THE GERONTOLOGICAL SOCIETY OF AMERICA®

Journals of Gerontology: Medical Sciences
cite as: *J Gerontol A Biol Sci Med Sci*, 2023, Vol. XX, No. XX, 1–11
https://doi.org/10.1093/gerona/glad042
Advance Access publication February 02, 2023

OXFORD

Special Issue: Sleep, Circadian Rhythms, and Aging: Advancing Knowledge to Promote Older Adults' Health

Characteristics of Atypical Sleep Durations Among Older Compared to Younger Adults: Evidence from the New Zealand Health Survey

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Received: July 26, 2022; Editorial Decision Date: January 30, 2023

Decision Editor: Lewis A. Lipsitz , MD, FGSA

Abstract

Background: Understanding and supporting sleep is important across the life span. Disparities in sleep status are well documented in mid-life but under-explored among older populations.

Methods: Data from 40,659 adults pooled from the New Zealand Health Surveys were used; 24.2% were "older adults" (aged ≥65 years), 57% were female, and 20.5% of Māori ethnicity. "Long," "short," or "typical" sleep categories were based on age-related National Sleep Foundation guidelines. Multinomial logistic regression examined predictors of atypical sleep, including sociodemographic characteristics, lifestyle factors, and health status.

Results: Prevalence of short and long sleep among older adults was 296 (3.0%) and 723 (7.4%), respectively. Correspondingly, prevalence among younger adults was 2 521 (8.2%) and 364 (1.2%). Atypical sleep was more significantly associated with indicators of reduced socioeconomic status and ethnicity among younger rather than older adults. Within both age groups, lower physical activity was associated with long sleep status. Higher physical activity and smoking were related to short sleep status among younger adults only. Within both age groups, atypical sleep was associated with SF-12 scores indicating poorer physical and mental health. Having ≥3 health conditions was related to short sleep among the older adults, while for young adults, it was related to both atypical durations.

Conclusions: Indicators of negative lifestyle and health factors remain consistent predictors of atypical sleep with aging. However, demographic disparities are less apparent among older atypical sleepers. This study highlights individual and contextual factors associated with atypical sleep patterns which may be important for age-appropriate recognition and management of sleep problems.

Keywords: Activity, Ethnicity, Illness, Sleep time, Socioeconomic status

Sleep is a crucial determinant of health and well-being across the life span (1). Sufficient sleep has been linked with better outcomes for mood, mental health, and cognitive functioning as well as metabolic, cardio, and cerebrovascular health (2–6). Sleep health is increasingly characterized using the dimensions of sleep duration, quality, timing, and regularity, as well as feelings of alertness during wake (7). Dimensions of sleep have been found to change with aging. Shorter, earlier, and less satisfying sleep are more frequently reported among older compared to younger adults. Furthermore, sleep disorders such as insomnia and sleep apnea have been identified as more prevalent with aging and disease (8,9). This has implications for outcomes such as frailty, cognitive impairment, and falls, as well as earlier formal care requirements and mortality (10–12). It is important to gain a better understanding of the factors associated with poor sleep across the life span to better support healthy aging.

Social-ecological models help illustrate the myriad of factors that may be associated with poor sleep health at individual (eg, genetics, physiology, behavior, and beliefs), social (eg, socioeconomic status, neighborhood, gender, and ethnicity), and broader societal levels (eg, public policy, economics, and living in a 24/7 society (13,14)). Research from New Zealand finds that self-reported sleep problems are prevalent in more than a quarter of the general population (15,16). Socioeconomic and ethnic disparities of sleep have consistently been found among young and middle-aged populations. Māori (the Indigenous peoples of New Zealand) have been identified as more likely to have insufficient sleep or sleep disorders compared to non-Māori (16,17). This has been attributed to living in a society that is not responsive to the values or needs of Māori as well as the impacts of individual and structural racism. Variations within factors such as work demands, social schedules, and health behaviors are also well-recognized predictors of sleep status among younger adults of New Zealand (16–18). Studies considering the sleep status of older New Zealanders have had mixed results. For example, an analysis of data from Māori and non-Māori aged over 80 years found that, while self-reported sleep problems were of a similar prevalence to their younger counterparts and consistently associated with poorer physical and mental health, sleep problems were less commonly reported among Māori (26.3%) than non-Māori (31.7%, (12,19)). This contrasts with previous studies with younger New Zealanders (16–18) and could be a reflection of changing beliefs, expectations, and perceptions of sleep with aging (20). However, further exploration into differences in sleep profiles by age are warranted using more consistent measures.

How sleep has been recorded between studies varies, often relying on self-reported "problems" which challenges the ability to reliably compare predictors of sleep between younger and older age. Sleep duration is a widely captured benchmark for healthy or typical sleep and is commonplace for populational health surveillance (21). The National Sleep Foundation have developed age-specific recommendations around optimal sleep durations per 24 hours (including what "might be appropriate") for healthy individuals (22). These are based on findings from epidemiological studies and scientific literature concerning health outcomes associated with various sleep durations and are now referred to as international guidelines around sleep. Sleeping unusually short or long durations is indicative of disordered sleep and have been associated with poorer health and socioeconomic situations.

Around a third of American and New Zealand adults have been found to be short sleepers (eg, ≤7 hours), while long sleeping (eg, ≥9 hours) is prevalent among 5%–10% of general adult populations with estimates varying between scheduled and unscheduled days (17,23). Studies often use broad definitions of optimal sleep duration despite recommendations varying over the life course. For example, while 7–9 hours is recommended as ideal for those aged 26–64 years, 6–10 hours is still deemed as appropriate; for adults aged 65 years or older, the range is shorter (7–8 hours as ideal, with 5–9 hours as appropriate, (22)). Studies using more accurate assessments of atypical sleep durations defined according to the National Sleep Foundation's consensus recommendations for what "may be appropriate" will help understand the relationships between sleep duration with socioeconomic and health factors in different strata of the population.

