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One-year changes in self-reported napping behaviors across the retirement transition

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ABSTRACT

Objective: To estimate associations of retirement with self-reported frequency and duration of naps.
Design: Prospective cohort study.
Setting: Population-based.
Participants: 1359 current and former Wisconsin state employees, aged 54-69.
Measurements: Four annual surveys mailed between 2010 and 2014 elicited employment status and nap characteristics. Changes in employment status and nap characteristics were identified from survey pairs measured 1 year apart (up to 3 survey pairs per subject). General linear mixed models with repeated measures were used to estimate changes in minutes napped per week (MNPW), weekly nap frequency, and individual nap duration as predicted by retirement transitions vs stable employment status. All models were adjusted for demographic characteristics, self-rated health, medical diagnoses, sleep problems, circadian preference, and change in nocturnal sleep duration.
Results: There were 3101 survey pairs in the analytic sample. Full retirement (transition from working ≥35 h/wk to not working for pay) over a 1-year period predicted a statistically significantly larger mean change in MNPW than stable employment status: mean (95% confidence interval) = +48 (+16, +80) MNPW. Associations between staged retirement transitions (from full-time to part-time work, or from part-time work to full retirement) and 1-year changes in MNPW were not statistically significant. The MNPW changes associated with full retirement were attributable to nap frequency increase of +0.4 (+0.1, +0.8) d/wk; nap duration did not change significantly.
Conclusions: Compared with stable employment status, full retirement is associated with an average 1-year increase of +48 MNPW. This change is attributable to a frequency gain of 0.4 d/wk napped. Changes in nap duration were negligible.

Introduction

Napping is a prevalent behavior, especially in certain cultures and with advancing age, yet remarkably little is known about the character and trajectories of napping behaviors in middle-aged and older adults. Napping frequency has been shown to increase linearly from young adulthood to old age.[1–6] Some have hypothesized that the age-related increase in daytime sleep is due to restorative napping in response to well-documented nocturnal sleep fragmentation among the elderly.[7] Others hypothesize that napping causes or exacerbates nocturnal sleep problems in the elderly by disrupting circadian rhythms.[8] Regardless of whether napping is a cause or consequence of nocturnal sleep problems (or both), age-related napping changes should be considered in relation to the social phenomenon of retirement, which increases the opportunity to nap. Longitudinal analyses have revealed changes in nocturnal sleep patterns across the work-to-retirement transition in the United States and abroad. In the Retirement and Sleep Trajectories (REST) study, Hagen et al found that retirement transitions were associated with increased nocturnal sleep duration, later bedtimes, and later wake times.[9] The VISAT study found a retirement-associated reduction in premature

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awakening among a cohort of workers in Southern France.[10] Similarly, the GAZEL study of retired French national gas and electric company employees found that retirement was associated with a reduction in the prevalence of self-reported disturbed sleep (except for those who retired due to poor health); the study's authors attributed these findings to reduced exposure to work-related physical and psychological stress.[11] A large, population-based Australian cohort study found that retirement was associated with a reduction in prevalence of extreme (long or short) sleep durations, as well as increased self-reported physical activity and decreased self-reported sedentary time.[12] Two cross-sectional studies have demonstrated more frequent napping among retired persons than among those working.[4,13] However, to our knowledge, the relationship between retirement transition and napping behaviors has not been explored in a longitudinal study.

Retirement from the paid workforce carries implications for health. A recent regression discontinuity analysis of health and retirement revealed a 0.25 standard deviation improvement in self-reported health associated with retirement transitions in Germany.[14] Potential hypothesized mechanisms included relief from work-related physical and mental stressors, improved sleep parameters, and increased leisure activity. The objectives of the present study were to estimate associations of retirement transitions with 1-year changes in the following typical nap characteristics: minutes napped per week, weekly nap frequency, and nap duration. We focused on 1-year changes (as opposed to 2- and 3-year changes) because there were substantially more data—and thus greater statistical power—to examine 1-year changes. We further tested these associations for interactions with age, sex, and change in nocturnal sleep duration.

Participants and methods

The REST study used a prospective cohort design to characterize pre- and postretirement trajectories of sleep patterns and problems in a community-dwelling population of middle-aged and older adults. REST data collection began in 2010 and included 4 surveys sent at approximately 1-year intervals. REST surveys targeted habitual sleep patterns, employment status, and a variety of biopsychosocial domains. Over the 4-year REST study period, roughly 7500 surveys were collected from more than 2000 participants. The REST study was approved by the Human Subjects Committee of the Health Sciences Institutional Review Board of the University of Wisconsin-Madison; all participants provided informed consent.

Study sample

The REST sample used the sampling frame of the Wisconsin Sleep Cohort Study (WSCS), which recruited participants aged ~30-60 years from the personnel rolls of 4 Wisconsin state agencies in 1988. These individuals were ~46-85 years of age at the time of the REST study. WSCS participants who were alive in September 2010 were eligible to participate in the REST study if they had previously responded to at least 3 mailed surveys or at least 1 WSCS overnight polysomnography study plus 1 mailed survey ($n = 2427$). Response rates were high: 86% ($n = 2137$) of participants in the target sample participated in the REST study. Of REST participants, 93% ($n = 1989$) returned at least 2 of 4 mailed REST surveys, and 75% ($n = 1612$) returned all 4. Because shift workers often manifest anomalous napping patterns,[15–18] we excluded those REST participants who indicated having worked nights or rotating shifts at any time during the 4-year study period ($n = 146$). Age distributions of participants by retirement transition status displayed an incomplete overlap between participants undergoing retirement transition and nontransitioning participants. Specifically, ages of the former group were most concentrated in the middle of the distribution, whereas ages of the latter group (workers who continued to work and retirees who stayed retired) extended to the extremes. Thus, the age range of the analytic samples in this study was limited to a span of 54 to 69 years to ensure that regression models could better adjust for the effect of age.

