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ORIGINAL ARTICLE

SLEEP-RELATED BEHAVIOURS AND THEIR ASSOCIATIONS WITH OVERWEIGHT, OBESITY AND HYPERTENSION IN ADULTS

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ABSTRACT

Background. Sleep plays an important role in physiological regulation and has been increasingly recognised as a contributor to chronic non-communicable diseases, including obesity and hypertension.

Objective. This study examined the relationships between sleep duration, sleep-related problems, and selected health indicators, including BMI (body mass index) and hypertension, and evaluated the prevalence of sleep-related difficulties, stress, and night-shift work in adults.

Materials and Methods. A total of 260 respondents (125 men, aged 42.24 ± 12.35 years; BMI 27.19 ± 4.3 kg/m²; and 135 women, aged 47.83 ± 11.72 years; BMI 26.57 ± 6.54 kg/m²) completed a 14-item questionnaire assessing sleep duration and quality, sleep-related problems, night-time awakenings, fatigue, stress, night-shift work and self-reported chronic conditions, including physician-diagnosed hypertension.

Results. A significant association was found between insufficient sleep and overweight/obesity ($p = 0.003$), whereas no relationship was observed between sleep duration and hypertension ($p = 0.232$). Overall, 55% of respondents slept fewer than 7 hours, 35% slept 7-8 hours, and 10% slept more than 8 hours per night; overweight or obese individuals reported an average of 6.2 hours of sleep. Sleep problems were reported by 35% of participants, but showed no significant association with BMI. Stress was reported by 53% of respondents and was significantly associated with higher BMI ($p = 0.005$). Night-shift work was reported by 51.8% of participants and was significantly linked to overweight/obesity ($p = 0.039$). Hypertension was reported by 40.3% of respondents and was significantly associated with BMI ($p < 0.0001$), but not with sleep duration.

Conclusions. Insufficient sleep, stress, and night-shift work were associated with increased BMI, while no association was found between sleep duration and hypertension. These factors should be considered when addressing weight-related health risks.

Keywords: *sleep-related behaviours, body mass index, obesity, hypertension, non-communicable diseases*

INTRODUCTION

Obesity and hypertension are among the most important risk factors for cardiovascular diseases (CVDs) [1-4], which belong to the broader group of noncommunicable diseases (NCDs). NCDs represent a major global public health challenge, contributing substantially to morbidity and ranking among the leading causes of death and disability worldwide [5]. According to Unwin and Alberti [6], chronic NCDs account for nearly 60% of global mortality, with approximately 80% of NCD-related deaths occurring in low and middleincome countries. Cardiovascular diseases are the dominant contributor, responsible for almost 80% of all premature NCD deaths, underscoring their central role in the global NCD epidemic. Given the strong metabolic and cardiovascular consequences of obesity and hypertension, increasing attention has been directed toward additional modifiable factors that may influence these conditions, including sleep duration and sleep quality [7].

Obesity is also recognised as a significant risk factor for sleep disorders [8], and sleep disturbances have been shown to increase the risk of developing hypertension [9]. Sleep disorders are highly prevalent in the general population and are associated with substantial medical, psychological and social consequences [10]. Growing evidence further indicates

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that sleep disorders constitute an important and often under-recognized risk factor for major NCDs, including cardiovascular and metabolic diseases [11].

Insufficient or mistimed sleep perturbs multiple neuroendocrine pathways that regulate energy balance and cardiometabolic homeostasis. Experimental and clinical data show that curtailed or fragmented sleep can alter appetiteregulating hormones (e.g., leptin, ghrelin), impair insulin sensitivity, and shift energy intake toward caloriedense foods, thereby promoting positive energy balance and adiposity. These effects are mediated in part by activation of the hypothalamic-pituitary-adrenal (HPA) axis, changes in sympathetic tone and disruptions in glucose-insulin dynamics [12-14]. Together, these mechanisms provide biological plausibility for the observed links between short or irregular sleep and obesity, insulin resistance and cardiometabolic risk.

Healthy sleep is increasingly acknowledged as a key component of NCD prevention alongside nutrition and physical activity, yet it continues to receive insufficient attention in public health strategies [15]. Recent studies also demonstrate that poor sleep quality is strongly linked to chronic NCDs, with these associations partly mediated by mental-health factors such as anxiety and depression [16].

