

The Relationship Between Sleep Quality and Blood Pressure

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An estimated thirty million Americans suffer from chronic sleep deprivation (Lusardi, Zoppi, Preti, et al., 1999). The mystery of sleep and its effects on the body has been the object of researchers' attention for decades. It has been suggested that without sufficient sleep, our ability to think clearly is impaired, our moods are altered, and even our blood pressure (BP) rises. A recent study found that persons who slept less than six hours a night exhibited signs of poor health and had a 70% higher mortality rate than those who slept 7-8 hours each night (Lusardi, et al.). Similarly, in a study of more than 6,000 older adults, those with sleep apnea had a 45% greater risk of hypertension than those without sleep apnea (Nieto, Young, Lind, et al., 2000).

Kario, Schwartz, and Pickering (1999) found that impaired sleep quality may actually alter the sympathovagal balance by increasing the sympathetic influence of the nervous system. In fact, this effect continues into the next day, consequently leading to elevated heart rate and BP, which could then result in organ damage. Most recently, the focus of attention has been on the effects of sleep quality on BP. Many persons with hypertension have reported difficulties sleeping. Conversely, many persons with sleeping disorders characteristically have hypertension. (Lusardi et al, 1999). Sleep disorders such as sleep apnea, snoring, and feeling exhausted upon waking, are predisposing factors for hypertension (Journal of American Medical Association, 2000). Given this, the purpose of this study was to explore the effects of sleep quality on a person's nighttime BP.

SAMPLE

A convenience sample of 25 subjects was recruited by posting flyers at the University of Florida Health Science Center. Telephone screenings were then used to determine if the participant met the following inclusion criteria: 1) at least 18 years of age 2) could read and understand the English language, and 3) had no memory disorders. The final sample consisted of 7 men and 18 women aged 20 to 58, all of whom were healthy normotensive adults. Ethnicities represented include 16 Caucasian, 5 African-American, 1 Asian, & 3 Other.

INSTRUMENTS

Sleep quality was objectively measured using the Mini-Motionlogger Actigraph

(Ambulatory Monitoring, Inc, Ardsely, NY). This instrument measures the number of times that the pointer of the acceleration sensor built into the actigraph crosses zero per epoch minute. This information is then downloaded into the ActionW software to analyze the following sleep measures: percent sleep (number of minutes asleep/number of minutes in bed), sleep latency (the amount of time it took to fall asleep), wake episodes after sleep onset, and total number of sleep minutes.

BP was quantified using an ambulatory BP monitor (ABPM; Model 90207, SpaceLabs Medical, Inc, Redmond, WA). This instrument is designed to be worn over a 24 hour period as the subject goes about his/her normal routine. This instrument has a high level of accuracy and clinical performance and meets guidelines determined by the Association for the Advancement of Medical Instrumentation (AAMI) as well as those defined by the British Hypertension Society (O'Brien, Atkins, & Staussen, 1995). Values recorded by this monitor were downloaded using the ABP Report Management System software. From this, average systolic BP (SBP), diastolic BP (DBP), mean arterial pressure (MAP), and heart rate (HR) were calculated for wake and sleep times.

METHODS AND PROCEDURES

This study was approved by the Institutional Review Board for the Protection of Human Subjects. All participants signed an informed consent document prior to data collection. The ABPM was programmed using the ABP Management System to record BPs every thirty minutes beginning at 9pm and ending at 9am. The Motionlogger Actigraph was programmed using the ActionW software to continuously record activity per one minute epoch period beginning at 9pm and ending at 9am.

Subjects were instructed on the use of both instruments and were required to give a return demonstration before participating in the study. At 8:45pm the subject placed the ABPM on his/her dominant arm and the actigraph on the wrist of the nondominant hand. This was judged to be the most accurate method to achieve precise readings. Subjects then continued about their regular nightly routine and were instructed to sleep as they would on any other normal night. Upon awakening, the participants estimated the time they fell asleep and awoke and recorded this on their sleep/wake log. These times were used to differentiate between awake and sleep BP. At 9am, the equipment was disconnected and turned off.

The participants repeated the same procedure for a second night. The first night served as an adaptation to sleeping with the equipment.

