

Nocturnal awakenings of Brazilian immigrants in Massachusetts

Talita Monsores Paixão^{1*}
Liliane Reis Teixeira¹
Eliana Napoleão Cozende-Silva¹
Carlos Eduardo Gomes Siqueira²

¹Oswaldo Cruz Foundation, National School of Public Health Sergio Arouca - Rio de Janeiro - RJ - Brazil.

²University of Massachusetts Boston, School for the Environment - Boston - MA - United States.

ABSTRACT

Objective: The purpose of this study was to assess the relationship between the quantity of jobs and nocturnal awakenings of Brazilians living in Massachusetts. **Material and Methods:** We sampled of 48 documented Brazilians around the age of 45.5 years old. 52.1% of them were women. Data gathering occurred for three weeks, using the Pittsburgh Sleep Quality Index. Participants also wore wrist actigraph and filled sleep/wake diary for a week. **Results:** The sleep quality of immigrants with one job (mean=8.58, SD=4.16) is better when compared to immigrants with 2-3 jobs (mean=12.7, SD=3.57) according to the PSQI scores. Immigrants with 2-3 jobs reported dissatisfaction on three components of the scale: sleep duration, sleep efficiency and sleep quality. **Discussion:** There is a positive relationship between the quantity of jobs and nocturnal awakenings and between nocturnal awakenings and complaints related to sleep apnea among Brazilians in Massachusetts. The assessment of systemic morbidities associated with sleep pattern changes should be considered in future research.

Keywords: Brazilian Immigrants; Work; Sleep; Sleep Wake Disorders; Sleep Apnea Syndrome; Sleepiness.

* Corresponding author:

Talita Monsores Paixão
E-mail: talitamonsores@gmail.com

Received: April 1, 2020;
Accepted: July 20, 2020.

DOI: 10.5935/1984-0063.20200040

INTRODUCTION

The emigration of Brazilians to developed countries has been increasingly prominent since it started some decades ago, and the United States of America is the top hosting country¹ for Brazilians. This immigrant population consists mainly of young adults entering the informal labor market, and work is the main factor that drives them out of Brazil²⁻⁵. The state of Massachusetts is one of the main destinations for Brazilian immigrants in the U.S., besides Florida, New Jersey, New York and California⁴⁻⁶.

The most employable occupations for Brazilian immigrants are in the food sector, domestic work and civil construction^{2,7}. Siqueira⁸ believes that most of these immigrants are informal workers who work in substandard conditions, without work contracts and health insurance, with low wages and long working hours.

It is recognized in the literature that long, uninterrupted working hours, or with few breaks impair physical and mental post-work recovery, even in healthy populations, generating health-related problems such as metabolic changes, gastrointestinal and cardiovascular disorders, altered eating habits, decreased attention and reaction speed, feeling of isolation, fatigue and sleep-related complaints⁹⁻¹¹.

Besides the most direct occupational factors, especially related to precarious work with long working hours, issues such as low schooling, low income, language barriers, different customs and food, as well as the deportation of family and friends¹², also appear as aggravating factors to the health of Brazilian immigrants in the U.S.^{2,13}. Research shows that Latino immigrants in the U.S. have higher rates of mortality, injuries and illnesses, and greater exposure to occupational risks and workload when compared to the Native American population⁶.

Insomnia¹⁴ is one of the most common sleep-related complaints, with a prevalence of 10% to 15% depending on the diagnostic criterion adopted and a yearly incidence of 5%. The International Classification of Sleep Disorders¹⁵ defines insomnia as the complaint of difficulty in initiating or maintaining sleep, associated with daytime consequences (e.g., drowsiness, fatigue and impaired attention) and not attributable to environmental circumstances or inadequate sleeping opportunities. It involves sleep quantity and quality dissatisfaction (nocturnal awakenings and nonrestorative sleep)¹⁶. Chronic insomnia¹⁵ occurs when sleep-related complaints persist for at least three months, with a minimum frequency of three times a week. The most common symptom of insomnia is difficulty in maintaining sleep throughout the night (61% frequency), followed by waking up ahead of time (52% frequency) and difficulty falling asleep (38% frequency)^{14,17,18}. Insomnia symptoms are often associated with psychosocial factors^{19,20}. Hale et al.²¹ affirm that high-risk sleep in immigrants in the U.S. has been associated with chronic psychosocial stressors such as unemployment, low education and low social support.

In a review of the literature on sleep disorders in Latino immigrants in the U.S., among other factors, Baldwin et al.²² observed greater insomnia symptoms related primarily

to psychological factors in Latino women with a longer life span in the U.S. when compared to other women, shorter sleep duration in non-Mexican Latinos when compared to Caucasians and Mexican Latinos, and excessive daytime sleepiness associated with worse mental health conditions in immigrants.

