Polysomnography Data Extraction and Analysis Specification –

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Definitions	
Variable	**Definition**
AASM	American Academy of Sleep Medicine
NREM	Non-Rapid Eye Movement sleep, epochs represented by N1, N2, N3
PSG	Polysomnography
REM	Rapid Eye Movement sleep, epochs represented by REM
A or Artefact	These are epochs in which either the recording was un-readable or epochs which should be excluded from the analysis (i.e. epochs from Recording Start until Lights Off and from Lights On until Recording End)
WAKE	Awake epochs represented by Wake

General Criteria

1. Ranges are based on a duration between 7 and 8 hours (420 and 480 mins) from LIGHTS OFF to LIGHTS ON. Please note that the code/script is specifically designed for a minimum of this duration and will not function correctly with shorter time ranges.
2. For all epochs between lights off and lights on, the following key should be used to identify stages of sleep:
    - an epoch equals one page of data, 30 seconds in duration
    - an entry of N1 equates to an epoch of NREM stage 1
    - an entry of N2 equates to an epoch of NREM stage 2
    - an entry of N3 equates to an epoch of NREM stage 3
    - an entry of REM equates to an epoch of stage REM
    - an entry of Wake equates to an epoch of Wake
    - an entry of A or Artefact equates to an epoch that cannot be scored.
3. An undefined epoch of sleep (scored as A or Artefact) will not be included in the final analysis of sleep parameters but will only denote a time period of 30 seconds (per epoch) within the total recording period.
4. Any recording with A or Artefact between LIGHTS OFF and LIGHTS ON will be identified and submitted for re-analysis. Unscored or un-scorable epochs are those in which, due to either the loss of connection or any other event, the stage of sleep is not clearly defined and cannot be assigned.
5. Recordings where A, Artefact or any other characters other than the valid characters defined above, are found between LIGHTS OFF and LIGHTS ON should be flagged.
6. Ranges in the PSG extraction output: labels & definitions table is meant as a reference for an 8 hour hypnogram.

PSG extraction output: labels & definitions

Variable Name	Unit	Name	Definition	Range	
RECSTART	(dd.mm.yyyy hh:mm:ss,SSS)	Recording Start	Defined as the time (dd.mm.yyyy hh:mm:ss,SSS) when the recording commenced. This time corresponds with the first epoch of the Hypnogram	n/a	n/a
RECEND	(dd.mm.yyyy hh:mm:ss,SSS)	Recording End	Defined as the time (dd.mm.yyyy hh:mm:ss,SSS) when the recording ended. This time corresponds with the last epoch of the Hypnogram	n/a	n/a
LIGHTOFF	(dd.mm.yyyy hh:mm:ss,SSS)	Lights off time	Defined as the time (dd.mm.yyyy hh:mm:ss,SSS) when laboratory lights are switched off. Corresponds with the start of the analysis period and the first epoch of scored data (WAKE, REM, NREM)	n/a	n/a
LIGHTON	(dd.mm.yyyy hh:mm:ss,SSS)	Lights on time	Defined as the time (dd.mm.yyyy hh:mm:ss,SSS) when laboratory lights are switched on. Corresponds with the end of the analysis period and the last epoch of scored data (WAKE, REM, NREM)	n/a	n/a
SOL	Minutes	Sleep Onset Latency (min)	Defined as the time in minutes occurring from lights off to the first epoch of NREM or REM	00	120
LPS	Minutes	Latency to persistent sleep (min)	Defined as the time in minutes from lights off to the first consecutive 20 epochs of NREM or REM	00	240
FINALAWK	Epoch	Final awakening	Defined as the first epoch of wake which is not followed by any epoch of NREM, REM or lights on, whichever comes first	840	960
TRT	Minutes	Total recording time (mins)	Defined as the time in minutes from lights off to lights on. This time constitutes the sleep opportunity period. Epochs of sleep are only scored between these two points.	420	480
TST	Minutes	Total sleep time (min)	Defined as the time in minutes scored as NREM or REM, excluding epochs of Unsure and Wake within the period between lights off and lights on	120	420
SPT	Minutes	Sleep Period Time (min)	Defined as the total time in minutes scored as NREM, REM, WAKE occurring from sleep onset until lights on or the FINALAWK, whichever comes first	120	420
DUR _W	Minutes	Stage W duration (min)	Defined as the time in minutes scored as WAKE from lights off to lights on	01	240
DUR_N1	Minutes	Stage N1 duration (min)	Defined as the time in minutes scored as N1 from lights off to lights on	01	160
PTST_N1	Percent	Percent of TST for Stage N1	Defined as the percentage of epochs scored as N1 within TST (time in N1/TST) x100	01	20
DUR_N2	Minutes	Stage N2 duration (min)	Defined as the time in minutes scored as N2 from lights off to lights on	01	360

