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Perceived stress, sleep disturbances and cardiovascular health outcomes

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Abstract

Sleep is well defined as an important contributor to health. Sleep duration, mostly short sleep, and sleep quality have been assessed as being related to cardiovascular diseases. The purpose of this study is to investigate the correlation between perceived stress levels, sleep duration and sleep quality in connection with chronic diseases such as cardiovascular (arterial hypertension) and endocrine diseases (type 2 diabetes mellitus). Thirty-four patients diagnosed with arterial hypertension and 35 patients with type 2 diabetes were assessed. The MOS: SS, the perceived stress scale, and pulse wave velocity were determined with applanation to nometry. The results of the study are discussed in relation to the significance of perceived stress levels and established sleep disturbances with respect to pulse wave velocity in patients with arterial hypertension and type 2 diabetes mellitus.

Keywords: Perceived stress, sleep duration, sleep quality, pulse wave velocity.

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1. Introduction

Sleeping for an adequate time period and quality of sleep are emerging as important issues in the process of maintaining optimal health and well-being (Mullan, 2014). Stress and sleep are significantly correlated. Stress is a factor that can seriously impact sleep quality and sleep duration. In turn, sleep deprivation can increase the risk of stress. Stress is a complex condition with emotional, cognitive and biological factors. Sleep is an important component of human homeostasis. Sleep is a vital and complex physiological process inherent in each individual. A previously conducted research (Nunes da Silva, Martins Costa, Waquim Machado & Lopes Xavier, 2012) found that sleep is affected by psychological and social factors, such as emotional stress, anxiety, depressive mood, financial hardship, smoking and alcohol consumption. The modulation of metabolic and endocrine regulation, immune function and cardiovascular variables by sleep is well documented (Parmeggiani, 1994). There are recent studies providing data for a number of diseases associated withsleep quality, such as cardiovascular problems (Kashani, Eliasson & Vernalis, 2012), cancer (Carlson et al., 2007), metabolic disorders (Luyster, Strollo, Zee & Walsh, 2012; Theadom & Cropley, 2008) and endocrine diseases (Theadom & Cropley, 2008). Poor sleep quality is related to emotions and previous studies have observed the effects of stress on sleep (Cho et al., 2013; Okun, Tolge & Hall, 2014). Growing epidemiological evidence has linked short sleep and poor sleep quality to increased incidence and progression of several chronic medical conditions observed at a greater prevalence among patients with type 2 diabetes and arterial hypertension (Ayas et al., 2003; Grandner, Jackson, Pak & Gehrman, 2011).

Sleep duration and sleep complaints are known to have predictive powers in relation to cardio metabolic health outcomes (Grandner et al., 2011). Most of the authors consider pulse wave velocity (PWV) to be the most precise way to evaluate, non-invasively, arterial stiffness. Some authors conclude that high PWV values are associated with increased arterial stiffness and increased risk of cardiovascular disease (Doupis, Papanas, Cohen, McFarlan & Horton, 2016). Many studies have investigated the association of sleep duration and sleep quality to arterial stiffness (Tsai, Wu, Yang, Huang & Chang, 2014). However, subjective sleep duration is variably associated with arterial stiffness, differing from studies, and the evidence of the relationship between sleep duration and cardiovascular risks for women was weaker and less conclusive than that for men (Aziz et al., 2017).

Sabanayagam and Shankar (2010) found greater risks of myocardial infarction and stroke in subjects who slept for ≤5 and ≥9 hours. In 2011, some authors (Cappuccio, Cooper, D'Elia, Strazzullo & Miller, 2011) carried out a systematic review and showed that both short and long sleep durations are associated with a greater relative risk of coronary heart disease and stroke. Sleep quality (insomnia and sleep deprivation) has also been linked to adverse cardiovascular disease (CVD) outcomes. The exact mechanism by which compromised sleep quality leads to CVD is not clear, but possible explanations include changes in hormones and inflammatory markers, lipid levels, glucose tolerance/metabolism, sympathetic nervous system and subclinical atherosclerosis. Another systematic review (Cappuccio, D'Elia, Strazzullo & Miller, 2010) showed that sleep ≤5–6 and >8–9 hours was associated with a higher relative risk of developing type 2 diabetes mellitus. It has been showed that five nights of partial sleep deprivation can significantly cause a trigger in the sympathetic activity and venous endothelial dysfunction and this evidence is in alignment with the association between short sleep and increased cardiovascular risk in other epidemiological studies (Dettoni et al., 2012).