The International Classification of Sleep Disorders identifies more than 80 distinct sleep conditions, grouped into eight categories, including insomnia, sleepdisordered breathing (SDB) and sleep-related movement disorders [17]. Chronic sleep restriction has become increasingly common over recent decades, and both laboratory and epidemiological studies suggest that insufficient sleep contributes to the rising incidence of diabetes and obesity. Proposed mechanisms linking sleep restriction to metabolic dysfunction include impaired glucose metabolism, increased appetite and reduced energy expenditure [18].

Recent advances in sleep research further highlight the biological and clinical importance of sleep in maintaining metabolic and cardiovascular health [19]. Emerging technologies also show that physiological signals recorded during sleep can predict longterm risk for numerous health conditions, emphasising the diagnostic potential of sleep monitoring [20].

The aim of this study was to examine the associations between sleep duration, sleep-related problems and selected health indicators, including BMI and hypertension, and to assess the prevalence of sleep-related difficulties in an adult population.

MATERIAL AND METHODS

The study group consisted of 260 participants, including 125 men (42.24 ± 12.35 years; BMI 27.19 ± 4.3 kg/m²) and 135 women (47.83 ± 11.72 years; BMI 26.57 ± 6.54 kg/m²). Body weight was measured using a calibrated digital personal scale (Brutus Tanita HD 351; Harrmed Medica ČR, Tanita Europe, Hoofddorp, The Netherlands) with an accuracy of 0.1 kg. Body height was assessed using an ultrasonic height meter (Bodyson; ADE GmbH & Co., Hamburg, Germany). Body mass index (BMI) was calculated from the measured values (Table 1).

The average age of all respondents was 45.5 ± 12.44 years (range: 22-67 years). The mean height of the participants was 170.78 ± 8.66 cm, and the mean body weight was 78.37 ± 17.98 kg. The average BMI was 26.82 ± 5.68 kg/m², placing the mean respondent in the overweight category.

In addition to basic anthropometric characteristics, participants were classified by BMI category, as this

Table 1. Basic characteristics of the monitored population

Sex	Age (years) Mean ± SD	Height (cm) Mean ± SD	Weight (kg) Mean ± SD	BMI (kg/m²) Mean ± SD
Male ♂ (n = 125)	42.24 (± 12.35)	177.04 (± 6.96)	85.24 (± 14.77)	27.18 (± 4.30)
Female ♀ (n = 135)	47.83 (± 11.72)	166.31 (± 6.83)	73.46 (± 18.64)	26.57 (± 6.54)
Total (n = 260)	45.50 (± 11.72)	170.79 (± 8.66)	78.37 (± 17.98)	26.82 (± 5.68)

BMI – body mass index

Table 2. Characteristics of the study population according to BMI

Classification	BMI (kg/m²)	Sample size (n = 260)	Relative abundance (%)
Underweight	< 18.5	13	5
Normal weight	18.5-24.9	86	33
Overweight	25.0-29.9	86	33
Obesity I. degree	30.0-34.9	52	20
Obesity II. degree	35.0-39.9	18	7
Obesity III. degree	≥ 40	5	2

was one of the key variables assessed. The largest groups were respondents with normal weight (33%) and overweight (33%), while the smallest group was individuals with class III obesity (2%) (Table 2). BMI categories were determined according to the World Health Organisation (WHO) classification [21].

The participants administered a short, study-specific 14-item questionnaire designed to capture sleep-related behaviours and relevant cofactors. Items assessed: (i) sleep duration (hours/night; categorised as < 7 h, 7-8 h, > 8 h); (ii) difficulties falling asleep and/or maintaining sleep (yes/no); (iii) night-time awakenings (frequency categories); (iv) fatigue upon awakening and during the day (regular/occasional/none); (v) night-shift work (current or recent; yes/no); (vi) timing of the last meal before bedtime (≥ 2 h, last hour, immediately before bedtime, eating during the night); (vii) self-reported stress (work or personal; yes/no); and (viii) self-reported hypertension (physician diagnosis and/or antihypertensive medication; yes/no/unknown).

A total of 268 individuals completed the questionnaire; partially completed questionnaires were excluded. The final analytical sample consisted of 260 respondents who answered all items.

