



Original Article

Both habitual short sleepers and long sleepers are at greater risk of obesity: a population-based 10-year follow-up in women



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ABSTRACT

Objective: To assess how change in sleep duration is related to subsequent obesity.

Methods: In this 10-year follow-up, 4903 non-pregnant participants answered a questionnaire on sleeping habits, obesity, and lifestyle factors (questions identical to baseline questionnaire). Habitual normal sleepers were defined as sleeping 6–9 h/night at both baseline and follow-up, whereas women sleeping <6 h/night or ≥9 h/night at both occasions were defined as habitual short sleepers and habitual long sleepers, respectively. Logistic regression was used to analyze associations between changes in sleep duration, general obesity (body mass index ≥30 kg/m²), weight gain (≥10 kg) and also, central obesity (waist circumference ≥88 cm), and increase in waist circumference (≥10 cm) at follow-up.

Results: Among younger women (aged <40 years) both habitual short sleepers and habitual long sleepers had a higher prevalence of general (short: 31.3%, $P < 0.0001$; long: 38.1%, $P = 0.01$) and central obesity (short: 60.5%, $P = 0.01$; long: 82.4%, $P = 0.01$) compared with habitual normal sleepers (general obesity: 8.9%; central obesity: 35.9%) at follow-up. Younger women who were short sleepers at baseline but normal sleepers at the follow-up had a higher prevalence of both general (19.3%, $P = 0.01$) and central obesity (45.4%, $P = 0.07$) compared with habitual normal sleepers at follow-up. In adjusted analyses, both habitual short [adjusted odds ratio (aOR), 6.78; 95% confidence interval (CI), 2.71–17.0] and long (aOR, 4.64; 95% CI, 1.09–19.8) sleep durations were risk factors for general obesity in younger women. In younger women habitual long sleep duration was a risk factor also for central obesity (aOR, 6.05; 95% CI, 1.19–30.7) whereas habitual short sleep duration was not (aOR, 1.93; 95% CI, 0.87–4.81). Similar results were seen also for weight gain and increased waist circumference as dependent variables. In addition, decreased sleep duration from normal to short duration was a risk factor for both weight gain (aOR, 1.85; 95% CI, 1.14–3.02) and increased waist circumference (aOR, 1.84; 95% CI, 1.20–2.81). There were no associations between changes in sleep duration and any of the measures of obesity at the follow-up in women aged >40 years at baseline.

Conclusion: In younger women, both habitual short and long sleep duration was a risk factor for obesity, whereas no such relationship was seen in older women.

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1. Introduction

Over the last decade, several cross-sectional studies have shown associations between sleep duration, sleeping habits, and measurements of obesity [1–9]. An inverse relationship between self-reported sleep duration and obesity is found in adult men and women, as well as in children [10]. Short sleep duration is also found to predict weight gain and obesity later in life [2,3].

The results of previous studies on the longitudinal relationship between sleep duration and obesity vary, with some studies only finding a relationship between short sleep duration and obesity [3], some revealing a U-shaped relationship [11] and some showing no relationship [9]. However, sleep duration is not necessarily fixed over time, and studies of the relationship between changes in sleep duration over time and the development of obesity are still sparse and have produced diverse results.

This project is part of a 10-year follow-up of the epidemiological population-based study entitled 'Sleep and Health in women' (SHE) [12]. The overall aim of the SHE study is to analyze the long-term evolution and consequences of sleeping habits and sleep disturbances. The aim of the present study was to assess how changes in sleep duration over time were related to obesity over a 10-year

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period, in a population-based sample of women. A second aim was to examine these associations stratified by age.

2. Methods

2.1. SHE questionnaire

The SHE study started in 2000, when a questionnaire on sleep habits and somatic disorders was sent to women aged ≥ 20 years, randomly selected from the population registry of the City of Uppsala, Sweden. The response rate was 71.6% ($n = 7051$). In 2010, a follow-up questionnaire was sent to all the women who had answered the baseline questionnaire and who were still alive. Of the original study population, 8.5% were lost at follow-up due to death ($n = 461$), emigration ($n = 130$) and unknown addresses ($n = 5$). The follow-up questionnaire was therefore sent to 6455 women (91.6% of the initial study population) and completed by 5193 (response rate 80.5%). In the present study, women who were pregnant or who had omitted the question on sleep duration at one or both time-points were excluded, and the final study population comprised a total of 4903 non-pregnant women (Fig. 1). The study was approved by the Ethics Committee at the Medical Faculty at Uppsala University and all the participants gave their informed consent before participating.

The follow-up questionnaire included mostly the same questions as the baseline questionnaire, which has been previously described in detail [12]. Briefly, the follow-up questionnaire included questions on sleep duration, snoring habits, insomnia, occupational status, shift work, civil status, physical activity, smoking, alcohol dependence, anxiety and depression. Both at baseline and at follow-up, sleep duration (h/night) was assessed using the question: ‘How many hours do you sleep on average during the night?’ Sleep duration, at baseline and at follow-up, was classified into three categories: short sleepers (< 6 h/night), normal sleepers (6–9 h/night), and long sleepers (≥ 9 h/night). In addition, a sleep habit variable was constructed where the women were divided into ha-

bitual short sleepers (short sleepers at both baseline and follow-up), habitual long sleepers (long sleepers at both baseline and follow-up), women with ‘normalized’ sleep duration (short or long sleepers at baseline who were normal sleepers at follow-up), women with decreased sleep duration (normal sleepers at baseline who were short sleepers at follow-up), women with increased sleep duration (normal sleepers at baseline who were long sleepers at follow-up), habitual normal sleepers (normal sleep duration at both baseline and follow-up), as well as a group of women changing from short to long sleep duration or from long to short sleep duration.

