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Comparisons of Sleep, Demographics, and Health-Related Variables in Older Long and Average Duration Sleepers

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Abstract

Introduction Long sleep duration is associated with many health risks, particularly in older adults, but little is known about other characteristics associated with long sleep duration.

Methods Across 5 sites, adults aged 60-80 years who reported sleeping 8-9 h ("long sleepers", n = 95) or 6-7.25 h ("average sleepers", n = 103) were assessed for two weeks using actigraphy and sleep diary. Demographic and clinical characteristics, objective sleep apnea screening, self-reported sleep outcomes, and markers of inflammation and glucose regulation were measured.

Results Compared to average sleepers, long sleepers had a greater likelihood of being White and unemployed and/or retired. Long sleepers also reported longer time in bed, total sleep time and wake after sleep onset by sleep diary and by actigraphy. Other measures including medical co-morbidity, apnea/hypopnea index, sleep related outcomes such as sleepiness, fatigue, depressed mood, or markers of inflammation and glucose metabolism did not differ between long and average sleepers.

Conclusion Older adults with long sleep duration were more likely to be White, report unemployment and retirement suggesting the social factors or related sleep opportunity contributed to long sleep duration in the sample. Despite known health risks of long sleep duration, neither co-morbidity nor markers of inflammation or metabolism differed in older adults with long sleep duration compared with those with average sleep duration.

Keywords
- sleep duration
- sleepiness
- quality of life
- depression

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Introduction

Multiple epidemiologic studies have described a U-shaped association between self-reported sleep duration and health risks.[1–11] Short and long sleep duration have been associated with mortality,[6–11] heart disease,[8] stroke,[12] hypertension,[13] diabetes,[14] depression,[15] obesity,[16] metabolic syndrome,[17] and dyslipidemia.[18] Short and long sleep are also associated with markers of inflammation,[19] which might partly mediate morbidities such as heart disease and stroke.[20,21]

Whereas the associations of health risks with short sleep are widely accepted, the associations of health risks with long sleep have faced skepticism. Indeed, given that long sleep is often defined as little as 8 hours of reported sleep, further understanding of the characteristics of those with long sleep duration has the potential to inform recommendations to sleep duration in adults which currently suggest 7-9 hours of sleep-in young adults and 7-8 hours of sleep in older adults.[22,23]

Several issues arise regarding drawing inferences about risks associated with reported sleep duration. First, there is some question about the extent to which self-reported long sleep is indicative of long objective sleep or other factors.[24] Self-reported sleep duration can be as much as 120 min longer than objectively measured sleep duration, and some evidence suggests that self-reported sleep duration closely tracks time in bed (TIB).[24–27] Longer TIB could confer independent risks associated, with, for example, greater sleep fragmentation, and more sedentary time.[10] Second, as with short sleep, associations of long sleep with health risks could reflect reverse causality, i.e., ill health, insomnia or sleep apnea resulting in longer TIB and/or sleep. Third, some evidence indicates that long sleep is associated with evening chronotype (at least on the weekends),[28] which has also been associated with health risks. Fourth, it has been speculated that long sleepers are more concerned about obtaining adequate sleep compared with average or short sleepers,[29] and that their sleep patterns can be explained partly by habit.[29,30] Potentially, long sleepers have more dysfunctional attitudes about sleep, and they do not necessarily need to sleep as long as they do.

Better understanding of the characteristics of reported long sleepers, such as how long they sleep objectively, could allow more thorough study of potential risks of long sleep. This might be particularly important among older adults who seem to have a higher prevalence of self-reported long sleep,[25] but less objective sleep duration[31] compared with young adults. Long sleep duration has also become more prevalent.[32] Older adults may be more vulnerable than young adults to the negative effects related to long sleep duration, as evidenced, for example, by the highest mortality rates associated long sleep.[33] In this study, we describe multiple metrics of self-reported and objectively recorded sleep, and the characteristics of older self-reported long and average sleepers prior to entry into a randomized control trial evaluating the effects of chronic moderate sleep restriction in these two groups.[34]

Methods

Subjects/ Study Design

Details of the study design have been published previously.[34] Briefly, this was a multi-site prospective randomized control trial (ClinicalTrials.gov NCT01642719). Sites enrolling subjects included the University of South Carolina, Arizona State University, University of Arizona, University of California-Los Angeles, and New York University. Internal Review Board approval was obtained at each of the sites, with a total goal of 200 subjects.