Measures

Each wave of REST surveys collected detailed information about employment status and habitual sleep-wake habits. Additionally, REST survey questions cover a broad array of known predictors of both napping and/or retirement, including self-perceived well-being, sociodemographic factors, health practices, and circadian preference. Each subject contributed up to 3 pairs of observations for 1-year transition analyses (from survey years 1 and 2, survey years 2 and 3, and survey years 3 and 4).

Principal predictor variable: 1-year retirement transition

Retirement transitions across each year were identified from questions about employment status on each wave of REST surveys. Responses included working full-time (≥35 hours per week); working part-time; partially retired; fully retired; and not retired but not working for pay. We excluded the latter group (which was both small and heterogeneous, including unemployed participants as well as those on leave of absence, $n = 58$ observations) and collapsed part-time work and partially retired status into a single category, leaving 3 possible employment status options: full-time work (FT), part-time work (PT), and fully retired. Full and partial retirement transitions were identified as employment status changes across pairs of successive surveys. Values of our 4-level retirement transition class variable were (1) stable employment status (the reference level, which included FT-FT pairs, PT-PT pairs, and retired-retired pairs), (2) transition from FT to PT (hereafter, FT-PT), (3) transition from PT to fully retired status (hereafter, PT-retired), and (4) transition from FT to fully retired status (hereafter, full retirement). In some analyses, the retirement transition variable was recoded to test for linear trend, with the previously described categories representing increasing "doses" of retirement as follows: 0 = stable employment status (reference), 1 = FT-PT, 2 = PT-retired, 3 = full retirement. Although 1-year retirement transitions were ascertained by changes in employment status measured across a pair of surveys administered roughly 1 year apart, the actual date of a given subject's retirement could have taken place at any time between successive surveys. Hence, our "1-year transition" analyses capture an exposure to retirement transition of up to 1 year.

Within the general category of full retirement, participants were also asked to identify as many of the following reasons for retirement they thought fit their decision: poor health/disability; wanted to do other things; did not like the work; wanted to spend more time with family and/or friends; wanted or needed to provide care for family or friend; financially secure and/or no need to work; and/or hours reduced or laid off/let go led to decision to retire. Respondents also indicated how important each selected reason was to their decision to retire: very important, moderately important, somewhat important, or not important. Participants were identified as retiring for a particular reason if they indicated it was a moderately important to a very important reason in their decision to retire.

Outcome variable: 1-year changes in typical nap characteristics

Respondents who, on a given survey, indicated having had "a daytime or evening nap that lasted more than 5 minutes" in the prior month were considered "nappers" for that survey observation and were asked follow-up questions about typical nap frequency and duration over the prior month. Nap frequency was elicited as the "number of days out of 7 napped in a typical week." Nap duration referred to the length of each individual nap and was elicited in continuous hours and minutes as the "time spent napping during a typical day that you napped." A derived variable, minutes napped per week (MNPW), was computed by taking the product of each individual's typical weekly nap frequency and typical nap duration in minutes. Non-nappers were assigned values of zero for nap frequency, nap duration, and MNPW. One-year changes in nap frequency ($frequency_{time2} - frequency_{time1}$), duration ($duration_{time2} - duration_{time1}$), and MNPW ($MNPW_{time2} - MNPW_{time1}$) were computed as differences between survey responses collected 1 year apart (ie, $time_2 - time_1 = 1$ year).

Covariates

Sociodemographic covariates

Sociodemographic covariates included age, sex, currently living with a partner (vs not), educational attainment, and race/ethnicity. The original educational categories of ≤8th grade, 9th-11th grade, high school graduate/GED, some college, bachelor's degree, and postgraduate work were collapsed into a 4-level class variable for regression models because of small numbers in the first 3 groups. Race/ethnicity, collected from participants' state agency employer at time of recruitment into the WSCS, was coded as a 3-level class variable: white, non-Hispanic; other; and missing.

Health-related covariates

Because napping has been associated with excess morbidity[5,19–26] and mortality[26–32] from chronic disease, we adjusted for health indices. Self-reported physical and mental well-being over the prior 4 weeks were measured by the 12-item Medical Outcomes Survey Short Form (version 2)[33] (hereafter described as SF-12). SF-12 physical and mental component summary scores are continuous and norm-based to the 1998 general United States adult population, with a mean of 50 and an SD of 10; higher scores reflect better well-being. We adjusted for ever having been told by a health care professional on any of the surveys that you have the following medical conditions: hypertension, diabetes mellitus, cardiovascular disease (including coronary artery disease, myocardial infarction, congestive heart failure, stroke, and any heart surgery [pacemaker, balloon angioplasty, coronary artery angioplasty, coronary artery stent placement, coronary artery bypass surgery, other heart surgery]), and cancer (excluding basal and squamous cell carcinomas). We also adjusted for health behaviors: smoking status (current vs not current smoker), body mass index, caffeinated drinks per day, alcoholic drinks per week, and physical activity (estimated metabolic equivalent hours per week). Health insurance coverage was not included in the regression models because of lack of variability (>97% were insured across all employment categories).

Sleep-related covariates

The following sleep-related covariates were also considered in the analysis: ever told you had sleep apnea or use of continuous positive-airway pressure, ever told you had restless legs syndrome, and any symptom of insomnia. Participants were considered to have insomnia if they endorsed "often" (5-15 times a month) or "almost always" (>15 times a month) having difficulty with ≥1 of the following symptoms: (1) getting to sleep, (2) getting back to sleep after awakening at night, (3) repeated nighttime awakenings, and (4) awakening too early in the morning and being unable to get back to sleep.

