Sleep Medicine 14 (2013) 850–857

Contents lists available at SciVerse ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep

Original Article

Perceptions of short and long sleep duration and comorbid conditions: the PLATINO study

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ARTICLE INFO

Article history:
Received 2 October 2012
Received in revised form 23 April 2013
Accepted 24 April 2013
Available online 12 July 2013

Keywords:
Sleep duration
Quality of life
Short sleepers
Long sleepers
Chronic diseases
Comorbidities
Apnea

ABSTRACT

Objectives: We aimed to describe the distribution of self-reported sleep duration in adults over the age of 40 years and to analyze the associated risk factors, comorbid conditions, and quality of life (QoL).
Methods: Our study was constructed as a cross-sectional population-based study and is part of the PLATINO (Spanish acronym for the Latin American Project for Research in Pulmonary Obstruction) study. It includes data from Mexico City (Mexico), Montevideo (Uruguay), Santiago (Chile), and Caracas (Venezuela). Data from 4533 individuals were analyzed using a single questionnaire entitled, PLATINO, which was designed to collect data on self-reported sleep symptoms. Spirometry also was performed in accordance with international standards. All statistical analyses took the study design into consideration with adjustments for each city.
Results: The prevalence of subjects who reported sleeping <7 h was 38.4%, ⩾7 to <9 h was 51.4%, and ⩾9 h was 10.2%. In the multivariate analysis, individuals with shorter sleep duration had higher frequencies of insomnia, increased forced expiratory volume in one second in liters and percentage/forced vital capacity in liters (FEV1/FVC) of predicted ratios, and a higher presence of coughing and phlegm. The main risk factor associated with longer duration of sleep was the number of comorbidities.
Conclusions: Self-reported sleep duration discriminated among groups that differed in sleep-related symptoms, respiratory symptoms, QoL and comorbid conditions.

1. Introduction

Standards for the quality and quantity of sleep are affected by cultural, social, psychologic, pathologic, and environmental influences, as well as by working hours and shifts [1]. Alterations in sleep–wake rhythms result in increased frequencies of fatigue, tiredness, and excessive daytime sleepiness [2]. As a result of a reduced quality or quantity of sleep, metabolic [3,4], cardiovascular [5], endocrine [4,6], and immunologic alterations [7] have been documented; however, overall mortality was lower in individuals who slept an average 7 h per night but was increased in those who slept less [8]. These findings have been consistently confirmed in subsequent studies [9]. Additionally long sleepers have been associated with a significant increase in morbidity and mortality; however, the underlying pathophysiologic mechanisms of this phenomenon are still unknown [9].

The deleterious effects of both deficits and excesses in the number of hours of sleep have been demonstrated in the outcomes of several clinical studies and include increased mortality [10], cardiovascular disease [11–13], diabetes mellitus (DM) [14], respiratory diseases, obesity [15], among others. Moreover, the same effects have been observed in children [3], adults [16,17], and older subjects [18]. Another aspect related to the nature of sleep is the association of sleep quality with morbidity and mortality. A recent meta-analysis which showed that individuals who slept less than 7 h were at increased risk for death (relative risk [RR], 1.12; 95% CI, 1.06–1.18) also documented an increased risk for death from all causes among individuals with a habitual sleep duration of more than 10 h (RR, 1.30; 95% CI, 1.22–1.38) [9].

One link between increased mortality and a low number of hours of sleep per night could be obesity. The meta-analysis by

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http://dx.doi.org/10.1016/j.sleep.2013.04.014

Cappuccio et al [3] showed that a reduction of 1 h in habitual sleep time per night is associated with an increase in body mass index (BMI) of 0.35 kg/m^2 over an indefinite period of years. Similarly, Patel et al [17] documented that men and women with a habitual sleep duration of 5 h showed an increase in BMI of 2.5 kg/m^2 and 1.8 kg/m^2, respectively. The risk for developing obesity was 27% and 21%, respectively, among subjects with long and short sleep duration during a 6-year follow-up study, even after adjusting for several covariates including physical activity [19]. The prevalence of DM in individuals who slept less than 6 h doubled (10%) compared to those who slept more than 7 h (5%) [20]. Increased mortality in long sleepers has been associated with low socioeconomic status and psychiatric disorders, particularly depression, and with confounding factors or intermediary causes of increased mortality [21].

The population-based, cross-sectional PLATINO study conducted in five Latin American cities (São Paulo, Mexico City, Montevideo, Santiago, and Caracas) has allowed us to determine the sleeping habits and sleep-related symptoms of adults over the age of 40 years [22]. The research questions in our paper were: (1) Is there an association between sleep duration and the number and type of comorbidities in adults ages 40 years or older? (2) Is there an association between sleep duration, respiratory symptoms, and lung function? and (3) Is there an association between sleep duration and the mental and physical domains of the quality of life (QoL) index (Short-Form 12-Item Health Survey [SF-12])? The central hypothesis of our study was that short sleepers have a higher prevalence of comorbidities and respiratory symptoms with a decrease in lung function and QoL compared to those who sleep $\geqslant$7 to <9 h.