Inclusion criteria were; ages 60-80 years; sleeping an average of 8-9 hours per night (long sleepers) or sleeping an average of 6.0-7.25 hours per night (average sleepers). Exclusion criteria were recent major health condition (3 years: heart attack, stroke, cancer); body mass index ≥ 35 (calculated from height and weight); Epworth Sleepiness Scale ≥ 10; depressed mood [Patient Health Questionnaire-9 > 15]; high risk of obstructive sleep apnea (STOP Questionnaire ≥ 2); medical conditions related to inflammation (e.g. arthritis); TIB >30 minutes outside of the major sleep period; napping greater than two times a day or for more than 90 minutes/day; or recent shift work or transmeridian travel (1 month?).[34] Participants were also excluded if their apnea-hypopnea index (AHI) was ≥ 15 by objective screening. In addition, median actigraphic TIB estimates over the two-week baseline period were required to be between 8-9 hours in long sleepers, and between 6-7.25 hours in average sleepers.

Note: sleep duration was verified by actigraphic recording which typically results in estimates of sleep duration that are below subjective reports of sleep duration upon which recommendations about sleep duration have been made. Thus, we designated average sleep (6-7.25 h and long sleep as 8-9 h for these older adults.

Demographic and Clinical Characteristics

Information was obtained regarding demographic characteristics (i.e., race/ethnicity, age, sex, employment status), medical co-morbiditiy (i.e.. Charlson Comorbidity Index),[35] depressive symptoms (i.e. Geriatric Depression Scale),[36] beliefs about sleep (i.e., Dysfunctional Beliefs and Attitudes about Sleep Scale),[37]sleep wake activity (i.e., Munich Chronotype Questionnaire, corrected for sleep debt, if applicable),[38] fatigue (i.e., Multi-Dimensional Fatigue Symptom Inventory),[39] health functioning (i.e., Short-Form 36),[40] sleepiness outcomes (i.e., Epworth Sleepiness Scale, Functional Outcomes of Sleepiness Questionnaire),[41] and sleep quality (i.e., Pittsburgh Sleep Quality Index).[42]

Objective Sleep Apnea Screening

Objective assessment of obstructive sleep apnea was evaluated with home recording using the WatchPAT device (WP-Itamar-Medical, Caesarea, Israel).

Medical Screening

Subjects underwent a physical exam to ensure adequate health in addition to reported medical comorbidity.

Evaluation of Metabolic Factors

Following a 12 hour fast, laboratory screening of lipid (total cholesterol, triglycerides, high-density lipoprotein (HDL), low-density lipoprotein (LDL), cholesterol/LDL ratio, non-HDL cholesterol, non-HDL cholesterol) and inflammatory levels (C-reactive protein (CRP) and interleukin-6 (IL-6)) were completed. Then, a morning oral glucose tolerance test was completed in which subjects consumed a 1.75 gram/kg dose of glucose (maximum dose of 75 grams) with repeated antecubital blood sampling at 5 min pre and 30, 60, 90, and 120 min post-ingestion. Furthermore, insulin and hemoglobin A1C measurements were obtained.

Sleep-wake Activity

Two weeks of actigraphic recording (Philips, Actiwatch), in which participants were asked to follow their usual sleep/wake habits were used to characterize sleep wake activity. Actigraphic recording was supplemented with a daily sleep diary. Actigraphic times were determined based on the Cole et al. algorithm[43] which has been well validated in comparison with PSG.[43,44]