However, we found no evidence on occupational factors related to emigration and sleep complaints, including insomnia, in a population of Brazilian immigrants. Knowledge about the health-work-sleep disorders among Brazilian immigrants in the U.S. is quite limited³.

Published studies^{12,21-23} have focused on comorbidities among Latino immigrants residing in the U.S. However, surveys very rarely include Brazilians. Analyzing Brazilian immigrants separated from Latinos is important due to cultural, social or behavioral differences^{7,24}. Thus, this study aimed to contribute to the literature by assessing the relationship between the number of jobs and the nocturnal awakenings of Brazilian immigrants in Massachusetts, U.S.

MATERIAL AND METHODS

This study used secondary data with restricted access from data collected in Lowell and Framingham, MA, during the winter. A convenience sample of 48 Brazilians in these locations included documented women and men aged 18-65 years. 52.1% of respondents were women.

Participants were recruited through a variety of means, such as brochures distributed in Brazilian companies in both cities, contacts with the Massachusetts Alliance for Portuguese Speakers (MAPS) team, and personal contacts at health fairs and several churches, since the latter are fundamental to the lives of many Brazilian immigrants. The study involved collaboration between the University of Massachusetts campuses in Lowell and Boston and MAPS. MAPS is a non-profit community organization for members of Portuguese-speaking communities which aims at increasing access and removing barriers to health, education and social services through direct services, advocacy, leadership and community development.

Data were collected over three weeks on two successive visits to MAPS offices. In the first visit to the MAPS office in Framingham, MA (day 1), study participants were fully briefed about the study, signed the informed consent form and completed a personal health assessment that included their medical history and the Pittsburgh Sleep Quality Index (PSQI). All documents were in Portuguese. The Portuguese version of the PSQI was validated in a previous study²⁵.

The PSQI evaluates subjective sleep quality. It consists of 19 self-applied questions grouped into seven components with weights distributed on a scale of 0 to 3: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disorders, sleeping medications and daytime sleepiness. The final score of the instrument can range from 0 to 21 points, and the higher the score, the worse the sleep quality. Scores above five points are already indicative of poor sleep quality, and individuals may have great difficulties in at least two components, or moderate difficulties in more than three components²⁶.

At the end of the visit, actigraphs were placed on the wrists of the participants, which allowed collecting information on nocturnal awakenings. Participants also received a package of sleep/activity diaries to be completed in the next seven days. One week after the material was delivered, participants went back and returned both.

From day 2 to day 7, participants completed the sleep/activity diaries while constantly wearing the wrist actigraph, which was only removed when bathing. On day 8, participants returned the sleep/activity diaries and the actigraph.

For the next two weeks (between the 15th and the 22nd), participants returned to MAPS offices in Lowell and Framingham to receive a summary report of all their results. During this second visit, participants received feedback sheets related to sleep quality and information on sleep hygiene, insomnia and the importance of maintaining sleep quality for optimal health. A nurse who was a sleep specialist carefully explained all results and advised those with abnormalities to schedule appointments with health professionals for specific clinical diagnosis and treatment. In some cases, this nurse wrote specific letters explaining the results of wrist actigraphy to facilitate communication between participants and health care professionals.

We first performed descriptive statistics analysis (distribution of frequencies, means and standard deviations) followed by a normality test (Shapiro-Wilk test). The variables that showed normal distribution were tested using the Student's t-test and ANOVA. Only the variable nocturnal awakenings did not have a normal distribution and was analyzed by the Mann-Whitney test. The significance level of $\alpha=5\%$ was considered in all analyses. The SPSS 23.0 software was used to perform the analysis.

This research was approved by the University of Massachusetts Institutional Review Board (UMass Lowell), per IRD opinion 11-082-PHI-XP/2011. In Brazil, a study protocol was approved by the Ethics Committee of ENSP/Fiocruz, as per CAAE 3225.1014.7.0000.5240 for access and use of the restricted database.

RESULTS

The studied population had a mean age of 45.5 years (SD=9.8 years), was documented and had been living on average for 12 years in the U.S. (SD=4.7 years). In total, 53% had completed high school, 66% were married, 71% had up to two children and 80% already had family in the U.S. When they lived in Brazil, 44% were commercial workers, while 33% were cleaning service workers in the U.S. Half of the workers had two jobs, in which 32% worked over 60 hours a week, and 68% worked more than 9 hours a day. Workers with one job had lower level of education (61% had complete high school, 39% had complete middle school and no one had college education) compared to workers with two jobs, but this association was not significant. The body mass index (BMI) showed that 21% were normal weight (18.5-24.9), 46% were overweight (25.0-29.9) and 33% were obese (BMI of 30 or more).