RESULTS

Data were analyzed and descriptive statistics were summarized using the Statistical Program for the Social Sciences (SPSS, Chicago, IL). Data acquired from night 1 were not included in the final analysis as these data reflected adaptation of the equipment into the subjects' sleeping pattern.

Sleep efficiency was inversely correlated to nighttime DBP ($r = -0.427, p < 0.05$). See **Figure 1**. The poorer one's sleep quality, the higher their nighttime DBP. This does not mean that difficulty sleeping causes high nighttime BP or that high nighttime BP causes difficulty sleeping. It merely indicates that difficulty sleeping and high nighttime BP tend to occur together. The number of minutes awake after sleep onset positively correlated with nighttime DBP ($r = 0.457, p < 0.05$), as shown in **Figure 2**, and nighttime HR ($r = 0.46, p < 0.05$), as shown in **Figure 3**. Again, no cause and effect is demonstrated, merely that they occur together.

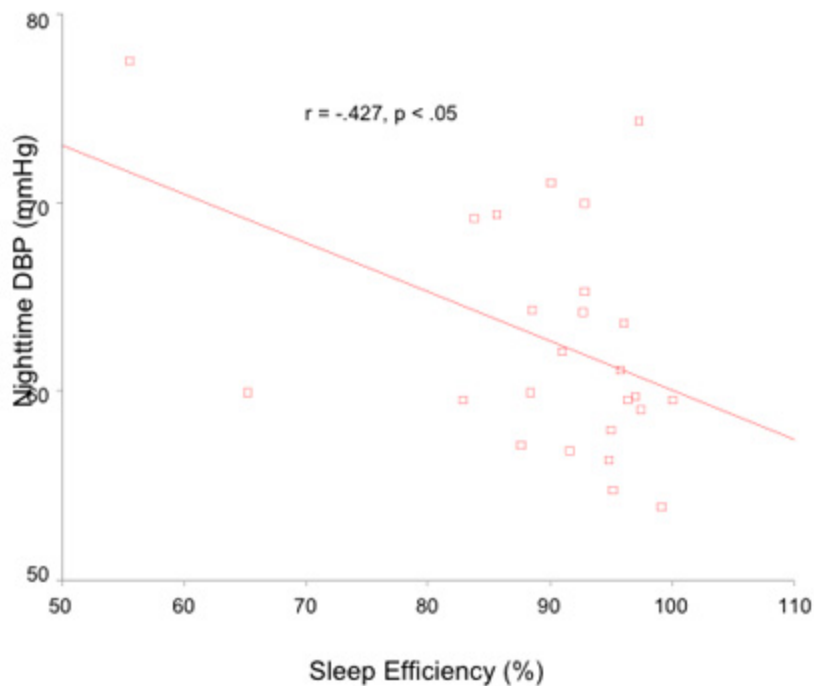


Figure 1

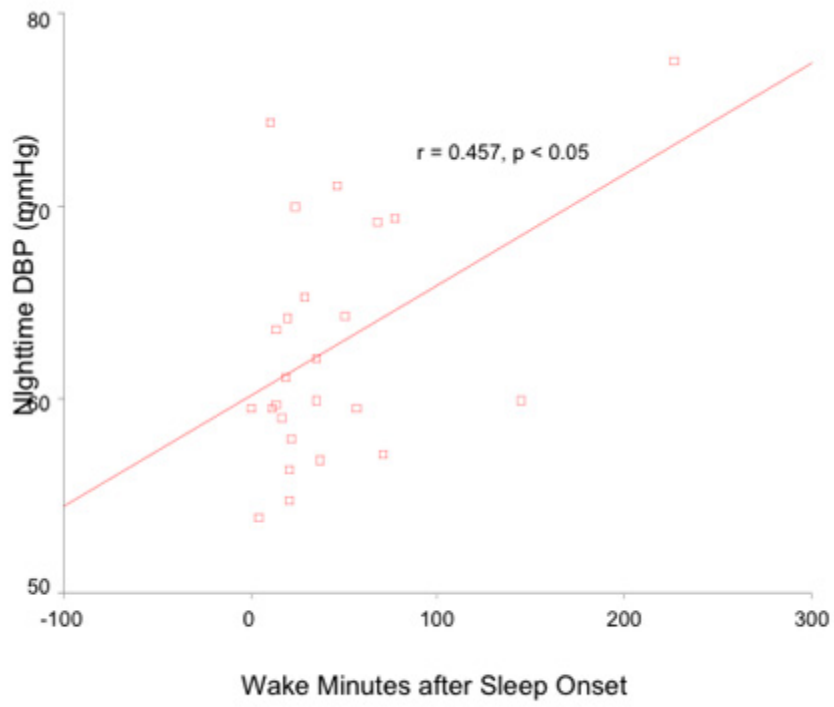


Figure 2

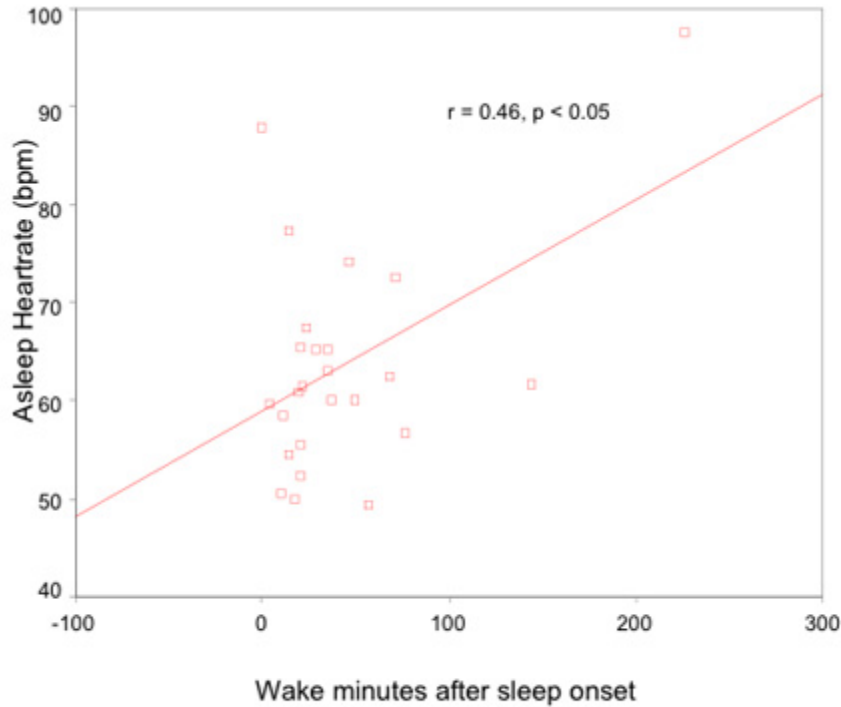


Figure 3

DISCUSSION

The results of this study support the notion that poor sleep quality is associated with higher nighttime BP. As suggested by previous studies, this may be due to an increase in the influence of the sympathetic nervous system. It follows that waking after sleep onset would increase the sympathetic nervous system. This would cause the heart rate to increase potentially leading to higher BP.

