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The effect of menopause on objective sleep parameters: Data from an epidemiologic study in São Paulo, Brazil

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ABSTRACT

Objective: Our objective was to investigate the influence of menopausal status on sleep patterns in a representative sample of women from São Paulo, Brazil.
Study design: A population-based survey with a probabilistic three-stage cluster sample of the city of São Paulo was used to represent the local population according to gender, age (20–80 years) and socioeconomic status.
Main outcome measures: The female participants answered a sleep questionnaire, underwent polysomnographic recording and allowed their hormone levels to be measured. They also completed a gynecological questionnaire for classification of the reproductive aging stages: premenopausal or reproductive, perimenopausal or menopausal transition, and postmenopausal, defined as being after 12 months of amenorrhea. Women were allocated into early (the first 5 years after menopause) and late (after the first 5 years) stages.
Results: A total of 535 women were included in this study: 339 were premenopausal, 53 were early postmenopausal, 118 were late postmenopausal and 25 were using hormone therapy or isoflavone compounds. Our main findings were that women in postmenopause spent more time in N3 sleep, had a higher apnea-hypopnea index (AHI) and lower SaO_2 compared with premenopausal women after an analysis adjusted for confounding factors. We found no significant differences between early and late postmenopausal women in the adjusted analysis.
Conclusion: Our results indicate menopause itself exerts a modest, but important influence on objective sleep patterns, independent of age, in particular on AHI and SaO_2.

1. Introduction

Sleep is a complex phenomenon of physiologic and behavioral processes, necessary to maintain quality of life at any age. Sleep is classified into rapid eye movement (REM) sleep and non-REM (NREM) sleep, the latter being further subdivided into Stage 1 (N1), Stage 2 (N2) and Stage 3 (N3). Stage 3 is also known as slow wave sleep (SWS) or deep sleep [1]. In normal individuals, NREM sleep predominates in the first half of the night, while REM sleep is more frequent in the second half of the night (Fig. 1).

Sleep can be measured subjectively and sleep pattern, objectively through polysomnography (PSG). Some of its variables are: Sleep Latency (time it takes to fall asleep: normally under 30 min), Total Sleep Time (TST) (variable within person), Sleep Efficiency (greater than 85% of TST), Stages N1 (up to 5% of TST), N2 (45–55% of TST), N3 or SWS (up to 23% of TST), REM sleep (20–25% of TST) and apnea hypopnea index (AHI) (normal index is under 5 events per hour and defined as the mean number of obstructive apneas and hypopneas per hour of sleep) [2].

Sleep alterations are associated with the aging process [3] as sleep complaints become more frequent at older ages [4]. Sleep patterns change across lifespan in both genders. For adults, sleep latency, stage N1 (light sleep) and the amount of time spent awake after sleep onset (WASO) significantly increase with age, while TST and SWS decrease with age [5]. Sleep efficiency also declines with age [6].

Sleep disturbance is a common complaint of middle-aged women and is often attributed to the transition to menopause [7,8].

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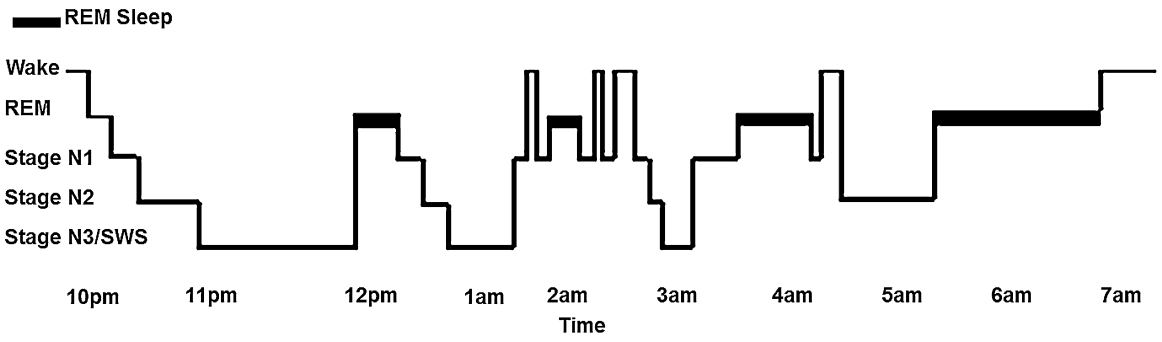

Fig. 1. *Hypnogram of a normal night's sleep.* REM sleep: rapid eyes movement; stage 1 (N1); stage 2 (N2); stage 3 (N3 or SWS: slow wave sleep), also known as deep sleep

Menopausal status, age and depressed mood are factors associated with sleep disturbance [9].