2. Methods

Our report is part of our ongoing, population-based, cross-sectional study designed to estimate the prevalence of chronic obstructive pulmonary disease (COPD) in a total of 5315 subjects ages 40 years and older in the five Latin American cities mentioned above [22,23]. Our report presents an analysis of 4533 of the individuals examined in the sleep study from four of the cities. Brazil did not participate in this stage because the staff had already begun to apply the survey without the section on sleep symptoms.

2.1. Sampling

A similar multistage sampling strategy was used in all participating cities. The metropolitan areas were first stratified into the main city and its surrounding municipalities. These two subsets were then further stratified according to socioeconomic status. We selected 68 census tracts at each site, considering stratification and using a selection probability proportionate to the number of households in each one. For each tract, we then counted the number of individuals in each household and updated all figures in accordance with the most recent census. Simple sampling was used to select an average of 15 households per tract. All adults ages 40 years and older living in the selected households were invited to participate. The sample was self-weighted in each city. Sample size calculations suggested that 1000 individuals would be needed in each area to attain a margin of error in the 2% to 4% range [23].

Assuming a refusal rate of 20%, the aim was to locate approximately 1200 eligible participants per site [23]. Sampling considered population density, rural vs urban zones, and the marginalization index of each city. Thus, the design of the population-based sample in our study allowed the findings in individuals aged 40 years and older to be generalized to the global population of this age group in the cities studied. The Science and Bioethics Committees of all the institutions involved in each participating city approved the project and all participants signed the appropriate informed consent forms (Approval numbers, Mexico [C02-03]; Chile [09-223]; Uruguay [Ethics Committee Hospital Maciel, Montevideo, 16/09/2002]; and Venezuela [Universidad Central de Venezuela, 2004]).

2.2. Definitions of variables and study procedures

All interviews and measurements took place at subjects' homes. The questionnaire included sections from the American Thoracic Society Division of Lung Diseases [24], the European Community Respiratory Health Survey II [25], and the Lung Health Study instruments [26]. In addition, questions from the QoL index (SF-12) were included to assess overall health status [27]. The study was exclusively based on the results of the PLATINO questionnaire. To evaluate the prevalence of the main sleep-related symptoms (SRS), we applied an additional section that consisted of a set of questions previously applied in surveys after consultations with two specialists in the field of sleep medicine (JRPP, LTB). All questions related to the signs and symptoms of sleep referred to the present, except those on insomnia, which covered the previous 6 months. Topics included self-reported sleep duration (number of hours of sleep per night). Because this was an open question, the interviewers made no suggestion to respondents as to the possible number of hours of sleep. The exact phrasing of the question was, "Generally speaking, how many hours of sleep do you obtain per night from Monday to Friday?" Sleep latency was determined by the question, "In general, how long does it take you to fall asleep after going to bed and turning off the light?" The question on insomnia read, "In the last 6 months, have you suffered from insomnia or had difficulty sleeping at least two nights a week?" This question had been used by our group in a separate analysis of this database and was published in indexed journals [28].

The presence of sleepiness was based on the question, "Do you have trouble staying awake during the day at least three days a week?" No scales were used to assess sleepiness. We also asked about the number of awakenings per night, sedative use $\geqslant$2 nights a week in the previous 6 months, alcohol consumption at least once a week, instance of snoring on most nights, observed breathing pauses during sleep time, excessive daytime sleepiness, daytime napping (nap duration in min) on most days, excessive tiredness during the day, and previous adenotonsillectomy.

Short sleepers were considered to be those individuals who reported sleeping less than 7 h per night (n = 1741), normal sleep subjects were defined as those who slept $\geqslant$7 to <9 h (n = 2328), and long sleepers were defined as those who reported sleeping nine or more hours (n = 454). Following international criteria, naptime during the day was not included in total sleep duration.

The PLATINO questionnaire includes questions on sociodemographic characteristics (age, sex, education, social security, paid work in the last 12 mo), current and former smoking status, smoking intensity in packs per year, use of oxygen in the home, and vaccination against influenza. Current smoking was defined as smoking any amount of tobacco in the previous 30 days. If the participant had smoked fewer than 20 packs of cigarettes in his or her entire life, less than 12 ounces of tobacco, or less than one cigarette per day per year, he or she qualified as having never smoked. The employment variable was defined as any type of work for which the individual received remuneration, whether formal or informal, independent, salaried, or as a business owner. Any individual who had a disability leave during the previous 12 months was still considered an employed subject.

