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RESEARCH ARTICLE

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Associations of menopausal status and eating behaviour with subjective measures of sleep

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Summary

Eating and sleeping behaviour are known to interact with each other, yet research is limited in the context of menopausal women. The aim of this study was to examine whether menopausal status is associated with perceived problems in sleeping. Furthermore, we studied different aspects of eating behaviour as potential risk factors for poor sleep in menopausal women. The present study is exploratory in nature, thus the results should be interpreted as hypothesis-generating. We analysed the sleeping and eating behaviour of 1098 women aged 47–55 years and represented different menopausal statuses with regression analyses. Over 20% of them reported fairly poor or poor perceived sleep quality. A higher number of postmenopausal women reported experiencing at least fairly poor sleep quality compared with the other menopausal groups. However, in regression models controlled for several confounding factors menopausal status was not associated with measures of sleep. Women who reported more snacking-type eating behaviour were more likely to report shorter sleep duration, and more daytime tiredness. Externally cued eating was associated with shorter sleep duration and emotional eating was associated with experiencing daytime tiredness. However, after adjusting for multiple testing, it appears that eating behaviour is associated only with daytime tiredness. Menopausal women with sleeping problems may benefit from nutritional interventions targeting eating behaviour.

KEYWORDS
eating styles, health behaviour, menopausal transition, middle-aged women, sleep health, sleeping problems

1 | INTRODUCTION

Adequate sleep is essential for maintaining good physical and mental health (Appleton et al., 2022; Irwin, 2016). According to previous research, 40–60% of menopausal women report sleeping problems (Kravitz et al., 2008; Pengo et al., 2018). Menopausal transition is often characterised by poorer sleep quality such as an insufficient amount of sleep at night, reduced perceived sleep quality, or feeling daytime tiredness, and postmenopause in particular is often said to worsen the sleep quality (Hung et al., 2014; Young et al., 2003). Changes in reproductive hormone levels during the menopausal transition are one plausible mechanism related to poorer sleep in menopause (Kravitz et al., 2008). However, not all studies have found a difference in sleep satisfaction between postmenopausal and pre or perimenopausal women (Zolfaghari et al., 2020). In a longitudinal study women had longer objectively measured sleep duration as the menopausal transition progressed (Matthews et al., 2020). Another cross-sectional study showed no change in sleep duration measured by polysomnography during menopause (Kalleinen et al., 2008). Likewise, differences between menopausal groups in daytime tiredness were not observed in a study by Lampio et al. (2014). Menopausal symptoms have been shown to contribute to poor sleep (Pien et al., 2008; Smith et al., 2018). In general, depression and other psychological conditions are likely to worsen sleep (Pien et al., 2008; Smith et al., 2018).

Although life habits, such as eating and sleeping behaviour, are known to interact with each other (Capers et al., 2015), research is limited in the context of menopausal women. Sex hormones are suggested to contribute to eating behaviour (Hirschberg, 2012). Oestrogen is known to reduce food intake (Hirschberg, 2012), and given the altered sex hormone levels in menopause, it is plausible that eating habits change in parallel with advancing menopause. For example, Grisotto et al. (2021) did not find changes in total or food item specific calorie intake among women experiencing menopausal transition compared with women who stayed premenopausal during a follow-up period. However, one study suggests menopausal transition is associated with an increase in appetite (Duval et al., 2014), while the other contradictorily points to restrained eating (Drobnjak et al., 2014). These results highlight the question of whether eating behaviour could be one factor contributing to poor sleep in menopausal women. Although sleep-related problems are well recognised in causing various health problems in the general population, as well as in menopausal women, it is not clear whether eating behaviour is related to poor sleep in menopause.

The objective of this study was to investigate the associations of menopausal status and eating behaviour with subjective measures of sleep, including perceived sleep quality, duration, and daytime tiredness, in a sample of menopausal women. We hypothesised that sleeping problems increase with advancing menopausal status. We also hypothesised that in menopausal women, adverse eating behaviour, such as snacking and emotional eating, is associated with poorer subjective measures of sleep, while health-conscious eating presumably is associated with better overall sleep health.

2 | METHODS

2.1 | Study design and participants

This study utilises the data from the Estrogenic Regulation of Muscle Apoptosis (ERMA) cross-sectional study which investigates middle-aged women's physiological and psychological functions across different menopausal statuses [dataset] (Laakkonen et al., 2022; 10.17011/jyx/dataset/83491). The ERMA study protocol and participant selection has been described in detail elsewhere (Kovanen et al., 2018).

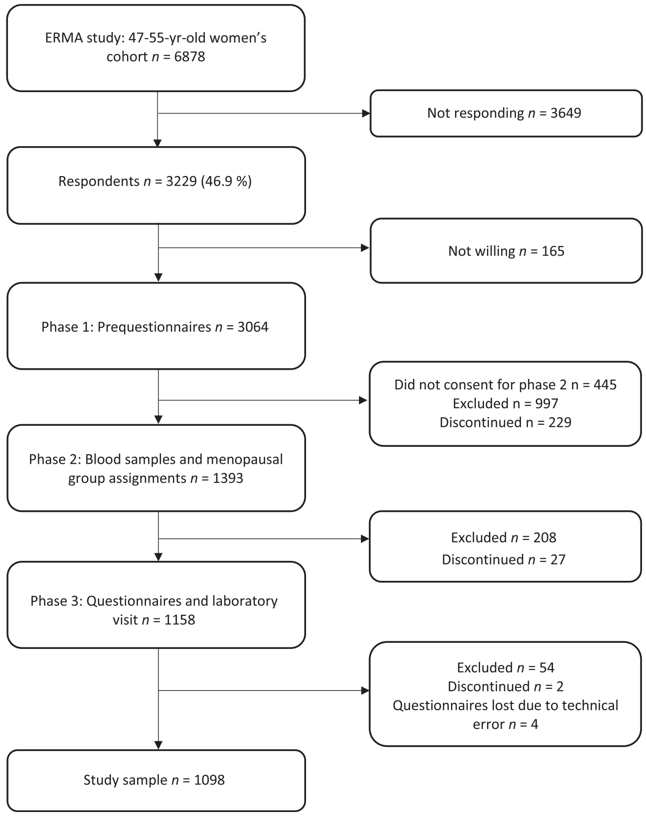

FIGURE 1 Flow chart of the study population selection. The flow chart describes the participant recruitment, and information about exclusions and discontinuations in each phase.

Briefly, postal invitations were sent to a random sample of 6878 women aged 47–55 years living in Central Finland drawn from the Population Register Center of Finland. Of these, a total of 3064 women returned the prequestionnaire in phase 1 (Figure 1). Exclusion criteria included a self-reported body mass index (BMI) over 35 kg/m^2, as well as chronic diseases, conditions and the use of medications affecting the participant's inflammatory status or ovarian function or significantly reducing mental or physical functioning. Altogether, a total of 1393 women were included for the baseline measurements in phase 2, and thereafter 1158 women came to the laboratory visit for physiological and psychological measurements and to fill in the full baseline questionnaire (including questions for example about life habits and menopausal symptoms) in phase 3. Due to a technical error, four questionnaires were lost. Furthermore, 54 participants were excluded and two discontinued, therefore the final study sample consisted of 1098 participants. All participants provided written informed consent. The study was approved by the ethical committee of the Central Finland Health Care District (Dnro 8 U/2014).