The New Zealand Health Survey (NZHS) is a large, nationally representative survey of the health status, lifestyle and behavioral characteristics, and health service utilization of New Zealand adults. Establishing a comprehensive assessment of sleep health has not been a key focus of this population health survey. However, the importance of sleep for health and well-being is recognized. Therefore, sleep duration has been collected and is available across three of the survey years. The current study aimed to explore the characteristics associated with sleep duration profiles ("short," "typical," and "long") according to the appropriate ranges defined by the National Sleep Foundation's guidelines for various life stages (22) between older and younger adults of New Zealand.

Method

Data Source

This study uses data from the 3 rounds of the NZHS. The NZHS is a cross-sectional survey collecting nationally representative information on the health and wellbeing of New Zealanders since 1992. The NZHS initially collected information every three years but became an annual (continuous) survey in 2011. For the present study, the NZHS-2013/2014, NZHS-2017/2018, and NZHS-2018/2019 were pooled and used because sleep duration was collected within all three (24) (items pertaining to sleep disorder diagnosis and excessive daytime sleepiness were also included in the 2013–2014 survey only and will be reported elsewhere).

Survey Design

Participants of the NZHS were recruited via a multi-stage, stratified, probability-proportional-to-size sampling design to yield an annual sample size of approximately 14,000 adults (aged ≥15 years) and 5 000 children (aged ≤14 years). Unique participants are drawn each year either through area-based sampling or electoral roll sampling. This dual sampling frame is used to improve the representation of Māori and minority ethnicity groups to ensure the estimates derived and differences detected could be achieved with statistical precision. All information obtained in these surveys was self-reported and collected through separate questionnaires for adults and children. Details of the design and data collection procedures have been described in the individual survey reports (24).

Ethical Approval

This research involves human participants but relies on the analysis of secondary data. The survey rounds were approved by the New Zealand Health and Disability Multi-region Ethics Committee (24). During the survey-related interviews, informed consent was obtained from participants. Ethics approval for the present study was provided by The Massey University Northern Ethics Committee (NOR 20/73). The proposal was approved by Statistics New Zealand and provided the Confidentialised Unit Record File (CURF) data for analyses (CURF2020-29).

Study Participants

Data from participants of the adult surveys (ie, aged ≥15 years) were included in this study, and consequently, included 13,309, 13,869, and 13,572 participants from 2013/2014, 2017/2018, and 2018/2019 of the NZHS, respectively.

Outcome Variable

The primary outcome of interest in this study was sleep duration. This was obtained using the question "How many hours of sleep do you usually get in a 24-hour period, including all naps and sleeps?." Responses were rounded to the nearest whole hour. The National

Sleep Foundation's guidelines were used to define participants as per the "may be appropriate" ranges (between 0 and 24 hours, 22). The recommended appropriate duration of sleep for adolescents (14–17 years old), young adults (18–25 years old), adults (26–64 years old), and older adults (65+ years) is 7–11 hours, 6–11 hours, 6–10 hours, and 5–9 hours, respectively. Participants in the present study were defined as "*typical sleepers*" if they slept within the range appropriate of their respective age group. "*Short sleepers*" and "*long sleepers*" were defined if their sleep duration was shorter than or longer than their age-appropriate range, respectively.

Exposure Variables

Based on previous literature, this investigation considered a total of 14 independent variables from the domains of sociodemographic characteristics; lifestyle and behavioral characteristics; and health status (15,18). Sociodemographic variables included sex, education, ethnicity, neighborhood deprivation, and equivalized household income from the group of sociodemographic characteristics. Education was categorized as "lower than secondary," "secondary," "tertiary," and "other" (which encompassed other qualifications gained not recognized within New Zealand). Ethnicity was included as a binary variable (Māori or non-Māori). Neighborhood deprivation referred to the NZ Deprivation Index 2013 and measured the level of socioeconomic deprivation for each neighborhood (meshblock, (25)). The index was constructed using nine variables from census data to provide a deprivation score for each meshblock area in NZ, where higher scores indicate the most deprived (26). Here, the index was considered in the quintile form provided in the data sets. Following the previous literature, equivalized household income was calculated by adding the total household income and then dividing by the equivalence scale (18,26). Income was then divided into terciles (low, medium, and high) for the present analysis. Note, marital status was not collected in these surveys and work status, while collected, was deemed unreliable due to the skewed proportion (80%) of older adults categorized as "unemployed" and lack of other items to distinguish waking responsibilities.

Variables pertaining to lifestyle and behavioral characteristics included the individual's physical activeness, intake of vegetables and fruits, current smoking status, and hazardous drinking. The NZHS defined physical activeness if someone met the New Zealand Ministry of Health's physical activity guidelines in the past 7 days—at least 30 minutes of exercise on 5 or more days in the past week (27). Similarly, nutritional guidelines recommend 3 or more servings of vegetables and two or more servings of fruit per day (28). Those reporting physical activity and nutritional consumption less than these guidelines were defined as "low" (27). Hazardous drinking Alcohol Use Disorders Identification Test summary score was also available as a derived variable in the data sets and was included as a continuous variable (range 0–40, (27)).

Variables pertaining to health status used in the present analyses included a body mass index (BMI) indicative of obesity (BMI > 30), number of comorbid health conditions, polypharmacy, as well as the SF-12 physical and mental health component scores. The comorbidity variable was derived based on reports of diagnosis of up to 17 morbidities, broadly related to heart problems, high blood pressure, high cholesterol, stroke, asthma, diabetes, arthritis, and gout. Counting the morbidities, the comorbidity variable was coded as 0, 1, 2, and "3 or more" morbidities. Conversely, polypharmacy was defined as a binary variable if an individual simultaneously took 5 or more medicines for those morbidities (29). Following Frieling et al. (30), the SF-12 Physical Component Score and SF-12 Mental Component Score (MCS) for all 3 surveys were created. Following previous research, the present analysis categorized both physical and mental health as the lowest quartile of SF-12 component score compared to all else (15). Note, although NZHS-2013/2014 data provided the score based on SF-36, the SF-12 score was also created for this round and used this way for consistency with the other 2 survey waves used in the present analyses.