Snoring habits were assessed using the question: ‘How often do you snore loudly and disturbingly?’ The response options for this question were ‘never’ (1), ‘seldom’ (2), ‘sometimes’ (3), ‘often’ (4) and ‘very often’ (5). Based on their response to this question, the participants were categorized into two groups: non-snorers (scores 1–3) and snorers (scores 4 and 5).

The women further indicated their current height and weight in both questionnaires, and body mass index (BMI, kg/m^2) was calculated and rounded off to one decimal point. BMI was categorized as underweight (< 19.9), normal weight (20–24.9), overweight (25–29.9), and obese (≥ 30). In conjunction with the questionnaire, the women were given a tape measure and instructions on how to measure their waist circumference [12]. A waist circumference of ≥ 88 cm was used to define central obesity according to National Cholesterol Education Program (NCEP) criteria [13]. All the data are self-reported. However, for 400 of the women BMI and waist circumference have been measured by a research nurse 2 years later. In spite of the time lapse between the two measures there was good correlation between measures at the two time-points (BMI: $\beta = 0.80$, $P < 0.0001$; waist circumference: $\beta = 0.85$, $P < 0.0001$). The mean difference between measured and self-reported BMI was 0.87 ± 2.51 and the corresponding difference in waist circumference was -0.39 ± 7.85 cm.

The participants’ physical activity was analyzed by four questions adopted from a questionnaire used in a large population-based study of the correlation between physical activity and mortality [14]. Six questions assessed smoking habits. The participants were categorized as ‘current smokers’ or ‘non-smokers’ (i.e. had quit smoking at least 6 months before answering the questionnaire or had never smoked). Alcohol dependence was assessed by the CAGE (acronym for Cut down, Annoyed by criticism, Guilty about drinking and Eye-opener drinks) alcohol and screening questionnaire [15]. The women were also asked to indicate how many cups of coffee they drank every day and this number was used as a continuous variable in the analyses. Psychological distress was assessed using the Hospital Anxiety and Depression (HAD) scale [16] and was used as a dichotomized score with a cut-off at score 10.

The participants were asked at both time-points to indicate how many months they had worked nights or shifts over the past 10 years. A cut-off point of 60 months was chosen when analyzing working nights or shifts.

The women were asked whether they were taking any medication on a regular basis. Taking insulin or oral medication, or both, for diabetes were categorized together as ‘diabetes medication’.

Compared with the responders, the non-responders at the follow-up were older (mean ages 45.0 ± 16.0 vs 43.3 ± 15.3 years, $P < 0.001$), somewhat more obese (mean BMI 24.5 ± 4.3 vs 24.0 ± 4.1 , $P = 0.0007$), and more often smokers (21.9% vs 15.9%, $P < 0.0001$) at baseline. Responders had somewhat longer sleep duration (mean sleep duration 7.0 vs 6.9 h, $P = 0.03$) but prevalence of habitual snoring did not differ between the groups (7.6 vs 7.8%, not significant). However, the non-responders were less physically active at baseline as 16.3% reported a high level of physical activity and 23.8% reported a low level of physical activity as compared with 21.1% and 15.7%, respectively for the responders ($P < 0.001$).

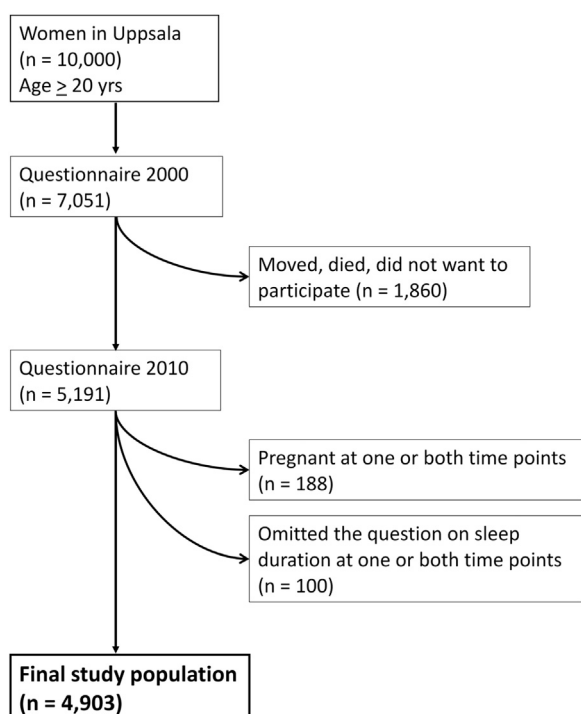


Fig. 1. Overview of study protocol.

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