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Original Article

Increasing trends of sleep complaints in the city of Sao Paulo, Brazil

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ABSTRACT

Objective: The aim of this study was to compare the prevalence of sleep habits and complaints and to estimate the secular trends through three population-based surveys carried out in 1987, 1995, and 2007 in the general adult population of the city of Sao Paulo, Brazil.
Methods: Surveys were performed using the same three-stage cluster-sampling technique in three consecutive decades to obtain representative samples of the inhabitants of Sao Paulo with respect to gender, age (20–80 years), and socio-economic status. Sample sizes were 1000 volunteers in 1987 and 1995 surveys and 1101 in a 2007 survey. In each survey, the UNIFESP Sleep Questionnaire was administered face-to-face in each household selected.
Results: For 1987, 1995, and 2007, respectively, difficulty initiating sleep (weighted frequency %; 95% CI) [(13.9; 11.9–16.2), (19.15; 16.8–21.6), and (25.0; 22.5–27.8)], difficulty maintaining sleep [(15.8; 13.7–18.2), (27.6; 24.9–30.4), and (36.5; 33.5–39.5)], and early morning awakening [(10.6; 8.8–12.7), (14.2; 12.2–16.5), and (26.7; 24–29.6)] increased in the general population over time, mostly in women. Habitual snoring was the most commonly reported complaint across decades and was more prevalent in men. There was no statistically significant difference in snoring complaints between 1987 (21.5; 19.1–24.2) and 1995 (19.0; 16.7–21.6), but a significant increase was noted in 2007 (41.7; 38.6–44.8). Nightmares, bruxism, leg cramps, and somnambulism complaints were significantly higher in 2007 compared to 1987 and 1995. All were more frequent in women.
Conclusions: This is the first study comparing sleep complaints in probabilistic population-based samples from the same metropolitan area, using the same methodology across three consecutive decades. Clear trends of increasing sleep complaints were observed, which increased faster between 1995 and 2007 than from 1987 to 1995. These secular trends should be considered a relevant public health issue and support the need for development of health care and educational strategies to supply the population's increased need for information on sleep disorders and their consequences.

1. Introduction

Sleep disorders are recognized as a major public health concern [1]. Population surveys that address sleep complaints and disorders to assess secular trends are still limited. The literature shows a scarcity of data from South America, as opposed to the number of studies conducted in North America, Europe, Australia, and Asia [2]. Also, previous epidemiological studies applied different sampling and recruitment procedures, making comparison of prevalence estimates difficult [2,3]. Most studies evaluated a portion of the population of interest and extrapolated that prevalence to the entire population [2], introducing a potential selection bias between results from the sampled populations vs. results applied to the entire group. Despite these limitations in earlier estimates of the prevalence of sleep complaints and disorders, some cohort studies evaluating sleep disorders in clinical populations have already been published [4,5].

Sao Paulo is the capital of the state of Sao Paulo and is located in southeast Brazil. The city is the largest in the southern hemisphere, with an area of 1523 square kilometers. National censuses have shown that in the last three decades, the mean rate of geometric annual population growth of Sao Paulo was 1.1, while the population grew from 8.5 to 11 million [6]. Sao Paulo is one of the most ethnically diverse cities of Brazil because of its history of European

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and Asian immigration as well as a slave trade with Africa. Previous studies have demonstrated high levels of ethnic admixture in this population, as measured by ancestry-informative genetic markers [7].

Two household surveys were performed in 1987 and 1995 to estimate the prevalence of sleep complaints in adults living in the city of Sao Paulo and showed a tendency of increase in most frequencies compared [8]. To confirm these trends, a third survey was carried out in 2007 using similar methodology [9]. A comparison of these three population-based surveys allows the establishment of secular trends of sleep complaints in the same large population over the last three decades. Hence, the aim of this study was to compare the prevalence of sleep complaints and to describe secular trends of three population-based surveys carried out in 1987, 1995, and 2007 in a probabilistic sample of the adult inhabitants of the city of Sao Paulo, Brazil.