Statistical Analysis

All 3 relevant surveys were pooled to provide a sufficient sample size for the disaggregated analyses by age group. First, descriptive analyses were conducted to determine the characteristics of the study participants across different sleep profiles disaggregated by the age groups of "older adults" and "younger adults." The older adults group included all those aged 65 years or older. The younger adults group included adolescents, young adults, and adults (ie, all adults aged <65 years) as sample size did not allow for multiple stratifications by age. This decision was driven primarily by the low number of adolescent respondents.

Multinomial logistic regression was used to examine associations between the different sleep profiles (short, typical, and long) and the selected sociodemographic characteristics, lifestyle and behavioral characteristics, and health status variables. In these analyses, both unadjusted and adjusted odds ratios were calculated separately for older adults and younger adults. All statistical analyses were performed using STATA version 15.1 (StataCorp LLC, College Station, TX). The STATA survey commands were used to adjust the sampling design.

Results

A total of 40,659 adults were included in these analyses, of whom 9 825 (24.2%) were "older adults" and 30,834 (75.8%) were "younger adults." Among the older adults, the prevalence of short, typical, and long sleep was 296 (3.0%), 8 806 (89.6%), and 723 (7.4%). The corresponding prevalence of sleep type for younger adults was 2 521 (8.2%), 27,949 (90.6%), and 364 (1.2%), respectively. The detailed characteristics of study participants across the sleep types by age groups are given in Table 1. In brief, the sociodemographic characteristics indicated that the proportion of female participants was a little higher than males (57.0%), and 20.5% of the samples identified as of Māori ethnicity. Lifestyle and behavioral characteristics demonstrated that 20.0% of study participants were smokers and 62.2% were eating below the vegetable and fruit intake guidelines. In the case of health status, a higher proportion of participants with 3 or more comorbidities (48.0%) and polypharmacy (6.8%) were observed among the older adult group compared to the younger adults (12.0% and 1.4%, respectively).

The unadjusted odds ratios exhibiting the associations between sleep type and different characteristics of participants are given in Table 2. Except for hazardous drinking, it was observed that all selected predictors were significantly associated with being a short and/or long sleeper within both older and younger adult age groups. In general, the likelihood of reporting short sleep was greater for the selected variables (compared to its reference group) in both age groups. Similar patterns of association were observed for long sleepers in both age groups.

Table 3 presents the adjusted odds ratios demonstrating the associations between sleep profile and the sociodemographic

Table 1. Participants' Characteristics by Sleep Type Between Younger and Older Adult Age Groups

	Sleep Type: Younger Adults (<65 y)			Sleep Type: Older Adults (≥65 y)		
	Short (2 521)	Typical (27,949)	Long (364)	Short (296)	Typical (8 806)	Long (723)
	% (*n*)	% (*n*)	% (*n*)	% (*n*)	% (*n*)	% (*n*)
Sociodemographic characteristics						
Sex						
Male	40.9 (1 031)	43.3 (12,097)	44.5 (162)	39.5 (117)	42.1 (3 709)	49.8 (360)
Female	59.1 (1 490)	56.7 (15,851)	55.5 (202)	60.5 (179)	57.9 (5 097)	50.2 (363)
Education						
Lower than secondary school	34.1 (800)	22.8 (5 873)	44.0 (154)	54.9 (152)	44.8 (3 597)	53.4 (353)
Secondary	37.1 (871)	34.6 (8 900)	37.7 (132)	20.9 (58)	23.2 (1 864)	24.5 (162)
Tertiary	24.1 (566)	37.7 (9 695)	14.6 (51)	14.4 (40)	22.9 (1 837)	14.4 (95)
Other	4.6 (109)	4.9 (1 267)	3.7 (13)	9.7 (27)	9.1 (727)	7.7 (51)
Ethnicity						
Non-Māori	67.9 (1 712)	77.8 (21,742)	57.7 (210)	83.1 (246)	88.2 (7 767)	87.1 (630)
Māori	32.1 (809)	22.2 (6 206)	42.3 (154)	16.9 (50)	11.8 (1 039)	12.9 (93)
Neighborhood deprivation index						
Quintile-1 (least deprived)	8.3 (210)	14.0 (3 915)	3.0 (11)	10.1 (30)	15.1 (1 328)	11.8 (85)
Quintile-2	12.5 (314)	16.1 (4 497)	6.9 (25)	15.2 (45)	16.8 (1 480)	13.3 (96)
Quintile-3	16.4 (413)	19.1 (5 344)	14.3 (52)	17.6 (52)	19.2 (1 690)	18.1 (131)
Quintile-4	25.8 (651)	23.7 (6 611)	23.6 (86)	26.4 (78)	25.7 (2 259)	27.7 (200)
Quintile-5 (most deprived)	37.0 (933)	27.1 (7 581)	52.2 (190)	30.7 (91)	23.3 (2 049)	29.2 (211)
Equivalized household income						
Low	30.6 (771)	20.6 (5 754)	42.3 (154)	53.4 (158)	48.1 (4 240)	56.4 (408)
Medium	24.4 (616)	28.7 (8 035)	14.6 (53)	15.2 (45)	24.6 (2 165)	18.4 (133)
High	20.4 (514)	29.6 (8 279)	6.0 (22)	5.1 (15)	10.8 (955)	3.5 (25)
Unknown/missing	24.6 (620)	21.0 (5 880)	37.1 (135)	26.4 (78)	16.4 (1 446)	21.7 (157)
Lifestyle and behavioral characteristics						
Less physically active						
No	52.1 (1 298)	52.5 (14,536)	34.7 (125)	34.5 (101)	45.0 (3 934)	29.0 (207)
Yes	47.9 (1 191)	47.5 (13,168)	65.3 (235)	65.5 (192)	55.0 (4 812)	71.0 (507)
Lower intake of vegetables and fruits						
No	30.0 (753)	35.5 (9 906)	27.5 (100)	43.0 (126)	47.3 (4 156)	38.0 (273)
Yes	70.0 (1 761)	64.5 (18,011)	72.5 (263)	57.0 (167)	52.7 (4 638)	62.0 (446)
Currently smoking						
No	65.2 (1 638)	78.7 (21,965)	59.5 (216)	88.4 (259)	92.5 (8 136)	88.9 (643)
Yes	34.8 (874)	21.3 (5 938)	40.5 (147)	11.6 (34)	7.5 (656)	11.1 (80)
AUDIT Summary Score mean (*SE*)	5.04 (0.11)	4.75 (0.03)	5.21 (0.35)	2.47 (0.18)	2.77 (0.04)	2.60 (0.13)
Health status						
Obesity (BMI > 30)						
No	53.0 (1 228)	65.1 (17,078)	53.6 (172)	61.5 (163)	65.5 (5 355)	61.2 (390)
Yes	47.0 (1 087)	34.9 (9 141)	46.4 (149)	38.5 (102)	34.5 (2 822)	38.8 (247)
Comorbidities						
0	31.4 (792)	50.8 (14,196)	37.6 (137)	5.4 (16)	11.5 (1 009)	10.1 (73)
1	26.1 (657)	26.1 (7 284)	26.1 (95)	15.5 (46)	19.4 (1 712)	15.2 (110)
2	18.4 (465)	12.4 (3 475)	12.4 (45)	17.2 (51)	22.1 (1 946)	20.2 (146)
3 or more	24.1 (607)	10.7 (2 993)	23.9 (87)	61.8 (183)	47.0 (4 139)	54.5 (394)
Polypharmacy						
No	96.6 (2 435)	98.8 (27,620)	96.4 (351)	88.2 (261)	93.6 (8 245)	90.2 (652)
Yes	3.4 (86)	1.2 (328)	3.6 (13)	11.8 (35)	6.4 (561)	9.8 (71)
Lowest quartile of SF-12 PCS						
No	64.2 (1 566)	83.0 (22,544)	58.8 (201)	33.9 (96)	57.7 (4 879)	37.8 (254)
Yes	35.8 (873)	17.0 (4 627)	41.2 (141)	66.1 (187)	42.3 (3 584)	62.2 (418)
Lowest quartile of SF-12 MCS						
No	53.0 (1 293)	74.3 (20,200)	52.0 (178)	66.8 (189)	84.5 (7 153)	78.3 (526)
Yes	47.0 (1 146)	25.7 (6 971)	48.0 (164)	33.2 (94)	15.5 (1 310)	21.7 (146)