Statistical analysis

The questionnaire data were processed using Microsoft Office Excel 2010 (Los Angeles, CA, USA) and Statistica 12 (Dell Statistica, Tulsa, OK, USA). Statistical significance between the monitored categories was assessed using the *Chi*-square test, which evaluates the agreement between expected and observed frequencies. Results were considered statistically significant at the level of $p < 0.05$.

RESULTS

Results are presented for behavioural indicators (sleep duration, sleep-related problems, nocturnal awakenings, fatigue) and exposures (nightshift work, lastmeal timing, stress). Hypertension was selfreported.

Sleep duration

Among all respondents, the most commonly desired sleep duration was 7-8 hours (50%). A total of 27% preferred sleeping fewer than 7 hours, while 23% preferred sleeping more than 8 hours per night. When actual sleep duration was evaluated, 55% of respondents reported sleeping fewer than 7 hours per night, 35% reported sleeping 7-8 hours, and 10% reported sleeping more than 8 hours.

Table 4 presents the average sleep duration across BMI categories. Respondents with normal weight slept an average of 7.2 hours, whereas overweight or obese individuals averaged 6.2 hours per night. This difference was statistically significant ($p = 0.003$). Across all BMI categories, the overall mean sleep duration was 6.6 hours.

Difficulties falling asleep and sleep problems

In total, 29.4% of respondents reported difficulties falling asleep, and 35.1% reported sleep problems. The remaining 64.9% did not report sleep problems. No significant association was observed between BMI and the occurrence of sleep problems ($p = 0.410$).

Waking during sleep

Only 27.8% of respondents reported mostly uninterrupted sleep, while 72.2% experienced at

Table 3. The subjective need for sleep length and the actual length of sleep of the respondents

The subjective need for sleep	Absolute abundance (n)	Relative abundance (%)
Less than 7 hours	70	27
7-8 hours	130	50
More than 8 hours	60	23
Actual sleep length	Absolute abundance (n)	Relative abundance (%)
Less than 7 hours	143	55
7-8 hours	91	35
More than 8 hours	26	10

Table 4. Average length of sleep by weight category

Classification according to BMI	Average length of sleep (hours)	p-value*
Normal weight	7.2	NS
Overweight and obesity	6.2	0.003
All categories	6.6	NS

**Chi*-squared test; NS – not significant

least one night-time awakening (Table 5). The largest proportion (31.6%) reported two to three awakenings per night.

Fatigue after waking up/subsequently during the day

Regular fatigue after waking was reported by 35.1%, occasional fatigue by 53.2%, and no fatigue by 11.7%. Daytime fatigue was reported regularly by 36.9%, occasionally by 48.3%, and not at all by 14.8%.

Timing of the last meal before bedtime

A total of 30.2% of respondents did not eat for at least two hours before bedtime, 26.7% avoided eating during the last hour, 33.1% ate immediately before going to bed, and 10.3% ate during the night after waking. The association between BMI and lastmeal timing was statistically significant ($p = 0.020$).

Night-shift work

More than half of the respondents (51.8%) reported current or recent nightshift work. This variable was significantly associated with overweight and obesity ($p = 0.039$) (Table 8).

Stress

A total of 53.4% of respondents reported experiencing stress at work or in their personal lives, while 46.6% reported no stress. Although stress was not associated with sleep parameters, it was significantly associated with BMI ($p = 0.005$).

Hypertension

Hypertension was reported by 40.3% of respondents, 56.7% reported no hypertension, and 3.0% were unsure of their status. No significant association was found between sleep duration and hypertension ($p = 0.232$). However, BMI was significantly associated with hypertension ($p < 0.001$).

DISCUSSION

This study explored the relationships between multiple sleep-related behaviours and key health indicators, with a particular focus on overweight, obesity and hypertension. By examining sleep duration, sleep difficulties, night-time awakenings, fatigue, meal timing, nightshift work and stress, the findings provide insight into how different dimensions of sleep may interact with metabolic and cardiovascular risk factors in adults.