We also adjusted for concurrent change in nocturnal sleep duration as well as circadian preference. Change in nocturnal sleep duration was derived by (1) computing a weighted weekly average of nocturnal duration based on participants' reports of typical week/work-night and weekend/nonwork-night sleep duration for each survey (ie, [5*weeknight sleep duration] + [2*weekend sleep duration]/7) and then (2) computing the change in the average nighttime sleep duration between successive surveys. Circadian preference was established with a highly informative 3-item subset of the Morningness-Eveningness Questionnaire (MEQ),[34] with the following chronotype categories: evening preference, neutral preference, somewhat morning preference, and most morning preference. The 3-item modified MEQ was found to have good correlation ($r = 0.70$, $P < .0001$) with the full MEQ in the REST sample; detailed scoring methods have been described previously.[9]

Adjustment variables came from the first survey of each survey pair, with the following exceptions: (1) for individual diagnosed health conditions, we generated composite "ever diagnosed" values across all surveys returned by a given subject; (2) for circadian preference, we used each subject's last reported value (circadian questions were not asked at survey year 1). Models were additionally adjusted for year of the first survey in a given pair.

Statistical analyses

All analyses were performed with SAS, release 9.4 (SAS Institute, Inc, Cary, NC). Participants contributed up to 3 pairs of observations for 1-year transition analyses. Basic descriptive statistics were computed from the first survey returned by each subject to characterize baseline values of the sample. Generalized linear modeling was used to estimate unadjusted 1-year changes in MNPW, nap frequency, and nap duration, as predicted by 4-level retirement transition class variable. Empirical estimates ("sandwich" estimator) were used to compute standard errors and statistical tests of the fixed-effects parameters. Repeated measures modeling was used to account for the correlated nature of multiple measures of within-person changes. For estimation of adjusted changes in nap characteristics predicted by 1-year retirement transitions, we implemented the same analytic strategy, adjusting for covariates. In some analyses, a "linear" construction of the retirement transition predictor was used in lieu of the 4-level class variable to test for associations between increasing "doses" of retirement and changes in nap characteristics.

Nonlinear associations with age were explored with a quadratic term. Age and sex were considered as potential effect modifiers in models of associations between retirement transition status and change in nap characteristics, as was concurrent change in weekly weighted average nocturnal sleep duration. We stratified the sample by sex and estimated associations separately for men and women.

The final models were adjusted for age (years from age 54), sex, living with a partner, race/ethnicity, education, BMI (centered at 29.9), current smoker, caffeine consumption (centered at 2.5 drinks per day), alcohol consumption (centered at 4.6 drinks per week), exercise (centered at 26.5 MET-h/wk), SF-12 physical summary score (transposed into mean = 0 SD = 1), SF-12 mental summary score (transposed into mean = 0 SD = 1), hypertension, diabetes, cardiovascular disease, cancer (excluding skin), restless leg syndrome, sleep apnea, insomnia, change in nocturnal sleep duration, circadian preference, and survey year.

We performed a set of sensitivity and additional analyses to further explore these associations and to investigate their robustness for the MNPW outcome. These additional analyses included the following: adding change in BMI to main models to see whether this potential confounding variable affected our main results; excluding retired-retired pairs from the reference group to investigate whether removing entirely postretirement observations substantially changed results; and performing a residualized analysis of $MNPW_{time2}$ as a function of $MNPW_{time1}$ + covariates. Additionally, we investigated whether different reasons for retirement were associated with different napping behavior changes by estimating models that considered each of the 7 possible retirement reasons separately. Participants who endorsed a particular reason as an important reason for retirement were compared to same reference group as that used in the main models.

Results

Baseline descriptive statistics

Baseline descriptive statistics (Table 1) were obtained from the first surveys received by participants who had returned at least 1 pair of eligible surveys (n = 1359 participants). Distribution of employment status at baseline was 34% FT, 20% PT, and 46% fully retired. Not surprisingly, FT workers were the youngest group with mean (SD) age of 58.7 (3.6) years. Mean (SD) ages of PT and fully retired groups were comparable: 63.0 (3.9) and 63.7 (3.7) years, respectively. The sample was 54% female, and 74% reported living with a spouse/domestic partner. Approximately one quarter of the sample had completed a graduate degree. Fourteen percent of the sample was missing a value for race/ethnicity (these participants all came from the same state agency, which did not release race/ethnicity data for any participants). The nonmissing race/ethnicity data were quite homogeneous: 97% were white, non-Hispanic. Three quarters of the baseline surveys were derived from survey year 1 (2010-2011). Medical diagnoses and sleep problems were more prevalent among the fully retired group than among those working FT and PT at baseline.

At baseline, approximately two thirds of the sample endorsed napping (ie, having taken ≥1 nap lasting >5 minutes in the prior month). The proportion of baseline nappers was somewhat higher among PT (71%) and fully retired (68%) than among FT (63%). Among nappers, baseline mean number (SD) of minutes napped per week was 114 (171). When stratified by employment category,

Table 1
Subject characteristics by baseline employment level (first observation)

