables: *smeff_mn*, *smeff_sd*, *smeff_wk_mn*, *smeff_wk_sd*, *smeff_wknd_mn*, *smeff_wknd_sd*

9. Naps (24-hr/daily)

Nap measures include any sleep intervals in a 24-hr cut-point day that are not the nighttime sleep interval. The nap variables include: the mean minutes per day of total nap duration (i.e. *nap_mins_mn*), the total number of naps (sum) across all valid days (*nap_n_sum*), and the mean number of naps across all valid days (*nap_n_mn*). Flag variable *napper* indicates whether a participant napped at least once throughout their valid actigraphy days.

- *nap_mins_mn*, *nap_mins_sd*, *nap_n_sum*, *nap_n_mn*, *napper*, *nap_mins_wk_mn*, *nap_mins_wk_sd*, *nap_mins_wknd_mn*, *nap_mins_wknd_sd*

The data dictionary (table below) lists the variables and provides a short description for each.

DATA DICTIONARY

Note: Variable names listed in the data dictionary below exclude the “a6_” prefix. Please refer to the "Variable Naming Convention" section for more information.

#	Variable	Variable Description
1	idnum	Family ID
2	wavestatus	missing_ACT (Wave Status Code)
3	year	Year of Sleep Data Collection
4	month	Month of Sleep Data Collection
5	vday_n	Total Num of Valid Days
6	nightslp_start_dec_c_mn	Night Sleep Start Decimal Midnight-Centered Time - Mean
7	nightslp_start_dec_c_sd	Night Sleep Start Decimal Midnight-Centered Time - SD
8	nightslp_end_dec_mn	Night Sleep End Decimal Time - Mean
9	nightslp_end_dec_sd	Night Sleep End Decimal Time - SD
10	nightslp_mid_dec_c_mn	Night Sleep Midpoint Decimal Midnight-Centered Time - Mean
11	nightslp_mid_dec_c_sd	Night Sleep Midpoint Decimal Midnight-Centered Time - SD
12	dailysleepdur_mins_mn	Daily (24h) Sleep Duration in Min (includes WASO) - Mean
13	dailysleepdur_mins_sd	Daily (24h) Sleep Duration in Min (includes WASO) - SD
14	nightsleepdur_mins_mn	Night Sleep Duration in Min (includes WASO) - Mean
15	nightsleepdur_mins_sd	Night Sleep Duration in Min (includes WASO) - SD