PTST_N2	Percent	Percent of TST for Stage N2	Defined as the percentage of epochs scored as N2 within TST (time in N2/TST) x100	01	50
DUR_N3	Minutes	Stage N3 duration (min)	Defined as the time in minutes scored as N3 from lights off to lights on	01	180
PTST_N3	Percent	Percent of TST for Stage N3	Defined as the percentage of epochs scored as N3 within TST (time in N3/TST) x100	01	40
DUR_REM	Minutes	Duration of REM sleep (min)	Defined as the time in minutes scored as REM from lights off to lights on	00	220
PTST_REM	Percent	Percent of TST for REM sleep	Defined as the percentage of epochs scored as REM within TST (time in REM/TST) x100	00	40
DUR_NREM	Minutes	Duration of NREM sleep	Defined as the time in minutes scored as NREM from lights off to lights on	240	420
PTST_NREM	Percent	Percent of TST for NREM sleep	Defined as percentage of epochs scored as NREM within TST (time in NREM/TST) x100	01	90
SEFF	Percentage	Sleep Efficiency (%)	Defined as the percentage of TST against TRT (TST/TRT x 100)	40	99
STAGEC	Count	Number of stage changes	Defined as the number of stage transitions from sleep onset until lights on or FINALAWK	50	420
TAWAKE	Minutes	Total Time Awake from SOL (min)	Defined as the time in minutes scored as wake from sleep onset to lights on or FINALAWK	01	320
NAW	Count	Number of night awakenings after LPS until lights on	Defined as the number of blocks of consecutive epochs (minimum of 2) of wake from LPS until lights on	01	60
NAWSP	Count	Number of awakenings after LPS until final awakening	Defined as the number of blocks of consecutive (minimum of 2) epochs of wake from NAW until FINALAWK	01	60
WASO	Minutes	Wake after sleep onset (min)	Defined as the time in minutes of epochs scored as wake from SOL until lights on (WASO; TRT-SOL-TST)	00	300
WASOSP	Minutes	Total duration of awakenings after sleep onset until the final awakening	Defined as the time in minutes of epochs scored as wake from SOL until FINALAWK	00	300
WAS	Minutes	Wake after sleep	Defined as the time in minutes from final awakening to lights on	00	120

N2_LAT	Minutes	Latency to stage N2	Defined as the time in minutes from lights off to the first epoch of N2	01	90
N3_LAT	Minutes	Latency to N3 (min)	Defined as the time in minutes from SOL to the first epoch of N3	01	120
REM_LAT	Minutes	REM Sleep Latency	Defined as the time in minutes from SOL to the first epoch of REM	00	320
REMRATIO	Ratio	REM/NREM ratio	Defined as the total duration of REM divided by the total duration of NREM	00	0.4
EUS	Count	Epochs of Un-scored Sleep	Defined as the time in minutes scored as A or Artefact between LIGHTOFF to LIGHTON	n/a	n/a
DUR_W_THRD1	Minutes	Duration of Stage W during 1st 3rd of night (min)	Defined as the time in minutes scored as AWAKE occurring within the 1st 3rd of the period from lights off to lights on	00	100
DUR_W_THRD2	Minutes	Duration of Stage W during 2nd 3rd of night (min)	Defined as the time in minutes scored as AWAKE occurring within the 2nd 3rd of the period from lights off to lights on	00	100
DUR_W_THRD3	Minutes	Duration of Stage W during the final 3rd of night (min)	Defined as the time in minutes scored as AWAKE occurring within the final 3rd of the period from lights off to lights on	00	200
DUR_N1_THRD1	Minutes	Duration of Stage N1 sleep during 1st 3rd of night (min)	Defined as the time in minutes scored as N1 occurring within the 1st 3rd of the period from lights off to lights on	00	50
DUR_N1_THRD2	Minutes	Duration of Stage N1 sleep during 2nd 3rd of night (min)	Defined as the time in minutes scored as N1 occurring within the 2nd 3rd of the period from lights off to lights on	00	50
DUR_N1_THRD3	Minutes	Duration of Stage N1 sleep during final 3rd of night (min)	Defined as the time in minutes scored as N1 occurring within the final 3rd of the period from lights off to lights on	00	50
DUR_N2_THRD1	Minutes	Duration of Stage N2 sleep during 1st 3rd of night (min)	Defined as the time in minutes scored as N2 occurring within the 1st 3rd of the period from lights off to lights on	00	150
DUR_N2_THRD2	Minutes	Duration of Stage N2 sleep during 2nd 3rd of night (min)	Defined as the time in minutes scored as N2 occurring within the 2nd 3rd of the period from lights off to lights on	00	150
DUR_N2_THRD3	Minutes	Duration of Stage N2 sleep during the final 3rd of night (min)	Defined as the time in minutes scored as N2 occurring within the final 3rd of the period from lights off to lights on	00	150
DUR_N3_THRD1	Minutes	Duration of Stage N3 sleep during 1st 3rd of night (min)	Defined as the time in minutes scored as N3 occurring within the 1st 3rd of the period from lights off to lights on	00	150