Notes: Data source—pooled data using NZHS-2013/14, NZHS-2017/18, NZHS-2018/19. Total number varies between categories because of missing values. AUDIT = Alcohol Use Disorder Identification Test; BMI = body mass index; SF-12 PCS = SF-12 Physical Health Component Scores; SF-12 MCS = SF-12 Mental Health Component Scores.

Table 2. Unadjusted ORs Showing the Associations of Participants' Characteristics with Short Sleeper and Long Sleeper Among the Younger and Older Adult Age Groups

	Sleep Type*: Younger Adults (<65 y)				Sleep Type*: Older Adults (≥65 y)			
	Short		Long		Short		Long	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sociodemographic characteristics								
Sex								
Male (ref)	1.00		1.00		1.00		1.00	
Female	**1.10**	(1.01, 1.20)	0.95	(0.77, 1.18)	1.11	(0.88, 1.41)	**0.73**	(0.63, 0.86)
Education								
Lower than secondary school	**2.33**	(2.08, 2.62)	**4.98**	(3.60, 6.89)	**1.94**	(1.37, 2.75)	**1.90**	(1.50, 2.39)
Secondary	**1.68**	(1.50, 1.87)	**2.82**	(2.06, 3.86)	**1.43**	(0.96, 2.14)	**1.68**	(1.29, 2.19)
Tertiary (ref)	1.00		1.00		1.00		1.00	
Other	**1.47**	(1.18, 1.84)	**1.95**	(1.06, 3.60)	**1.71**	(1.04, 2.79)	**1.36**	(0.94, 1.95)
Ethnicity								
Non-Māori (ref)	1.00		1.00		1.00		1.00	
Māori	**1.66**	(1.51, 1.81)	**2.57**	(2.08, 3.17)	**1.52**	(1.09, 2.11)	1.10	(0.87, 1.40)
Neighborhood deprivation index								
Quintile-1 (least deprived) (ref)	1.00		1.00		1.00		1.00	
Quintile-2	**1.30**	(1.08, 1.57)	1.98	(0.98, 4.01)	1.35	(0.85, 2.14)	1.01	(0.76, 1.36)
Quintile-3	**1.44**	(1.21, 1.72)	**3.46**	(1.82, 6.59)	1.36	(0.86, 2.16)	1.21	(0.91, 1.61)
Quintile-4	**1.84**	(1.56, 2.16)	**4.63**	(2.47, 8.67)	1.53	(0.99, 2.36)	**1.38**	(1.07, 1.79)
Quintile-5 (most deprived)	**2.29**	(1.96, 2.69)	**8.92**	(4.87,16.32)	**1.97**	(1.29, 3.00)	**1.61**	(1.25, 2.08)
Equivalized household income								
Low	**1.75**	(1.56, 1.96)	**4.06**	(2.99, 5.51)	**1.79**	(1.29, 2.50)	**1.57**	(1.28, 1.91)
Medium (ref)	1.00		1.00		1.00		1.00	
High	**0.81**	(0.72, 0.91)	**0.40**	(0.24, 0.66)	**0.76**	(0.42, 1.35)	**0.43**	(0.27, 0.66)
Unknown/missing	1.38	(1.22, 1.55)	3.48	(2.54, 4.77)	2.60	(1.79, 3.76)	1.77	(1.40, 2.24)
Lifestyle and behavioral characteristics								
Less physically active								
No (ref)	1.00		1.00		1.00		1.00	
Yes	1.01	(0.93, 1.10)	**2.08**	(1.67, 2.59)	**1.55**	(1.21, 1.99)	**2.00**	(1.70, 2.36)
Lower intake of vegetables and fruits								
No (ref)	1.00		1.00		1.00		1.00	
Yes	**1.29**	(1.18, 1.40)	**1.45**	(1.14, 1.83)	1.19	(0.93, 1.51)	**1.46**	(1.25, 1.72)
Currently smoking								
No (ref)	1.00		1.00		1.00		1.00	
Yes	**1.97**	(1.80, 2.16)	**2.52**	(2.04, 3.10)	**1.63**	(1.14, 2.33)	**1.54**	(1.21, 1.97)
AUDIT Summary Score	**1.01**	(1.00, 1.02)	1.02	(0.99, 1.05)	0.97	(0.92, 1.01)	0.98	(0.95, 1.01)
Health status								
Obesity (BMI > 30)								
No (ref)	1.00		1.00		1.00		1.00	
Yes	**1.65**	(1.52, 1.79)	**1.62**	(1.30, 2.02)	1.19	(0.92, 1.53)	**1.20**	(1.02, 1.42)
Comorbidities								
0 (ref)	1.00		1.00		1.00		1.00	
1	**1.62**	(1.45, 1.80)	**1.35**	(1.04, 1.76)	1.69	(0.96, 2.99)	0.89	(0.65, 1.21)
2	**2.40**	(2.13, 2.70)	1.34	(0.96, 1.87)	1.65	(0.94, 2.90)	1.04	(0.78, 1.38)
3 or more	**3.64**	(3.24, 4.08)	**3.01**	(2.31, 3.93)	**2.79**	(1.67, 4.66)	**1.32**	(1.02, 1.70)
Polypharmacy								
No (ref)	1.00		1.00		1.00		1.00	
Yes	**2.97**	(2.32, 3.81)	**3.12**	(1.78, 5.47)	**1.97**	(1.35, 2.88)	**1.60**	(1.23, 2.08)
Lowest quartile of SF-12 PCS								
No (ref)	1.00		1.00		1.00		1.00	
Yes	**2.72**	(2.49, 2.97)	**3.42**	(2.74, 4.27)	**2.65**	(2.06, 3.41)	**2.24**	(1.90, 2.64)
Lowest quartile of SF-12 MCS								
No (ref)	1.00		1.00		1.00		1.00	
Yes	**2.57**	(2.36, 2.79)	**2.67**	(2.15, 3.31)	**2.72**	(2.11, 3.49)	**1.52**	(1.25, 1.84)