The evaluation of medical diagnoses of various chronic diseases was based on the question, "Has a doctor ever told you that you have asthma, bronchitis, or allergic bronchitis, etc.?" This question

was posed for each of the following conditions, including asthma, emphysema, chronic bronchitis, COPD, lung cancer, heart disease, arterial hypertension, DM, pulmonary tuberculosis, gastritis and ulcer, overweight, obesity, and malnutrition. The survey also asked about the presence of the following respiratory symptoms, including wheezing, productive coughing, and severity of dyspnea and dyspnea. Conditions of obesity (BMI $\geqslant$30 kg/m^2), overweight (BMI $\geqslant$25 to <30 kg/m^2), normal weight (BMI $\geqslant$18.5 to <25 kg/m^2), and malnutrition (BMI <18.5 kg/m^2) were assessed according to the World Health Organization criteria [29,30].

We measured subjects' weight (solar scale HS-301 Tanita Corporation, Inc., USA), height (208 stadiometer Seca Corporation, USA), and neck circumference (fiberglass tape measure) on two occasions and used the average values for analysis. Spirometry (Easy-One; ndd Medizintechnik AG, Zurich, Switzerland) was performed in accordance with American Thoracic Society/European Respiratory Society recommendations [31]. COPD was defined by the GOLD (Global Initiative for Chronic Obstructive Lung Disease) criteria (i.e., a forced expiratory volume in the first second [FEV1] to forced vital capacity [FVC] ratio of <0.70). The only questionnaire used was PLATINO, which had been tested in a previous pilot phase to identify any difficulties in subjects' understanding of the questions and to make any required improvements.

2.3. Statistical analyses

All of the measures summarized above were expressed as mean and standard errors or as frequencies and proportions. Participants were classified into one of three groups based on self-reported sleep duration: <7 h (short sleepers, group 1); $\geqslant$7 to <9 h (normal sleepers, group 2); and $\geqslant$9 h (long sleepers, group 3). Group 2 was considered the reference group. Comparisons of the continuous variables among groups were performed using the Mann–Whitney test, whereas the χ^2 test was used to compare frequencies.

Multinomial logistic regression models adjusted for study design were constructed to explore the factors associated with sleep duration. The independent variables tested in the models were demographic and anthropometric data, lung function, quality of life, and comorbid conditions. In addition to evaluating each chronic disease separately, the study included a new variable, the number of comorbidities that each individual presented, up to a maximum possible score of five. Any variables that proved significant in the univariate analysis were included in the multivariate models. The significance level was set at $P < .05$ bimarginally, but we did not correct the P value for multiple comparisons. All analyses were performed using a commercially available statistical package (Stata v.10.0 StataCorp, College Station, TX, USA) with the survey command that considered sampling strategy (cities and basic geostatistical areas).

3. Results

A total of 4533 participants were included from the four cities where the sleep survey was applied: Mexico City, Santiago, Montevideo, and Caracas. The number of subjects selected and those studied were Mexico (selected, 1452; studied, 1062), Montevideo (selected, 1106; studied, 941), Santiago (selected, 1476; studied, 1173), and Caracas (selected, 1527; studied, 1357). Overall response rates were 73%, 85%, 79.5%, and 89%, respectively. All participants answered the sleep questionnaire. Characteristics of the sample included 39.8% men (mean age [±standard error], 56.7 [±0.66]), a BMI of 28.1 (±0.10), and an average of 8 years of formal schooling (±0.08). The prevalence of overweight (BMI $\geqslant$25 to <30 kg/m^2) in the population was 42%, while that of obesity was 30.8% (BMI $\geqslant$30 kg/m^2). The major chronic diseases reported by participants and diagnosed by a physician were hypertension (33.5%), though only 51% had received antihypertensive treatment at the time of the interview; gastritis and ulcer (29.9%); asthma (12.7%); and DM (9.5%). Of the 4533 participants, 41.4% reported having no associated diseases, 36% indicated having one chronic illness, 16.7% reported two chronic diseases, 4.9% reported having three chronic diseases, and 0.9% and 0.1%, respectively, reported four or five such conditions. Malnutrition (BMI <18.5 kg/m^2) was present in 1.3% of the population. As a whole, the mean number of comorbidities for the group was 0.81 (±0.01) (Table 1).

Of the total sample population, 38.4% (1741/4533) reported sleeping <7 h (short sleepers, group 1), 51.4% (2328/4533) $\geqslant$7 to <9 h (normal sleepers, group 2), and 10.2% (464/4533) $\geqslant$9 h (long sleepers, group 3). Compared to the reference group (group 2, $\geqslant$7 to <9 h), the short sleepers (group 1) were older ($P < .0001$), had a higher proportion of individuals with paid employment ($P = .02$), and had more respiratory signs and symptoms (i.e., coughing with phlegm, wheezing, dyspnea; $P < .001$). Additionally, this group had SRS, including somnolence (20.6% vs 13.2%); insomnia (46.3% vs 27.5%); observed apneas (14% vs 11%); snoring plus somnolence (9.8% vs 6.9%); and apnea, snoring, and sleepiness (3.9% vs 2.4%) ($P < .001$). Long sleepers (group 3) were older and had less education and paid employment but reported more somnolence, nap taking, and observed apneas and dyspnea than the reference group ($P < .0001$) (Table 2).