Table 5. Waking up during sleep (n = 260)

Sleep fragmentation – number of awakenings per night	
Usually don't wake up	27.8%
Once per night	27.4%
2-3 times per night	31.6%
More than 3 times per night	13.2%

Table 6. Fatigue after waking up, fatigue during the day (n = 260)

Possibilities	Fatigue after waking up (%)	Fatigue during the day (%)
Yes, regularly	35.1	36.9
Rarely	53.2	48.3
No	11.7	14.8

Table 7. The last-meal timing (n = 260)

Last meal before bedtime	
2 or more hours before bedtime	30.2%
1 hour before bedtime	26.4%
Eat right before going to sleep	33.1%
Eat at night after waking up from sleep	10.3%

Table 8. BMI and night-shift work (n = 260)

	Total (%)	Normal weight (%)	Overweight and obesity (%)	p-value*
Day-time work	48.2	25.8	48.3	NS
Night-shift work	51.8	51.7	74.2	0.039

**Chi*-squared test; NS – not significant

Although half of the respondents considered 7-8 hours of sleep ideal, 55% did not achieve this duration, indicating a discrepancy between perceived sleep needs and actual sleep behaviour. Such a mismatch may reflect lifestyle demands or insufficient sleep hygiene, highlighting the importance of promoting healthy sleep routines. This is consistent with European data showing that sleep disturbances remain prevalent, particularly in older adults, and are linked to increased morbidity and frailty [22]. Numerous studies further demonstrate that short sleep duration is associated with higher allcause mortality and adverse metabolic outcomes [23, 24].

Short sleep duration has also been widely associated with increased body weight and central adiposity [25, 26]. Evidence suggests a dose-response relationship, whereby the likelihood of obesity increases as sleep duration falls below 7 hours per night [27, 28]. Our findings are consistent with this trend, as insufficient sleep was significantly associated with overweight and obesity, whereas sleep problems such as difficulties falling or staying asleep did not show a significant relationship with BMI.

Sleep fragmentation, reflected in frequent nighttime awakenings, was common among respondents, with 72.2% reporting at least one awakening per night. Previous research indicates that disrupted sleep continuity contributes to poor sleep quality and is linked to metabolic dysfunction and chronic diseases [29]. Fatigue was also highly prevalent and aligns with evidence that both short sleep and fragmented sleep negatively affect daytime functioning and cognitive and physical performance [30-33].

More than half of the respondents (51.8%) reported current or recent nightshift work, which was significantly associated with overweight and obesity. This finding is supported by studies showing that shift work disrupts circadian rhythms and increases cardiometabolic risk [34-37]. Circadian misalignment associated with irregular work schedules is known to impair metabolic regulation, promote adiposity and elevate longterm health risks.

Stress was reported by 53.4% of participants and was significantly associated with BMI, suggesting that stress may contribute to weight gain through behavioural or physiological pathways. Although no association between stress and sleep parameters was found in this sample, previous research indicates that stress can disrupt sleep and eating patterns, which may, in turn, indirectly influence body weight.

Hypertension was reported by 40.3% of respondents. Although sleep duration was not associated with hypertension, BMI showed a strong and significant relationship with elevated blood pressure, which is consistent with wellestablished links between excess body weight and hypertension [38-40]. These results suggest that, within this population, weight status may play a more prominent role in hypertension risk than sleep duration alone.

Limitations of the study

This study has several limitations that should be taken into account when interpreting the findings. Its cross-sectional design enables the identification of associations between sleep-related behaviours, stress, BMI, and hypertension, but does not allow conclusions regarding causality or temporal direction. Information on sleep patterns, stress, and selected lifestyle factors was obtained through self-reported questionnaires, which may be subject to recall bias or subjective misestimation. The sample represents a specific adult population, which may limit the generalisability of the results to other groups. Furthermore, BMI was used as an indicator of body weight status, although it does not fully reflect differences in body composition. This crosssectional study used selfreported data for sleep, stress and hypertension and did not include validated diagnostic instruments for insomnia, anxiety or depression; therefore, results pertain to behavioural indicators and selfreports rather than clinical diagnoses.

CONCLUSION

This study showed that insufficient sleep duration, night shift work, and stress were significantly associated with higher BMI in adults. Respondents with overweight or obesity reported shorter sleep and a higher prevalence of stress and nightshift work, while neither sleep problems nor sleep duration were related to hypertension. Hypertension occurred more frequently among individuals with elevated BMI, confirming BMI as an important contributor to blood pressure, whereas no association was found between sleep duration and hypertension. These findings highlight the importance of considering sleep habits, occupational schedules and stress management when addressing excess body weight and related health risks.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Conflicts of interest

The authors declare no conflicts of interest.

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