Notes: Data source—pooled data using NZHS-2013/14, NZHS-2017/18, NZHS-2018/19. Bold OR's indicative of statistically significance ($p < .05$). AUDIT = Alcohol Use Disorder Identification Test; BMI = body mass index; CI = Confidence interval; OR = odds ratio; SF-12 PCS = SF-12 Physical Health Component Scores; SF-12 MCS = SF-12 Mental Health Component Scores.

*Reference category for dependent variable was typical sleep.

Table 3. Adjusted ORs Showing the Associations of Participants' Characteristics with Short Sleeper and Long Sleeper Among the Different Age Groups

	*Sleep Type**: Younger Adults (<65 y)				*Sleep Type**: Older Adults			
	Short		Long		Short		Long	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sociodemographic characteristics								
Sex								
Male (ref)	1.00		1.00		1.00		1.00	
Female	0.98	(0.89, 1.08)	**0.66**	(0.51, 0.85)	0.97	(0.72, 1.31)	**0.61**	(0.49, 0.75)
Education								
Lower than secondary school	**1.56**	(1.35, 1.80)	**2.02**	(1.37, 2.96)	1.46	(0.99, 2.16)	**1.58**	(1.20, 2.08)
Secondary	**1.38**	(1.22, 1.58)	**1.74**	(1.22, 2.48)	1.30	(0.84, 2.02)	**1.45**	(1.06, 1.98)
Tertiary (ref)	1.00		1.00		1.00		1.00	
Other	1.13	(0.88, 1.45)	1.23	(0.64, 2.37)	1.44	(0.85, 2.46)	1.25	(0.83, 1.89)
Ethnicity								
Non-Māori (ref)	1.00		1.00		1.00		1.00	
Māori	**1.13**	(1.01, 1.26)	1.17	(0.92, 1.51)	1.27	(0.86, 1.87)	0.96	(0.72, 1.27)
Neighborhood deprivation index								
Quintile-1 (least deprived) (ref)	1.00		1.00		1.00		1.00	
Quintile-2	1.14	(0.92, 1.39)	1.82	(0.83, 3.97)	1.23	(0.73, 2.08)	0.95	(0.68, 1.34)
Quintile-3	1.12	(0.93, 1.36)	**2.38**	(1.16, 4.91)	1.24	(0.73, 2.08)	1.04	(0.74, 1.46)
Quintile-4	**1.26**	(1.04, 1.51)	**2.34**	(1.15, 4.77)	1.14	(0.69, 1.88)	1.09	(0.80, 1.49)
Quintile-5 (most deprived)	**1.29**	(1.07, 1.55)	**3.13**	(1.55, 6.30)	1.17	(0.71, 1.91)	1.16	(0.84, 1.60)
Equivalized household income								
Low	1.14	(0.99, 1.30)	**2.59**	(1.80, 3.74)	1.27	(0.87, 1.85)	**1.46**	(1.13, 1.87)
Medium (ref)	1.00		1.00		1.00		1.00	
High	0.97	(0.85, 1.11)	0.63	(0.37, 1.07)	0.89	(0.47, 1.65)	**0.54**	(0.33, 0.87)
Unknown/missing	1.12	(0.97, 1.28)	**2.60**	(1.78, 3.80)	**1.90**	(1.24, 2.91)	**1.67**	(1.25, 2.23)
Lifestyle and behavioral characteristics								
Less physically active								
No (ref)	1.00		1.00		1.00		1.00	
Yes	**0.82**	(0.75, 0.90)	**1.50**	(1.17, 1.93)	1.12	(0.84, 1.51)	**1.47**	(1.22, 1.77)
Lower intake of vegetables and fruits								
No (ref)	1.00		1.00		1.00		1.00	
Yes	1.08	(0.97, 1.19)	0.87	(0.66, 1.14)	1.01	(0.77, 1.31)	1.11	(0.92, 1.35)
Currently smoking								
No (ref)	1.00		1.00		1.00		1.00	
Yes	**1.41**	(1.26, 1.59)	1.28	(0.99, 1.66)	1.24	(0.82, 1.89)	1.00	(0.72, 1.39)
AUDIT Summary Score	0.99	(0.98, 1.00)	0.99	(0.97, 1.02)	0.99	(0.95, 1.04)	0.99	(0.96, 1.02)
Health status								
Obesity (BMI > 30)								
No (ref)	1.00		1.00		1.00		1.00	
Yes	**1.24**	(1.13, 1.36)	1.03	(0.80, 1.32)	0.91	(0.69, 1.20)	1.07	(0.89, 1.29)
Comorbidities								
0 (ref)	1.00		1.00		1.00		1.00	
1	**1.36**	(1.20, 1.54)	1.22	(0.90, 1.67)	1.60	(0.82, 3.13)	0.85	(0.60, 1.22)
2	**1.80**	(1.56, 2.08)	1.04	(0.70, 1.56)	1.38	(0.70, 2.69)	0.93	(0.66, 1.32)
3 or more	**2.01**	(1.73, 2.34)	**1.61**	(1.12, 2.32)	**1.90**	(1.02, 3.54)	0.87	(0.62, 1.20)
Polypharmacy								
No (ref)	1.00		1.00		1.00		1.00	
Yes	1.01	(0.75, 1.37)	0.64	(0.31, 1.34)	1.10	(0.70, 1.71)	1.01	(0.72, 1.43)
Lowest quartile of SF-12 PCS								
No (ref)	1.00		1.00		1.00		1.00	
Yes	**1.72**	(1.55, 1.92)	**2.14**	(1.63, 2.80)	**1.97**	(1.46, 2.67)	**1.66**	(1.37, 2.02)
Lowest quartile of SF-12 MCS								
No (ref)	1.00		1.00		1.00		1.00	
Yes	**2.07**	(1.88, 2.28)	**2.05**	(1.60, 2.62)	**2.18**	(1.66, 2.88)	**1.31**	(1.04, 1.65)