Table 1
General characteristics of participants and distribution by city ($n = 4533$).

Parameter	Mean (SE)
Age (y)	56.7 (±0.66)
Men, *n* (%)	1804 (39.8%)
BMI, kg/m2	28.1 (±0.10)
Education (y)	8.0 (±0.08)
City, *n* (%) Mexico City, Montevideo, Santiago, Caracas	1062 (23.4%), 941 (20.8%), 1173 (25.9%), 1357 (29.9%)
Perception of poor or regular health *n* (%)	1256/3176 (39.6%)
SF-12 physical scale	50.7 (±0.42)
SF-12 mental scale	51.2 (±0.19)
No. of comorbidities *n* (%)	
0	1872/4516 (41.4%)
1	1627/4516 (36.0%)
2	754/4516 (16.7%)
3	219/4516 (4.9%)
4	40/4516 (0.9%)
5	4/4516 (0.1%)
No. of comorbidities, mean (±SE)	0.81 (±0.01)
Malnutrition (BMI $\geqslant$18.5 kg/m^2)	57/4517 (1.3)
Normal weight (BMI >18.5 to <25 kg/m^2)	1171/4517 (25.9)
Overweight (BMI $\geqslant$25 to <30 kg/m^2)	1896/4517 (42.0)
Obesity (BMI $\geqslant$30 kg/m^2)	1393/4517 (30.8)
Self-reported physician diagnosed diseases (*n*)	
Asthma	577/4533 (12.7)
Emphysema	71/4528 (1.6)
Chronic bronchitis	138/4533 (3.0)
COPD	39/4528 (0.9)
Lung cancer	6/4533 (0.1)
Heart disease	594/4533 (13.1)
Hypertension	1519/4533 (33.5)
Hypertension treatment	776/3176 (24.4)
Diabetes mellitus	431/4532 (9.5)
Tuberculosis	103/4533 (2.3)
Gastritis or ulcer	1355/4533 (29.9)
Influenza vaccination	715/4530 (15.8)
Using oxygen at home	16/4521 (0.4)

Abbreviations: y, years; SE, standard error; BMI, body mass index; SF-12, Short-Form 12-Item Health Survey; COPD, chronic obstructive pulmonary disease.
Data are expressed in mean ± standard error or number and percentage.
BMI, body mass index expressed in kg/m^2.

Table 2a
Characteristics, sleep-associated symptoms, and respiratory symptoms according to sleep duration (n = 4533) (1/3).

	Self-reported sleep duration (h)				
	<7 h n = 1741 (38.4%)	P value	⩾7 to <9 h n = 2328 (51.4%)	⩾9 h n = 464 (10.2%)	P value
Caracas, Venezuela (n = 1357) (%)	(450/1357) 33.2%	P < .0001	(797/1357) 58.7%	(110/1357) 8.1%	P < .0001
Montevideo, Uruguay (n = 941) (%)	(412/941) 43.8%	P = .6	(429/941) 45.6%	(100/941) 10.6%	P < .0001
Mexico City, Mexico (n = 1062) (%)	(400/1062) 37.7%	P < .0001	(567/1062) 53.4%	(95/1062) 8.9%	P < .0001
Santiago, Chile (n = 1173) (%)	(479/1173) 40.8%	P = .07	(535/1173) 45.6%	(159/1173) 13.6%	P < .0001
Age (y)	57.2 (±0.28)	P < .0001	55.9 (±0.23)	60.7 (±0.66)	P < .0001
Men (%)	40.5%	P = .2	38.6%	43.1%	P = .07
Education, y	7.9 (±0.11)	P = .3	8.1 (±0.09)	7.0 (±0.19)	P < .0001
Social security (%)	61.2%	P = .7	58.0%	62.0%	P = .2
Worked in the last 12 mo for a salary (%)	57.3%	P = .02	53.7%	37.3%	P < .0001
BMI kg/m^2 (mean [±SE])	28.3 (±0.12)	P = .4	28.1 (±0.10)	28.0 (±0.29)	P = .6
Neck circumference (cm) (mean [±SE])	36.4 (±0.13)	P = .03	36.1 (±0.09)	36.5 (±0.30)	P = .07
Waist circumference (cm) (mean [±SE])	94.0 (±0.45)	P = .6	94.3 (±0.42)	93.9 (±1.05)	P = .7
Former smoker (%)	17.5%	P = .3	18.8%	19.5%	P = .7

Table 2b
Characteristics, sleep-associated symptoms, and respiratory symptoms according to sleep duration (n = 4533) (2/3).