2. Methods

2.1. Sampling procedures

Surveys were performed in three consecutive decades: 1987, 1995, and 2007. All of them utilized a three-stage cluster-sampling technique to obtain representative samples of the inhabitants of Sao Paulo, using a conceptual framework similar to that used for the North American National Health Surveys [10]. Households were selected if they were permanently occupied private homes, thus excluding clinics, schools, and other commercial and non-commercial establishments. Pregnant or lactating women, people with physical or mental impairments that prevented self-care, individuals younger than 20 or older than 80 years old, and people who worked every night were not included. Substitutes were chosen from the neighboring home according to defined random selection criteria in the following instances: three unsuccessful attempts to contact the target individual, refusal to participate, objection by a family member, or inability to participate for a specified reason (e.g., travel, unavailability, hospitalization). The substitution rates were 17%, 13%, and 14.9%, in the 1987, 1995, and 2007 surveys, respectively.

Sample sizes of 1000 volunteers in the 1987 and 1995 surveys [8] and 1101 in the 2007 survey [9] were considered representative for assessing prevalence of the principal sleep disorders with a sampling error under 5% and confidence interval within 95%.

The study protocol was approved by the Ethics Committee for Research of the Universidade Federal de Sao Paulo (CEP 0593/06) and registered with ClinicalTrials.gov (Identifier NCT00596713). All volunteers read and signed the informed consent form.

Methodological details are described elsewhere [8,9].

2.2. Questionnaire

The UNIFESP Sleep Questionnaire which was developed, pretested, and validated for content and comprehensiveness by Braz and colleagues [11] was used for each of the three surveys. Subjects underwent individual face-to-face interviews in their own residence by a professional interviewer who had received extensive training on the questionnaire.

A total of 58 questions were included in the UNIFESP Sleep Questionnaire. The first group of questions evaluated socio-demographic characteristics such as gender, age, marital status and socio-economic status. The second group of questions assessed sleep habits, such as time at which subjects went to bed and got up, sleep problems and their frequency. Insomnia was assessed through complaints of difficulty initiating sleep, difficulty maintaining sleep, or awakening earlier than desired and not resuming sleep. Excessive daytime somnolence was assessed through complaints of diurnal sleepiness with impairment of daytime activities. Subjects were asked about the frequency with which they experienced sleep problems, and answers were given on a seven-point scale: (1) never; (2) less than once a month; (3) once a month; (4) 2–3 times a month; (5) 1–2 times a week; (6) 3–6 times a week; and (7) daily. Those who answered 6 or 7 were considered to have a significant complaint of insomnia or excessive diurnal somnolence. The questionnaire also queried the presence of other sleep disorders, defined as follows: (1) nocturnal bruxism, nocturnal leg cramps and snoring were considered habitual experiences when they occurred at least three times a week; and (2) somnambulism, nightmares, and sleep paralysis attacks were considered habitual when they occurred at least once a month.

2.3. Statistics

Results were expressed as proportions and associated lower and upper limits of the 95% confidence interval (CI). Differences among prevalence of sleep complaints were assessed using the 95% CI and were considered statistically different if their CIs did not intersect. To perform calculations involving sleeping hours, stated bedtime or waking hours after midnight and before noon were converted by the addition of 24 h. After analysis, values were converted back. Comparisons between sleeping hours were carried out by ANOVA, followed by Tukey's post hoc test, with differences of 5% considered statistically significant.

3. Results

Gender proportions and age group distributions were similar throughout the decades evaluated (Table 1).

Table 2 shows the time of going to bed, time of waking up, and sleep duration during weekdays in each survey. Compared to the 1987 results, a tendency of going to bed and waking up later on all weekdays was observed over the last two decades. But significant decrease in sleep duration was seen only during weekends (Saturday and Sunday).