Notes: Data source—pooled data using NZHS-2013/14, NZHS-2017/18, NZHS-2018/19. Bold OR's indicative of statistically significance ($p < .05$). AUDIT: Alcohol Use Disorder Identification Test; BMI = body mass index; CI = confidence interval; OR = odds ratio; SF-12 PCS = SF-12 Physical Health Component Scores; SF-12 MCS = SF-12 Mental Health Component Scores. Results have been drawn from a multinomial logistic regression model considering sociodemographic characteristics, health-behavioral characteristics, and health state-related variables in the same model.

*Reference category for the dependent variable was typical sleep.

characteristics, lifestyle and behavioral characteristics, and health status separately for older adults and younger adults.

Among both age groups, lower self-rated physical and mental health was associated with increased likelihood of both short and long sleep duration status. For example, older adults scoring within the lowest quartile for SF-12 MCS were 2.18 times more likely to be short sleepers compared to those with better mental health. For both age groups, short sleep status was more likely among those with three or more comorbidities. Conversely, within both age groups, long sleep status was more likely among males, those whose educational qualifications were secondary school level or lower, as well as those who lived in low-income households. The analysis exhibited a similar association in both age groups with regards to physical activity and long sleep—with the odds of long sleep increased by around 50% among those with lower levels of physical activity.

The analysis also demonstrated differences in factors associated with atypical sleep durations between the age groups. Among the sociodemographic characteristics, compared to typical sleepers, short sleepers who were younger were more likely to be among those whose educational qualifications were secondary school level or lower, identified as Māori ethnicity, and living in the more deprived neighborhoods. Among the lifestyle and behavioral characteristics, the likelihood of short sleep was reduced for younger adults who were less physically active and increased among current smokers, furthermore, the odds of short sleep were 1.24 times more likely among in younger adults with BMIs in the range for obesity. However, none of these variables remained independently related to short sleepers among the sample of older adults.

With regards to long sleep, a higher likelihood was observed among those living in the more deprived neighborhoods but, again, only for younger adults. However, the odds of long sleep decreased for older adults who belonged to high-income households compared to medium-income households. Finally, long sleep was also associated with having 3 or more comorbidities among the younger adult group only.

Discussion

This study examined data pooled from three waves of the NZHS to allow for comparative descriptions of atypical sleep duration profiles among younger and older New Zealanders using a large representative sample. The findings suggest that predictors of problematic sleep are not necessarily universal across ages. Prevalence of long sleep was higher among older adults, whereas short and typical sleep were more evident among their younger counterparts. Regardless of age, atypical sleep durations were principally associated with individual negative behaviors and health status, however, socioeconomic factors were significant factors of atypical sleep durations in younger adulthood only.

Prevalence estimates of atypical sleep duration reported here differ from those reported previously in New Zealand. For example, using data from the New Zealand Attitudes Value Study, Lee and Sibley found that more (37%) of New Zealand adults reported short sleep (<7 hours), while 5% were classified as having long sleep (≥9 hours) (31). In contrast to the current study, short sleep was found to increase with older age. In a postal survey specific to understanding sleep timing, Paine et al. found that the prevalence of long sleep may be higher (17). Differences in prevalence between studies may be related to the current study's incorporation of adults aged over 65 years, more refined age-related definitions of long and short sleep, and the collection of sleep per 24 hours as opposed to just night-time sleep (eg, as per Lee and Sibley, 31).

Atypical sleep durations were defined according to the life stage-specific widely accepted National Sleep Foundation's "appropriate duration" guidelines founded on epidemiological evidence pertaining to sleep in healthy individuals and informed expert judgment (22). Short and long sleep defined in this study represent those sleeping outside of the appropriate ranges for an individual's age rather than more generic thresholds used elsewhere. Considering sleep across the 24-hour period is important given that age-related changes in sleep physiology often result in more fragmented or biphasic sleep patterns in older life (32). Important here, the physiological requirement for sleep is governed by intrinsic biological rhythms and a function of the length of time spent awake (33). In younger adulthood and middle age, this sleep requirement is typically met with one consolidated period of sleep that coincides with the day–night cycle. However, with advancing age, these rhythms become less robust and the ability to stay asleep at night and awake in the day are challenged. Therefore, sleep is more likely fulfilled across several periods and to include daytime sleep (32). By quantifying sleep in terms of all bouts of sleep within a 24-hour period, the sleep duration estimates reported here may offer a more reliable figure, reflective of age and stage. It would be of interest to assess this assumption using objective sleep measures as well as distinguish between day and night sleep bouts (as excessive daytime sleep may be a marker of ailing health (32)).