	Self-reported sleep duration (h)				
	<7 h n = 1741 (38.4%)	P value	⩾7 to <9 h n = 2328(51.4%)	⩾9 h n = 464 (10.2%)	P value
Current smoker (%)	30.3%	P = .9	30.3%	30.4%	P = .9
Smoking (>10 packs/y) (%)	12.5%	P = .5	11.8%	11.4%	P = .8
Alcohol use (%)	30.6%	P = .9	30.6%	29.1%	P = .5
Snoring (%)	60.9%	P = .4	59.7%	60.6%	P = .7
EDS (%)	20.6%	P < .0001	13.2%	17.5%	P = .01
Apneas (%)	14.0%	P = .005	11.0%	13.4%	P = .2
Insomnia (%)	46.3%	P < .0001	27.5%	27.7%	P = .9
Sedative use (%)	18.5%	P < .0001	12.4%	17.0%	P = .007
Daytime napping (%)	28.1%	P = .9	28.3%	38.4%	P < .0001
Daytime napping duration (min) (mean [±SE])	72.0 (±3.22)	P = .01	62 (±2.63)	82.3 (±8.33)	P = .002
Snoring + EDS (%)	9.8%	P = .001	6.9%	8.2%	P = .3

Table 2c
Characteristics, sleep-associated symptoms, and respiratory symptoms according to sleep duration (n = 4533) (3/3).

	Self-reported sleep duration (h)				
	<7 h n = 1741 (38.4%)	P value	⩾7 to <9 h n = 2328 (51.4%)	⩾9 h n = 464 (10.2%)	P value
Apnea + EDS (%)	0.6%	P = .06	0.3%	1.5%	P < .0001
Snoring + EDS + apnea (%)	3.9%	P = .008	2.4%	2.4%	P = .9
Primary snoring (%)	39.2%	P = .01	43.0%	41.8%	P = .6
Sleep latency (min) [mean, (±SE)]	36.3 (±1.30)	P < .0001	25.2 (±0.84)	26.2 (±1.78)	P = .6
Cough and phlegm (%)	35.0%	P < .0001	26.3%	29.5%	P = .2
Wheezing (%)	29.4%	P < .0001	19.8%	23.1%	P = .1
Degree of dyspnea (MRC) (mean [±SE])	0.97 (±0.02)	P < .0001	0.81 (±0.02)	1.02 (±0.04)	P < .0001

Abbreviations: h, hours; y, years; mo, months; BMI, body mass index; SE, standard error; EDS, excessive daytime sleepiness; min, minutes; MRC, Medical Research Council. Data are expressed in mean ± standard error or number and percentage.

Short sleepers reported more comorbidities than controls (P < .0001). The prevalence of asthma (P = .02), COPD (P = .01), heart disease (P = .02), hypertension (P < .0001), tuberculosis (P = .01), and gastritis or ulcer (P < .0001) was significantly higher among those who slept less compared to those who slept ⩾7 to <9 h. The frequency of healthy lungs (according to spirometry and in the absence of self-reported lung diseases) and the average ratio of predicted FEV1/FVC were both significantly lower in the group that slept less; in contrast, long sleepers showed higher incidences of lung cancer (0.4% vs 0.04%; P = .02), heart disease (16% vs 11.7%; P = .01), DM (11.9% vs 8.6%; P = .02), and hypertension (36% vs 30.5%; P = .02) than the reference group. The FEV1/FVC ratio was lower among those who slept more hours compared to the reference group (P < .0001). Short sleepers had lower scores on the physical and mental domains of SF-12 than the reference group. Perceptions of poor health among the short and long sleepers were more common than in the reference group (Table 3).

In the multivariate analysis, individuals with short sleep reported more frequent insomnia (odds ratio [OR], 1.4 [95% CI, 1.2–1.8]; P = .001), increased FEV1/FVC ratios (OR, 1.1 [95% CI, 1.01–1.2]; P = .02), and a greater frequency of cough and phlegm (OR, 1.3 [95% CI, 1.02–1.6]; P = .02), after controlling for age, sex, neck circumference, number of comorbidities, use of oxygen at home, paid work, and final year of schooling. The model revealed a strong association between the presence of lung cancer and oxygen use at home among short-sleep subjects compared to the reference group (Table 4).

Meanwhile, long sleepers had more comorbidities (OR, 1.2 [95% CI 1.00–1.14]; P = 0.04) after controlling for age, sex, FEV1/FVC, and neck circumference than the reference group. Scores on the SF-12

mental domain for the three groups (short sleepers [n = 1741], normal sleepers [n = 2328], and long sleepers [n = 454]) were 48.1 (±0.27), 51.4 (±0.20), and 50.2 (±0.50), respectively; therefore, when the adjusted ORs were calculated in the multivariate analysis, even when the P value and the confidence interval were significant, they remained close to one. Moreover, these findings meant that the variable was neither a risk nor a protective factor but instead was similar in all groups. Finally, comorbid conditions were more common in short and long sleepers, even after excluding cases of apnea and insomnia or those patients with previously diagnosed heart disease (data not shown).