Nocturnal awakenings after the onset of sleep averaged 50.42 minutes (SD=33.39 min), and the longest nocturnal awakening episodes lasted around 32 minutes (SD=17.21 min), without any variation by age and gender (Table 1). Women's nocturnal awakenings lasted 11.88 minutes longer than men did on some weekdays.

The mean nocturnal awakenings by number of jobs fluctuated over the days of the week, with significant differences from Thursday to Sunday (Figure 1). The means are higher for workers with a single job during all days of the week. However, this difference increases by 10-15 minutes from Thursday to Sunday.

Table 1. Mean duration of nocturnal awakening episodes during the week, by gender and age group.

Variables		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Gender								
Male	Mean	29.40	40.65	31.11	30.70	32.82	34.95	34.95
	SD	11.68	19.78	16.63	17.54	16.53	17.43	17.43
Female	Mean	30.46	27.86	30.27	32.82	28.55	34.21	34.21
	SD	19.25	17.28	12.93	19.84	16.62	12.25	12.25
Total	Mean	29.98	33.44	30.65	31.81	30.41	34.56	34.56
	SD	16.09	19.26	14.52	18.58	16.50	14.72	14.72
Age group								
19-42 years	Mean	31.67	36.40	31.73	27.92	33.27	34.92	36.23
	SD	8.17	13.13	12.54	13.00	11.32	15.09	17.67
43-48 years	Mean	27.23	27.69	33.38	30.67	29.27	35.15	32.38
	SD	10.17	19.02	15.53	12.96	18.16	24.04	12.35
49-68 years	Mean	30.79	36.25	27.69	35.17	29.29	28.41	34.89
	SD	22.37	22.45	15.28	24.32	18.78	22.45	14.64
Total	Mean	29.98	33.44	30.65	31.81	30.41	32.42	34.56
	SD	16.09	19.26	14.52	18.58	16.50	20.80	14.72

SD = Standard deviation.

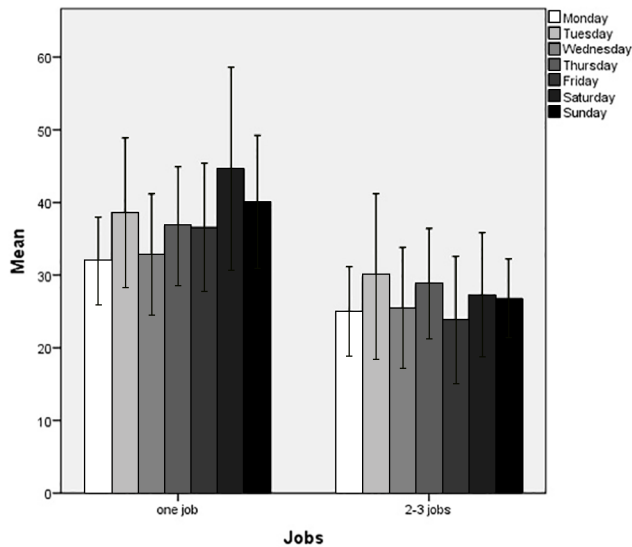


Figure 1. Means of nocturnal awakenings during days of the week, by number of jobs.

Table 2 also shows the higher mean of nocturnal awakenings among immigrants with a single job, on weekdays and weekends, compared to those with 2-3 jobs. Therefore, we found that immigrants with a single job reported longer sleep duration, but less efficiency, due to nocturnal awakenings. Another significant result observed was the duration of nocturnal awakenings higher than 10 minutes for immigrants who reported “stopping breathing” during sleep. After adjusting for gender and age (Table 3), we observed that men of working age (19-50 years old) with a single job

Table 2. Mean duration of nocturnal awakenings, for weekdays and weekends, by number of jobs and reported stopping breathing.

Variable		Nocturnal awakenings		Nocturnal awakenings	
		(Weekday)		(Weekend)	
		Mean	SD	Mean	SD
N° of jobs	1 job	34.83	12.38	41.91**	17.82
	2-3 jobs	26.57	10.23	26.84	9.18
Stopping breathing	Yes	39.89*	14.36	42.27*	17.31
	No	29.72	10.41	30.83	13.43

SD = Standard deviation; * $p < 0.05$; ** $p < 0.01$: Mann-Whitney test applied.

had a higher mean duration of nocturnal awakenings on weekends when compared to other groups. Moreover, the higher duration of nocturnal awakenings for immigrants who reported “stopping breathing” during sleep remained significant on weekends, showing that men of working age had a higher mean duration of nocturnal awakenings, when compared to others.

We also observed a significant association ($p=0.04$) between overweight (67%) and obese (33%) immigrants who reported “stopping breathing” during sleep, when compared to normal weight immigrants (none of those reported “stopping breathing” during sleep). There was no significant difference by gender and age.