This study found that socioeconomic differences were associated with atypical sleep durations particularly among the younger adults. Poorer socioeconomic status has been related to reduced physical and mental health status as well as limited access to services and support (34). Inequalities of living and sleeping environments, work patterns, financial pressures, and balancing multiple care roles are all factors which have been previously identified as impacting sleep (17,31,35). Such differences have been found to be disproportionate by gender and ethnicity. Indeed, here younger adults who were Māori were more likely to report atypically short sleep compared to non-Māori. However, ethnicity was no longer an independent predictor for sleep duration among the older adults. This is in support of previous research concerning sleep and aging in New Zealand, possibly reflective of changing sleep practices or perceptions (12,19). Gender-related differences in reporting sleep problems and timing are mixed (36,37). Here, males were more likely to report atypically long sleep durations compared to females, irrespective of age. This is reflective of an increased likelihood of females reporting disturbed sleep across the life span compared to males (37).

While research from America indicates an association between the economic status of geographical neighborhood with healthy sleep durations of older adults (35), this relationship was only identified in the younger sample in this study. This may be due to the norms of housing and living situations for older people within New Zealand (eg, a high tendency for living in retirement village models or with extended family), thereby impacting the reliability of geographical location as a marker of socioeconomic positioning (38). Instead, in the present sample, household income was a significant predictor of atypical sleep status. However, more than 20% of the sample did not know or disclose these details, somewhat limiting this finding. In the present sample, most of the older adults were categorized as unemployed. As New Zealanders aged over 65 years are eligible for pension and typically retire from work this was not considered reliable to use as a marker of socioeconomic position. Similarly, it was deemed unsuitable as a marker of routines because

indicators of work times and hours were not collected in the NZHS, nor were other responsibilities which may have a similar impact on routines of sleep and wake with older adulthood (eg, volunteering, grandparenting, or caregiving). Further research is therefore recommended to corroborate and identify mechanisms or causality explaining relationships between sleep and socioeconomic positioning.

A growing body of work highlights the importance of considering individual, social and cultural contexts when attempting to understand and support sleep. Sleep-related beliefs and attitudes, experiences and barriers to good sleep, and social practices vary, including perceptions around what "normal" or "good sleep" is across the life course and with different beliefs, waking roles and responsibilities (20,39). For example, an American survey found that positive attitudes to sleep were more evident among those of older age but that did not always align with healthy sleep status and practices indicative of changing norms and expectations (38). Interviews with older healthy New Zealanders identified more relaxed attitudes to time use, sleep disturbances, and recuperation of lost sleep as they grew older (20). Changes to sleep attitudes could be reflective of the social transitions of older adulthood, changing roles and health, or changing beliefs around what constitutes "problem sleep" with aging. Together, these works support a notion that socioeconomic pressures on sleep appear to change in older age. Perhaps indicating that the roles of health, culture, and family context become more vital than factors representative of socioeconomic status when it comes to predicting sleep status with older age. Alternatively, a survivorship bias may explain these trends. If those who are ethnically and/or socioeconomically marginalized have reduced capacities and earlier mortality rates, then they are less likely represented in research concerning later life (40). The ability to represent social contexts and attitudes was limited in this study. Therefore, it is recommended that such factors are deliberately explored in future research designed to assess sleep and aging.

Factors indicative of negative lifestyle and health were identified to have a deleterious association with sleep in both life stages. Those with atypical sleep durations were found to be less physically active, had more comorbid health conditions, and lower self-rated physical and mental health statuses. This is in support of previous research which has found sleep problems and disorders to have strong associations with the onset of long-term health morbidities and poorer general physical and mental health (30,40). The severity of sleep disturbances has been linked to quantity and severity of chronic disease outcomes (40). Sleep's role with health, particularly mental health, has been recognized as bidirectional with issues such as feelings of depression or anxiety being a predictor for as well as an outcome of problem sleep (6). Here, categorical SF-12 scores indicative of poorer physical and mental health were associated with atypical sleep. Future studies may consider more advanced structural equation modeling to ascertain which aspects of the health measures were most significantly correlated with sleep outcomes. Medication use and polypharmacy have also been identified as problematic for sleep (41). However, in this study, medications did not remain independently related once all other factors were controlled for. This could possibly be due to the limitation of pharmacological information, pertaining only to the treatment of a limited list of conditions, as opposed to all dispensed medications. Physical activity has a well-defined relationship with regulating sleep (42). While not as powerful a time cue as bright light; regular physical activity has been found to help maintain the circadian cycles of sleep and wake as well as promote deeper quality of sleep (42). This helps explain why those with reduced physical activity in the current study were significantly more likely to have atypical sleep durations.

While health-related associations with sleep were apparent in both age groups, younger adults appeared to have a greater response to comorbid health conditions with each additional condition increasing the likelihood of shorter sleep duration. Conversely, older adults were only significantly impacted when experiencing three or more comorbid health conditions. This could be indicative of the increased likelihood, and therefore norms, of ailing health with advancing age. Indeed, in the current study, more of the older adults scored within the lowest quartiles for physical and mental health status and were also more likely to have multiple diagnosed health conditions compared to the younger adults. This common shift in health status is anticipated to have secondary impacts on sleep status and the associated behaviors and attitudes mentioned above. Short sleep was more likely among the younger adults who were smokers. This is supportive of previous research (36) and could be related to the catalytic effect smoking has on noncommunicable diseases, its addictive nature, and the impact it can have on sleep architecture (43). Habitual smoking was not a significant predictor of atypical sleep duration among the older adults in this study. A possible explanation for this could be cessation trends associated with declines in health status and the increased cost of smoking. Likewise, having a BMI indicative of obesity was associated with short sleep among younger, but not older, adults. Increased weight has a well-defined relationship with sleep disturbances, particularly sleep disordered breathing (eg, snoring or sleep apnea). However, this relationship appears less pertinent with aging, when other physical and physiological characteristic are attributed to such sleep disturbances (44).