4. Discussion

Our study confirms that older age, insomnia, and the presence of cough and phlegm were significantly more common characteristics of short sleepers. Additionally, in short sleepers sleep latency, the presence of lung cancer, and the use of oxygen in the home were more frequent than in the reference group. The presence of increased sleep latency, lung cancer, and the use of oxygen at home among short sleepers can be explained by the presence of respiratory symptoms that impede falling asleep, as there have been reports that patients with lung cancer have poor sleep quality [32]. Our study confirms that a higher number of comorbidities was associated with long sleepers. In contrast, education, the presence of lung cancer, and the use of oxygen at home were all significantly lower than in the reference group of long sleepers. In both models, the study controlled for all potential confounders, including age, gender, neck circumference, and lung function; nevertheless, there may be residual confounding.

Our study is the first population-based study of chronic conditions and SRS in Latin American adults aged 40 years or older. A high prevalence of overweight and obese individuals (BMI $\geqslant$25 to <30 kg/m^2, 48.1% and BMI $\geqslant$30 kg/m^2, 31.1%, respectively), hypertension (33.5%), and gastritis and ulcers (29.9%) were noted. DM was reported by 9.5% of subjects, which is consistent with the index for Mexico as a whole in 2006 [33]. A higher prevalence than those found by our team was recently reported from Brazil (obesity, 62.5%; hypertension, 39.2%; and gastritis, 30.9%) [34].

The elevated incidence of chronic diseases in Latin America, ascertained using identical methods in a population-based survey is alarming, as they are associated with a higher number of other comorbidities and sleep-disordered breathing, increased use of health services, and a higher risk for death. Approximately 50% of our total sample population had inappropriate sleep duration (short in 38.4% of respondents and long in 10.2%). Adequate sleep duration (51.4%) was less frequent than in white populations that were previously studied [35,36] but were similar to those results found in the Korean Community Health Survey conducted in 2008 [37]. Some differences in sleep duration and quality among ethnic groups have been reported [38], and the socioeconomic factors that have been associated with short or long sleep duration include gender, age, marital status, average monthly income, and type of employment [34,39]. In one longitudinal study, socioeconomic position proved to be a robust determinant of short sleep duration, even after adjusting for health-related characteristics linked to this condition [40]. Our study found an association between sleep duration and socioeconomic characteristics (e.g., schooling and paid work in the previous year), which recently has been described by other authors [41].

As expected, individuals who reported short sleep duration had more reports of insomnia and longer sleep latencies than subjects with longer sleep duration as well as a higher frequency of sedative use (Table 2) and excessive daytime sleepiness [42]. The

Table 3a
Quality of life, comorbid conditions, and lung function according to sleep duration (1/3).

	Self-reported sleep duration (h)				
	<7 h n = 1741 (38.4%)	P value	$\geqslant$7 to <9 h n = 2328 (51.4%)	$\geqslant$9 h n = 464 (10.2%)	P value
Perception of poor or regular health (%)	42.5%	P = .005	37.4%	38.1%	P = .8
SF-12 physical scale (mean [±SE])	49.6 (±0.21)	P < .0001	50.9 (±0.16)	49.3 (0.42)	P = .0001
SF-12 mental scale (mean [±SE])	48.1 (±0.27)	P < .0001	51.4 (±0.20)	50.2 (0.50)	P = .01
Number of comorbidities (mean [±SE])	0.97 (±0.02)	P < .0001	0.79 (±0.01)	0.96 (±0.04)	P = .0002
Malnutrition (BMI $\geqslant$18.5 kg/m^2) (%)	1.1%	P = .7	1.2%	2.2%	P = .1
Normal weight (BMI >18.5 to <25 kg/m^2) (%)	25.4%	P = .9	25.4%	30.4%	P = .06
Overweight (BMI $\geqslant$25 to <30 kg/m^2) (%)	41.5%	P = .3	43.3%	38.6%	P = .1
Obesity (BMI $\geqslant$30 kg/m^2) (%)	30.1%	P = .1	32.4%	28.9%	P = .7
Asthma diagnoses (%)	14.4%	P = .02	12.0%	9.9%	P = .2
Emphysema (%)	1.5%	P = .9	1.5%	2.2%	P = .3
Chronic bronchitis (%)	3.5%	P = .2	2.8%	2.8%	P = .9

Table 3b
Quality of life, comorbid conditions, and lung function according to sleep duration (2/3).