DUR_N3_THRD2	Minutes	Duration of Stage N3 sleep during 2nd 3rd of night (min)	Defined as the time in minutes scored as N3 occurring within the 2nd 3rd of the period from lights off to lights on	00	100
DUR_N3_THRD3	Minutes	Duration of Stage N3 sleep during the final 3rd of night (min)	Defined as the time in minutes scored as N3 occurring within the final 3rd of the period from lights off to lights on	00	80
DUR_REM_THRD1	Minutes	Duration of Stage REM sleep during 1st 3rd of night (min)	Defined as the time in minutes scored as REM occurring within the 1st 3rd of the period from lights off to lights on	00	80
DUR_REM_THRD2	Minutes	Duration of Stage REM sleep during 2nd 3rd of night (min)	Defined as the time in minutes scored as REM occurring within the 2nd 3rd of the period from lights off to lights on	00	100
DUR_REM_THRD3	Minutes	Duration of Stage REM sleep during the final 3rd of night (min)	Defined as the time in minutes scored as REM occurring within the final 3rd of the period from lights off to lights on	00	150
NAWSL_THRD1	Count	Number of night awakenings from Sleep onset during 1st 3rd of night	Defined as the number of blocks of consecutive epochs of wake occurring within the 1st 3rd of the period from sleep onset to lights on	00	30
NAWSL_THRD2	Count	Number of night awakenings from Sleep onset during 2nd 3rd of night	Defined as the number of blocks of consecutive epochs of wake occurring within the 2nd 3rd of the period from sleep onset to lights on	00	30
NAWSL_THRD3	Count	Number of night awakenings from Sleep onset during the final 3rd of night	Defined as the number of blocks of consecutive epochs of wake occurring within the final 3rd of the period from sleep onset to lights on	00	30
DUR_W_HR1	Minutes	Duration of Stage W during 1st hour of night (min)	Defined as the time in minutes scored as AWAKE occurring within the 1st hour from lights off	00	60
DUR_N1_HR1	Minutes	Duration of Stage N1 during 1st hour of night (min)	Defined as the time in minutes scored as N1 occurring within the 1st hour from lights off	00	60
DUR_N2_HR1	Minutes	Duration of Stage N2 during 1st hour of night (min)	Defined as the time in minutes scored as N2occurring within the 1st hour from lights off	00	60