The prevalence of complaints of difficulty initiating sleep increased from the first survey to the next (Fig. 1). In women, we found an increase in this complaint in 2007 compared to 1987, but no significant difference compared to 1995. Men did not display any significantly greater difficulty of initiating sleep in a comparison of the 1987 and 1995 surveys but had significantly more difficulty initiating sleep in 2007 (Fig. 1).

The frequency of complaints of difficulty maintaining sleep increased in the general population over decades. Both women and men displayed a similar pattern, but women complained of this in significantly higher proportions than men did in the three surveys (Fig. 2).

Complaints of early morning awakening trended upwards throughout the study period for both genders and were more fre-

Table 1
Weighted frequencies (%) (95% confidence intervals) of demographic characteristics found in surveys carried out in 1987, 1995, and 2007 in the city of Sao Paulo.

	1987	1995	2007
Gender, % (CI 95%)			
Male	44.1 (41.1–47.2)	42.6 (39.6–45.7)	46.4 (42.7–50.1)
Female	55.9 (52.8–58.9)	57.4 (54.3–60.4)	53.6 (49.9–57.3)
Age classes, % (CI 95%)			
20–30 years	25.3 (22.7–28.1)	25.0 (22.4–27.8)	27.5 (25.0–30.2)
31–40 years	28.2 (25.5–31.1)	24.8 (22.2–27.8)	23.7 (20.9–26.7)
41–50 years	19.3 (17.0–21.9)	18.9 (16.6–21.4)	21.6 (19.1–24.2)
⩾51 years	29.1 (26.4–32.0)	31.3 (28.5–34.2)	27.2 (23.4–31.3)

Table 2
Sleeping times and sleep duration found in surveys carried out in 1987, 1995, and 2007 in the Sao Paulo city. Data are reported as means ± SD (decimal system).

	1987	1995	2007	P[a]
Time of going to bed				
Monday–Thursday	22.45 ± 1.84	23.29 ± 1.75[b]	23.01 ± 1.85[c,d]	>0.001
Friday	22.79 ± 1.94	23.51 ± 1.92[b]	23.44 ± 2.12[c]	>0.001
Saturday	22.89 ± 2.12	23.99 ± 2.08[b]	23.83 ± 2.17[c]	>0.001
Sunday	21.98 ± 1.72	23.29 ± 1.74[b]	22.99 ± 1.81[c]	>0.001
Time of waking up				
Monday–Thursday	6.27 ± 1.76	6.89 ± 2.34[b]	6.52 ± 1.70[c]	>0.001
Friday	6.22 ± 1.34	6.91 ± 2.36[b]	6.75 ± 1.79[c]	>0.001
Saturday	6.86 ± 1.65	7.43 ± 3.08[b]	7.67 ± 1.95[c]	>0.001
Sunday	6.98 ± 1.72	7.68 ± 3.23[b]	7.59 ± 1.91[c]	>0.001
Sleep duration				
Monday–Thursday	7.82 ± 3.25	7.60 ± 4.26	7.50 ± 1.83	0.070
Friday	7.43 ± 2.79	7.40 ± 4.62	7.31 ± 2.03	0.683
Saturday	7.97 ± 3.62	7.44 ± 6.91[b]	7.84 ± 2.17[d]	0.027
Sunday	9.00 ± 2.96	8.39 ± 6.72[b]	8.61 ± 2.15[c]	0.006

[a] ANOVA Tukey's post hoc.
[b] 1995–1987.
[c] 2007–1987.
[d] 2007–1995.

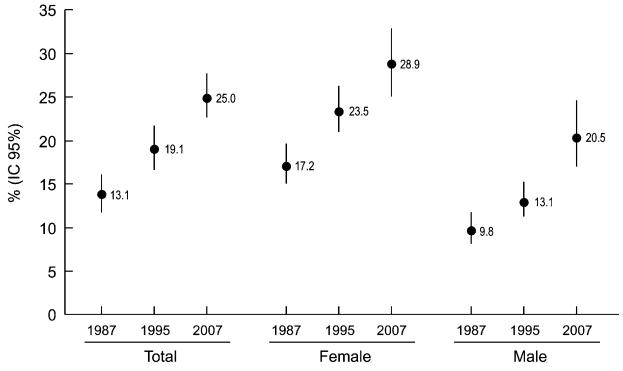

Fig. 1. Weighted frequencies (%) and 95% confidence intervals of difficulty initiating sleep complaint found in surveys carried out in 1987, 1995, and 2007 in the Sao Paulo city.