The mean of nocturnal awakenings related to the question “Does the intensity of snoring cause the partner to leave the room in order to sleep?” is significant for weekdays (39.04 min, SD=14.38) and weekends (44.10 min, SD=16.50). According to Table 4, the mean duration of nocturnal awakenings is 12-

Table 3. Gender and age adjusted analysis of mean duration of nocturnal awakenings, for weekdays and weekends, by number of jobs and reported stopping breathing.

Variable		Gender	Age (y)	Nocturnal awakenings		Nocturnal awakenings	
				(Weekday)		(Weekday)	
				Mean	SD	Mean	SD
N° of jobs	1 job	Men	19-50	40.45	15.88	50.64*	16.02
			51-75	30.40	18.10	26.66	8.51
		Women	19-50	31.35	3.67	41.12	24.07
			51-75	29.26	2.61	35.75	5.30
	2-3 jobs	Men	19-50	29.12	7.78	32.28	7.07
			51-75	25.60	0	19.0	1.41
		Women	19-50	26.23	14.29	26.78	8.16
			51-75	23.66	8.30	19.50	12.67
Stopping breathing	Yes	Men	19-50	41.76	16.98	49.50*	17.03
			51-75	0	0	18.00	0
		Women	19-50	40.00	7.35	34.25	8.13
			51-75	28.40	0	32.0	0
	No	Men	19-50	29.70	7.10	30.50	9.50
			51-75	28.46	13.23	25.00	7.71
		Women	19-50	29.10	10.54	34.61	17.41
			51-75	31.20	14.00	29.30	16.44

y = years old; SD = Standard deviation; * $p < 0.05$ Mann-Whitney test applied.

15 minutes longer for participants who reported this type of discomfort in the partner. The partners of Brazilian immigrants also reported stopping breathing during sleep, related to the duration of nocturnal awakenings during the week (39.89 min, SD=14.36) and weekend (42.27 min, SD=17.31). When adjusted for gender and age (Table 5), the mean duration of nocturnal awakenings for participants who reported this type of discomfort in the partner remained significant for women and for immigrants of working age on weekends, compared to women and immigrant of working age with partners who did not experience this discomfort. We also observed a borderline association for immigrants of working age on weekdays ($p=0.058$). The analysis of snoring by number of jobs did not show significant results.

Table 4. Mean duration of nocturnal awakenings per reported snoring discomfort for partners.

Duration		Snoring disturbs partner	N	Mean	SD
Nocturnal (Weekday)	awakening	Yes	10	39.04	14.38*
		No	16	27.81	8.53
Nocturnal (Weekend)	awakening	Yes	10	44.10	16.50**
		No	21	29.21	9.93

N = Absolute frequency; SD = Standard deviation; * $p<0.05$; ** $p<0.01$: Mann-Whitney test applied.

The quality of sleep of immigrants with a single job (mean of 8.58, SD=4.16) is better compared to immigrants with 2-3 jobs (mean of 12.7, SD=3.57), according to the PSQI. Immigrants with 2-3 jobs reported dissatisfaction on three components of the scale, namely, sleep duration, sleep efficiency and sleep quality.

The sleep duration reported by immigrants with 2-3 jobs was less than 7 hours a day, while immigrants with only a single job reported sleep duration greater than 7 hours a day. Sleep efficiency (percentage of total sleep time while lying down) for immigrants with 2-3 jobs was over 84%, unlike immigrants with only a single job (less than 84%). In total, 85% of immigrants with 2-3 jobs reported poor or very poor self-reported sleep quality, while 73.7% of those with a single job reported good or very good sleep quality.

In total, 22.9% of immigrants reported taking sleeping pills. When analyzing the association between the use of medications and the duration of nocturnal awakenings, we found a significant association during weekdays, where the mean duration of nocturnal awakenings for those who did not take medication was 27 min (SD=8.25 min), while it was 49.2 min (SD=6.79 min) for immigrants taking medication. The use of melatonin was reported by one immigrant, whose mean of nocturnal awakenings fell to 19.4 min.

DISCUSSION

Poor sleep quality has a complex relationship with comorbid conditions such as stress, overweight/obesity, anxiety and depression, for example^{24,27-30}. Our findings found a positive association between number of jobs and nocturnal awakenings from Thursday to Sunday in Brazilian immigrants in Massachusetts.