	Total	Full-time	Part-time	Fully retired
Mean (SD) or % [n]	[N = 1359]	[n = 465]	[n = 266]	[n = 628]
Age (y)	61.9 (4.3)	58.7 (3.6)	63.0 (3.8)	63.7 (3.7)
Female	54.4% [739]	53.8% [250]	57.5% [153]	53.5% [336]
Living with partner	74.0% [1005]	76.3% [355]	73.3% [195]	72.5% [455]
Health insurance	98.6% [1340]	98.9% [460]	97.7% [260]	98.7% [620]
White, non-Hispanic[a]	97.1% [1133]	96.1% [370]	97.0% [233]	97.4% [530]
Education				
≤High school graduate/GED	19.1% [259]	14.0% [65]	21.1% [56]	22.0% [138]
Some college	30.2% [411]	27.5% [128]	31.6% [84]	31.7% [199]
Bachelor's degree	24.8% [337]	30.3% [141]	18.0% [48]	23.6% [148]
Graduate degree	25.9% [352]	28.2% [131]	29.3% [78]	22.8% [143]
Nappers (>5 min, ≥1 episode/mo)	66.8% [908]	63.2% [294]	71.1% [189]	67.7% [425]
Among nappers				
Minutes napped per week	114.1 (171.2)	89.1 (147.2)	112.7 (143.0)	133.2 (194.9)
Nap frequency (d/wk)	1.9 (2.0)	1.5 (1.8)	2.2 (2.0)	2.1 (2.1)
Nap duration (min/nap day)	38.4 (41.8)	37.5 (42.7)	37.1 (37.5)	39.6 (42.9)
SF-12 Physical Component Score[b]	48.5 (10.2)	50.9 (8.9)	49.7 (8.8)	46.3 (11.2)
SF-12 Mental Component Score[b]	51.5 (8.8)	49.6 (8.7)	52.5 (8.1)	52.6 (8.9)
Hypertension[c]	47.3% [643]	37.8% [176]	49.6% [132]	53.3% [336]
Diabetes mellitus[c]	15.5% [210]	11.4% [53]	16.2% [43]	18.2% [114]
Cardiovascular disease[c,d]	13.7% [186]	7.1%[33]	12.0% [32]	19.3% [121]
Cancer[c,e]	12.6% [171]	9.7% [45]	12.4%[33]	14.8% [93]
Restless legs syndrome[c]	10.4% [141]	9.5% [44]	6.4%[17]	12.7% [80]
Sleep apnea[c,i]	21.3% [290]	18.8% [87]	23.3% [62]	22.4% [141]
Insomnia[f]	57.8% [785]	54.0% [251]	57.5% [153]	60.7% [381]
Nocturnal sleep duration[g] (h)	7.1 (1.1)	7.0 (0.9)	7.2 (1.1)	7.1 (1.2)
Circadian preference[h]				
Most evening	3.8% [51]	3.9%[18]	2.6%[7]	4.1%[26]
Somewhat evening	7.6% [103]	8.6%[40]	3.8%[10]	8.4% [53]
Neutral	28.0% [381]	25.6% [119]	24.8% [66]	31.2% [196]
Somewhat morning	26.6% [361]	26.0% [121]	29.7% [79]	25.6% [161]
Most morning	34.0% [463]	35.9% [167]	39.1% [104]	30.6% [192]
Baseline survey year				
Year 1 (2010-2011)	74.1% [1007]	73.8% [343]	71.0% [189]	75.6% [475]
Year 2 (2011-2012)	13.8% [188]	13.3% [62]	19.2% [51]	11.9% [75]
Year 3 (2012-2013)	12.1% [164]	12.9% [60]	9.8%[26]	12.4% [78]
Health behaviors				
BMI (kg/m^2)	29.8 (7.1)	29.7 (6.6)	29.0 (6.3)	30.3 (7.7)
Current smoker	8.0% [109]	7.5%[35]	9.0%[24]	8.0% [50]
Caffeine (cups per day)	2.6 (2.1)	2.6 (2.2)	2.7 (2.1)	2.5 (2.1)
Alcohol (drinks per week)	4.6 (6.6)	4.6 (5.8)	4.7 (6.9)	4.6 (7.0)
MET h/wk	26.8 (29.5)	26.7 (31.4)	24.9 (24.1)	27.6 (30.1)

[a] Missing values of race/ethnicity variable % [n]: 14.1% [192], 16.5% [80], 10.3% [28], and 13.2% [86] for total, full-time, part-time, and fully retired participants, respectively
[b] Twelve-item Medical Outcomes Survey Short-Form, version 2 (US population mean [SD] = 50 [10], higher scores better).
[c] Ever told by a health care professional that they had the condition across any of the 4 survey years.
[d] Includes coronary artery disease, congestive heart failure, myocardial infarction, stroke, or history of heart surgery.
[e] Excludes benign skin cancers.
[f] Report of "often" or "almost always" having difficulty with ≥1 of the following symptoms: (1) getting to sleep, (2) getting back to sleep after awakening at night, (3) repeated nighttime awakenings, and (4) awakening too early in the morning.
[g] Weighted average of work/weeknights and nonwork/weekend nights.
[h] Obtained via modified 3-item MEQ.
[i] Ever told by a health care professional that they had sleep apnea or reported current use of continuous positive-airway pressure/bilevel positive-airway pressure across any of the 4 survey years.

mean number (SD) of typical minutes napped per week among nappers was 89 (147) for FT, 113 (143) for PT, and 133 (195) for fully retired. Baseline mean (SD) typical nap frequency among nappers was 1.5 (1.8) d/wk for FT compared with 2.2 (2.0) and 2.1 (2.1) for PT and fully retired, respectively. Baseline mean (SD) typical nap duration among nappers was 38 (42) minutes and was relatively consistent (37-40 minutes) across employment categories. There were 3101 pairs of surveys that were included in the analysis. The reference group included 2814 survey pairs with stable employment status (FT-FT, PT-PT, and retired-retired). There were 51 FT-PT pairs, 127 FT-retired pairs, and 109 PT-retired pairs.