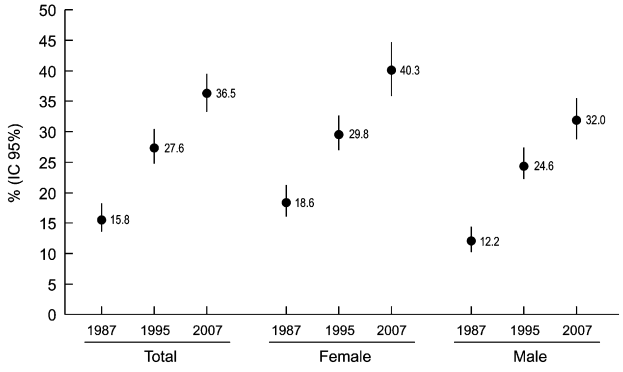

Fig. 2. Weighted frequencies (%) and 95% confidence intervals of difficulty maintaining sleep complaint found in surveys carried out in 1987, 1995, and 2007 in the Sao Paulo city.

quent in women. There were no statistically significant differences, however, between 1987 and 1995. A major increase was observed in 2007, mostly in women (Fig. 3).

Table 3 shows the frequencies of other sleep complaints in each survey. Habitual snoring was the most commonly reported com-

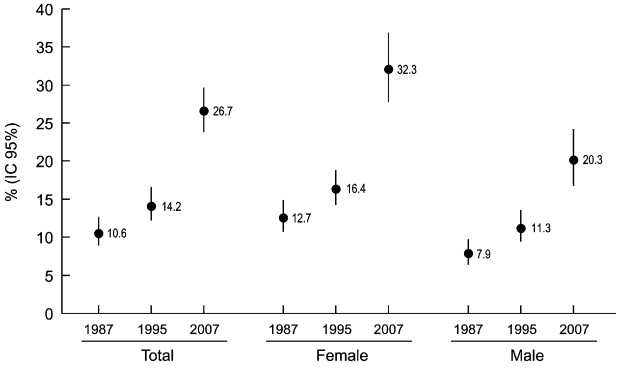

Fig. 3. Weighted frequencies (%) and 95% confidence intervals of early morning awakening complaint found in surveys carried out in 1987, 1995, and 2007 in the Sao Paulo city.

plaint across decades. There was no statistically significant difference in snoring complaints between 1987 and 1995 surveys, but a significant increase was evident in 2007. In all surveys, men had higher frequencies of snoring complaints compared to women.

Nightmares were the second most prevalent complaint. As observed for snoring, there was no statistically significant difference in complaints of nightmares from 1987 to 1995, but a significant increase was observed in 2007, mostly in women.

Bruxism, leg cramps, somnambulism, sleep paralysis attacks, and excessive diurnal somnolence complaints were significantly higher in 2007 vs. 1987 or 1995. All were more frequent in women than men.

A frequency of 12.5% (10.6–14.7) of those interviewed in 1987, 10.8% (9.0–12.9) in 1995, and 10.2% (8.8–11.8) in 2007 sought medical help for their sleep problems. In all surveys, significantly more women than men consulted physicians for sleep problems (1987: 16.5% [14.3–18.9] vs. 7.5% [6.0–9.3], 1995: 14.3% [12.3–16.6] vs. 6.1% [4.8–7.8], and 2007: 12.9% [10.3–14.8] vs. 7.7% [6.1–9.7]). The use of sleep-promoting substances on three or more nights per week was reported by 3.9% (2.9–5.3) of those interviewed in 1987, 3.0% (2.1–4.3) in 1995, and 4.6% (3.5–6.0) in 2007. In all surveys, women reported the use of sleep medicine at least twice as often as men (1987: 5.4% [4.2–6.9] vs. 2.0% [1.3–3.1], 1995: 4.0% [2.9–5.5] vs. 1.6% [1.0–2.6], and 2007: 6.0% [4.8–8.6] vs. 2.9% [1.8–4.8]).

