

Objective Sleep by Age and Sex in a Large At-Home Sample

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Background and Aims:

It is well known that differences in sleep quality and architecture arise across the age spectrum and between males and females. However, few studies have investigated the effects of both factors across the adult lifespan.

Data collected via Zeo (Zeo, Inc, Newton, MA), a consumer product that measures sleep stage information in users' homes, were uploaded to a central database voluntarily by consumers who purchased the product. The data were then de-identified and collated into the Data Observations of the Zeo Extraction Registry (DOZER), an IRB-approved research database.

The aim of this study was to investigate the cross-sectional relationships between age, biological sex, and sleep in the home in a large sample from DOZER.

Methods:

Subjects:

- Data from subjects who uploaded at least one night of nocturnal sleep data of at least 3 hours as of May 4, 2011 were included.
- 9,930 subjects (25% female), 418,391 nights, Aged 17-90+ years

Data Analysis:

- Average sleep measures were generated for each subject:
 - Total Sleep Time (TST) – total sleep between bedtime and rise time
 - Bedtime – time subject started collecting data
 - Rise Time – time of the epoch after the last epoch scored as sleep
 - Latency to Persistent Sleep (LPS) – from bedtime to first of 10 continuous minutes of scored sleep
 - Wake Time During Sleep (WTDS) – wake between LPS and rise time
 - Number of Awakenings (NA) – times woken for at least 2 continuous minutes
 - Percentage of REM sleep (%REM)– time in REM sleep divided by TST *100
 - Percentage of Light sleep (%Light) – time in Light sleep (stages 1 and 2) divided by TST * 100
 - Percentage of Deep sleep (%Deep) – time in Deep sleep (stages 3 and 4) divided by TST *100
- Subjects were grouped into 6 age categories (17-29, 30-39, 40-49, 50-59, 60-69, 70+) for two-way factorial ANOVA (age, sex, age x sex).
 - An α value of 0.001 was set to account for the large sample size
- Effect size correlations for the main and interaction effects were calculated by eta-squared (η^2).
 - Values of at least 0.0099 are considered small effects, values of at least 0.0588 medium, and those of at least 0.1379 large.
 - Negative signs on effect sizes indicate a negative trend for age, or that women have a higher value when comparing by sex.

Results:

Significant main effects of age were found for all sleep measures. Significant main effects of sex were found for all sleep measures except TST and Rise Time. Significant age by sex interaction effects were found for %Light, %Deep, Bedtime, and Rise Time.

Effect sizes of age were medium for WTDS, NA, and %Deep, and small for TST, %Light, Bedtime, and Rise Time. Effect sizes of sex were small for LPS, NA, and %REM. All other effect sizes were very small.

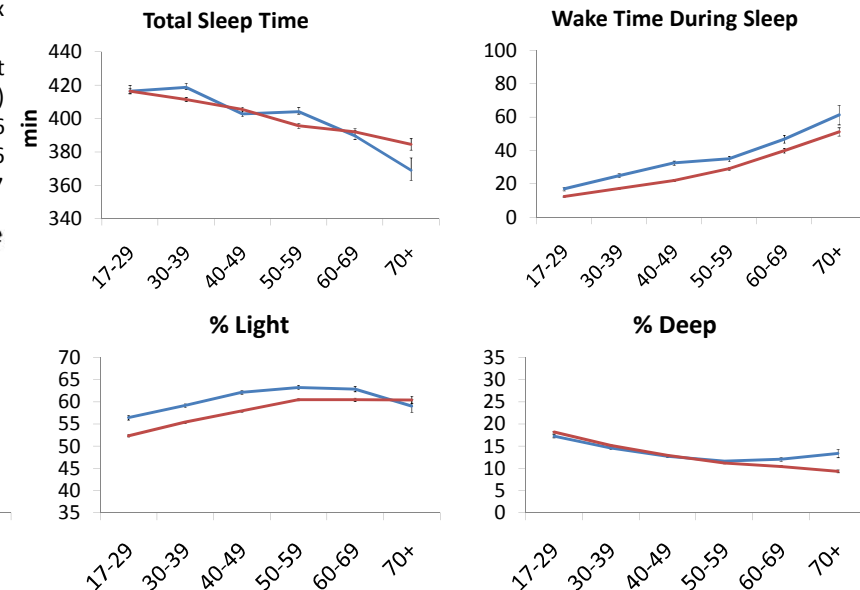
Plots of sleep measures by age show the main and interaction effects of age and sex (error bars = SEM).

Significant differences between sexes not shown in plots were found for LPS(min) (mean \pm SD) 21.5 \pm 16.8 females, 15.9 \pm 12.6 males; NA(#) 4.7 \pm 2.9 females, 3.6 \pm 2.6 males; and Bedtime(time \pm min) 23:27 \pm 77 females, 23:44 \pm 83 males.

	Age		Sex		Age x Sex	
	F (5, 11)	Effect Size	F (1, 11)	Effect Size	F (5, 11)	Effect Size
TST	46.67*	-0.0228	0.26	-0.0000	3.99	0.0020
WTDS	181.69*	0.0804	84.53*	-0.0075	2.10	0.0009
LPS	12.00*	0.0058	203.64*	-0.0198	0.32	0.0002
NA	153.26*	0.0672	155.99*	-0.0137	2.49	0.0011
%REM	6.70*	-0.0032	212.24*	0.0205	1.15	0.0006
%Light	120.04*	0.0539	95.64*	-0.0086	5.50*	0.0025
%Deep	207.8*	-0.0890	17.72*	0.0015	11.60*	0.0050
Bedtime	104.36*	-0.0478	26.73*	0.0024	7.64*	0.0035
Rise Time	112.46*	-0.0517	0.10	0.0000	6.63*	0.0030

Two-way factorial ANOVA, * $p < 0.0001$

Effect size: η^2 , very small < 0.0099 , small ≥ 0.0099 , medium ≥ 0.0588



Discussion and Conclusion:

Less TST and %Deep, more %Light and WTDS, higher NA and earlier Bed- and Rise- Times occur across increasing age groups. Also, women tend to experience a longer LPS, higher NA than men. Age effect sizes tended to be smaller than previously reported, though were directionally consistent. Though effect sizes were small, the significant difference in the percentage of REM sleep between sexes (higher in men) was unexpected. Differences between this and previous reports may be accounted for by an unscreened heterogeneous sample, with relatively high socio-economic status, and displayed ability with wireless and internet technologies.

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