Sleep Medicine 35 (2017) 27–34

Contents lists available at ScienceDirect

Sleep Medicine

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

Original Article

Agreement between sleep diary and actigraphy in a highly educated Brazilian population

Marcela Zambrim Campanini [a], Esther Lopez-Garcia [b, c], Fernando Rodríguez-Artalejo [b, c], Alberto Durán González [a], Selma Maffei Andrade [a], Arthur Eumann Mesas [a, *]

[a] Department of Public Health, Universidade Estadual de Londrina, Londrina, Paraná, Brazil
[b] Department of Preventive Medicine and Public Health, Universidad Autónoma de Madrid/Idipaz and CIBERESP, Madrid, Spain
[c] MDEA-Food Institute, CEI UAM+CSIC, Madrid, Spain

ARTICLE INFO

Article history:
Received 3 November 2016
Received in revised form
4 April 2017
Accepted 6 April 2017
Available online 25 April 2017

Keywords:
Actigraphy
Sleep duration
Sleep quality

ABSTRACT

Objective: This study evaluated the agreement between a sleep diary and actigraphy on the assessment of sleep parameters among school teachers from Brazil.
Methods: A total of 163 teachers (66.3% women; aged 45 ± 9 years) filled out a sleep diary and wore a wrist actigraph device for seven consecutive days. Data were collected from August 2014 to March 2015 in Londrina, a large city in southern Brazil. Intraclass correlation coefficients (ICC) and Pearson correlation coefficients (r) were used to compare self-reported and actigraphic data.
Results: Self-reported total sleep time (TST), sleep onset latency (SOL), and sleep efficiency were higher than measured by actigraphy (mean difference: 22.6 ± 46.9 min, 2.6 ± 13.3 min, and 7.3± 5.7%, respectively). Subjective total time in bed (TIB) and wake-up time were lower than measured by actigraphy (mean difference: −10.7 ± 37.6 and −19.7 ± 29.6, respectively). Moderate or good agreement and correlation were found between the sleep diary and the actigraphic data for TST (ICC = 0.70; r = 0.60), TIB (ICC = 0.83; r = 0.73), bedtime (ICC = 0.95; r = 0.91), sleep start time (ICC = 0.94; r = 0.88), and wake-up time (ICC = 0.87; r = 0.78). However, SOL (ICC = 0.49; r = 0.38) and sleep efficiency (ICC = 0.16; r = 0.22) showed only fair or poor agreement and correlation.
Conclusion: In this highly educated population, the sleep diary and the actigraphy showed moderate or good agreement to assess several sleep parameters. However, these methods seemed to measure different dimensions of sleep regarding sleep onset latency and efficiency. These findings moderately varied according to the individual's subjective sleep quality.

1. Introduction

Sleep duration and quality are associated with several adverse health outcomes, including obesity [1], diabetes [2], and mortality [3]. Polysomnography (PSG) is the most complete and most accurate method to measure sleep [4]. However, PSG is generally conducted in a laboratory setting, with the individual connected to several monitors, which may affect sleeping conditions and may not represent habitual sleep patterns [4–6]. Actigraphy is an alternative objective method based on the uninterrupted use of a wrist device during several days throughout an individual's routine [6–8], which may better represent usual sleep. On the other hand, self-reported methods (ie, questionnaires, sleep diaries) are practical and low in cost [9], and allow collection of, besides timing variables, information related to personal perception of sleep [10,11].

Although self-reported methods represent the major source of information about sleep in epidemiological studies [2,3], over the past decades the number of publications that include actigraphy has increased [8]. In this context, understanding the relation between those two types of measures represents an important step in the investigation of associations between sleep and health-related outcomes.

Several studies have examined the agreement between self-reported measures and actigraphic data in selected populations, such as adolescents [12], women [9], and older persons [13], among others [14–16]. However, they have yielded inconsistent results for the overall agreement and the direction of the difference between

* Corresponding author. Departamento de Saúde Coletiva, CCS, Universidade Estadual de Londrina, Av. Robert Koch 60, Vila Operária, CEP 86039-440 Londrina, Paraná, Brazil.
E-mail address: aemesas@gmail.com (A.E. Mesas).

http://dx.doi.org/10.1016/j.sleep.2017.04.004
1389-9457/

methods. For instance, several studies found poor correlation between methods and an overestimation of total sleep time (TST) in sleep diaries compared to actigraphy, with a mean difference of 50–60 min [12,16–18]. In contrast, in other studies, sleep diaries showed TST approximately 40–50 min higher than actigraphy, and the agreement was moderate to good [14,15,19]. In two other studies, TST was underestimated in sleep diaries when compared to actigraphy; agreement between both methods was poor for one study [20] and moderate to good for the other study [21]. An equivalent level of inconsistency was found for other sleep parameters, including sleep onset latency (SOL) [9,13,15,16,18,20,21] and sleep efficiency [13,15,16].