Distributions of napping characteristics

Table 2 displays the frequency distribution of nap frequencies and durations among nappers at baseline. Our definition of *napping* was quite broad (≥1 nap lasting >5 minutes in the prior month). Further exploration of baseline napping characteristics showed that short nap durations were uncommon: only 3% of the sample reported typical nap durations under 15 minutes. At the other extreme, 4% reported durations of ≥150 minutes. Extreme low and high nap frequencies were rare: 2% reporting fewer than 1 day napped per week and 7% reporting 7 days napped per week. (See Table 3.)

Regression analyses

One-year changes in typical MNPW

Retirement transition category was a statistically significant predictor of adjusted change in MNPW (Fig. 1; values for all variables in the main model are shown in Supplementary Table 1). Compared with stable employment status, full retirement predicted a statistically significant 1-year change of mean (95% confidence interval [CI]) +48.0 (+16.2, +79.9) MNPW. In contrast, staged retirement categories (ie, FT-PT and PT-retired) predicted smaller changes in MNPW, which were not statistically significant. In a separate analysis for linear trend, the association was statistically significant: (Beta = +11.1 MNPW for every 1-level increase in “retirement dose,” P = .01).

One-year changes in typical nap frequency

Retirement transition category was a statistically significant predictor of adjusted change in nap frequency (Fig. 2). Compared with stable employment status, full retirement predicted a change of mean (95% CI) +0.4 (+0.1, +0.8) nap per week. Changes in nap frequency associated with staged retirement categories were smaller in magnitude and not statistically significant. In a separate analysis for linear trend, the association was statistically significant (Beta = +0.1 d/wk for every 1-level increase in “retirement dose,” P = .02).

Table 3
Retirement transition pairs (n = 3101 pairs)

Retirement transition	type	n (%)
Stable employment status (reference group)	Full-time work to full-time work (FT-FT)	743 (24.0%)
	Part-time work to part-time work (PT-PT)	474 (15.3%)
	Fully retired to fully retired (RET-RET)	1597 (51.5%)
Transitioned to retirement	Full-time work to part-time work (FT-PT)	51 (1.6%)
	Full-time work to fully retired (FT-RET)	127 (4.1%)
	Part-time work to fully retired (PT-RET)	109 (3.5%)

One-year changes in typical nap duration

Adjusted changes in mean (95% CI) nap duration for each individual nap were small and not statistically significantly associated with retirement transition category: +6.2 (−0.4, +12.7) minutes per nap day for full retirement, +1.1 (−7.8, +9.9) for FT-PT, and −0.9 (−7.4, +5.6) for PT-retired (Fig. 3). In a separate analysis for linear trend, the association was not statistically significant (Beta = +1.3 minutes for every 1-level increase in “retirement dose,” P = .15).

Effect modification and additional analyses

Associations of retirement transitions with 1-year changes in nap outcomes were not significantly modified by sex, age, or concurrent change in nocturnal sleep duration.

Analyses stratified by sex are included in Supplemental Table 4.

One-year change in BMI was added as a predictor variable to the main MNPW model, and it was only weakly associated with changes in napping. Also, adding change in BMI to the main model did not

Table 2
Frequency distributions at baseline of typical nap durations by typical nap among nappers[a] (first observation)

Typical nap duration (min)	Typical nap frequency (d/wk)								
	< 1[b]	1	2	3	4	5	6	7	Total n (%)
Missing	0	1	0	0	0	0	0	0	1 (0.1%)
<15	0	9	12	3	3	0	0	0	27 (3.0%)
15-29	0	38	43	25	22	17	3	9	157 (17.3%)
30-59	10	78	61	57	37	24	14	15	296 (32.6%)
60-89	3	52	47	24	12	14	8	18	178 (19.6%)
90-119	1	33	18	23	11	19	3	8	116 (12.8%)
120-149	4	22	26	15	12	15	3	7	103 (11.3%)
≥150	0	7	5	7	1	5	0	5	30 (3.3%)
Total n (%)	18 (2.0%)	240 (26.4%)	212 (23.3%)	154 (17.0%)	97 (10.7%)	194 (10.4%)	31 (3.4%)	62 (6.8%)	908

[a] A total of 66.8% of participants were considered “nappers” at baseline based on indication of “a daytime or evening nap that lasted more than 5 minutes” in the month prior.
[b] At least 1 nap in the month prior but fewer than 1 per week (eg, every other week or once a month).

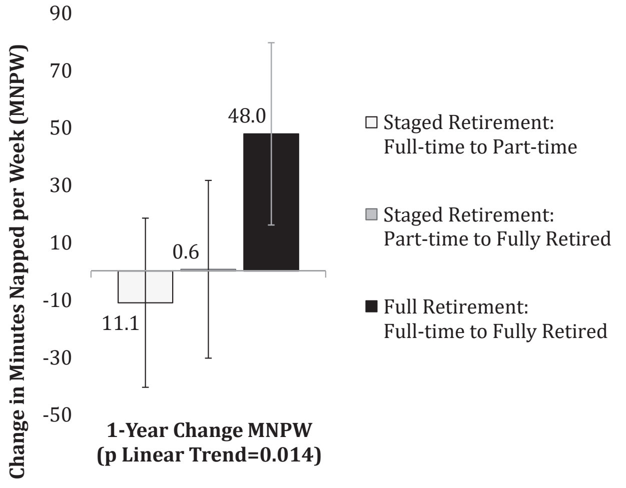

Fig. 1. Adjusted mean change in MNPW by retirement transition (vs stable employment status) (error bars represent 95% CI). Adjusted for sex, living with a partner, race/ethnicity, education, BMI, current smoker, caffeine consumption, alcohol consumption, exercise, SF-12 physical and mental summary scores, hypertension, diabetes, cardiovascular disease, cancer, restless leg syndrome, sleep apnea, insomnia, change in nocturnal sleep duration, circadian preference, and survey year.