Immigrants with a single job had a longer nocturnal awakening, and an increase in these awakenings on weekends was due to social activities, especially drinking. As for the relationship with the number of jobs, for those workers who had a single job^{31,32}, the lack of satisfaction with the job, the self-imposed demand to be efficient at work and the fear of losing the job can explain the higher mean of nocturnal awakenings in these individuals. Moreover, the fear and stress generated by the possibility of losing the only job may explain the longer mean duration of nocturnal awakenings in immigrants of working age, who usually have greater concern about the monthly contribution to family earnings, since factors such as anxiety and stress are related to sleep disorders³³. It may also be related to the higher mean duration of nocturnal awakenings associated with apnea-hypopnea episodes (report of "stopping breathing" during sleep) and snoring intensity in this group, discussed further below.

On the other hand, immigrants with 2-3 jobs, although with mean weekly working hours similar to immigrants with a single job (49.7h and 49.1h, respectively), had to travel more often, besides the probable fragile relationships. In other words, exhaustion resulting from the commitment to two or more jobs and the perception that their financial situation was better

Table 5. Gender and age adjusted analysis of mean duration of nocturnal awakenings per reported snoring discomfort for partners.

Variable	Nocturnal awakenings						
	Nocturnal awakenings (Weekday)		Nocturnal awakenings (Weekend)				
	Mean	SD	Mean	SD			
Snoring disturbs partner	Yes	Gender	Men	40.94	16.67	44.81	18.61
			Women	34.60	7.30	41.26*	1.76
		Age (y)	19-50	40.00	15.56	46.11*	16.14
		51-75	35.20	11.31	26.00	0	
	No	Gender	Men	29.34	7.20	30.04	11.46
			Women	26.62	9.68	28.30	8.44
Age (y)		19-50	28.21	9.68	30.10	10.67	
	51-75	26.92	6.04	27.42	8.72		

y = years old; SD = Standard deviation; * $p<0.05$: Mann-Whitney test applied.

in the U.S. than in Brazil, even if the working conditions were worse²³ or required greater physical effort²⁷, could act as inducers for the consolidated sleep period.

The association between snoring and nocturnal awakenings has been relatively well-established³⁴ in recent decades. Snoring is an audible condition due to the vibration of soft tissues in the nasopharynx and oropharynx, due to the passage of air during sleep³⁵. While snoring is a common and harmless occurrence in many people, it can also appear as a clinical manifestation or warning sign of sleep disorders and comorbidities²⁹.

Data from the literature confirm that airways become more vulnerable³⁶ during sleep. Bosi et al.³⁶ conducted a systematic review of anatomical and non-anatomical factors in patients with obstructive sleep apnea and hypopnea syndrome. They found that both the anatomical factors that predispose upper airway obstruction (UAO) during sleep (e.g., anatomical features and contribution to the narrowing of the upper airways) and neuromuscular factors during sleep (progressive reduction of neuromuscular activity that modulates the excitation, from NREM sleep to the REM sleep stage), are related to restricted airflow or upper airways collapse, and are the main factors for hypopnea and obstructive sleep apnea. In turn, these events are directly associated with nocturnal awakening and sleep fragmentation, contributing to fatigue, daytime drowsiness, reduced professional performance and risk of occupational accidents.

The snoring intensity and apnea-hypopnea episodes can be exacerbated by the relaxation of upper airway structures caused by the use of alcohol or sleep-inducing drugs, given that the neuromuscular compensation factors depend on the waking-sleep state^{36,37}. Moreover, the association between BMI and apnea-hypopnea episodes is widely discussed in literature, including in immigrant populations. Studies show³⁸⁻⁴⁰ that increased body weight, especially obesity, and increased neck circumference are associated with increased episodes of apnea-hypopnea during sleep. This exacerbation could explain the means of snoring intensity (39.9 min, SD=14.4 min for weekdays, and 42.3 min, SD=17.3 min for weekends), the mean duration of nocturnal awakenings (> 10 min) for immigrants who reported “stopping breathing”, the longest mean duration (49.2 min; SD=6.79 min) of nocturnal awakenings for immigrants who took medication compared to those who did not (27 min; SD=8.25 min), and the higher frequencies of overweight and obese immigrants who reported “stopping breathing” during sleep, compared to normal weight immigrants. Moreover, some sleep-inducing pills (e.g., longer-acting medications, indicated for sleep maintenance) alter the sleep architecture in such a way that the N2 of NREM sleep is longer than normal, which can increase sleep time, without, however, ensuring restful sleep^{15,36,37,41}.

Concerning the Pittsburgh Sleep Quality Index and number of jobs, the PSQI showed difficulties for immigrants with more than a single job in three components of the scale. In essence, they had shorter sleep duration, lower sleep efficiency and poor or very poor sleep quality, which can be

explained by the reduction in time to sleep as a result of increased number of hours worked, similar to that observed by Marucci-Wellman et al.⁴².