Statistical Analysis

All statistics were performed with IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp. Data were first examined to assess completeness and systematic patterns of missingness. Distributional qualities of the measures were examined, and mathematical transformation applied to meet assumptions for the analytical methods to be applied if needed. A combination of the likelihood ratio chi-squared or t-tests were used to compare the two groups (average vs. long) for categorical and continuous measures, respectively. Daily repeated measures (e.g., actigraphy) were averaged across the baseline assessment period. Secondary analyses utilized analysis of covariance (ANCOVA) to control for any demographic variables which differed between the groups. In consideration of multiple comparisons, results were also considered after Simes p-value correction for correlated outcomes. Insulin sensitivity was calculated by the quantitative insulin-sensitivity check index (QUICKI).[45] QUICKI was calculated as $Q = 1 / (\log FPI + \log FPG)$, where FPI is the fasting plasma insulin (mU L)1 where FPI is the fasting plasma insulin and FPG is the fasting plasma glucose.[45]

Power calculation: Given a sample of 100 average sleepers and 100 long sleepers, medium effect sizes of $d \geq .4$ are detectable with $\alpha = .05$ (two-tailed) at $\geq 80\%$ power.

Results

Out of the 5,494 subjects who were screened, 5,296 subjects were either not interested in participating or did not meet study criteria, resulting in 103 subjects who were average sleepers and 95 subject who were long sleepers.

Demographic characteristics of the participants are displayed in ►**Table 1**. Compared with the average sleepers, the percentage of long sleepers who were White and unemployed or retired was significantly greater. There were no statistically significant differences between the long and average sleepers in the other demographic variables including age, gender, body mass index, education, or income. There was also no difference in the groups regarding medical comorbidities assessed with the Charlson Comorbidity Index.

Actigraphic data are presented in ►**Table 2**. The long sleepers had significantly longer TIB, total sleep time (TST) and wake after sleep onset (WASO) compared to the average sleepers even after controlling for the differences in race and employment. TIB was 48.7 min (SD = 17.2) longer than TST for the long sleepers and 41.6 min (SD = 16.4) longer for the average sleepers.

The two-week sleep diary data are presented in ►**Table 2**. The long sleepers reported significantly greater TIB, TST, and WASO compared with the average sleepers even after controlling for race and employment status. On average, the TIB was 48.3 minutes (SD = 32.1) longer compared to TST for the long sleepers and 42.3 minutes (SD = 35.3) longer for the

Table 1 Demographics Characteristics of Participants by Sleep Duration.

Variable	Average Sleepers (N = 103)	Long Sleepers (N = 95)	p
Age (60 to 81 years), mean (SD)	66.7 (4.9)	67.7 (5.1)	.18
Gender, Female, n (%)	42 (41.2)	31 (32.6.7)	.24
Race, non-White, n (%)	34 (34.0)	11 (11.6)	<.001
Ethnicity, Hispanic/Latinx, n (%)	8 (9.8)	5 (5.8)	.40
Marital status, Married/Partner, n (%)	39 (47.6)	43 (49.4)	.88
Income ($K), mean (SD)	22.0 (22.9)	26.7 (22.5)	.20
Employment, Working, n (%)	80 (77.7)	60 (63.2)	.029
Retired, n (%)	36 (35.0)	56 (58.9)	.001
Education (years)	15.9 (2.3)	15.7 (2.5)	.51
Body mass index (kg/m^2)	26.4 (4.2)	25.8 (4.6)	.37
Charlson Co-Morbidity Index	2.5 (0.7)	2.4 (0.6)	.72

Table 2 Actigraphy and Sleep Diary Results of Participants by Sleep Duration Collected over 2 weeks.

Variable	Average Sleepers (N = 103)[a]	Long Sleepers (N = 95)[a]	p[b]
Actigraphy, mean (SD)			
Sleep Period	409.3 (52.5)	494.7 (41.7)	<**.001**
Total Sleep Time	368.2 (50.3)	445.9 (37.6)	<**.001**
WASO	40.6 (16.4)	48.6 (17.3)	**.018**
Sleep Efficiency	85.1% (5.5%)	86.4% (3.9%)	.18
Diary, mean (SD)			
Time in Bed	453.6 (48.9)	519.7 (41.7)	<**.001**
Sleep Period	418.4 (58.3)	483.0 (66.1)	<**.001**
Total Sleep Time	411.0 (46.1)	471.4 (47.3)	<**.001**
Sleep Onset	15.6 (20.9)	20.5 (37.2)	.20
WASO	16.1 (17.5)	24.7 (27.5)	**.02**
Sleep Efficiency	93.6% (7.5%)	91.5% (9.7%)	.085
Sleep Quality rating	4.0 (0.5)	3.8 (0.5)	**.004**
Rested rating	3.7 (0.5)	3.6 (0.6)	.15
Bedtime, time (SD min)	10:23p (70)	10:21p (79)	.79