Implications

Having poor sleep at a younger age has been found to be a key contributor to continued or chronic sleep problems, as well as poorer health outcomes and mortality (12,19). In New Zealand, access to health care and sleep services is limited, impacting diagnosis and treatment pathways, especially for older people and Māori (16,17,45). Poor health status may be symptomatic of barriers to primary health care services, or a lack of recognition that sleep could be improved as the baseline for "normal sleep" gradually becomes what is classed as "abnormal" due to changed contexts, illness, or negative lifestyle or health-related behaviors. When a sleep disorder or sleep problem is suspected among older adults, it may fail to get adequate or timely attention given clinical demands, highlighting a need for tailored services (45). With the differing contexts associated with atypical sleep by age, the findings of this study provide insight into where, when, and for whom screening for sleep problems may be prioritized. This includes consideration of the socioeconomic positioning, demographic region, ethnicity, and gender and the potential impact on sleep from a young age into older adulthood. Furthermore, with aging, periods such as retirement and widowhood have been identified as impacting factor such as physical activity and mental health (46) which, as indicated here, also contribute to atypical sleep durations. This has important implications for future research approaches, individual and family health considerations, as well as for the healthcare system especially considering the projected population growth and aging population structures nationally and internationally (47).

This research indicates that management of underlying health conditions and supporting better psychological health may be important for good sleep, health, and well-being in older adulthood. Interventions to improve sleep should look to address modifiable

lifestyle and health behaviors that will be relevant across life stages. For older adults, future research could investigate barriers to physical activity and interventions address barriers to promote more active lifestyles. Interventions in younger adulthood that address smoking and promote an active lifestyle and healthy weight may be important for life-course improvements in sleep and health. Socioeconomic disparities associated with atypical sleep durations signal that tailored approaches to intervention are required, incorporating cultural and educational diversity, and accommodating for the diverse social context in which they are being delivered.

Considerations and Recommendations

Use of self-reported sleep duration is a useful measure to describe sleep in a sample of this size. Basing atypical durations on the National Sleep Foundation guidelines is considered a strength. However, as alluded to above, it may be that the older age categories for "atypical" durations may be less abnormal than anticipated. Studies indicate that self-reported sleep durations are typically overestimated compared to objective sleep measures such as actigraphy (36). Therefore, it could be that short sleep is underestimated here. Polysomnographic sleep studies also indicate unique differences by age group which also differ again from self-reports, such as reported here (48). Despite the size of the pooled sample, age groups could not be further stratified, masking any nuanced differences, for example, between adolescents and younger adults and then older adults. This would be of interest for developing an understanding of sleep profiles across the life span (as opposed to older vs younger adults as categorized here).

Regardless of its limits, with a sample of this size, sleep duration has been illustrated as a useful tool for indicating atypical sleep and the factors associated with it. Variance between studies is apparent and may, in part, be explained by differences in sleep duration survey items and what individuals constitute as true "sleep" (as opposed to "rest" or "time in bed"). Sleep-related beliefs are influenced by numerous factors and experiences, spanning disease status, cultural perspectives, psychosocial context, and waking responsibilities (20,49). While sleep duration is less subjective than some measures, differences in how sleep is understood and experienced is a limitation of quantitative approaches to understanding sleep. Growing evidence supports the clinical relevance of subjective assessments of other sleep characteristics within the general population. For example, considerations of optimal sleep timing, efficiency, regularity, satisfaction with sleep, good daytime function, and alertness are all important qualities of good sleep (7,36) which, to date, have not captured consistently in this broad health monitoring survey. It is recommended that other dimensions of sleep as well as diagnosed sleep disorders are considered and collected alongside sleep duration in future surveys to provide a more holistic view of sleep for population health surveillance in New Zealand.

Due to the cross-sectional nature of the study, it is not possible to comment on the mechanisms underpinning the factors associated with atypical sleep durations observed here. For example, the results cannot elucidate whether short sleep is a precursor for health issues, or if it is more likely that health issues result in poor sleep. Further research using longitudinal cohorts with a more equal proportion of older adults is warranted to explore the long-term implications of atypical sleeping. Such research would provide a better understanding of the role of sleep for modifying health trajectories and the long-term efficacy of lifestyle and health behavior interventions.

While atypical sleep durations were associated with poor health status, evidence also demonstrates that supporting sleep may be similarly important for improving physical and mental health status. Supporting sleep, therefore, has implications for enabling "aging well." Future work should look to establish characteristics of sleep status profiles that encompass duration alongside other measures of sleep to identify opportunities for sleep health interventions appropriate for older people. For example, incorporating single-item measures of sleep quality, as well as measures of sleep continuity and daytime function would be valuable to establish a holistic view of sleep health and indication of potentially undiagnosed or poorly managed sleep disorders.

Conclusion

This study presents characteristics of atypical sleep among young and older New Zealand adults. The research demonstrates the importance of considering unique profiles for predicting sleep status in consideration of age-related changes. This work indicates key groups prone to atypical sleep durations and insight into areas of potential intervention. Sleep duration is a potentially modifiable health factor. Early recognition and management of sleep problems are important to support optimal sleep. In turn, this is important for enhancing physiological and psychological well-being among the public across the life course.

Funding

This work was supported by Health Research Council of New Zealand Emerging Researcher grant (18/621).

Conflict of Interest

None declared.

Acknowledgments

We would like to acknowledge the support of Emeritus Professor Philippa Gander who supported the original project design within a suite of research concerning sleep and aging and who has provided mentorship throughout; Dr Sarah-Jane Paine for guidance in early stages of the project proposal and design; and Rennee Seebeck for assistance with literature collation. For the team at the Statistics New Zealand, thank you for supporting these analyses, your guidance and providing the data necessary during busy pandemic times. Finally, we acknowledge those who have participated in the New Zealand Health Surveys, for their contribution toward a greater understanding of health, including sleep, across the life span.

Author Contributions

Conception, study design, application for funding, ethics, applications for data, overseeing write up and submission: R.G. Guidance on study design: A.T. Statistical analyses: T.A. Data interpretation: all authors. Drafting and review of the manuscript: all authors.

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