More recently, sleep has been investigated in the female population, with some evidence showing the impact of hormones on sleep during the different phases of women's lives [10,11]. Thus, menopause is considered an important stage in women's lives as evidence points to an increase in sleep problems (evident in midlife), as well as an increase in other diseases/comorbidities, pain, mood symptoms and weight gain [12].

Sleep difficulties can be initiated by menopause transition and there are factors that are often observed during the same period, as the effect of hormone therapy on sleep, sleep-disordered breathing, pain disorders, movement disorders and comorbidities [12]. Sleep disturbances may increase during menopausal stages, becoming severe in postmenopause [13], and leading to a higher risk of having poor subjective sleep quality and quantity [14] as well as an increased AHI [15]. Also, there is some evidence of the effect of menopause on sleep. Women in perimenopausal and postmenopausal stages have an increased risk of having sleep problems, compared to premenopause [16,17]. Within the menopausal transition, perimenopausal women may have longer and more frequent periods of arousal with an increased prevalence of mood symptoms compared to postmenopausal women [18]. In addition, postmenopausal women have shorter sleep duration, report more insomnia and use more sleep medications than premenopausal women [19].

In a study controlled for age with a large sample size, the odds ratio for sleep problems in postmenopausal women was 1.5 compared to premenopausal [20]. Postmenopausal women were also 1.5 times more likely to have an AHI greater than 5 relative to premenopausal women and indeed presented lower sleep efficiency and REM sleep, and more sleep alterations due to menopause status [15].

Few studies have focused directly on the association of menopause stages on sleep using objective methods such as PSG and considering the influence of age in an epidemiological sample [21–25]. Large population-representative surveys worldwide would provide important information about the prevalence of specific symptoms and problems in women and their associations with quality of life. Thus, this study aimed to explore the association of menopausal stages (premenopausal *versus* postmenopausal) and of postmenopausal stages (early *versus* late) with sleep parameters in a representative sample of women from the city of São Paulo, Brazil.

2. Methods

2.1. Study design

This study is a part of a cross-sectional study called the São Paulo Epidemiologic Sleep Study (EPISONO), conducted in São Paulo (Brazil) in 2007. It is a population-based survey, with a probabilistic 3-stage cluster sample from the city of São Paulo, weighted to match the demographic projections for the city inhabitants in 2007 by gender, age and socioeconomic status. These projections were derived from the 2000 city census.

2.2. Sampling procedures

An initial sample size of 1056 participants from both genders was defined to obtain a representative sample of the city of São Paulo, using a 3-stage cluster sampling technique [27]. In the first stage, to assure the representativeness of different levels of wealth, 96 districts (from the 1500 districts in which the city is divided for census purposes) were proportionally selected from the 4 homogenous socioeconomic macro-regions of São Paulo. Slums and shantytowns were excluded due to high criminal activity, as they were considered risk areas for the safety of the interviewers involved in the current study. Households were selected if they were permanently occupied private homes, thus clinics, schools, and other commercial and non-commercial establishments were excluded. In the second stage, the selection of a given household was made by randomly picking the first home and subsequently skipping a specified number, calculated by dividing the total number of homes by a fixed number, to select 11 households in each sector. Each apartment in an apartment building was considered a home, and counting was carried out from the upper floor to the lower floor. Finally, in the third stage of sampling, all eligible residents of each chosen home were ranged from the youngest to the oldest, and the subject was selected by means of 96 pre-established random tables, which designated which individual to choose from each of the 11 households, from the 96 selected districts.

Pregnant and lactating women, people with physical or mental impairments that prevent self-care, individuals below 20 or over 80 years old and people who work every night were not included in the selection from the household. Substitutes were chosen from the next home, following the same random selection criteria described above. In addition, individuals were not included in the following instances: following 3 unsuccessful attempts to contact the target individual, total refusal to participate, obstruction by a family member, or inability to participate for a specified reason [26]. These individuals were replaced using method described above.

2.3. Subjects

From the total of 1056 who agreed to participate in the study, 1042 completed the study. Of those, 574 were women and were included in the current study. Thus, all the female population of the EPISONO was considered for this study. At the time of selection, all participants signed a written consent that was included in the sleep questionnaire, which authorized us to collect and use data for future research studies. The volunteers that agreed to visit the Sleep Institute were collected by car on the scheduled visit date