4. Discussion

This is the first study that compares three consecutive decades of sleep complaints using the same data-gathering methodology in a large, representative sample of the adult inhabitants of one of the world's largest cities. Our results showed a progressive increase of sleep complaints throughout the decades represented in our 1987, 1995, and 2007 surveys.

In recent decades, the hectic lifestyle of industrialized societies has wrought detrimental effects on sleep quality and duration. Regular exposure to artificial light coupled with social and economic pressures has shortened the time spent asleep [12–14]. As demonstrated in our study, in the last two decades the general adult population has shifted towards going to bed and waking up later on weekdays. This has consequently affected sleep duration by decreasing sleep time during working days (Monday to Friday) and significantly increasing it on weekends (Saturday and Sunday). Although the sleep duration on weekends was longer than during weekdays, in the last two decades sleep duration on weekends (mostly on Sunday) has also decreased. Some studies have found that a large proportion of people increase their sleep duration on the weekends likely as a result of the "sleep-debt" incurred during

Table 3
Weighted frequencies (%) (95% confidence intervals) and relative gender frequencies of sleep complaints found in surveys carried out in 1987, 1995, and 2007 in the Sao Paulo city.

	1987	1987 (male:female)	1995	1995 (male:female)	2007	2007 (male:female)
Snoring	21.5 (19.1–24.2)	1:0.5	19.0 (16.7–21.6)	1:0.5	41.7 (38.6–44.8)	1:0.6
Nightmares	11.0 (9.2–13.1)	1:1.3	8.5 (6.9–10.4)	1:1.7	24.3 (21.8–27.4)	1:1.7
Bruxism	3.2 (2.3–4.5)	1:1.5	3.8 (2.8–5.2)	1:0.9	9.3 (7.7–11.3)	1:1.3
Leg cramps	2.6 (1.8–3.8)	1:1.8	3.4 (1.8–5.0)	1:1.7	5.6 (4.5–6.9)	1:1.2
Somnambulism	0.8 (0.4–1.6)	1:1.3	0.9 (0.4–1.7)	1:0.9	2.8 (1.8–4.0)	1:0.9
Sleep paralysis	1.8 (1.1–2.8)	1:1.2	1.8 (0.8–2.8)	1:1.5	7.6 (6.0–9.5)	1:1.4
Daytime somnolence	4.5 (3.4–6.0)	1:2.4	3.8 (2.8–5.2)	1:1.3	8.6 (7.1–10.5)	1:1.4

the working days, which is then "paid off" by sleeping longer during the weekends. Nevertheless, weekend sleep may not compensate for weekday sleep deprivation. Recent experimental evidence indicates that chronically restricting sleep to 4 h per night decreases the immune response to vaccination by half, impairs blood glucose control, and markedly disrupts appetite regulation [12–18]. Shortened sleep has prospectively and independently been associated with obesity, type 2 diabetes, cardiovascular disease, and death [19–24].

In accordance with other studies [3,14], we found that complaints of insomnia are common in the general population. In addition, we found that these complaints have increased steadily over the last three decades. Since the increasing frequencies seen in the two initial decades could have been simple normal fluctuations in rates of insomnia, these data provide strong confirmation of a genuine rise in the incidence of insomnia.

Interestingly enough, early morning awakening was the complaint that increased the most in 2007, showing a nearly 2-fold increase as compared to the 1995 results. This complaint is usually associated with depression, which is highly prevalent in the city of Sao Paulo (18.3% lifetime occurrence), as well as with insomnia [25,26]. As discussed previously, insomnia complaints were more frequent in women than in men [27].