2.2 | Menopausal status assignment

Menopausal status was determined based on participant's follicle-stimulating hormone concentration and self-reported menstrual bleeding diary and categorised as premenopausal, early perimenopausal, late perimenopausal, or postmenopausal as detailed in Kovanen et al. (2018).

2.3 | Health behaviour measurements

To assess sleeping behaviour the participants completed a self-administered questionnaire. The questionnaire assessed different dimensions of sleep, namely perceived sleep quality, sleep duration, daytime tiredness, and the use of sleep medication. Perceived sleep quality was assessed with a question "on average, I usually sleep", with five answering options given ("good", "fairly good", "fairly poorly", "poorly", and "can't tell"). Women who had answered "can't tell" ($n = 15$), were categorised in to the "fairly good" category. Our justification for recoding those women who had answered can't tell, as "fairly good" is merely practical. The reason for this choice was pragmatic as we considered that those women who remain unsure if they had or had not experienced low sleeping quality, were not likely to have confronted much of the sleeping quality problems, thus their sleeping quality should be at least fairly good. For the main statistical analyses, good and fairly good categories were further combined to form a three-category perceived sleep quality variable: good, fairly poor, and poor quality. The question was collapsed into three categories, because we wanted to hold those women, who perceived their sleep quality as at least fairly good as a reference category. Sleep duration was assessed with a question "on average, how many hours do you sleep?" including six answering options: "less than 5 hours", "5 hours", "6 hours", "7 hours", "8 hours", and "9 or more than 9 hours". For statistical analysis, sleep duration was recoded into two categories, normative sleep duration (7–8 h or more) and short (under 7 h). We included 38 participants with sleep duration ≥9 h in the normative sleep duration group. Daytime tiredness was evaluated with a question "do you experience daytime tiredness", with dichotomous answering option ("yes" and "no"). The use of sleep medication was assessed with the question "do you use sleep medication?", with three answering options given ("no", "yes, occasionally", and "yes, regularly, several times a week").

Eating behaviour was assessed with a 12-item questionnaire including five items assessing snacking eating styles, three health-conscious eating, one externally cued eating, two emotional eating, and one night eating (Keski-Rahkonen et al., 2005, 2007). Each question had four options to choose from ("usually", "often", "sometimes", or "rarely"). For the main statistical analysis of this study we dichotomised the responses by combining options "usually" or "often", and "sometimes" or "rarely" to form usual and rare behaviour classes, with the exception of one separate eating behaviour question (visual cues prompt eating) which was dichotomised by combining responses "usually", "often", and "sometimes" to form the usual class (Table 3) in order to avoid constructing a zero response category to be used in the regression modelling (Table 4). Exploratory factor analysis was carried out, but similar to as reported by Keski-Rahkonen et al. (2007), a low internal consistency (Cronbach's alpha <0.70) was observed. Furthermore, reliability analyses were run for eating behaviour subscales. Cronbach's alpha was 0.21 for the snacking type of eating behaviour, 0.69 for the health-conscious eating behaviour, and 0.59 for the psychological eating behaviour (which includes externally cued and emotional eating behaviour). Therefore, all eating behaviour variables were analysed separately.

2.4 | Covariates

Controllable covariates were selected based on previous literature. We considered educational status to be a potential confounding factor in the analyses as it is known to be associated with several types of health behaviours including sleep and eating behaviour (Lê et al., 2013; Stringhini et al., 2015). Educational status was self-reported and for the analyses, categorised into three categories: primary, secondary, and tertiary.

2.4.1 | Depressive symptoms

Depressive symptoms have been associated with poorer sleep quality (Lampio et al., 2016) and unhealthier eating behaviour (Lopresti et al., 2013). Depressive symptoms were assessed using the 20-item depression scale CES-D (The Center for Epidemiologic Studies Depression Scale) (Radloff 1997). A higher score on the scale indicates more depressive symptoms. Cronbach's alpha for the CES-D questionnaire was 0.90.

2.4.2 | Physical activity

Physical activity has been associated with better sleep health (Loprinzi & Cardinal, 2011), as well as with eating behaviour (Beaulieu et al., 2018). Metabolic equivalent hours per day (MET-h/d) was calculated based on the intensity and volume of current physical activity (Kujala et al., 1998).

2.4.3 | Visceral fat

Visceral fat gives more information about metabolic health, than for example body mass index. Both subjective poor sleep quality (Sweatt et al., 2018) and short sleep duration (Chaput et al., 2011b) have been previously demonstrated to be related to the accumulation of visceral fat. Furthermore, some eating behaviour is suggested to be associated with visceral fat as well (Iwasaki et al., 2019). In this study, visceral fat was measured in the morning after overnight fasting using a bioimpedance device (InBody720; Biospace, Seoul, Korea).

2.4.4 | Vasomotor symptoms

Vasomotor symptoms have been shown to be related to poorer sleep quality (Lampio et al., 2016; Tomida et al., 2021). For the present study, vasomotor symptoms of the participants were assessed using a self-administered questionnaire with two items (hot flashes and sweating), and with dichotomous answering options (Laakkonen et al., 2017).

2.5 | Statistical analyses

Continuous data are presented as mean and standard deviation (SD) and categorical data as the percentage. Group differences were examined using independent *t*-tests for the continuous and chi-square tests for the categorical variables. The main analyses investigating associations with measures of sleep behaviour were carried out using multinomial (perceived sleep quality) and binary (sleep duration and daytime tiredness) logistic regression models. In the first models, we included the menopausal status and adjusting variables (educational status, CES-D score, visceral fat, vasomotor symptoms, and physical activity). The second models (model 2–12) additionally included the aforementioned 11 dichotomised eating behaviour variables using the class "rare" as a reference. Because the high number of separate analyses, we applied a false-discovery rate (FDR) adjustment protocol to evaluate the reliability of the results in models 2–12 (Benjamini & Hochberg, 1995). A false-discovery rate of 0.10 was used. We did not construct a model including night eating because it was seldom reported by participating women and was considered obvious to associate it with compromised sleep. We did two sensitivity analyses. We conducted a sensitivity analysis with women who did not report sleep medication use ($n = 129$ sleep medication users were excluded). Furthermore, to assess the potential bias due to including participants with sleeping 9 h or longer ($n = 38$) into the normative sleep duration category, we ran all analyses without them. Statistical analyses were conducted using IBM SPSS Statistics for Windows version 28.1. The statistical significance was set at <0.050 or 95% confidence intervals not containing 1.

2.5.1 | Missing data

The analytical sample was 1098. The distribution of missing data is reported in Tables 1–3. There were 2–35 missing observations in explanatory (eating behaviour) variables, and 1–4 in outcome (sleeping behaviour) variables. The data were missing due to unclear or missing responses in questionnaires, or invalid or missing measurements, thus the missing data were considered to occur at random. Visceral fat had 5–74 (3–19%) missing observations. Due to a fairly large amount of missing data and an uneven distribution of missing observations of visceral fat in each menopausal group, we ran a linear regression model that predicted visceral fat based on the value of self-reported BMI and imputed missing visceral fat with the formula obtained from the regression line. Additionally, complete case analyses without imputation were performed for all main outcomes (Table S1).