	Self-reported sleep duration (h)				
	<7 h n = 1741(38.4%)	P value	$\geqslant$7 to <9 h n = 2328 (51.4%)	$\geqslant$9 h n = 464 (10.2%)	P value
COPD (%)	1.4%	P = .01	0.6%	0.2%	P = .3
Lung cancer (%)	0.2%	P = .2	0.04%	0.4%	P = .02
Heart disease (%)	14.2%	P = .02	11.7%	16.0%	P = .01
Hypertension (%)	36.8%	P < .0001	30.5%	36%	P = .02
Diabetes mellitus (%)	10.2%	P = .07	8.6%	11.9%	P = .02
Tuberculosis (%)	2.9%	P = .01	1.7%	2.8%	P = .1
Gastritis or ulcer (%)	34.9%	P < .0001	26.4%	28.7%	P = .3
Influenza vaccination (%)	17.1%	P = .006	13.9%	20.3%	P < .0001
Clinical/functional diagnoses of COPD (LLN) (%)	5.0%	P = .1	4.0%	4.3%	P = .8
Use of oxygen at home (%)	0.6%	P = .03	0.2%	0	P = .3
Normal spirometry (%)	24.3%	P < .0001	30.2%	27.2%	P = .8

Table 3c
Quality of life, comorbid conditions, and lung function according to sleep duration (3/3).

Spirometry	Self-reported sleep duration (h)				
	<7 h *n* = 1741 (38.4%)	*P* value	⩾7 to <9 h *n* = 2328 (51.4%)	⩾9 h *n* = 464 (10.2%)	*P* value
FEV1 %	2.6 (±0.01)	*P* = .2	2.6 (±0.01)	2.5 (±0.03)	*P* = .001
FEV1 L	94.8 (±0.45)	*P* = .2	94.5 (±0.37)	96.3 (±1.13)	*P* = .001
FVC %	3.4 (±0.02)	*P* = .3	3.5 (±0.01)	3.4 (±0.04)	*P* = .02
FVC L	100.4 (±0.42)	*P* = .2	99.7 (±0.34)	101 (±1.04)	*P* = .1
FEV1/FVC %	76.5 (±0.06)	*P* = .003	76.8 (±0.05)	75.9 (±0.14)	*P* < .0001

Abbreviations: h, hours; SF-12, Short-Form 12-Item Health Survey; SE, standard error; BMI, body mass index; COPD, chronic obstructive pulmonary disease; LLN, lower limit of normal; FVC, forced vital capacity in liters and percentage of predicted; FEV1, forced expiratory volume in one second in liters and percentage of predicted.
Data are expressed in mean ± standard error or number and percentage.
Severity of COPD was determined using the LLN values.

Table 4
Results of multivariate analysis using multinomial logistic regression for long and short sleepers.

Characteristics	Short sleepers vs reference group		Long sleepers vs reference group	
	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Age (y)	1.02 (1.007–1.04)	.007	1.02 (0.9–1.05)	.05
Men	1.3 (0.9–1.8)	.06	1.6 (0.9–2.5)	.05
Neck circumference (cm)	1.01 (0.9–1.04)	.1	1.01 (0.98–1.1)	.3
Insomnia	1.4 (1.2–1.8)	.001	0.8 (0.6–1.1)	.2
Sleep latency	1.003 (1.001–1.006)	.005	0.9 (0.9–1.001)	.2
Cough and phlegm	1.3 (1.02–1.6)	.02	1.2 (0.8–1.6)	.4
SF-12 mental scale	0.98 (0.97–0.99)	<.0001	0.98 (0.96–0.99)	.03
FEV1/FVC ratio (predicted)	1.1 (1.01–1.2)	.02	1.2 (0.98–1.3)	.08
Number of comorbidities	1.1 (0.9–1.2)	.2	1.2 (1.001–1.4)	.04
Worked in the last 12 mo for wage or salary	1.4 (1.1–1.7)	.01	0.6 (0.4–0.8)	.004
Education (y)	0.98 (0.95–1.002)	.07	0.95 (0.92–0.97)	.001
Lung cancer	3.7×10^{13} (1.0^{13}–1.4^{14})	<.0001	0.6 (0.92–0.97)	.001
Using oxygen at home	1.6×10^{13} ($3.5\ 10^{12}$–$7.0\ 10^{13}$)	<.0001	0.4 (0.2–0.8)	.009

Abbreviations: OR, odds ratio; CI, confidence interval; y, years; mo, months; SF-12, Short-Form 12-Item Health Survey; FVC, forced vital capacity in liters and percentage of predicted; FEV1, forced expiratory volume in one second in liters and percentage of predicted.
Reference group: subjects with ⩾7 to <9 hours of sleep, *n* = 2328 (Group 2).
All models were adjusted for study design (by city and census tract).

combination of observed apneas plus habitual snoring and sleepiness – indicators of obstructive sleep apnea – was more common among long sleepers than in the other two groups. Snoring alone showed no intergroup differences; however, previous epidemiologic studies found this symptom to be associated with increased sleep duration, together with restless legs syndrome and rotating shift work [21].