All other sleep complaints evaluated (habitual snoring, nightmares, bruxism, leg cramps, somnambulism, attacks of sleep paralysis, and daytime somnolence) were more prevalent in 2007 compared with the other two decades studied. Moreover, all sleep complaints (other than snoring) were more frequent in women than men, as previously demonstrated [28].

Habitual snoring was the most commonly reported complaint throughout the decades and was the only complaint that was mostly prevalent in men. Previous population-based cohort studies in adults identified age, obesity, smoking, asthma, and nasal congestion as independent risk factors for self-reported habitual snoring [29]. As shown in the Sao Paulo Epidemiologic Sleep Study, 60% of the adult population of Sao Paulo have a body mass index greater than 25 kg/m^2 [30]. This could in part explain the high frequency of snoring, mostly in men, as a result of the "global epidemic of obesity" [31].

Other sleep complaints increased at even steeper rates: sleep paralysis (>4-fold increase), somnambulism (>3-fold), bruxism (2.4-fold), and nightmares (2.2-fold). Most astonishingly, none of these were significantly different between 1987 and 1995. Indeed, with the exception of early morning awakening, which also doubled in frequency in 2007 compared to earlier dates and changed little between 1987 and 1995, the altered frequencies of these sleep complaints are among the most significant findings of this survey. It is hard to explain the extraordinary changes which took place between 1995 and 2007.

Although difficult to prove and quantify, one may speculate that the changes in answers to our questionnaire may also reflect changes in the general perception and behavior of society. This population has improved in education level and has increased its consumption capability due to monetary stability and governmental action [6]. Access to information has increased, and the media have augmented coverage of health issues, particularly sleep disorders. Some investigations have shown that information, education, and communication strategies have been effective in raising awareness and improving self-reporting [32,33].

Unexpectedly, while sleep complaints increased over the decades, neither visits to physicians for sleep problems nor use of sleep-promoting medication changed over time, although women consistently reported consulting a physician due to sleep problems and using sleep-promoting substances significantly more frequently than men. Despite the fact that the population suffers from and acknowledges sleep difficulties more frequently, they have not increased proportionally their search for medical care. This might be explained by the availability of sleep health services and practitioners; sleep health services have not grown enough to cope with the increasing incidence of sleep complaints in the population.

Hopefully, complementary data collected for the first time alongside the 2007 survey will help to interpret the results. The information now available to us includes blood tests, DNA tests, other questionnaires, actigraphy results, and many data collected by polysomnography (methodology in [9]). Indeed, DNA analysis has already enabled the confirmation of high levels of ethnic admixture of the population of the city of Sao Paulo, with parental contributions estimated as European (75.1 ± 18.2%), West African (19.6 ± 16.4%), and Native American (6.2 ± 9.1%)—similar to other urban environments around the world—making the results of our study applicable to different populations [30].

This is to our knowledge the only investigation carried out over such a long time frame. One concern is that many other long-term epidemiological studies use longitudinal techniques instead of the cross-sectional method used here [4,5,34–48]. It may be more comfortable for a statistician to have paired results, but re-sampling during each decade may have provided better representation of the population. Indeed, people who have taken a survey once are "prepared" for it when re-exposed to it, an effect which is rarely considered during analyses. Such people may also experience a change in socio-economic status, move to another place, or leave the study for other reasons.

In summary, the epidemiological evidence presented in this study should be considered a relevant public health issue and supports the need for investment in health care and educational strategies by health care providers and health agencies. More sleep-specialized services are necessary, not only to provide services for the growth in sleep complaints, but also to prevent consequences of sleep disorders such as labor and traffic accidents and impairment of academic and labor productivity. The implications for the individual and society are enormous and cannot be ignored. Specific social policies and programs directed toward controlling sleep complaints, which can address human capabilities, equipment, and installation issues, are in urgent need.

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