3 | RESULTS

The baseline characteristics for the sample including 304 premenopausal, 198 early perimenopausal, 209 late perimenopausal, and 387 postmenopausal Caucasian women, are shown in Table 1. The mean age of the participants ($n = 1098$) was 51.4 years (SD = 2.0). The further the menopause had advanced the more commonly women reported compromised sleep quality or short sleep duration (Table 2). Fairly poor or poor perceived sleep quality was reported by 18% of premenopausal, 20% of early perimenopausal, 23% of late perimenopausal, and 29% of postmenopausal women ($p = 0.020$). Participants not reaching the normative of at least 7 h per night sleep duration were reported by 18% of premenopausal, 17% of early perimenopausal, 20% of late perimenopausal, and 25% of postmenopausal women, but the group differences in the proportions between menopausal groups were non-significant ($p = 0.205$). Menopausal status-related trends were not observed in daytime tiredness, which was most commonly reported by late perimenopausal women (39%) compared with pre (35%), early peri (37%), and postmenopausal women (35%).

Table 3 shows distributions of different types of eating behaviour across all three main outcomes (perceived sleep quality, sleep duration, and daytime tiredness). Regarding the snacking type of eating behaviour, participants with poor or fairly poor perceived sleep quality were more likely to report the highest food consumption in the evening ($p = 0.030$) and grazing throughout the evening ($p = 0.003$) than participants reporting at least fairly good sleep quality. Similarly, participants who reported short sleep duration, were more likely to have the highest food consumption in the evening ($p = 0.037$) and to eat while watching TV ($p = 0.004$), compared with those who slept normatively. All five assessed snacking parameters were found to differ statistically significantly within daytime tiredness; women who experienced daytime tiredness also tended to report not avoiding snacking between meals ($p < 0.001$), replacing their meals with snacks ($p < 0.001$), having the highest food consumption in the evening ($p = 0.006$), grazing throughout the evening ($p < 0.001$), and eating while watching TV ($p = 0.014$) compared with those who did not report daytime tiredness. No group differences were observed for the health-conscious eating parameters except that women with daytime tiredness were less likely to attempt to maintain healthy eating patterns ($p = 0.036$) than women without daytime tiredness. Externally cued eating behaviour was assessed with one item – eating prompted by visual cues – and found to be rather rare (only 13% to 19% of women in all groups reported it to occur sometimes or more frequently). However, it was somewhat less rare among women with short sleep duration ($p = 0.025$) and among women with daytime tiredness ($p = 0.046$). Emotional eating was assessed with two items; using food as a reward was more common with women reporting daytime tiredness ($p = 0.010$). Similarly, participants, who reported daytime tiredness, were more likely to eat for comfort ($p < 0.001$) compared with those not reporting daytime tiredness. Night eating was more common among women with poor sleep quality ($p < 0.001$) although over 90% of women in all groups reported it to be rare.

TABLE 1 Baseline characteristics for the ERMA observational study population ($n = 1098$).

	Premenopausal $n = 304$	Early perimenopausal $n = 198$	Late perimenopausal $n = 209$	Postmenopausal $n = 387$
Age (years)	50.4 (1.7)	50.7 (1.8)	51.6 (1.9)	52.3 (2.0)
Education				
Primary	5 (1.6)	3 (1.5)	7 (3.3)	9 (2.3)
Secondary	165 (54.3)	109 (55.1)	106 (50.7)	239 (61.9)
Tertiary	134 (44.1)	86 (43.4)	96 (45.9)	13 (35.9)
Vasomotor symptoms				
Yes	91 (29.9)	103 (52.0)	131 (62.7)	318 (82.2)
No	213 (70.1)	95 (48.0)	78 (37.3)	69 (17.8)
Smoking				
Never	194 (64.2)	137 (69.5)	132 (63.5)	261 (67.8)
Former	91 (30.1)	47 (23.9)	55 (26.4)	97 (25.2)
Current	17 (5.6)	13 (6.6)	21 (10.1)	27 (7.0)
Missing, *n*	$n = 2$	$n = 1$	$n = 1$	$n = 2$
Alcohol doses per week	3.6 (3.5)	4.0 (4.1)	4.1 (3.5)	3.8 (3.8)
Physical activity				
Low	27 (8.9)	25 (12.6)	17 (8.1)	51 (13.2)
Medium	82 (27.0)	56 (28.3)	61 (29.2)	98 (25.3)
High	195 (64.1)	117 (59.1)	131 (62.7)	238 (61.5)
MET-h/d*	3.9 (4.0)	3.6 (3.5)	3.7 (3.9)	3.6 (3.4)
Missing, *n*	$n = 2$	$n = 1$	$n = 2$	$n = 1$
Diet quality score	5.7 (2.3)	5.6 (2.2)	6.0 (2.2)	5.9 (2.2)
Missing, *n*	$n = 1$	$n = 2$	$n = 4$	$n = 1$
Body mass index (kg/m^2)				
Normal weight, <25	116 (48.7)	95 (50.0)	92 (46.0)	170 (55.9)
Obese, 25–29.9	99 (41.6)	62 (32.6)	76 (38.0)	96 (31.6)
Severe obesity, >30	23 (9.7)	33 (17.4)	32 (16.0)	38 (12.5)
Missing, *n*	$n = 67$	$n = 10$	$n = 10$	$n = 84$
BMI, self-reported	25.3 (3.4)	25.6 (3.7)	25.5 (3.6)	24.9 (3.6)
Missing	$n = 1$	$n = 0$	$n = 1$	$n = 3$
Body mass index (kg/m^2)**	25.6 (3.4)	25.8 (3.8)	25.8 (3.8)	25.1 (3.8)
Missing	$n = 55$	$n = 5$	$n = 6$	$n = 74$
Visceral fat	107.3 (24.7)	110.2 (26.4)	112.2 (25.3)	110.9 (26.3)
Missing, *n*	$n = 55$	$n = 5$	$n = 6$	$n = 74$
CES-D***	8.4 (6.7)	10.2 (7.9)	9.4 (7.0)	9.9 (8.1)
Missing, *n*	$n = 0$	$n = 1$	$n = 0$	$n = 0$
Use of sleep medication				
No	266 (87.8)	173 (87.4)	188 (90.0)	338 (88.0)
Yes, occasionally	29 (9.6)	20 (10.1)	17 (8.1)	39 (10.2)
Yes, regularly	8 (2.6)	5 (2.5)	4 (1.9)	7 (1.8)
Missing, *n*	$n = 1$	$n = 0$	$n = 0$	$n = 3$

Note: Data are mean (SD) for continuous variables and *n* (%) for categorical variables.; *MET, metabolic equivalent of task; **Assessed with InBody device; ***CES-D, Center for Epidemiologic Studies Depression Scale.

The results from the regression analyses are shown in Table 4 for imputed data and Table S1 for complete cases. Complete case analysis indicated that postmenopausal status is associated with fairly poor sleep quality (Table S1), but the association was no longer significant after adjusting for confounders (educational status, CES-D score, visceral fat, vasomotor symptoms, and physical activity).

TABLE 2 Perceived sleep quality, sleep duration, and daytime tiredness in different menopausal groups.