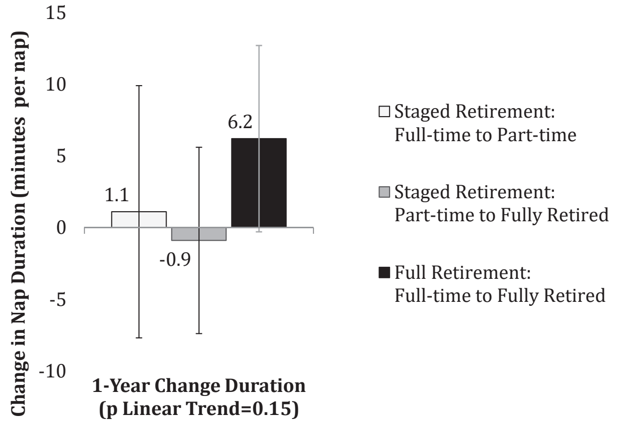

Fig. 3. Adjusted mean change in nap duration by retirement transition (vs stable employment status) (error bars represent 95% CI). Adjusted for age, sex, partner status, race/ethnicity, education, physical and mental well-being, health behaviors, medical diagnoses, sleep problems, circadian preference, concurrent change in nocturnal sleep duration, and survey year.

change (confound) associations between retirement transition and MNPW.

Excluding retired-retired pairs of observations from the reference group of the MNPW model did not appreciably change the results of the analysis. Retirement transition was associated with a 48-minute change in MNPW ($P < .01$) in the original model and with a 45-minute change in MNPW ($P < .01$) in the modified (retired-retired pairs removed) analysis.

The analysis of residualized $MNPW_{time2}$ as a function of $MNPW_{time1}$ + main model covariates produced similar estimates of the association of retirement transition with MNPW as the main models (42 minutes in the residualized analysis vs 48-minute change in MNPW in the main models). Results are shown in Supplementary Table 3.

The following reasons for retirement were associated with significant changes in MNPW: poor health/disability (160 greater MNPW associated with full retirement); wanted to do other things (45 greater MNPW with full retirement); financially secure and/or no need to work (57 greater MNPW); and hours reduced or laid off/let go led to decision to retire (70 greater MNPW associated with full retirement) (Supplementary Table 2).

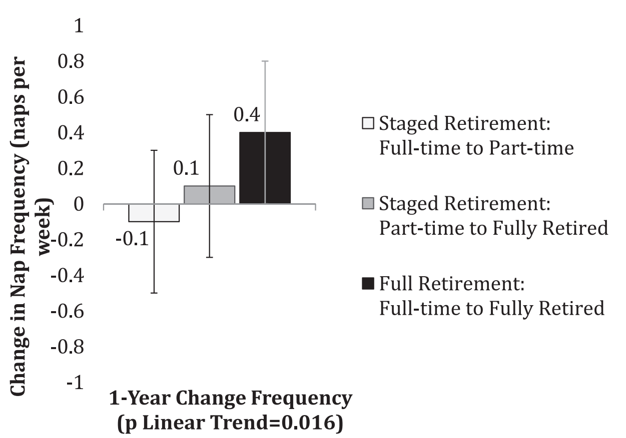

Fig. 2. Adjusted mean change in nap frequency by retirement transition (vs stable employment status) (error bars represent 95% CI). Adjusted for age, sex, partner status, race/ethnicity, education, physical and mental well-being, health behaviors, medical diagnoses, sleep problems, circadian preference, concurrent change in nocturnal sleep duration, and survey year.

Discussion

Changes in napping behaviors associated with retirement transitions varied by retirement type, with the full retirement transition associated with the largest 1-year change in mean minutes napped per week of +48 minutes. This increase was attributable to gains in mean nap frequency of approximately 2 naps per month. Interestingly, full retirement transition was not associated with statistically significant changes in mean nap duration. In contrast to full retirement transition, staged retirement transitions (FT-PT and PT-retired levels) of the categorical predictor were not significantly associated with any change in nap behavior outcomes. However, significant tests for linear trend suggest a continuum of effect between retirement "dose" and change in MNPW as well as change in nap frequency.

Longitudinal research on napping behaviors is rare: a literature search revealed 2 small studies of elderly volunteers.[2,35] As in the REST sample, both studies found statistically significant increases in nap frequency and no change in nap duration over time. In the first study, Hoch et al examined 2-week sleep diaries in a small sample of healthy, elderly, community-dwelling volunteers at 4 time points over a 3-year period.[2] Over 3 years of follow-up, nap frequency increased significantly (+0.5 to +0.6 nap per week), but nap duration did not change.

In the second study, Bliwise et al followed 31 members of a convenience sample with a high prevalence of insomnia symptoms over a decade.[35] At baseline, mean (SD) age was 66.5 (8.0) years, and more than 90% of participants were retired. Sleep diary data were collected over 2 weeks at baseline and over 1 week at follow-up, which occurred a mean (SD) 122 (21) months later. Mean (SD) nap frequency was 2.7 (3.7) days per week at baseline and 4.2 (3.6) at follow-up, a change of +1.5 days per week over 10 years ($P = .01$).

The ramifications of increasing the number of naps per week are unknown. The longer-term consequences of napping, generally, are not well understood. Napping has been associated, in the short term, with improvements in various cognitive processes, but longer naps have also been associated with sleep inertia, which is a state of decreased alertness following awakening.[36] Additionally, a meta-analysis found that taking longer naps (>60 minutes) was associated with increased risk for CVD and CVD-related death.[37] Whether shorter naps are associated with lower risk for CVD and other conditions is not known. The health costs and benefits associated with napping in retired populations are an important future area of investigation.