Stress encompasses all kinds of stimuli of varying amounts of aversiveness and duration (Dimsdale, Irwin, Keefe& Stein, 2009). Many authors have grouped stressors into physical as opposed to psychological or social, acute to chronic and high intensity to low intensity (Kecklund & Akerstedt, 2004). Although there are numerous animal models of social stress, it is still challenging to attribute psychosocial stress responses in animals to those in humans.

Different types of stressors may bring along different impacts on sleep. Issues such as the chronicity and virulence of stress exposure can be considered in defining the stressors' effect on sleep. The examination of the relationship between stress and subjectively measured sleep will allow a deeper understanding of sleep psychology and possible ways of the influence of stress on sleep.

2. Methods

2.1. Perceived stress scale

The perceived stress scale is a self-reported questionnaire to measure perceived stress (Cohen, Kamarck & Mermelstein, 1983). Scores are obtained by reversing the scores on the seven items and summing up the14 items. The subjects indicate how often they have found their lives unpredictable, uncontrollable and overloaded in the last month. This scale assesses the degree to which people perceive their lives as stressful.

2.2. Medical outcomes study sleep scale (MOS-SS)

The medical outcomes study sleep scale includes 12 items assessing sleep disturbance, sleep adequacy, somnolence, quantity of sleep, snoring and awakening with shortness of breath or with a headache (Stewart & Ware, 1992). A sleep problem indexes grouping items from each of the former domains.

2.3. Perceived deficits questionnaire(PDQ)

PDQ assesses perceived cognitive deficits from the patient's perspective. The PDQ is designed to have four 5-item sub-scales: attention/concentration, retrospective memory, prospective memory and planning/organisation. The PDQ score can also be computed. Higher scores indicate greater perceived cognitive impairment.

2.4. Applanation tonometry

The PWV measurements in duplicate were carried out using a SphygmoCor apparatus (SphygmoCor system, AtCor Medical, Sydney, Australia) after a 10-minute rest (supine position) (Laurent et al., 2006; Townsend et al., 2015). To reduce the effect of the circadian cycle, the participants were assessed at approximately the same time during the morning (Papaioannou et al., 2006). Measurements were carried out on an empty stomach after instructions to refrain from any caffeine beverages, alcohol and smoking at least 12 hours prior to the estimates. The measurement of arterial blood pressure (BP) was preceded by a record of medical history and family history. PWV was registered between the carotid and femoral artery in the supine position. The SphygmoCor probe over the carotid and femoral artery was used for non-invasive pulse measurements. Simultaneously, ECG was recorded (Qureshi et al., 2007). The values of the distance from the carotid to femoral artery, measured directly between artery location and the supra-sternal notch, were entered into the SphygmoCor software database. PWV was automatically calculated using AtCor software.

2.5. Study population

Sixty-nine subjects (42 male and 27 female; mean age 51 ± 12 years) with confirmed medical diagnosis of type 2 diabetes mellitus and arterial hypertension were investigated. They were divided into two different groups as follows: Gr. 1 was arterial hypertension (n = 34) and Gr. 2 was type 2 diabetes mellitus (n = 35) non-hypertensive individuals (exclusion criteria for this group were BP >140/90 mmHg). The study was conducted in Stara Zagora in an outpatient clinic in the period of

January–March 2019. Before entering the study, all participants provided written informed consent according to the principles of the Declaration of Helsinki (World Medical Association, 2001).

3. Results and discussion

The purpose of this study is to investigate the correlation between perceived stress levels, sleep duration and sleep quality in connection with chronic diseases such as cardiovascular (arterial hypertension) and endocrine diseases (type 2 diabetes mellitus).