	Premenopausal $n = 304$	Early perimenopausal $n = 198$	Late perimenopausal $n = 209$	Postmenopausal $n = 387$	p value
Perceived sleep quality					**0.020**
Good	106 (34.9)	55 (27.8)	55 (26.3)	89 (23.1)	
Fairly good	143 (47.0)	103 (52.0)	106 (50.7)	185 (47.9)	
Fairly poor	45 (14.8)	31 (15.7)	38 (18.2)	91 (23.6)	
Poor	10 (3.3)	9 (4.5)	10 (4.8)	21 (5.4)	
Missing, n	$n = 0$	$n = 0$	$n = 0$	$n = 1$	
Sleep duration					0.205
≤5 h	9 (3.0)	6 (3.0)	9 (4.3)	15 (3.9)	
6 h	44 (14.5)	27 (13.6)	33 (15.8)	80 (20.8)	
7 h	154 (50.7)	97 (49.0)	98 (46.9)	176 (45.7)	
8 h	92 (30.3)	59 (29.8)	57 (27.3)	102 (26.5)	
≥ 9 h	5 (1.6)	9 (4.5)	12 (5.7)	12 (3.1)	
Missing, n	$n = 0$	$n = 0$	$n = 0$	$n = 2$	
Daytime tiredness					0.785
No	194 (64.7)	123 (62.8)	126 (60.9)	249 (64.7)	
Yes	106 (35.3)	73 (37.2)	81 (39.1)	136 (35.3)	
Missing, n	$n = 4$	$n = 2$	$n = 2$	$n = 2$	

Note: Data expressed as n (%).

Complete case analysis also indicated that postmenopausal status is associated with shorter sleep duration. Although this association remained significant after adjusting for confounders, it was not significant in the imputed data (Table 4).

Finally, we investigated the association of each of the 11 eating behaviour variables including them in turns to the adjusted models. Models 2–6 assessed snacking type of eating behaviour: no snacking between meals, snacks replacing the meals, highest food consumption in the evening, grazing throughout the evening, and eating while watching TV. None of them associated with perceived sleep quality and, having the highest food consumption in the evening was the only variable associated with a higher risk to perceive shorter sleep duration (OR = 1.56, 95% CI = 1.07–2.27, $p = 0.020$). No snacking between meals (OR = 0.53, 95% CI = 0.37–0.76, $p < 0.001$), snacks replace meals (OR = 2.59, 95% CI = 1.43–4.68, $p = 0.002$), grazing throughout the evening (OR = 1.41, 95% CI = 1.07–1.87, $p = 0.014$), and eating while watching TV (OR = 1.44, 95% CI = 1.01–2.06, $p = 0.046$) were associated with daytime tiredness. Of the associations between daytime tiredness and snacking type of eating behaviour, no snacking between the meals and snacks replaces meals remained statistically significant even after Benjamini-Hochberg correction (Table 4).

Health-conscious eating behaviour was assessed with three items (models 7–9): attempting to maintain healthy eating patterns, avoiding fatty foods, and avoiding calories. We did not find significant associations between health-conscious eating behaviour and the measures of sleep.

Externally cued and emotional eating were assessed with three items (models 10–12): visual cues prompt eating, food used as a reward and comfort eating. Of them, visual cues prompt eating (OR = 4.15, 95% CI = 1.14–15.06, $p = 0.031$) was associated with shorter sleep duration. Food used as a reward (OR = 1.64, 95% CI = 1.02–2.64, $p = 0.040$), and comfort eating (OR = 2.60, 95% CI = 1.39–4.89, $p = 0.003$) were associated with daytime tiredness. Only comfort eating remained statistically significant after Benjamini-Hochberg correction (Table 4). We did not find significant associations between externally cued and emotional eating behaviour and perceived sleep quality.

3.1 | Sensitivity analyses

Overall, the results from both sensitivity analyses for sleep medication users and longer sleep duration remained parallel to the main analyses. In the sleep medication sensitivity analysis slight differences were observed in some of the eating behaviour variables, but the significances remained merely stronger than weaker.

4 | DISCUSSION

To the best of our knowledge, this is the first study examining the relationship between menopausal status and eating behaviour with sleep health in menopausal women using extensive assessment of eating behaviour. In a univariable model, postmenopausal women were more likely to report fairly poor sleep quality and to experience shorter sleep duration than premenopausal women. However, this seems to be explained by potential confounders because after adjusting for them, associations were no longer statistically significant.

TABLE 3 Distributions of different eating behaviour across three main sleep outcomes. Cross tabulation with chi-square tests.

		Perceived sleep quality, *n* (%)				Sleep duration, *n* (%)			Daytime tiredness, *n* (%)		
		Good $n = 842$	Fairly poor $n = 205$	Poor $n = 50$	*p* value	Normative $n = 873$	Short $n = 223$	*p* value	No $n = 692$	Yes $n = 396$	*p* value
Snacking type of eating behaviour	No snacking between meals				0.586			0.142			**<0.001**
	Usually	395 (47.2)	92 (44.9)	20 (40.0)		407 (46.9)	100 (44.8)		355 (51.6)	147 (37.2)	
	Often	306 (36.6)	72 (35.1)	17 (34.0)		320 (36.9)	74 (33.2)		241 (35.1)	151 (38.2)	
	Sometimes	115 (13.7)	36 (17.6)	11 (22.0)		118 (13.6)	44 (19.7)		81 (11.8)	80 (20.3)	
	Rarely	21 (2.5)	5 (2.4)	2 (4.0)		23 (2.6)	5 (2.2)		11 (1.6)	17 (4.3)	
	Missing	$n = 5$	$n = 0$	$n = 0$		$n = 5$	$n = 0$		$n = 4$	$n = 1$	
	Snacks replace meals				0.268			0.123			**<0.001**
	Usually	4 (0.5)	2 (1.0)	0 (0.0)		3 (0.3)	3 (1.3)		2 (0.3)	4 (1.0)	
	Often	36 (4.3)	12 (5.9)	6 (12.0)		40 (4.6)	14 (6.3)		21 (3.0)	33 (8.4)	
	Sometimes	288 (34.2)	67 (32.8)	15 (30.0)		289 (33.2)	81 (36.3)		237 (34.3)	130 (32.9)	
	Rarely	513 (61.0)	123 (60.3)	29 (58.0)		539 (61.9)	125 (56.1)		431 (62.4)	228 (57.7)	
	Missing	$n = 1$	$n = 1$	$n = 0$		$n = 2$	$n = 0$		$n = 1$	$n = 1$	
	Highest food consumption in the evening				**0.030**			**0.037**			**0.006**
	Usually	47 (5.6)	14 (6.9)	7 (14.0)		49 (5.6)	19 (8.6)		35 (5.1)	33 (8.4)	
	Often	85 (10.1)	29 (14.3)	9 (18.0)		89 (10.2)	34 (15.4)		69 (10.0)	53 (13.5)	
	Sometimes	256 (30.5)	51 (25.1)	15 (30.0)		257 (29.6)	64 (29.0)		194 (28.2)	124 (31.5)	
	Rarely	450 (53.7)	109 (53.7)	19 (38.0)		474 (54.5)	104 (47.1)		390 (56.7)	184 (46.7)	
	Missing	$n = 4$	$n = 2$	$n = 0$		$n = 4$	$n = 2$		$n = 4$	$n = 2$	
	Grazing throughout the evening				**0.003**			0.374			**<0.001**
	Usually	19 (2.3)	7 (3.4)	1 (2.0)		23 (2.6)	4 (1.8)		12 (1.7)	15 (3.8)	
	Often	65 (7.7)	21 (10.3)	11 (22.0)		71 (8.2)	26 (11.7)		46 (6.7)	49 (12.4)	
	Sometimes	276 (32.9)	79 (38.7)	19 (38.0)		300 (34.5)	74 (33.2)		226 (32.8)	147 (37.2)	
	Rarely	480 (57.1)	97 (47.5)	19 (38.0)		476 (54.7)	119 (53.4)		406 (58.8)	184 (46.6)	
	Missing	$n = 2$	$n = 1$	$n = 0$		$n = 3$	$n = 0$		$n = 2$	$n = 1$	
	Eating while watching TV				0.288			**0.004**			**0.014**
	Usually	26 (3.1)	6 (2.9)	4 (8.0)		22 (2.5)	14 (6.3)		16 (2.3)	20 (5.1)	
	Often	113 (13.5)	30 (14.7)	10 (20.0)		120 (13.8)	33 (14.8)		86 (12.5)	65 (16.5)	
	Sometimes	352 (42.0)	78 (38.2)	15 (30.0)		371 (42.7)	73 (32.7)		284 (41.2)	157 (39.8)	
	Rarely	348 (41.5)	90 (44.1)	21 (42.0)		356 (41.0)	103 (46.2)		304 (44.1)	152 (38.6)	
	Missing	$n = 3$	$n = 1$	$n = 0$		$n = 4$	$n = 0$		$n = 2$	$n = 2$	