DUR_N3_HR1	Minutes	Duration of Stage N3 during 1st hour of night (min)	Defined as the time in minutes scored as N3 occurring within the 1st hour from lights off	00	60
DUR_REM_HR1	Minutes	Duration of Stage REM during 1st hour of night (min)	Defined as the time in minutes scored as REM occurring within the 1st hour from lights off	00	60
NAWSL_HR1	Count	Number of night awakenings from SL during 1st hour of night	Defined as the number of blocks of consecutive epochs of wake within the 1st hour from lights off	00	10
DUR_W_HR2	Minutes	Duration of Stage W during 2nd hour of night (min)	Defined as the time in minutes scored as AWAKE occurring within the 2nd hour from lights off	00	60
DUR_N1_HR2	Minutes	Duration of Stage N1 during 2nd hour of night (min)	Defined as the time in minutes scored as N1 occurring within the 2nd hour from lights off	00	60
DUR_N2_HR2	Minutes	Duration of Stage N2 during 2nd hour of night (min)	Defined as the time in minutes scored as N2occurring within the 2nd hour from lights off	00	60
DUR_N3_HR2	Minutes	Duration of Stage N3 during 2nd hour of night (min)	Defined as the time in minutes scored as N3 occurring within the 2nd hour from lights off	00	60
DUR_REM_HR2	Minutes	Duration of Stage REM during 2nd hour of night (min)	Defined as the time in minutes scored as REM occurring within the 2nd hour from lights off	00	60
NAWSL_HR2	Count	Number of night awakenings from SL during 2nd hour of night	Defined as the number of blocks of consecutive epochs of wake within the 2nd hour from lights off	00	10
DUR_W_HR3	Minutes	Duration of Stage W during 3rd hour of night (min)	Defined as the time in minutes scored as AWAKE occurring within the 3rd hour from lights off	00	60
DUR_N1_HR3	Minutes	Duration of Stage N1 during 3rd hour of night (min)	Defined as the time in minutes scored as N1 occurring within the 3rd hour from lights off	00	60

DUR_N2_HR3	Minutes	Duration of Stage N2 during 3rd hour of night (min)	Defined as the time in minutes scored as N2occurring within the 3rd hour from lights off	00	60
DUR_N3_HR3	Minutes	Duration of Stage N3 during 3rd hour of night (min)	Defined as the time in minutes scored as N3 occurring within the 3rd hour from lights off	00	60
DUR_REM_HR3	Minutes	Duration of Stage REM during 3rd hour of night (min)	Defined as the time in minutes scored as REM occurring within the 3rd hour from lights off	00	60
NAWSL_HR3	Count	Number of night awakenings from SL during 3rd hour of night	Defined as the number of blocks of consecutive epochs of wake within the 3rd hour from lights off	00	10
DUR_W_HR4	Minutes	Duration of Stage W during 4th hour of night (min)	Defined as the time in minutes scored as AWAKE occurring within the 4th hour from lights off	00	60
DUR_N1_HR4	Minutes	Duration of Stage N1 during 4th hour of night (min)	Defined as the time in minutes scored as N1 occurring within the 4th hour from lights off	00	60
DUR_N2_HR4	Minutes	Duration of Stage N2 during 4th hour of night (min)	Defined as the time in minutes scored as N2occurring within the 4th hour from lights off	00	60
DUR_N3_HR4	Minutes	Duration of Stage N3 during 4th hour of night (min)	Defined as the time in minutes scored as N3 occurring within the 4th hour from lights off	00	60
DUR_REM_HR4	Minutes	Duration of Stage REM during 4th hour of night (min)	Defined as the time in minutes scored as REM occurring within the 4th hour from lights off	00	60
NAWSL_HR4	Count	Number of night awakenings from SL during 4th hour of night	Defined as the number of blocks of consecutive epochs of wake within the 4th hour from lights off	00	10
DUR_W_HR5	Minutes	Duration of Stage 0 during 5th hour of night (min)	Defined as the time in minutes scored as AWAKE occurring within the 5th hour from lights off	00	60