In a future study, these same methods should be implemented with a larger sample size to increase the validity of these results. Secondly, it should be repeated with subjects diagnosed with primary hypertension to determine if sleep quality has the same, if not greater, effect on these participants. If the results concur with this study, techniques to improve one's sleep quality may be explored as a means of lowering a person's BP.

REFERENCES

Jean-Louis, G., Kripke, D.F., Mason, W.J., Elliott, J.A., Youngstedt, S.D. (2001). Sleep estimation from wrist movement quantified by different actigraphic modalities. *Journal of Neuroscience Methods*, 105, 185-191.

Lusardi, P., Zippi, A, Preti, P., Pesce, R.M., Piazza, E., Fogari, R. (1999). Effects of insufficient sleep in blood pressure in hypertensive patients: A 24 hour study. *American Journal of Hypertension*, 12, 63-68.

Nieto, F.J., Young, T.B., Lind, B.K., Shahar, E., Samet, J.M., Redline, S., D'Agostino, R.B., et al. (2000). Association of sleep-disordered breathing, sleep apnea, and hypertension in a large community-based study. Sleep Heart Health Study. *Journal of the American Medical Association*, 283(14), 1829-36.

O'Brien, E., Atkins, N., & Staessen, J. (1995) State of the market: A review of ambulatory blood pressure monitoring devices. *Hypertension*, 26, 835-842.