The authors who developed the PSQI²⁶ believe that sleep quality is an important clinical construct for two reasons. The first is because sleep quality-related complaints (such as difficulty falling asleep or maintaining sleep) are common, and the second is because poor sleep quality can be a symptom of different sleep disorders and other comorbidities. Sleep duration is one of the main components in assessing sleep quality. It is associated with different health problems and may be directly associated with mortality. Findings similar to shorter sleep duration observed in this study for immigrants with more than a single job compared to immigrants with a single job were also observed in other studies^{42,43}.

Basner et al.⁴³ observed a shorter sleep duration of 47 minutes for workers in multiple jobs. Marucci-Wellman et al.⁴⁴ showed that permanent or temporary workers with more than a single job also showed a 45-minute reduction in sleep duration on weekdays and 62-minutes on weekends, compared to those with a single fixed job or who were unemployed.

The worst sleep quality observed for immigrants with more than a single job in this study is of concern, as those workers may be subject to chronic and acute sleep deprivation due to reduced time to sleep and greater risk of accidents. They may also be subject to systemic fatigue and morbidities and low sleep efficiency^{42,43}.

The use of sleeping pills, in general, assists the initiation of sleep, reduces nocturnal awakenings, and increases the mean duration of sleep, but can cause tolerance due to prolonged use. Furthermore, there is no consistency in improving the quality or duration of sleep and reducing nocturnal awakenings^{15,37,41}.

This study has some limitations. First, it cannot be said that the findings discussed here are generalizable to other Brazilian immigrants in Massachusetts since the sampling was not random and due to the sample size. However, as there are few studies that assess the associations between sleep and health of Brazilian immigrants, this was an exploratory study that sought to generate hypotheses for future studies. Selection and memory biases may have likely occurred due to the recruitment sites and the subjective nature of some questions. While recruitment occurred in different cities and locations, the most acculturated Brazilians in American Society may not have been included in our sample because they would not visit these locations as often, or perhaps never. Furthermore, because immigrant populations in the U.S. often have multiple jobs, many in this situation may not have had time to participate in the study. Nevertheless, most U.S. immigrants do not have health insurance and may have taken advantage of the surveys as a way to get more information about their health status. Another limitation was the fact that data was collected in the morning, which reduced the participation of immigrants who worked at night.

Also, the Healthy Immigrant Effect, which is the tendency of immigrants to be healthier than the native-born population, especially recent immigrants (up to five years in the host country) and

younger ones, is described in the literature as an important feature to be observed in immigrant populations⁴⁵. Yet, since many immigrants in this study had a long time of residence in the U.S. (mean of 12 years), and we did not have participants with less than 5 years of residence in the U.S., the associations that sought to investigate the Healthy Immigrant Effect were not significant.

However, this study can contribute to not only make demands visible but also articulate support strategies for Brazilian immigrants in Massachusetts. Furthermore, its contribution to expand the horizon of health care professionals concerning changes in sleep patterns, the likely increased exposure to occupational risks and the plausible warning sign of comorbidities are made visible.

CONCLUSION

Our findings identified a relationship between the number of jobs and the nocturnal awakenings of Brazilian immigrants in Massachusetts. Moreover, an association was also found between nocturnal awakenings and sleep apnea-related complaints. However, additional studies are needed to better understand sleep problems in this population and how that affect their health. The assessment of the relationship between systemic morbidities (e.g., metabolic syndrome) and changes in sleep patterns in Brazilian immigrants should be considered in future research.

ACKNOWLEDGMENTS

We are grateful to Daniel Valente and Wellington Meira for their assistance in organizing the database.