16	dailytst_mins_mn	Daily (24h) Total Sleep Time in Min - Mean
17	dailytst_mins_sd	Daily (24h) Total Sleep Time in Min - SD
18	nighttst_mins_mn	Night Total Sleep Time in Min - Mean
19	nighttst_mins_sd	Night Total Sleep Time in Min - SD
20	restwaso_mins_mn	Night Wake After Night Sleep Onset in Min - Mean
21	restwaso_mins_sd	Night Wake After Night Sleep Onset in Min - SD
22	smeff_mn	Night Sleep Maintenance Efficiency in Percent - Mean
23	smeff_sd	Night Sleep Maintenance Efficiency in Percent - SD
24	nap_mins_mn	Daily Nap Duration in Min (includes WASO) – Mean
25	nap_mins_sd	Daily Nap Duration in Min - SD
26	nap_n_sum	Total Num of Naps across All Valid Days
27	nap_n_mn	Num of Naps Per Day - Mean
28	napper	Actigraphic Nap Flag (has at least 1 nap)
29	vday_wk_n	Total Num of Valid Weekdays
30	nightslp_start_dec_c_wk_mn	Night Sleep Start Decimal Midnight-Centered Time – Mean Weekdays
31	nightslp_start_dec_c_wk_sd	Night Sleep Start Decimal Midnight-Centered Time – SD Weekdays
32	nightslp_end_dec_wk_mn	Night Sleep End Decimal Time – Mean Weekdays
33	nightslp_end_dec_wk_sd	Night Sleep End Decimal Time – SD Weekdays
34	nightslp_mid_dec_c_wk_mn	Night Sleep Midpoint Decimal Midnight-Centered Time - Mean Weekdays
35	nightslp_mid_dec_c_wk_sd	Night Sleep Midpoint Decimal Midnight-Centered Time - SD Weekdays
36	dailysleepdur_mins_wk_mn	Daily (24h) Sleep Duration in Min (includes WASO) - Mean Weekdays
37	dailysleepdur_mins_wk_sd	Daily (24h) Sleep Duration in Min (includes WASO) - SD Weekdays
38	nightsleepdur_mins_wk_mn	Night Sleep Duration in Min (includes WASO) - Mean Weekdays
39	nightsleepdur_mins_wk_sd	Night Sleep Duration in Min (includes WASO) - SD Weekdays
40	dailytst_mins_wk_mn	Daily (24h) Total Sleep Time in Min - Mean Weekdays
41	dailytst_mins_wk_sd	Daily (24h) Total Sleep Time in Min - SD Weekdays
42	nighttst_mins_wk_mn	Night Total Sleep Time in Min - Mean Weekdays
43	nighttst_mins_wk_sd	Night Total Sleep Time in Min - SD Weekdays
44	restwaso_mins_wk_mn	Night Wake After Night Sleep Onset in Min - Mean Weekdays
45	restwaso_mins_wk_sd	Night Wake After Night Sleep Onset in Min - SD Weekdays
46	smeff_wk_mn	Night Sleep Maintenance Efficiency in Percent - Mean Weekdays
47	smeff_wk_sd	Night Sleep Maintenance Efficiency in Percent - SD Weekdays
48	nap_mins_wk_mn	Daily Nap Duration in Min (includes WASO) – Mean Weekdays
49	nap_mins_wk_sd	Daily Nap Duration in Min – SD Weekdays
50	vday_wknd_n	Total Num of Valid Weekend Days
51	nightslp_start_dec_c_wknd_mn	Night Sleep Start Decimal Midnight-Centered Time – Mean Weekends
52	nightslp_start_dec_c_wknd_sd	Night Sleep Start Decimal Midnight-Centered Time – SD Weekends
53	nightslp_end_dec_wknd_mn	Night Sleep End Decimal Time – Mean Weekends
54	nightslp_end_dec_wknd_sd	Night Sleep End Decimal Time – SD Weekends
55	nightslp_mid_dec_c_wknd_mn	Night Sleep Midpoint Decimal Midnight-Centered Time - Mean Weekends
56	nightslp_mid_dec_c_wknd_sd	Night Sleep Midpoint Decimal Midnight-Centered Time - SD Weekends

57	dailysleepdur_mins_wknd_mn	Daily (24h) Sleep Duration in Min (includes WASO) - Mean Weekends
58	dailysleepdur_mins_wknd_sd	Daily (24h) Sleep Duration in Min (includes WASO) - SD Weekends
59	nightsleepdur_mins_wknd_mn	Night Sleep Duration in Min (includes WASO) - Mean Weekends
60	nightsleepdur_mins_wknd_sd	Night Sleep Duration in Min (includes WASO) - SD Weekends
61	dailystst_mins_wknd_mn	Daily (24h) Total Sleep Time in Min - Mean Weekends
62	dailystst_mins_wknd_sd	Daily (24h) Total Sleep Time in Min - SD Weekends
63	nightstst_mins_wknd_mn	Night Total Sleep Time in Min - Mean Weekends
64	nightstst_mins_wknd_sd	Night Total Sleep Time in Min - SD Weekends
65	restwaso_mins_wknd_mn	Night Wake After Night Sleep Onset in Min - Mean Weekends
66	restwaso_mins_wknd_sd	Night Wake After Night Sleep Onset in Min - SD Weekends
67	smeff_wknd_mn	Night Sleep Maintenance Efficiency in Percent - Mean Weekends
68	smeff_wknd_sd	Night Sleep Maintenance Efficiency in Percent - SD Weekends
69	nap_mins_wknd_mn	Daily Nap Duration in Min (includes WASO) – Mean Weekends
70	nap_mins_wknd_sd	Daily Nap Duration in Min – SD Weekends

REFERENCES

The articles below used Year 15 Sleep Actigraphy Data. Date compiled: 1/21/2022.

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