DUR_N1_HR5	Minutes	Duration of Stage N1 during 5th hour of night (min)	Defined as the time in minutes scored as N1 occurring within the 5th hour from lights off	00	60
DUR_N2_HR5	Minutes	Duration of Stage N2 during 5th hour of night (min)	Defined as the time in minutes scored as N2occurring within the 5th hour from lights off	00	60
DUR_N3_HR5	Minutes	Duration of Stage N3 during 5th hour of night (min)	Defined as the time in minutes scored as N3 occurring within the 5th hour from lights off	00	60
DUR_REM_HR5	Minutes	Duration of Stage REM during 5th hour of night (min)	Defined as the time in minutes scored as REM occurring within the 5th hour from lights off	00	60
NAWSL_HR5	Count	Number of night awakenings from SL during 5th hour of night	Defined as the number of blocks of consecutive epochs of wake within the 5th hour from lights off	00	10
DUR_W_HR6	Minutes	Duration of Stage W during 6th hour of night (min)	Defined as the time in minutes scored as AWAKE occurring within the 6th hour from lights off	00	60
DUR_N1_HR6	Minutes	Duration of Stage N1 during 6th hour of night (min)	Defined as the time in minutes scored as N1 occurring within the 6th hour from lights off	00	60
DUR_N2_HR6	Minutes	Duration of Stage N2 during 6th hour of night (min)	Defined as the time in minutes scored as N2occurring within the 6th hour from lights off	00	60
DUR_N3_HR6	Minutes	Duration of Stage N3 during 6th hour of night (min)	Defined as the time in minutes scored as N3 occurring within the 6th hour from lights off	00	60
DUR_REM_HR6	Minutes	Duration of Stage REM during 6th hour of night (min)	Defined as the time in minutes scored as REM occurring within the 6th hour from lights off	00	60
NAWSL_HR6	Count	Number of night awakenings from SL during 6th hour of night	Defined as the number of blocks of consecutive epochs of wake within the 6th hour from lights off	00	10

DUR_W_HR7	Minutes	Duration of Stage W during 7th hour of night (min)	Defined as the time in minutes scored as AWAKE occurring within the 7th hour from lights off	00	60
DUR_N1_HR7	Minutes	Duration of Stage N1 during 7th hour of night (min)	Defined as the time in minutes scored as N1 occurring within the 7th hour from lights off	00	60
DUR_N2_HR7	Minutes	Duration of Stage N2 during 7th hour of night (min)	Defined as the time in minutes scored as N2occurring within the 7th hour from lights off	00	60
DUR_N3_HR7	Minutes	Duration of Stage N3 during 7th hour of night (min)	Defined as the time in minutes scored as N3 occurring within the 7th hour from lights off	00	60
DUR_REM_HR7	Minutes	Duration of Stage REM during 7th hour of night (min)	Defined as the time in minutes scored as REM occurring within the 7th hour from lights off	00	60
NAWSL_HR7	Count	Number of night awakenings from SL during 7th hour of night	Defined as the number of blocks of consecutive epochs of wake within the 7th hour from lights off	00	10
DUR_W_HR8	Minutes	Duration of Stage W during 8th hour of night (min)	Defined as the time in minutes scored as AWAKE occurring within the 8th hour from lights off	00	60
DUR_N1_HR8	Minutes	Duration of Stage N1 during 8th hour of night (min)	Defined as the time in minutes scored as N1 occurring within the 8th hour from lights off	00	60
DUR_N2_HR8	Minutes	Duration of Stage N2 during 8th hour of night (min)	Defined as the time in minutes scored as N2occurring within the 8th hour from lights off	00	60
DUR_N3_HR8	Minutes	Duration of Stage N3 during 8th hour of night (min)	Defined as the time in minutes scored as N3 occurring within the 8th hour from lights off	00	60
DUR_REM_HR8	Minutes	Duration of Stage REM during 8th hour of night (min)	Defined as the time in minutes scored as REM occurring within the 8th hour from lights off	00	60

NAWSL_HR8	Count	Number of night awakenings from SL during 8th hour of night	Defined as the number of blocks of consecutive epochs of wake within the 8th hour from lights off	00	10

References to related works:

- Revell VL, Della Monica C, Mendis J, Hassanin H, Halter RJ, Chaplan SR, Dijk DJ. Effects of the selective orexin-2 receptor antagonist JNJ-48816274 on sleep initiated in the circadian wake maintenance zone: a randomised trial. Neuropsychopharmacology. 2022. doi: 10.1038/s41386-021-01175-3

- Kiran K G Ravindran, C. della Monica, G. Atzori, D. Lambert, H. Hassanin, V. Revell, and D.-J. Dijk, “Three Contactless Sleep Trackers Compared with Polysomnography and Actigraphy in a Heterogenous Group of Older Men and Women in a Model of Mild Sleep Disturbance”, JMIR mHealth and uHealth, 2023. (DOI: https://doi.org/10.2196/46338)