Sociodemographic factors, particularly educational level and age [17,22,23], may influence the difference between subjective and objective methods to assess sleep data. In addition, some studies have reported decreased accuracy of activity measures of sleep in patients with sleep disorders [16,24–28], which could justify the inconsistency between self-reports and actigraphic measurements in these individuals. In fact, a certain level of disagreement could be expected, because actigraphy captures the presence or absence of movement, whereas self-reported sleep information is a complex variable and may be influenced by individuals' perception [10]. However, it is still unclear whether the disagreement in one parameter (eg, TST) is also observed for the other parameters (eg, SOL and efficiency) in the same population. Thus, we need a better understanding of the agreement between self-report and actigraphy across several sleep parameters; and, in particular, it varies according to sociodemographic characteristics, health status, and sleep quality.

Therefore, the objective of the present study was to evaluate the agreement and the correlation between several sleep parameters reported on a sleep diary and measured by actigraphy during a seven-day period in a population of Brazilian school teachers with high educational levels. Furthermore, we also explored whether sociodemographic variables, subjective health, and sleep quality were associated with differences between use of a sleep diary and actigraphy.

2. Methods

2.1. Study participants

This is a cross-sectional study conducted with school teachers, within the second wave of the PRO-MESTRE study [29]. Data were collected from August 2014 to March 2015 from all teachers from the 20 largest schools (ie, those with >70 teachers) in Londrina (State of Paraná, Brazil). The project was approved by the Local Human Research Ethics Committee. All participants were informed about the study purposes, goals, and data protection, and signed a consent form.

Inclusion criteria considered primary and secondary school teachers who conducted class work and who were in charge of a subject in class. A total of 168 teachers participated on the study, of whom four were excluded due to inadequate filling out of the sleep diary. Another participant was also excluded for presenting extremely divergent values of sleep onset latency and total sleep time; actigraphy registered >1 h sleep latency and <2 h of sleep, which was highly discrepant when compared to the sleep diary.

2.2. Study variables

Participants wore the Actiwatch 2 device on the wrist for seven consecutive days and completed a daily sleep diary. Use information was provided both orally and in writing. Participants were asked to press the event marker button when turning off the lights with the intention of sleeping. Actiwatch 2 was configured to collect data in 15-s epochs. Data were downloaded using Actiware software (version 6.0.5, Phillips Respironics, Murrysville, PA, USA). Sleep parameters were obtained according to Actiware predefined algorithms and supplemented by the event marker. Weighting algorithms used by Actiware were previously validated [30], and medium activity count thresholds were used in the present study because of their superior sensitivity/specificity ratio [30].

Only nighttime sleep data were included. The following parameters were obtained: time when the person lay down, time when lights were turned off with the intention to sleep (bedtime), the length of time it took until sleep onset (sleep onset latency [SOL]), sleep start time, wake-up time, total sleep time (TST), total time in bed (TIB), and sleep efficiency, which was calculated by dividing sleep time by the number of minutes in the rest interval. To calculate sleep efficiency, the software includes data on TIB, TST, and waking after sleep onset (WASO).

The sleep diary, in paper form, was delivered to the participant at the same time as the actigraph. The diary registered the following information: time when the person lay down, bedtime, SOL, and wake-up time. From these data, TST, TIB, and sleep start time (bedtime + SOL) were estimated. In addition, sleep efficiency was calculated as the ratio of the TST divided by TIB [17] (Fig. 1). The average sleep parameters were calculated separately during the weekdays (Monday through Friday) and the weekend (Saturday and Sunday). Next, a weighted average of sleep duration across the week was obtained as follows: (mean of 5 weekdays + mean of 2 weekend days)/7.

Information on sociodemographic variables (sex and age) and self-rated health (good, very good, fair, or poor) were self-reported. Self-rated health was classified as good (good or very good) and poor (fair or poor). Furthermore, sleep quality was assessed with the Pittsburgh Sleep Quality Index (PSQI) [31], a questionnaire adapted and validated to Brazilian Portuguese [32] that measures perception of sleep quality during the prior month. The score ranges from 0 to 30, with higher scores indicating poorer sleep quality; according to the standard cutoff, participants who scored above five were classified as having poor sleep quality.

2.3. Statistical analyses

Mean values of self-reported and objective parameters were compared with paired t tests or Wilcoxon tests, as appropriate. Bland–Altman plots [33] and intraclass correlation coefficients (ICC) were used to assess agreement between sleep parameters obtained from the sleep diary and from the actigraphy.

The strength of the association between both methods was calculated with the Pearson or Spearman correlation coefficients, as appropriate. Analyses were stratified by sex, age (tertiles), subjective health (good, poor), and sleep quality. For a better discrimination of sleep quality, a PSQI <5 was classified as “good sleep”; those who scored PSQI $\geq$5 were subsequently divided in two groups according to the median score: PSQI $\geq$5 to <9 as “poor sleep” and PSQI $\geq$9 as “very poor sleep”. Given the homogeneity of the educational level of our population, this variable was not used in the stratified analyses.

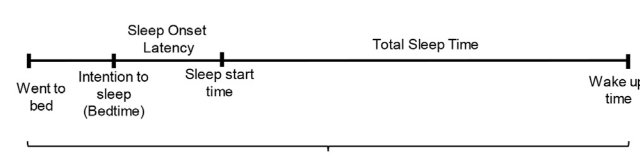

Fig. 1. Sleep parameters measured since the time the person went to bed to the wake-up time.