Note: [a]Likelihood ratio chi-squared or t-tests used to compare the groups for categorical and continuous measures, respectively. Measures averaged across the baseline assessment period. Analysis of covariance (ANCOVA) used to control for any demographic variables which differed between the groups.
[b]P-values are not corrected for multiple comparisons. When a Simes correction for multiple comparisons is applied to these results, variables that are significantly different with a family-wise error rate of $p < .05$ are noted in bold.

average sleepers. Sleep quality rating was lower for the long sleepers compared to the average sleepers even after adjusting for differences in race and employment. Both long and average sleepers overestimated their TST with the sleep diaries compared to actigraphy (15.1 min (SD = 54.3) and 27.6 min (SD = 52.4), respectively). Both long and average sleepers also overestimated their TIB with the sleep diaries compared to actigraphy (26.7 min (SD = 47.3) and 43.7 min (SD = 63.3), respectively).

Results of the Epworth Sleepiness, Pittsburgh Sleep Quality Index, Functional Outcome of Sleepiness Questionnaire, Dysfunctional Beliefs & Attitudes about Sleep Scale, and Munich Chronotype Questionnaires are summarized in ►**Table 3**. Epworth Sleepiness Scale scores were significantly lower in the long sleepers compared with the average sleepers (ESS of 4.1(± 3.1) vs. 5.1(± 2.9), p =0.034), but not correcting for multiple comparisons(p = 0.07). The overall Pittsburgh Sleep Quality Index, Dysfunctional Beliefs and Attitudes about Sleep Scale, Munich Chronotype Questionnaire findings did not differ significantly between the groups. Bedtimes based on a separate screening questionnaire were similar for the two groups. Similar scores for the Functional Outcomes of Sleepiness Questionnaire domains were noted across the two groups. Greater vigilance was reported by the long sleepers compared to the average sleepers (3.7 ± 0.5 vs.3.6 ± 0.6, p = 0.032) even after controlling for differences in race and employment, although this difference was minimal. Bedtimes based on a separate screening questionnaire were similar for the two groups.

The Geriatric Depression Scale scores were similar between the long and average sleepers. On the Multi-Dimensional Fatigue Symptom Inventory, the long sleepers reported significantly greater vigor compared with the average sleepers (22.1 ± 3.6 vs. 20.4 ± 4.9, p = 0.026), with similar results after adjustment for multiple comparisons (p = 0.051). There were no differences between the groups regarding quality of life, measured by the Short-Form 36. These data are displayed in ►**Table 4**.

There were no statistically significant differences in the lipid profile, glucose tolerance, insulin sensitivity and inflammatory markers between long sleepers compared with average sleepers even after adjusting for covariates of race and employment (►**Table 5**). The home sleep apnea testing revealed no differences between the long sleepers compared with the average sleepers. Detailed WatchPAT data are presented in ►**Table 5**. There were no notable differences in blood pressure results between the long sleepers compared with the average sleepers.

Discussion

The long sleepers were more likely to be White and unemployed or retired compared with the average sleepers. After adjusting for multiple comparisons and differences in the demographics, actigraphic and sleep diary estimations revealed that, compared with the average sleepers, the long sleepers had longer TIB, longer TST, and more WASO (►**Table 2**). The long sleepers reported lower sleep quality in their sleep diaries compared with the average sleepers.

Table 3 Sleep Quality and Chronotype of Participants by Sleep Duration Collected over Two Weeks.