Strength

This study sample offers a large population-based cohort with impressively high response rates. Another strength is the prospective nature of the data, which allowed description and analysis of longitudinal changes in napping behaviors in this sample. A third strength of this research is that REST was specifically designed to study sleep across work-to-retirement transitions in the 24-hour context of sleep patterns, including napping behavior. Thus, unlike most previous epidemiologic research in which survey questions about napping were peripheral to the study design and thus coarsely categorized, REST characterized napping behavior using fine-grained, multifaceted measures, including continuous measures of nap timing variables.[26,29,30] Furthermore, this project is more capable than most of adjusting for confounding by sleep-related factors such as obstructive sleep apnea and insomnia. Another strength of this work is REST's rich array of measured covariates. These include diagnosed medical conditions known to be associated with napping and sociodemographic factors associated with sleep. A final strength of our analysis of changes in napping behaviors across the retirement transition stems from our granular and longitudinal characterization of the retirement process itself. In this way, we were able to observe a dose-response in the associations with type of retirement transition.

Limitations

The REST sample is relatively homogeneous (geographically and racially/ethnically), and this may limit the generalizability of this study's findings to other population groups. Our sample of current and former Wisconsin state workers is younger at retirement and has more access to health coverage than the general American population. Still, REST baseline nap behavior characteristics are consistent with those reported elsewhere in the literature.[38] A recent randomized trial of a workplace flexibility intervention showed strikingly strong similarities in baseline nap characteristics with the REST sample[39] despite dramatic differences in study population and methods.

Because of the way the data were collected, we do not know when in the interval between 2 surveys that napping behavior changed (if it did), when a retirement transition occurred (if it did), or in which order these 2 changes happened. We have controlled for several variables to take into account concerns about confounding (eg, if poor health leads to contemporaneous changes in work status and napping behavior), but we cannot rule out reverse causality (ie, that changes in napping occur first and precipitate a change in working status) with our analyses. However, the scenario that increased opportunities to nap accompanying onset of retirement may lead to changes in nap behavior is highly plausible; preretirement changes in napping behavior per se leading to hastened or delayed retirement (independent of some confounding factor, such as illness) seem less likely to be a common scenario.

Finally, we used annually administered survey questions to measure typical napping behaviors. This approach is subject to measurement error due to imperfect perception and recall of nap frequency and duration and requires participants to not only estimate the bounds of daytime sleep episodes but also perform arithmetic operations to generate representative averages. Although accelerometry is an alternative method of measuring “typical” sleep patterns that could address problems associated with recall- and perception-related errors, this method has other potential problems in accurately measuring napping frequency and duration, as accelerometers cannot reliably discriminate between short periods of sleep and sedentary wakefulness, both of which might change due to a retirement transition.

Conclusions

The sleep medicine community has not established clear recommendations for adult napping frequency or duration.[40] To the extent that naps serve to ameliorate what would otherwise constitute sleep deficit, they are potentially beneficial to health. Although the optimal napping exposure for older adults is unclear, our results indicate that retirement transitions are important pivot points in trajectories of napping frequency. If and when definitive causal links are found between napping and well-being, the retirement transition may be an optimal time for public health napping awareness interventions.[4]

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Declaration of competing interests

The authors have no competing interests to declare.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sleh.2019.08.005.

References

1. Webb WB. Development of human napping. In: Dinges DF, Broughton RJ, eds. *Sleep and Alertness: Chronobiological, Behavioral, and Medical Aspects of Napping. New York*. Ltd.: Raven Press; 1989:31–49.
2. Hoch CC, Dew MA, Reynolds CF, et al. Longitudinal changes in diary- and laboratory-based sleep measures in healthy "old old" and "young old" subjects: a three-year follow-up. *Sleep*. 1997;20(3):192–202.
3. Tune GS. Sleep and wakefulness in normal human adults. *Br Med J*. 1968;2(5600):269–271.
4. Ohayon MM, Zulley J. Prevalence of naps in the general population. *Sleep and Hypnosis*. 1999;1(2):88–97.
5. Foley DJ, Vitiello MV, Bliwise DL, Ancoli-Israel S, Monjan AA, Walsh JK. Frequent napping is associated with excessive daytime sleepiness, depression, pain, and nocturia in older adults: findings from the National Sleep Foundation '2003 Sleep in America' poll. *Am J Geriatr Psychiatry*. 2007;15(4):344–350.
6. Ohayon MM. Interactions between sleep normative data and sociocultural characteristics in the elderly. *J Psychosom Res*. 2004;56(5):479–486.
7. Ruiter ME, VanderWal GS, Lichstein KL. Insomnia in the elderly. In: Pandi-Perumal SR, Monti JM, Monjan AA, eds. *Principles and Practice of Geriatric Sleep Medicine*. New York: Cambridge University Press; 2010:271–279.
8. Ancoli-Israel S, Martin JL. Insomnia and daytime napping in older adults. *J Clin Sleep Med*. 2006;2(3):333–342.
9. Hagen EW, Barnet JH, Hale L, Peppard PE. Changes in sleep duration and sleep timing associated with retirement transitions. *Sleep*. 2016;39(3):665–673.
10. Marquiáe JC, Folkard S, Ansiau D, Tucker P. Effects of age, gender, and retirement on perceived sleep problems: results from the VISAT combined longitudinal and cross-sectional study. *Sleep*. 2012;35(8):1115–1121.
11. Vahtera J, Westerlund H, Hall M, et al. Effect of retirement on sleep disturbances: the GAZEL prospective cohort study. *Sleep*. 2009;32(11):1459–1466.
12. Ding D, Grunseit AC, Chau JY, Vo K, Byles J, Bauman AE. Retirement—a transition to a healthier lifestyle?: evidence from a large Australian study. *Am J Prev Med*. 2016;51(2):170–178.
13. Tune GS. Sleep and wakefulness in 509 normal human adults. *Br J Med Psychol*. 1969;42(1):75–80.
14. Eibich P. Understanding the effect of retirement on health: mechanisms and heterogeneity. *J Health Econ*. 2015;43:1–12.