REFERENCES

- Patarrá NL. Migrações internacionais de e para o Brasil contemporâneo: volumes, fluxos, significados e políticas. *Sao Paulo Perspec*. 2005 Sep;19(3):23-33.
- Duarte NA, Escrivão Junior Á, Siqueira S. Access to health service by Brazilian emigrants in the United States. *Saúde Soc*. 2013 Jun;22(2):365-76.
- Siqueira CE, Jansen T. Working conditions of Brazilian immigrants in Massachusetts. *J Immigrant Minority Health*. 2012 Jun;14(3):481-8.
- Siqueira CE, Roche AG. Occupational health profile of Brazilian immigrant housecleaners in Massachusetts. *New Solut*. 2013;23(3):505-20.
- Lima A, Siqueira CE. Brazilians in the U.S. and Massachusetts: a demographic and economic profile. Boston, MA: Gastón Institute Publications - University of Massachusetts; 2007.
- Siqueira CE. Immigrant workers as the future of a progressive safety and health movement in the United States. *New Solut*. 2011 May;21(1):5-8.
- Siqueira CE. Community-engaged environmental justice research at University of Massachusetts Lowell. *Am J Public Health*. 2009 Nov;99(Suppl 3):S485-7.
- Siqueira CE. Does informal employment exist in the United States and other developed countries?. *New Solut*. 2016 Aug;26(2):337-9.
- Lindholm H, Sinisalo J, Ahlberg J, Hirvonen A, Hublin C, Partinen M, et al. Attenuation of vagal recovery during sleep and reduction of cortisol/melatonin ratio in late afternoon associate with prolonged daytime sleepiness among media workers with irregular shift work. *Am J Ind Med*. 2012 Jul;55(7):643-9.
- Ferreira SS, Alvarez D. Organização do trabalho e comprometimento da saúde: um estudo em caminhoneiros. *Sist Gestão*. 2013;8(1):58-66.
- Marqueze EC, Ulhôa MA, Moreno CRC. Leisure-time physical activity does not fully explain the higher body mass index in irregular-shift workers. *Int Arch Occup Environ Health*. 2014 Apr;87(3):229-39.
- Documét PI, Kamouyerou A, Pesantes A, Macia L, Maldonado H, Fox A, et al. Participatory assessment of the health of Latino immigrant men in a community with a growing Latino population. *J Immigr Minor Health*. 2015 Feb;17(1):239-47.
- Footracer KG. Immigrant health care in the United States: what ails our system? *JAAPA*. 2009 Apr;22(4):33-6. DOI: <https://doi.org/10.1097/01720610-200904000-00009>
- Sateia MJ. International classification of sleep disorders-third edition: highlights and modifications. *Chest*. 2014 Nov;146(5):1387-94. DOI: <https://doi.org/10.1378/chest.14-0970>
- Sateia MJ, Buysse DJ, Krystal AD, Neubauer DN, Heald JL. Clinical practice guideline for the pharmacologic treatment of chronic insomnia in adults: an American Academy of Sleep Medicine Clinical Practice Guideline. *J Clin Sleep Med*. 2017 Feb;13(2):307-49.
- Winkelman JW, Solomon CG, ed. *Insomnia disorder*. *N Engl J Med*. 2015 Oct;373(15):1437-44. DOI: <https://doi.org/10.1056/NEJMcp1412740>
- Müller MR, Guimarães SS. Impacto dos transtornos do sono sobre o funcionamento diário e a qualidade de vida. *Estud Psicol (Campinas)*. 2007 Dec;24(4):519-28.
- Outhoff K. Insomnia disorder: when sleep plays coy, aloof and disdainful. *S Afr Fam Pract*. 2016;58(3):18-22.
- Basta M, Chrousos GP, Vela-Bueno A, Vgontzas AN. Chronic insomnia and the stress system. *Sleep Med Clin*. 2007 Jun;2(2):279-91.
- Vgontzas AN, Liao D, Pejovic S, Calhoun S, Karataraki M, Basta M, et al. Insomnia with short sleep duration and mortality: the Penn state cohort. *Sleep*. 2010 Sep;33(9):1159-64.
- Hale L, Do P, Rivero-Fuentes E. What do we know about Mexican immigration and sleep? A population-based study and future research directions. *Hispanic Health Care International*. 2010 Dec;8(4):199-208.
- Baldwin CM, Reynaga-Ornelas L, Caudillo-Cisneros C, Márquez-Gamiño S, Quan SF. Overview of sleep disorders among Latinos in the United States. *Hispanic Health Care International*. 2010 Dec;8(4):180-7.
- Sandberg JC, Nguyen HT, Quandt SA, Chen H, Summers P, Walker FO, et al. Sleep quality among Latino farmworkers in North Carolina: examination of the job control-demand-support model. *J Immigr Minor Health*. 2016 Jun;18(3):532-41.
- Lazar-Neto F, Louzada ACS, Moura RF, Calixto FM, Castro MC. Depression and its correlates among Brazilian immigrants in Massachusetts, USA. *J Immigr Minor Health*. 2018 Aug;20(4):832-40.
- Bertolazi AN, Fagundes SC, Hoff LS, Dartora EG, Miozzo ICS, Barba MEF, et al. Validation of the Brazilian Portuguese version of the Pittsburgh Sleep Quality Index. *Sleep Med*. 2011 Jan;12(1):70-5.
- Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res*. 1989 May;28(2):193-213.
- Åkerstedt T, Garefelt J, Richter A, Westerlund H, Magnusson LL, Sverke M, et al. Work and sleep—a prospective study of psychosocial work factors, physical work factors, and work scheduling. *Sleep*. 2015 Jul;38(7):1129-36.
- Dikmen PY, Yavuz BG, Aydinlar EI. The relationships between migraine, depression, anxiety, stress, and sleep disturbances. *Acta Neurol Belg*. 2015 Jun;115(2):117-22.
- Andrechuk CRS, Ceolim MF. High risk for obstructive sleep apnea in patients with acute myocardial infarction. *Rev Latino-Am Enfermagem [Internet]*. 2015 Out;23(5):797-805.
- Reis C, Dias S, Rodrigues AM, Sousa RD, Gregório MJ, Branco J, et al. Sleep duration, lifestyles and chronic diseases: a cross-sectional population-based study. *Sleep Sci*. 2018 Jul/Aug;11(4):217-30.
- Åkerstedt T, Nordin M, Alfredsson L, Westerholm P, Kecklund G. Predicting changes in sleep complaints from baseline values and changes in work demands, work control, and work preoccupation – The WOLF-project. *Sleep Med*. 2012 Jan;13(1):73-80.
- Centers for Disease Control and Prevention (CDC). Work-related injury deaths among hispanics--United States, 1992-2006. *MMWR Morb Mortal Wkly Rep*. 2008 Jun;57(22):597-600.
- Kim EJ, Dimsdale JE. The effect of psychosocial stress on sleep: a review of polysomnographic evidence. *Behav Sleep Med*. 2007 Oct;5(4):256-78.
- Patel JA, Ray BJ, Fernandez-Salvador C, Gouveia C, Zaghi S, Camacho M. Neuromuscular function of the soft palate and uvula in snoring and obstructive sleep apnea: a systematic review. *Am J Otorhinolaryngol*. 2018 Mar;39(3):327-37.
- Pevernagie D, Aarts RM, Meyer M. The acoustics of snoring. *Sleep Med Rev*. 2010 Apr;14(2):131-44.
- Bosi M, Vito A, Gobbi R, Poletti V, Vicini C. The importance of obstructive sleep apnoea and hypopnea pathophysiology for customized therapy. *Eur Arch Otorhinolaryngol*. 2017 Mar;274(3):1251-61.
- Wilt TJ, MacDonald R, Brasure M, Olson CM, Carlyle M, Fuchs E, et al. Pharmacologic treatment of insomnia disorder: an evidence report for a clinical practice guideline by the American College of Physicians. *Ann Intern Med*. 2016 Jul;165(2):103-12.