Variable	Average Sleepers[a] (N = 103)	Long Sleepers (N = 95)[a]	p[b]
Epworth Sleepiness, mean (SD)	5.1 (2.9)	4.1 (3.1)	.034
Pittsburgh Sleep Quality Index (PSQI), mean (SD)			
Quality	0.7 (0.5)	0.8 (0.5)	.081
Latency	0.6 (0.7)	0.6 (0.7)	.75
Duration	0.6 (0.7)	0.1 (0.3)	**<.001**
Efficiency	0.3 (0.7)	0.3 (0.7)	.84
Disturbance	1.1 (0.2)	1.0 (0.3)	.22
Sleep Med Use	0.2 (0.7)	0.1 (0.6)	.17
Daytime Dysfunction	0.2 (0.5)	0.1 (0.4)	.080
TOTAL SCORE	3.6 (2.1)	3.0 (1.8)	.074
Functional Outcome of Sleepiness Questionnaire (FOSQ), mean (SD)			
General Productivity	3.7 (0.5)	3.8 (0.5)	.33
Activity Level	3.8 (0.3)	3.8 (0.3)	.095
Vigilance	3.6 (0.6)	3.7 (0.5)	.036
Social Outcome	4.0 (0.2)	3.9 (0.4)	.53
Intimacy & Sexual Relationships	3.7 (0.5)	3.7 (0.5)	.90
TOTAL SCORE	18.8 (1.4)	19.0 (1.5)	.35
Dysfunctional Beliefs & Attitudes about Sleep Scale (DBAS), mean (SD)			
Consequences	3.1 (1.8)	3.4 (2.0)	.40
Worry	2.6 (1.7)	3.0 (2.1)	.28
Expectations	4.9 (2.3)	5.8 (2.3)	.062
Medication	1.9 (1.7)	2.2 (1.4)	.37
TOTAL SCORE	2.9 (1.4)	3.3 (1.6)	.17
Munich Chronotype, time (SD min)	3:15a (78)	2:44a (65)	.062

Note: [a]Likelihood ratio chi-squared or t-tests used to compare the groups for categorical and continuous measures, respectively. Measures averaged across the baseline assessment period. Analysis of covariance (ANCOVA) used to control for any demographic variables which differed between the groups.
[b]P-values are not corrected for multiple comparisons. When a Simes correction for multiple comparisons is applied to these results, variables that are significantly different with a family-wise error rate of $p < .05$ are noted in bold.

However long and average sleepers scored similarly on the Pittsburgh Sleep Quality Index. The long and average sleepers did not differ significantly in their sleep wake activity, sleepiness outcomes, and beliefs and attitudes about sleep (►**Table 3**). They were similar in regard to health functioning, fatigue and depressive symptoms. The long and average sleepers also did not differ in lipid levels, glucose tolerance, insulin sensitivity inflammatory markers, blood pressure or in level of AHI estimated by WatchPAT recording.

The sleep data are similar to a previous study by Patel et al,[24]which showed that compared with "normal sleepers" (sleeping 7-8 hours), self-reported long sleepers (sleeping ≥9) had longer actigraphic estimates of sleep duration.[24] Moreover, consistent with many other studies,[26,46] participants overestimated their self-reported sleep duration compared with objective estimation. The extent of overestimation of sleep duration was lower among the long sleepers 15.1 min (SD = 54.3) compared with the average sleepers 27.6 min (SD = 52.4). In contrast, the Patel et al[24] study showed that this overestimation was significantly greater among the long sleepers (overestimate of 2 h) compared with the average sleepers (overestimation by 0.9 h) ($p < 0.001$).[24] This discrepancy may be partly explained by the varying definition of "long" and "average" sleep, and the fact that few adults objectively sleep ≥9 h.

While the differences between subjective and objective sleep duration are small, they could possibly lead to errors in making inferences regarding the impact of sleep duration in epidemiologic studies that use only subjective evaluations to measure sleep duration. Self-reported sleep duration may be related to time in bed for other reasons (e.g., fatigue) and not

Table 4 Depression, Fatigue and Quality of Life Indices of Participants by Sleep Duration.