(Continues)

TABLE 3 (Continued)

		Perceived sleep quality, *n* (%)				Sleep duration, *n* (%)			Daytime tiredness, *n* (%)		
Health-conscious eating behaviour	Attempting to maintain healthy eating patterns				0.444			0.603			**0.036**
	Usually	498 (59.4)	120 (58.5)	25 (50.0)		519 (59.7)	123 (55.2)		412 (59.8)	224 (56.6)	
	Often	298 (35.5)	71 (34.6)	19 (38.0)		301 (34.6)	87 (39.0)		247 (35.8)	139 (35.1)	
	Sometimes	42 (5.0)	14 (6.8)	6 (12.0)		49 (5.6)	13 (5.8)		29 (4.2)	33 (8.3)	
	Rarely	1 (0.1)	0 (0.0)	0 (0.0)		1 (0.1)	0 (0.0)		1 (0.1)	0 (0.0)	
	Missing	$n = 3$	$n = 0$	$n = 0$		$n = 3$	$n = 0$		$n = 3$	$n = 0$	
	Avoiding fatty foods				0.572			0.440			0.109
	Usually	285 (34.0)	63 (30.9)	15 (30.0)		290 (33.4)	73 (32.7)		242 (35.1)	120 (30.5)	
	Often	334 (39.8)	78 (38.2)	17 (34.0)		347 (39.9)	81 (36.3)		275 (39.9)	149 (37.8)	
	Sometimes	177 (21.1)	54 (26.5)	15 (30.0)		187 (21.5)	59 (26.5)		141 (20.4)	104 (26.4)	
	Rarely	43 (5.1)	9 (4.4)	3 (6.0)		45 (5.2)	10 (4.5)		32 (4.6)	21 (5.3)	
	Missing	$n = 3$	$n = 1$	$n = 0$		$n = 4$	$n = 0$		$n = 2$	$n = 2$	
	Avoiding calories				0.392			0.140			0.754
	Usually	103 (12.3)	14 (6.9)	4 (8.0)		104 (12.0)	17 (7.7)		81 (11.8)	40 (10.1)	
	Often	239 (28.5)	57 (27.9)	16 (32.0)		254 (29.2)	58 (26.1)		200 (29.0)	109 (27.6)	
	Sometimes	354 (42.2)	94 (46.1)	20 (40.0)		360 (41.4)	107 (48.2)		291 (42.2)	174 (44.1)	
	Rarely	143 (17.0)	39 (19.1)	10 (20.0)		152 (17.5)	40 (18.0)		117 (17.0)	72 (18.2)	
	Missing	$n = 3$	$n = 1$	$n = 0$		$n = 3$	$n = 1$		$n = 3$	$n = 1$	
Externally cued eating behaviour	Visual cues prompt eating				0.766			**0.025**			**0.046**
	Usually	2 (0.2)	0 (0.0)	0 (0.0)		0 (0.0)	2 (0.9)		1 (0.1)	1 (0.3)	
	Often	5 (0.6)	3 (1.5)	0 (0.0)		5 (0.6)	3 (1.4)		3 (0.4)	5 (1.3)	
	Sometimes	116 (13.9)	30 (14.6)	9 (18.0)		124 (14.3)	30 (13.5)		84 (12.2)	68 (17.3)	
	Rarely	711 (85.3)	172 (83.9)	41 (82.0)		737 (85.1)	187 (84.2)		598 (87.2)	320 (81.2)	
	Missing	$n = 8$	$n = 0$	$n = 0$		$n = 7$			$n = 6$	$n = 2$	
Emotional eating behaviour	Food used as reward				0.505			0.670			**0.010**
	Usually	21 (2.5)	2 (1.0)	2 (4.0)		18 (2.1)	7 (3.1)		12 (1.7)	13 (3.3)	
	Often	53 (6.3)	18 (8.8)	3 (6.0)		60 (6.9)	14 (6.3)		35 (5.1)	38 (9.6)	
	Sometimes	441 (52.6)	100 (48.8)	23 (46.0)		454 (52.2)	110 (49.3)		361 (52.5)	198 (50.0)	
	Rarely	323 (38.5)	85 (41.5)	22 (44.0)		337 (38.8)	92 (41.3)		280 (40.7)	147 (37.1)	
	Missing	$n = 4$	$n = 0$	$n = 0$		$n = 4$	$n = 0$		$n = 4$	$n = 0$	
	Comfort eating				0.113			0.608			**<0.001**
	Usually	7 (0.8)	2 (1.0)	2 (4.0)		7 (0.8)	4 (1.8)		3 (0.4)	8 (2.0)	

TABLE 3 (Continued)

		Perceived sleep quality, *n* (%)				Sleep duration, *n* (%)			Daytime tiredness, *n* (%)		
	Often	33 (3.9)	13 (6.4)	4 (8.0)		40 (4.6)	10 (4.5)		17 (2.5)	33 (8.4)	
	Sometimes	244 (29.1)	67 (32.8)	15 (30.0)		261 (30.0)	64 (28.8)		187 (27.2)	134 (33.9)	
	Rarely	554 (66.1)	122 (59.8)	29 (58.0)		561 (64.6)	144 (64.9)		481 (69.9)	220 (55.7)	
	Missing	*n* = 4	*n* = 1	*n* = 0		*n* = 4	*n* = 1		*n* = 4	*n* = 1	
Night eating behaviour	Night eating				**<0.001**			0.262			**0.013**
	Usually	1 (0.1)	1 (0.5)	0 (0.0)		2 (0.2)	0 (0.0)		2 (0.3)	0 (0.0)	
	Often	3 (0.4)	1 (0.5)	0 (0.0)		4 (0.5)	0 (0.0)		1 (0.2)	3 (0.8)	
	Sometimes	8 (1.0)	12 (6.1)	4 (8.2)		16 (1.9)	8 (3.7)		9 (1.4)	15 (3.9)	
	Rarely	797 (98.5)	183 (92.9)	45 (91.8)		816 (97.4)	208 (96.3)		651 (98.2)	367 (95.3)	
	Missing	*n* = 33	*n* = 8	*n* = 1		*n* = 35	*n* = 7		*n* = 29	*n* = 11	

We found that snacking eating as well as externally cued and emotional eating were associated with subjective measures of sleep in menopausal women even after controlling for potential confounders and for menopausal status. Different snacking eating behaviours were associated with all studied measures of sleep. Similarly, women who ate when prompted by visual cues reported shorter sleep duration, and women who ate for comfort and used food as a reward reported more daytime tiredness.