Cough and phlegm in subjects with short sleep duration compared to long sleepers may be related to the presence of asthma and COPD, two conditions commonly related to an increased latency to sleep onset, sleep maintenance insomnia, early morning awakening, sleepiness, and even nightmares [43–46]. In our study, the presence of cough with phlegm and longer sleep latencies were independent predictors of short sleep duration, even after controlling for lung function as assessed by the FEV1/FVC ratio (Table 4). Although statistically significant differences were observed in the FEV1/FVC% ratio in long sleepers compared to the reference group in the bivariate analysis, this association was not maintained in multivariate analysis.

QoL as measured by the SF-12 showed higher average scores in individuals who slept 7 to 8 h compared to short and long sleepers. After controlling for several potential confounders, scores on the mental domain of the SF-12 were similar for all three groups, with ORs around one. These results differed from those previously published, perhaps because sleep symptoms were self-reported in our study. There are findings related to various aspects of physical-mental performance after reduced sleep duration (e.g., response delay time [47–49], decreased short-term memory [50], difficulty in maintaining attention [51], decreased mood [52]). Although most studies found no abnormalities in performance in long sleepers, scientific evidence is controversial [53,54]. However, the mental domain scores on the SF-12 were similar among the three groups in our study. Additionally, no association between the various comorbidities and sleep duration was seen in our study; however, other authors have described an increased risk for DM [55], heart disease, vascular disorders, rheumatism, arthritis, osteoarthritis, osteoporosis, and emotional concerns, among other comorbidities in both long and short sleep duration groups [56]. Female short sleepers had a higher risk for hypertriglyceridemia [57] and a greater risk for overweight children and adults [58].

These differences may be explained by the fact that our data were obtained by questionnaires with self-reported diseases, even though they also were confirmed by a physician. Although self-reported questionnaires have been validated in many international surveys, the procedure does not have the same sensitivity and specificity as objective laboratory tests based on curves of glucose tolerance to evaluate DM [59], blood pressure readings [60], or the determination of triglyceride levels [55]. Nevertheless, a recent population-based cross-sectional study conducted in Brazil also found that reduced sleep duration was associated with three or more comorbidities [33]. Another study reported that hypertension was significantly associated with sleep duration only in the presence of concomitant sleep disorders [60]. In a meta-analysis of RR by Gallicchio et al [61], the authors reported a mortality index due to cardiovascular disease of 1.06 (95% CI, 0.94–1.30) and even related cancer (RR, 0.99 [95% CI 0.88–1.13]. Obstructive sleep

apnea syndrome, COPD, hypertension, and cardiovascular diseases, among others, could explain the increased risk for death observed in individuals with short sleep duration.

Our study found an association between lung cancer and short sleep duration and was a population-based cross-sectional survey that yielded information on respiratory diseases diagnosed by a physician and known by the respondent. The study has the limitations of surveys that are not based on precise diagnostic techniques including spirometry (misclassification bias). Given the failure to confirm an association between subjects with short sleep and smoking, the association between short sleep and lung cancer may be spurious.

In a multivariate analysis, the association among use of oxygen at home, lung cancer, and smoking was not found to be significantly related to short sleep; therefore, this association also may be spurious. In this same model, the presence of depression shows an OR of 2.0 (95% CI, 1.7–2.6; $P < .0001$). In contrast to an earlier published study [62], our research found no differences in the prevalence of obesity or neck and waist circumference across groups of different sleep duration. Obesity has been reported to increase when sleep duration was either more or less than 7 to 8 h; however, such findings are inconsistent and sleep duration has not been proven to be a potentially modifiable factor for obesity [63,64].

Our study has certain limitations inherent in study design. The PLATINO project primarily was designed to determine the prevalence of COPD, but a parallel sleep survey was included in four cities and is the source of our present report. The cross-sectional nature of the study precludes us from establishing the direction of the associations found or of any hypotheses based on them. Thus it is unclear if the symptoms or comorbid conditions created poor sleep quantity, if it was short sleep duration that generated the symptoms and comorbidities, or if both were caused by other factors. Associations also may be spurious or due to confounding bias; however, adjustment during multivariate analysis was used to reduce this risk and many of the associations maintained high ORs.

To definitively clarify this issue, longitudinal studies are required. In addition, sleep duration was self-reported and individuals' estimates of sleep time may differ from objective measures (i.e., when a group of individuals that report having insomnia underestimates real sleep duration) [65]. However, a study that compared self-reported sleep duration evaluated by a questionnaire along with the results of polysomnography and actigraphy did find a high correlation between the two methods in subjects that reported long sleep duration [66]. Gathering self-reported information allows researchers to measure sleep variables, which are difficult to obtain through studies that are narrower or more specific at the population level [67]. In any case, it is clear that individual perceptions of short or long sleep were associated with more comorbidities and a poorer QoL.

5. Conclusion

Self-reported sleep duration discriminated among groups of individuals who differed in sleep-related symptoms, respiratory symptoms, QoL and comorbid conditions. Adequate sleep quality and quantity therefore are markers of good health and improved sleep hygiene and also may help to promote general health.

Conflict of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: http://dx.doi.org/10.1016/j.sleep.2013.04.014.

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