Variable	Average Sleepers[a] (N = 103)	Long Sleepers (N = 95)[a]	P[b]
QOL, mean (SD)			
SF-36 Physical Functioning	88.5 (14.7)	88.8 (13.8)	.78
SF-36 Role Physical	93.1 (19.9)	89.6 (25.2)	.46
SF-36 Bodily Pain	84.1 (14.2)	80.8 (17.3)	.28
SF-36 General Health	83.3 (13.0)	82.3 (12.2)	.65
SF-36 Vitality	72.4 (14.6)	72.6 (14.3)	.84
SF-36 Social Functioning	96.3 (8.9)	95.7 (10.6)	.26
SF-36 Role Emotional	92.9 (18.9)	90.2 (24.1)	.27
SF-36 Mental Health	87.5 (11.5)	85.4 (11.7)	.12
SF-36 PCS	52.8 (5.6)	51.8 (6.7)	.44
SF-36 MCS	56.2 (6.9)	55.7 (6.4)	.31
Multi-Dimensional Fatigue Symptom Inventory (MDFSI), mean (SD)			
General	9.8 (3.7)	9.3 (2.9)	.24
Physical	7.8 (2.2)	7.7 (2.5)	.64
Mental	8.9 (2.9)	8.4 (2.7)	.58
Emotional	8.1 (2.8)	8.5 (3.0)	.24
Vigor	22.1 (3.6)	20.4 (4.9)	.051
TOTAL	12.5 (11.5)	13.5 (11.3)	.64
Geriatric Depression Scale (GDS), mean (SD)	3.23 (2.94)	3.70 (3.67)	.28

Note: [a]Likelihood ratio chi-squared or t-tests used to compare the groups for categorical and continuous measures, respectively. Measures averaged across the baseline assessment period. Analysis of covariance (ANCOVA) used to control for any demographic variables which differed between the groups.
[b]P-values are not corrected for multiple comparisons. When a Simes correction for multiple comparisons is applied to these results, variables that are significantly different with a family-wise error rate of $p < .05$ are noted in bold.

just sleep. If objective measures such as actigraphy were used in epidemiologic studies, then perhaps stronger associations could be observed between sleep duration and other variables. Further research is needed to delineate risks of sleep duration or TIB.

The relatively higher percentage of long sleepers who were retired or unemployed is also consistent with other research.[47,48] However, the higher percent of long sleepers who were White is inconsistent with the literature indicating that older Black adults are more likely to be long sleepers than older White adults.[49] Recruitment limitations may be contributing to a nonrepresentative sample of Black and White participants.

One interpretation of these data is that long sleep duration among older adults might be partly explained by a greater opportunity to stay in bed longer. However, contrary to other data suggesting later bedtimes and wake times during retirement,[47] the present study found similar reported bedtimes among the long and average sleepers. Moreover, the Munich Chronotype Questionnaire showed that mid-sleep on free days were similar for long and average sleepers. Other studies have also shown minimal to no differences in chronotype based on sleep duration, though these studies have mostly involved young adults.[50–52] Since wake time gets earlier with age, going to bed earlier is more likely to be associated with long sleep-in older adults.

Similar to previous studies, global score on Functional Outcomes of Sleepiness Questionnaire did not differ between the long and averages.[24] Previously, it has been reported that long sleepers reported better overall sleep quality assessed with the Pittsburgh Sleep Quality Index, but this was not noted in the global score of the Pittsburgh Sleep Quality Index results in our study.[24] The presence of comorbid medical conditions are closely correlated with Pittsburgh Sleep Quality Index results.[53] There may not have been a difference noted between the average and long sleepers in the Pittsburgh Sleep Quality Index as the average and long sleepers were quite similar in regard to medical comorbidities in this study.

Similar scores noted on the Epworth sleepiness scale and Functional Outcomes of Sleepiness Questionnaire among the long sleepers compared with the average sleepers in this study are consistent with a previous study which found no differences in the ESS or Functional Outcomes of Sleepiness Questionnaire between the two groups.[24] It has been posited that long sleepers are more concerned with their ability to experience longer sleep duration, which might correspond to higher Dysfunctional Beliefs and Attitudes about Sleep Scale. The present study showed no support for this hypothesis.

Table 5 Laboratory and Sleep Study Values of Participants by Sleep Duration.