4.1 | Menopausal status

The general conception suggests that menopausal transition is characterised by impairment in different sleep dimensions (Baker et al., 2018). Unexpectedly, after controlling for confounding factors, we did not observe a statistically significant association between any of the sleep dimensions and menopausal status with an imputed dataset. However, the association between postmenopausal status and shorter sleep duration was statistically significant in the complete case analysis. The reason behind this discrepancy most likely is the uneven distribution of missing data for visceral fat which causes bias in the results. Therefore, we conclude that menopause was not associated with the measures of sleep independently from the confounders.

As few studies have showed earlier, sleep quality does not necessarily vary across different menopausal statuses when assessed objectively (Young et al., 2003) or subjectively (Pien et al., 2008), while others have found the association (Lampio et al., 2013). There are not many studies concerning the association between sleep duration and menopausal status (Jones et al., 2018). Instead, prior research has focussed on sleep disturbances in a broader sense. The most prominent disturbances in the menopausal transition relate to maintaining sleep, sleep initiation, or early morning awakenings (Kravitz et al., 2008; Woods & Mitchell, 2010). However, other studies have not found a consistent association between menopausal status and sleep disturbances (Young et al., 2003). The inconsistency between the results concerning the association between menopausal status and different measures of sleep is largely due to the different research frames used, and further, the multifaceted nature of sleep. Assessed either objectively or subjectively, sleep dimensions are prone to be affected by various confounders. For example, it has been shown that women are at a higher risk for depression in menopausal transition (Vivian-Taylor & Hickey, 2014), and at the same time, depression is strongly related to sleep difficulties as well (Lampio et al., 2016). As the recommended cut-off value in epidemiological studies for depression assessed by CES-D score is 20 (Vilagut et al., 2016), in our sample the participants had a mean value of 9.5, which refers to the absence of depression. This might partly explain why we did not observe the association between menopausal status and measures of sleep. Another reason might be the level of physical activity. In our study, approximately 60% of the participants reported being moderately or vigorously active. This implies the sanatory effect of physical activity on sleep, as Yang et al.

TABLE 4 Odds-ratios (with 95% CI) of menopausal status and eating styles in each main sleep outcome (adjusted for educational status, CES-D score, and physical activity, visceral fat, and vasomotor symptoms).

	Perceived sleep quality				Sleep duration		Daytime tiredness	
	Fairly poor		Poor		Short		Yes	
	OR (95% CI)	*p* value	OR (95% CI)	*p* value	OR (95% CI)	*p* value	OR (95% CI)	*p* value
Univariable model								
Early perimenopause	1.09 (0.66–1.79)	0.747	1.42 (0.56–3.57)	0.458	0.95 (0.59–1.53)	0.823	1.09 (0.75–1.58)	0.665
Late perimenopause	1.31 (0.81–2.10)	0.271	1.55 (0.63–3.80)	0.342	1.19 (0.76–1.87)	0.446	1.18 (0.82–1.70)	0.384
Postmenopause	1.84 (1.24–2.73)	**0.003**	1.91 (0.88–4.13)	0.101	1.55 (1.07–2.26)	**0.022**	1.00 (0.73–1.37)	0.998
Model 1: Menopausal status[a]								
Early perimenopause	0.87 (0.51–1.47)	0.602	0.85 (0.32–2.28)	0.751	0.90 (0.55–1.47)	0.676	0.88 (0.58–1.34)	0.541
Late perimenopause	1.09 (0.65–1.82)	0.745	1.09 (0.42–2.85)	0.854	1.18 (0.73–1.89)	0.504	1.07 (0.71–1.62)	0.742
Postmenopause	1.41 (0.89–2.22)	0.141	1.00 (0.42–2.40)	0.997	1.47 (0.96–2.24)	0.075	0.82 (0.56–1.21)	0.316
Models for menopausal status and snacking eating behaviour[b]								
Model 2								
Early perimenopause	0.86 (0.50–1.46)	0.567	0.83 (0.31–2.21)	0.703	0.88 (0.54–1.45)	0.622	0.85 (0.56–1.29)	0.445
Late perimenopause	1.07 (0.64–1.80)	0.786	1.05 (0.40–2.77)	0.914	1.16 (0.72–1.87)	0.543	1.06 (0.70–1.61)	0.773
Postmenopause	1.41 (0.89–2.23)	0.140	1.00 (0.41–2.39)	0.992	1.46 (0.96–2.24)	0.079	0.81 (0.55–1.19)	0.289
No snacking between meals	0.90 (0.59–1.38)	0.635	0.77 (0.37–1.59)	0.473	0.75 (0.51–1.11)	0.149	0.53 (0.37–0.76)	**<0.001**[c]
Model 3								
Early perimenopause	0.86 (0.51–1.46)	0.570	0.84 (0.31–2.24)	0.725	0.89 (0.54–1.46)	0.641	0.86 (0.56–1.31)	0.479
Late perimenopause	1.05 (0.63–1.76)	0.856	1.06 (0.40–2.79)	0.908	1.17 (0.73–1.88)	0.517	1.05 (0.69–1.59)	0.829
Postmenopause	1.39 (0.88–2.19)	0.161	0.98 (0.41–2.37)	0.971	1.46 (0.96–2.23)	0.081	0.82 (0.57–1.20)	0.306
Snacks replace meals	1.23 (0.62–2.43)	0.551	1.73 (0.62–4.82)	0.296	1.38 (0.75–2.52)	0.298	2.59 (1.43–4.68)	**0.002**[c]
Model 4								
Early perimenopause	0.85 (0.50–1.44)	0.549	0.82 (0.31–2.19)	0.695	0.90 (0.55–1.47)	0.664	0.88 (0.58–1.34)	0.538
Late perimenopause	1.05 (0.63–1.76)	0.849	0.93 (0.35–2.42)	0.874	1.15 (0.71–1.86)	0.565	1.08 (0.71–1.63)	0.733
Postmenopause	1.35 (0.86–2.14)	0.197	0.92 (0.38–2.21)	0.850	1.46 (0.95–2.23)	0.084	0.83 (0.56–1.21)	0.328
Highest food consumption in the evening	1.21 (0.80–1.83)	0.363	1.73 (0.87–3.43)	0.119	1.56 (1.07–2.27)	**0.020**	1.20 (0.84–1.71)	0.318
Model 5								
Early perimenopause	0.86 (0.50–1.45)	0.565	0.86 (0.32–2.30)	0.766	0.89 (0.55–1.46)	0.650	0.87 (0.57–1.32)	0.502
Late perimenopause	1.04 (0.62–1.75)	0.877	1.08 (0.41–2.84)	0.876	1.18 (0.73–1.90)	0.494	1.04 (0.69–1.58)	0.837
Postmenopause	1.39 (0.88–2.19)	0.162	1.00 (0.42–2.41)	0.999	1.46 (0.95–2.23)	0.082	0.81 (0.55–1.19)	0.283
Grazing throughout the evening	1.32 (0.95–1.84)	0.096	1.65 (0.87–3.12)	0.123	0.96 (0.70–1.31)	0.794	1.41 (1.07–1.87)	**0.014**
Model 6								
Early perimenopause	0.84 (0.49–1.43)	0.515	0.87 (0.33–2.33)	0.782	0.92 (0.56–1.51)	0.744	0.85 (0.57–1.30)	0.454
Late perimenopause	1.07 (0.64–1.79)	0.795	1.12 (0.43–2.92)	0.825	1.20 (0.74–1.93)	0.461	1.09 (0.72–1.65)	0.679
Postmenopause	1.38 (0.88–2.19)	0.164	1.01 (0.42–2.44)	0.976	1.48 (0.97–2.26)	0.070	0.82 (0.56–1.20)	0.306
Eating while watching TV	0.97 (0.63–1.49)	0.880	1.46 (0.72–2.96)	0.292	1.28 (0.87–1.87)	0.213	1.44 (1.01–2.06)	**0.046**
Models for menopausal status and health-conscious eating behaviour[b]								
Model 7								
Early perimenopause	0.86 (0.51–1.46)	0.579	0.84 (0.31–2.23)	0.720	0.91 (0.55–1.48)	0.693	0.85 (0.56–1.30)	0.464
Late perimenopause	1.08 (0.64–1.80)	0.780	1.06 (0.40–2.78)	0.909	1.16 (0.72–1.87)	0.533	1.05 (0.70–1.59)	0.803
Postmenopause	1.39 (0.88–2.20)	0.157	0.96 (0.40–2.31)	0.925	1.46 (0.95–2.23)	0.081	0.80 (0.55–1.18)	0.263