38. Tufik S, Santos-Silva R, Taddei JA, Bittencourt LRA. Obstructive sleep apnea syndrome in the Sao Paulo epidemiologic sleep study. *Sleep Med* [Internet]. 2010 May; [cited 2020 Jul 06]; 11(5):441-6. Available from: <https://pubmed.ncbi.nlm.nih.gov/20362502/>
39. Loredó JS, Weng J, Ramos AR, Sotres-Alvarez D, Simonelli G, Talavera GA, et al. Sleep patterns and obesity - Hispanic community health study/study of Latinos Sueño Ancillar study. *Chest* [Internet]. 2019 Aug; [cited 2020 Jul 06]; 156(2):348-56. Available from: [https://journal.chestnet.org/article/S0012-3692\(18\)32884-8/fulltext](https://journal.chestnet.org/article/S0012-3692(18)32884-8/fulltext)
40. Corgosinho FC, Dâmaso AR, Marques FMC, Thivel D, Andrade TS, Mello MT. Obesity, inflammation, and OSA. In: *Neurological Modulation of Sleep – Mechanisms and Function of Sleep Health* [Internet]. Amsterdam: Elsevier - Academic Press; 2020; [cited 2020 Jul 06]; p. 35-47. Available from: <https://linkinghub.elsevier.com/retrieve/pii/B9780128166581000041>
41. Qaseem A, Kansagara D, Forcica MA, Cooke M, Denberg TD, Clinical Guidelines Committee of the American College of Physicians. Management of chronic insomnia disorder in adults: a clinical practice guideline from the American College of Physicians. *Ann Intern Med*. 2016 Jul;165(2):125-33.
42. Marucci-Wellman HR, Lombardi DA, Willetts JL. Working multiple jobs over a day or a week: short-term effects on sleep duration. *Chronobiol Int*. 2016 Jul;33(6):630-49.
43. Basner M, Spaeth AM, Dinges DF. Sociodemographic characteristics and waking activities and their role in the timing and duration of sleep. *Sleep*. 2014 Dec;37(12):1889-906.
44. Marucci-Wellman HR, Lin TC, Willetts JL, Brennan MJ, Verma SK. Differences in time use and activity patterns when adding a second job: implications for health and safety in the United States. *Am J Public Health*. 2014 Aug;104(8):1488-500.
45. Markides KS, Rote S. The healthy immigrant effect and aging in the United States and other western countries. *Gerontologist* [Internet]. 2018 Oct; [cited 2020 Jul 08]; 59(2):205-14. Available from: <https://academic.oup.com/gerontologist/article/59/2/205/5151354>.