15. Akerstedt T, Torsvall L, Gillberg M. Shift work and napping. In: Dinges DF, Broughton RJ, eds. *Sleep and Alertness: Chronobiological, Behavioral, and Medical Aspects of Napping*. New York: Raven Press; 1989:205–220.
16. Tepas DI, Duchon JC, Gersten AH. Shiftwork and the older worker. *Exp Aging Res*. 1993;19(4):295–320.
17. Bohle P, Di Milia L, Fletcher A, Rajaratnam S. Introduction: aging and the multifaceted influences on adaptation to working time. *Chronobiol Int*. 2008;25(2):155–164.
18. Tune GS. Sleep and wakefulness in a group of shift workers. *Br J Ind Med*. 1969;26(1):54–58.
19. Asplund R. Daytime sleepiness and napping amongst the elderly in relation to somatic health and medical treatment. *J Intern Med*. 1996;239(3):261–267.
20. Fang W, Li Z, Wu L, et al. Longer habitual afternoon napping is associated with a higher risk for impaired fasting plasma glucose and diabetes mellitus in older adults: results from the Dongfeng-Tongji cohort of retired workers. *Sleep Med*. 2013;14(10):950–954.
21. Xu Q, Song Y, Hollenbeck A, Blair A, Schatzkin A, Chen H. Day napping and short night sleeping are associated with higher risk of diabetes in older adults. *Diabetes Care*. 2010;33(1):78–83.
22. Lam KB, Jiang CQ, Thomas GN, et al. Napping is associated with increased risk of type 2 diabetes: the Guangzhou Biobank Cohort Study. *Sleep*. 2010;33(3):402–407.
23. Kerkhofs M, Linkowski P, Lucas F, Mendlewicz J. Naps and depression. *Acta Psychiatr Belg*. 1992;92(3):172–178.
24. Maglione JE, Ancoli-Israel S, Peters KW, et al. Depressive symptoms and subjective and objective sleep in community-dwelling older women. *J Am Geriatr Soc*. 2012;60(4):635–643.
25. Leng Y, Wainwright NW, Cappuccio FP, et al. Daytime napping and increased risk of incident respiratory diseases: symptom, marker, or risk factor? *Sleep Med*. 2016;23:12–15.
26. Stang A, Dragano N, Moebus S, et al. Midday naps and the risk of coronary artery disease: results of the Heinz Nixdorf Recall Study. *Sleep*. 2012;35(12):1705–1712.
27. Leng Y, Wainwright NW, Cappuccio FP, et al. Daytime napping and the risk of all-cause and cause-specific mortality: a 13-year follow-up of a British population. *Am J Epidemiol*. 2014;179(9):1115–1124.
28. Cohen-Mansfield J, Perach R. Sleep duration, nap habits, and mortality in older persons. *Sleep*. 2012;35(7):1003–1009.
29. Jung KI, Song CH, Ancoli-Israel S, Barrett-Connor E. Gender differences in nighttime sleep and daytime napping as predictors of mortality in older adults: the Rancho Bernardo study. *Sleep Med*. 2013;14(1):12–19.
30. Stone KL, Ewing SK, Ancoli-Israel S, et al. Self-reported sleep and nap habits and risk of mortality in a large cohort of older women. *J Am Geriatr Soc*. 2009;57(4):604–611.
31. Bursztyn M, Stessman J. The siesta and mortality: twelve years of prospective observations in 70-year-olds. *Sleep*. 2005;28(3):345–347.
32. Hays JC, Blazer DG, Foley DJ. Risk of napping: excessive daytime sleepiness and mortality in an older community population. *J Am Geriatr Soc*. 1996;44(6):693–698.
33. Ware J, Kosinski M, Keller SD. A 12-item short-form health survey: construction of scales and preliminary tests of reliability and validity. *Med Care*. 1996;34(3):220–233.
34. Horne JA, Ostberg O. A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. *Int J Chronobiol*. 1976;4(2):97–110.
35. Bliwise DL, Ansari FP, Straight LB, Parker KP. Age changes in timing and 24-hour distribution of self-reported sleep. *Am J Geriatr Psychiatry*. 2005;13(12):1077–1082.
36. Faraut B, Andrillon T, Vecchierini MF, Leger D. Napping: a public health issue. From epidemiological to laboratory studies. *Sleep Med Rev*. 2017;35:85–100.
37. Yamada T, Hara K, Shojima N, Yamauchi T, Kadowaki T. Daytime napping and the risk of cardiovascular disease and all-cause mortality: a prospective study and dose-response meta-analysis. *Sleep*. 2015;38(12):1945–1953.
38. Webb WB. Developmental aspects and a behavioral model of human sleep. In: Stampi C, ed. *Why We Nap: Evolution, Chronobiology, and Functions of Polyphasic and Ultrashort Sleep*. Boston: Burkhauser; 1992:58–67.
39. Lee S, Almeida DM, Berkman L, Olson R, Moen P, Buxton OM. Age differences in workplace intervention effects on employees' nighttime and daytime sleep. *Sleep Health*. 2016;2(4):289–296.
40. Ohayon M, Wickwire EM, Hirshkowitz M, et al. National Sleep Foundation's sleep quality recommendations: first report. *Sleep Health: Journal of the National Sleep Foundation*. 2017;3(1):6–19.