TABLE 4 (Continued)

	Perceived sleep quality				Sleep duration		Daytime tiredness	
	Fairly poor		Poor		Short		Yes	
	OR (95% CI)	*p* value	OR (95% CI)	*p* value	OR (95% CI)	*p* value	OR (95% CI)	*p* value
Attempting to maintain healthy eating patterns	0.97 (0.49–1.91)	0.925	0.66 (0.24–1.85)	0.433	1.30 (0.67–2.52)	0.441	0.71 (0.40–1.27)	0.244
Model 8								
Early perimenopause	0.84 (0.49–1.43)	0.511	0.85 (0.32–2.28)	0.753	0.90 (0.55–1.48)	0.685	0.86 (0.57–1.31)	0.486
Late perimenopause	1.08 (0.65–1.81)	0.762	1.09 (0.42–2.85)	0.862	1.17 (0.73–1.88)	0.519	1.04 (0.69–1.58)	0.839
Postmenopause	1.40 (0.89–2.21)	0.148	0.99 (0.41–2.38)	0.981	1.45 (0.95–2.21)	0.087	0.81 (0.55–1.20)	0.295
Avoiding fatty foods	0.87 (0.61–1.24)	0.434	0.83 (0.44–1.58)	0.576	0.91 (0.65–1.27)	0.573	0.87 (0.64–1.18)	0.371
Model 9								
Early perimenopause	0.85 (0.50–1.45)	0.558	0.83 (0.31–2.23)	0.717	0.89 (0.54–1.45)	0.635	0.87 (0.57–1.32)	0.511
Late perimenopause	1.07 (0.64–1.79)	0.800	1.07 (0.41–2.79)	0.895	1.16 (0.72–1.86)	0.551	1.06 (0.70–1.60)	0.799
Postmenopause	1.36 (0.86–2.15)	0.192	0.99 (0.41–2.37)	0.980	1.42 (0.92–2.17)	0.110	0.80 (0.55–1.18)	0.267
Avoiding calories	0.79 (0.57–1.11)	0.181	1.07 (0.57–1.99)	0.833	0.77 (0.56–1.06)	0.107	0.93 (0.70–1.23)	0.605
Models for menopausal status and externally cued and emotional eating behaviour[b]								
Model 10								
Early perimenopause	0.87 (0.51–1.47)	0.593	0.84 (0.32–2.26)	0.736	0.91 (0.55–1.49)	0.701	0.84 (0.55–1.29)	0.425
Late perimenopause	1.08 (0.65–1.81)	0.765	1.08 (0.41–2.82)	0.878	1.14 (0.71–1.84)	0.588	1.03 (0.68–1.56)	0.887
Postmenopause	1.39 (0.88–2.19)	0.160	0.98 (0.41–2.35)	0.962	1.48 (0.97–2.26)	0.071	0.80 (0.54–1.17)	0.249
Visual cues prompt eating	1.16 (0.75–1.82)	0.505	1.25 (0.56–2.79)	0.594	4.15 (1.14–15.06)	**0.031**	2.07 (0.52–8.28)	0.303
Model 11								
Early perimenopause	0.86 (0.51–1.46)	0.576	0.84 (0.31–2.23)	0.721	0.89 (0.55–1.46)	0.652	0.88 (0.57–1.33)	0.535
Late perimenopause	1.07 (0.64–1.79)	0.795	1.07 (0.41–2.79)	0.895	1.16 (0.72–1.86)	0.543	1.06 (0.70–1.61)	0.780
Postmenopause	1.38 (0.88–2.18)	0.165	0.97 (0.40–2.32)	0.938	1.45 (0.95–2.21)	0.087	0.82 (0.56–1.21)	0.316
Food used as reward	0.87 (0.49–1.52)	0.615	0.69 (0.24–1.95)	0.485	0.98 (0.58–1.67)	0.944	1.64 (1.02–2.64)	**0.040**
Model 12								
Early perimenopause	0.89 (0.52–1.51)	0.658	0.85 (0.32–2.27)	0.744	0.92 (0.56–1.50)	0.731	0.83 (0.54–1.27)	0.386
Late perimenopause	1.11 (0.66–1.85)	0.700	1.08 (0.41–2.83)	0.873	1.19 (0.74–1.91)	0.479	1.05 (0.69–1.58)	0.837
Postmenopause	1.44 (0.91–2.28)	0.122	0.99 (0.41–2.39)	0.986	1.49 (0.97–2.27)	0.070	0.82 (0.56–1.21)	0.319
Comfort eating	0.91 (0.45–1.85)	0.801	1.04 (0.35–3.07)	0.949	0.84 (0.42–1.66)	0.607	2.60 (1.39–4.89)	**0.003**[c]

Note: Model 1, menopausal status + confounding factors (educational status, CES-D score, visceral fat, vasomotor symptoms, and physical activity); Model 2, Model 1 + no snacking between meals; Model 3, Model 1 + snacks replace meals; Model 4, Model 1 + highest food consumption in the evening; Model 5, Model 1 + grazing throughout the evening; Model 6, Model 1 + eating while watching TV; Model 7, Model 1 + attempting to maintain healthy eating patterns; Model 8, Model 1 + avoiding fatty foods; Model 9, Model 1 + avoiding calories; Model 10, Model 1 + using food as reward; Model 11, Model 1 + comfort eating; Model 12, Model 1 + externally cued eating.

[a]In all models, premenopausal group is the reference group.

[b]In all models, eating behaviour variables are used as dichotomised variables and the category rare is used as a reference group.