3.1. Stress

Stress is produced by factors that impose excessive demands on the body that impact its state of balance. It can affect one's physical, as well as psychological, well-being and requires action to restore balance to avoid unwanted adverse health issues. The extent to which the individual can minimise stressors is confounded by self-esteem, coping skills, past experiences, presence of social support, perceived self-efficacy, genetic predisposition to stress and perception of the cause of stress. Many individuals perceive unpredictable events as a threat to their well-being. If stressors are overwhelming or prolonged and intense, they can result in physiological and psychological health problems, which include depression, insomnia, cognitive deficits or cardiovascular disorders.

The level of stress in this study refers to the overall patient's appraisal for their perceived stress level over the last 4 weeks. The patients with arterial hypertension show significantly higher levels of stress compared to the group of patients with diabetes mellitus (Table 1.).

Table1. Comparing levels of perceived stress between two groups of patients – with arterial hypertension and with diabetes mellitus.

Groups	*N*	Mean	Std. Deviation	*t*	Std. Error Mean
Arterial hypertension	34	48.59	3.465	4.307	0.049
Diabetes mellitus	35	44.46	4.428		

3.2. Cognitive deficits

The result of the study shows that there is significant correlation between perceived stress and cognitive deficits (concentration/attention, retrospective memory, planning and organisation). This result supports the idea that perceived stress has a significant influence on cognitive functioning. The higher the stress levels, the more difficulties in retrospective and prospective memory and the concentration and attention weaken, as well as the planning and organisation of everyday activities.

Taken together, physical and psychological stressors present a multifactorial challenge to individuals with sleep disturbances. These same factors may also impact cognitive function. Relevant studies found that disruptions in sleep behaviour, such as difficulty falling or staying asleep, were correlated with a decline in cognitive ability. Specifically, individuals reporting these symptoms display inefficiencies in attention, memory and selected aspects of executive functioning (Dodds et al., 2011; Zimmerman, Bigal, Katz, Brickman & Lipton, 2012).

Table 2 displays the means and significance for all groups with sleeping difficulties and their relationship with each cognitive domain. A one-way analysis of variance (ANOVA) found a significant effect of sleep problems on the scores of cognitive domains [$F(3.140) = 5.88$, $p < .01$]. *Post-hoc* analyses indicated that the group with somnolence evaluated their cognition more poorly than the sleep adequacy group. These results reveal that the overall cognition was lowest for study participants with snoring and somnolence and highest for participants with sleep adequacy. These results also reveal that attention was lowest for participants with snoring and sleep disturbances and greater for individuals with good quality of sleep. A one-way ANOVA found an insignificant effect of sleep problems on planning.

Table 2. ANOVA of sleep problems and cognitive domains

Cognitive domains	Sleep problems							
	Sleep adequacy	Somnolence	Quantity of sleep	Snoring	Sleep disturbance	Awakening with shortness of breath	*F*	Sig
Concentration/A	19.35	18.59	19.46	16.30	18.01	18.87	5.885**	0.000
ttention	19.67	17.14	19.32	18.78	18.54	19.23	5.933**	0.000
Retrospective	19.28	16.01	18.56	18.64	17.41	19.43	6.994**	0.000
Memory	19.69	18.59	19.15	19.11	17.92	19.02	1.150	0.234
Prospective Memory								
Planning/Organis ation								

*= $p < 0.05$; **= $p < 0.01$. Standard deviations appear in parentheses below means.

3.3. Sleep

Sleep requirements for an average adult are approximately 8 hours per night, regardless of environmental and cultural differences. According to many studies, those individuals who consistently experience less than 8 hours of sleep per night may suffer from exhaustion, irritability, have less concentration and may be more prone to suffer from arterial disease (especially those who sleep less than 4 hours per night). In addition, they have higher cancer, depression and anxiety rates. Our environment and the demands imposed on us by our work, families and society forces our physiological and psychological response mechanisms to increase sleep deprivation. If the individual continues to place excessive and unrelenting demands on his/her body, and is not able to adapt in an effective manner to their external environments, and life's demands, the compounding stress can affect the individual negatively (Mullan, 2014).

Table 3. Comparing levels of sleep problems between two groups of patients – with arterial hypertension and with diabetes mellitus.