Variable	Average Sleepers (N = 103)[a]	Long Sleepers (N = 95)[a]	P[b]
Lipids, mean (SD)			
Cholesterol	189.5.1 (33.0)	197.1 (40.1)	.15
Triglycerides	107.6 (63.7)	106.0 (83.4)	.54
HDL	55.5 (17.1)	58.0 (17.3)	.20
LDL	112.4 (30.5)	117.2 (35.1)	.31
Cholesterol/LDL ratio	3.69 (1.12)	3.73 (1.45)	.86
Non-HDL Cholesterol	134.1 (31.8)	139.1 (41.3)	.40
Glucose Tolerance Test, mean (SD)			
T1 Pre-glucose	104.8 (45.9)	98.3 (20.4)	.090
T2 30 min. Post	162.9 (60.5)	154.1 (46.7)	.18
T3 60 min. Post	174.7 (78.0)	163.3 (66.9)	.11
T4 90 min. Post	165.0 (87.2)	148.5 (75.4)	.13
T5 120 min. Post	149.6 (75.4)	136.1 (74.4)	.14
QUICKI	0.36 (0.04)	0.38 (0.04)	.073
Insulin	7.76 (6.93)	6.46 (5.26)	.092
HgbA1C	87.5 (11.5)	85.4 (11.7)	.065
Inflammatory Markers, mean (SD)			
C-Reactive Protein (CRP)	2.51 (3.50)	2.83 (4.12)	.70
Interleukin-6 (IL-6)	2.61 (3.75)	3.24 (6.14)	.27
Home Sleep Apnea Test, mean (SD)			
Respiratory Disturbance Index	11 (8.1)	11 (5.8)	.88
Apnea Hypopnea Index	5 (4.6)	5 (4.2)	.64
Oxygen Desaturation Index	3 (3.2)	3 (2.7)	.93
Minimum Oxygen Saturation	88 (3.6)	97 (54.5)	.47
Blood Pressure, mean (SD)			
Systolic	122.9 (18.1)	125.4 (14.9)	.44
Diastolic	73.2 (9.3)	72.4 (12.7)	.74

Note: [a]Likelihood ratio chi-squared or t-tests used to compare the groups for categorical and continuous measures, respectively. Measures averaged across the baseline assessment period. Analysis of covariance (ANCOVA) used to control for any demographic variables which differed between the groups.
[b]P-values are not corrected for multiple comparisons. When a Simes correction for multiple comparisons is applied to these results, variables that are significantly different with a family-wise error rate of $p < .05$ are noted in bold.

The data showing a lack of difference among long vs. average sleepers in measures of inflammation, lipids, blood pressure and glucose regulation are contrary to the extensive literature showing a higher prevalence of inflammation, lipids, hypertension, and impairments in glucose regulation and diabetes among long sleepers.[54] The lack of group differences in the present study might be explained partly by the exclusion criteria, which included recent heart attack, stroke or cancer, depression, moderate or severe sleep apnea, inflammatory conditions, TIB greater than 30 minutes outside the major sleep period and limited napping, which might have resulted in a sample that was not representative of the population of older long sleepers. Other comparisons between long and average or short sleepers have not employed similar exclusion criteria, which were important because of safety concerns in the subsequent intervention involving sleep restriction. The relatively demanding subsequent experimental study for which participants were recruited might have introduced further self-selection bias towards good health.

The study had several strengths including multiple measures of sleep and health. Our sample was predominantly healthy, which may increase generalizability of results to a relatively healthy population. The primary limitation is the generalizability of the results to those with significant medical conditions and/or excessive napping. However, the study adds information to existing literature on comparing long sleepers to average sleepers particularly in a relatively healthy population. Additional research is needed to further clarify the relationship between the variables investigated here and sleep duration.

In summary, the results confirm previous findings indicating that self-reported long sleepers and average sleepers also have long and average objective sleep durations, respectively. However, these results do not provide evidence to support substantial differences in other sleep or health-related variables between long and average sleepers. Potentially, retirement and/or unemployment afforded the long sleepers more opportunity to sleep. The results show neither positive nor negative health associations with longer sleep. Subsequent reports by our group will address whether chronic moderate sleep restriction has positive or negative effects in long and average sleepers.

Conflict of Interest
None declared.

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