[c]*p* values that survived false-discovery rate (FDR) adjustment protocol.

(2012) stated, and potentially diminished the association between sleep variables and menopausal status. The fact that the participants were physically active and psychologically stable raises the question whether it is more important to concentrate on the holistic well-being of an individual rather than be concerned about possible impairment of sleep health due to menopause. Indeed, Kalleinen et al. (2021) stated in their 10 year follow-up study that sleep does not worsen over the menopausal transition when assessed objectively (Kalleinen et al., 2021).

4.2 | Snacking eating

In line with our study, snacking eating has also been associated with shorter sleep duration (De Castro et al., 2019; Kant & Graubard, 2014). However, in the present study, the association did not remain statistically significant after adjusting for multiple testing. Evening-oriented eating behaviour might decrease the sleep duration, as there is less time to sleep. It is also noteworthy that we were not able to determine the causal pathway in this study. As Dweck et al. (2014) suggested, short sleep duration may cause overeating due to stress caused by sleep deprivation (Dweck et al., 2014). There are not many studies concerning eating behaviour and daytime tiredness. In a study run by Lopes and colleagues (do Vale Cardoso Lopes et al., 2019) an association was found between eating late and poor sleep quality and daytime tiredness in participants with sleep apnea. Impaired sleep quality due to late-night snacking may have an effect on the next day's energy, causing daytime tiredness. Furthermore, regular eating is more likely not to disturb the circadian clocks (i.e. clocks that regulate 24 h rhythms) (Grosjean et al., 2023), thus presumably promoting better sleep quality and reducing daytime tiredness. After all, further studies concerning the association between eating behaviour and daytime tiredness in adults are warranted to understand their combined health consequences.

According to the present study, snacking eating behaviour is associated with subjective measures of sleep which in turn may lead to compromised health. Snacking eating has been shown to be an obesogenic behaviour (Barrington & Beresford, 2019). Furthermore, sleeping problems are suggested to increase the risk of obesity, metabolic syndrome, and cardiovascular diseases (Chaput et al., 2013; Itani et al., 2017; Jike et al., 2018) while snacking eating especially in the late evening may be associated with incident cardiovascular diseases (Kaneko et al., 2021). In middle-aged women, hormonal changes due to menopause are likely to emphasise this connection, since the rapid decrease of oestradiol is related to accumulation of excess abdominal fat (Juppi et al., 2022).

4.3 | Externally cued and emotional eating

Interestingly, we observed a strong association between externally cued eating and short sleep duration. However, this association did not remain statistically significant after adjusting for multiple testing. Women who ate prompted by visual cues had over a four-fold likelihood of experiencing shorter sleep duration. Causes might lie in the time spent watching TV, and at the same time, less time in bed at sleep. Considering the causal pathway is not known, it is possible that short sleep duration, and tiredness caused by that, might intensify the externally cued eating. Comfort eating and using food as a reward were also positively associated with daytime tiredness. Of these, only comfort eating remained statistically significant after adjusting for multiple testing. In our sample, comfort eating was reported proportionally by a greater number of participants who scored >20 in CES-D measurement compared with the total sample. These associations may imply the presence of psychological issues and weight gain (Frayn & Knäuper, 2018; Konttinen et al., 2010). It is also notable, that the association between emotional eating behaviour and weight gain is suggested to be stronger in persons with shorter sleep duration (Chaput et al., 2011a; Van Strien & Koenders, 2014).

4.4 | Strengths and limitations

The present study has several strengths and limitations. The main strength of this study is the novel findings on the association of eating behaviour and subjective measures of sleep in four different menopausal stages determined by measured hormone levels and menstrual cycle diaries. Due to the hormonal changes women are prone to experience various and changeable physiological symptoms during the menopausal transition time. Therefore, it is important to evaluate possible differences in health behaviour across all menopausal stages. These findings can form the basis for future hypothesis-testing research. Another strength is our population-based large sample of women.

While objective sleep quality measurement has its benefits and is the gold standard, the subjective, or perceived sleep quality assessment is a feasible tool for evaluating a person's own perception. Indeed, as Buysse stated, all dimensions of sleep are associated with health, but often with different outcomes, and these dimensions are best evaluated with different methods suitable for each one of them (Buysse, 2014). For sleep quality or satisfaction, Buysse (2014) suggests self-report as a more feasible method. However, it is to be considered, that sleep duration is often overestimated when assessed subjectively (Matthews et al., 2018) but more likely to be underestimated by people suffering poor sleep quality (Regestein et al., 2004). Yet, Lauderdale et al. have found a moderate correlation between self-reported and objectively measured sleep duration (Lauderdale et al., 2008).

The present study is a secondary analysis. The ERMA study was not designed to investigate sleep dimensions in particular, and this study was not able to utilise objective measures of sleep. However, we consider using self-report questionnaires acceptable in this population because women have been shown to be capable of evaluating their quality of sleep rather objectively (Åkerstedt et al., 2016). Furthermore, the questions used to evaluate sleep quality in the present study resemble the questions concerning sleep quality in the validated Pittsburgh Sleep Quality Index questionnaire (Buysse Charles et al., 1989).

This study was exploratory in nature and explored potential associations without a specific a priori hypothesis testing framework. Therefore, our results should not be interpreted as confirmatory, but rather as hypothesis-generating. Although the high number of statistical tests performed is a considerable limitation of the present study, several methods are available for controlling the risk of false-positive findings. One of the commonly used methods is the Benjamini-Hochberg procedure to control the false-positive discovery rate (FDR) to be 10–20% (Benjamini & Hochberg, 1995). In our study, this led altogether three eating behaviour values ("no snacking between meals", "snacks replace meals", and "comfort eating" when examining the associations between eating behaviour and daytime tiredness) to be statistically significant after FDR correction. It is also noteworthy, that the pathway between eating and sleeping behaviour is likely to be bidirectional, but due to the cross-sectional design of our study, we could not investigate the phenomena. There are also various confounders not included in the present study that may have impact on sleeping and eating behaviour, such as various family stressors related to midlife (e.g. caring of one's parents or stressful work).

5 | CONCLUSION

The findings of this exploratory study show that women who snack and eat when externally cued, as well as console themselves with food, are more likely to experience shorter sleep duration and more daytime tiredness. However, after adjusting for multiple testing, it appears that eating behaviour is associated with only daytime tiredness. Considering the multiple testing correction, these results suggest that in order to enhance better sleep health, it is necessary to call attention to nutrition and regular eating as well. Menopausal women with sleeping problems may benefit from nutritional interventions targeted at eating behaviour rather than treating sleeping problems as a symptom caused by menopause. Nutritional intervention targeted at contributing to better sleep health in menopausal transition would subsequently help to prevent the progression of cardiovascular diseases.

AUTHOR CONTRIBUTIONS

Hannamari Lankila: Formal analysis; writing – original draft; writing – review and editing; data curation; methodology; conceptualization. **Mari A. Kuutti:** Writing – review and editing; conceptualization. **Tiia Kekäläinen:** Writing – review and editing; validation; conceptualization; supervision. **Enni-Maria Hietavala:** Conceptualization; funding acquisition; supervision; writing – review and editing. **Eija K. Laakkonen:** Conceptualization; funding acquisition; writing – review and editing; project administration; supervision.

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CONFLICT OF INTEREST STATEMENT

The authors report no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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