Groups	*N*	Sleep disturbance	Somnolence	Sleep adequacy	Snoring	Awakening with shortness of breath	Sleep quantity
Arterial hypertension	34	11.76	9.00	6.24	2.02	2.62	6.51
Diabetes mellitus	35	11.80	8.60	5.54	3.77	3.68	7.31
T		−0.11	1.00	2.61	−9.32	−7.62	−2.05
Sig		0.191	0.31	0.01	0.00	0.00	0.04

Table 3 shows the results of comparison between two groups of patients with different aspects of sleep problems. The results suggest that patients with arterial hypertension show greater issues with sleep adequacy and their sleep is shorter than the sleep in the second group. On the other hand, patients with diabetes mellitus experience snoring and awakening with shortness of breath more often. This result is consistent and corresponds to the results of many authors who indicate that excessively longer and shorter periods of sleep may both be risk factors for high BP. Most of the patients with arterial hypertension in this study report less than 7 hours of sleep duration per day and obviously have a greater cardiovascular risk than patients from the second group (Wang et al., 2015). Recently published literature confirms that sleep deprivation is associated with cardiovascular diseases and diabetes mellitus. Increased sympathetic nervous system activity is considered as a

common patho physiological mechanism in sleep deprivation's relationships with these diseases. The relationship between sleep time and incidence of cardiovascular diseases and diabetes mellitus is U-shaped. Sleep periods that are neither too short nor too long may be important for maintaining physical well-being (Nagai, Hoshide & Kario, 2010).

4. Conclusion

Diabetes mellitus and arterial hypertension are two of the most common diseases worldwide. These diseases cause different kinds of sleep disturbances.

In a group of patients with diabetes mellitus, the main sleep problems are snoring and awakening with shortness of breath. It is important for the healthcare providers treating patients with diabetes mellitus to address their sleep issues and the impaired quality of life due to inadequate and fragmented sleep, as it may severely affect their recovery and control of diabetes, as well as their quality of life. Sleep education should also be considered an essential part in the therapeutic process.

Patients with arterial hypertension show greater issues with sleep adequacy and their sleep is shorter. Most of the patients with arterial hypertension in this study report less than 7 hours of sleep duration per day, which is a risk factor for their cardiovascular health.

The results of the study confirm that sleep disruption increases cognitive disturbances, especially concentration and memory. Long-term sleep disruption may also worsen the symptoms of the disease and it is important for healthcare professionals to effectively treat sleep issues in connection the patient's quality of life.

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References

Ayas, N. T., White, D. P., Manson, J. E., Stampfer, M. J., Speizer, F. E., Malhotra, A. & Hu, F. B. (2003). A prospective study of sleep duration and coronary heart disease in women. *Archives of Internal Medicine, 163*, 205–209.

Aziz, M., Ali, S. S., Das, S., Younus, A., Malik, R., Latif, M. A., … Nasir, K. (2017). Association of subjective and objective sleep duration as well as sleep quality with non-invasive markers of sub-clinical cardiovascular disease (CVD): a systematic review. *Journal of Atherosclerosis and Thrombosis, 24*(3), 208–226. doi:10.5551/jat.36194

Cappuccio, F., Cooper, D., D'Elia, L., Strazzullo, P. & Miller M. A.(2011). Sleep duration predicts cardiovascular outcomes: a systematic review and meta-analysis of prospective studies. *European Heart Journal, 32*(12), 1484–1492. doi:10.1093/eurheartj/ehr007

Cappuccio, F. P., D'Elia, L., Strazzullo, P. & Miller, M. A. (2010). Sleep duration and all-cause mortality: a systematic review and meta-analysis of prospective studies. *Sleep, 33*(5), 585–592.

Cho, H. S., Kim, Y. W., Park, H. W., Lee, K. H., Jeong, B. G., Kang, Y. S. & Park, K. S. (2013). The relationship between depressive symptoms among female workers and job stress and sleep quality. *Annals of Occupational and Environmental Medicine, 25*(1), 12. doi:10.1186/2052-4374-25-12

Cohen, S., Kamarck, T. & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*, 385–396.

Dettoni, J. L., Consolim-Colombo, F. M., Drager, L. F., Rubira, M. C., Souza, S. B., Irigoyen, M. C., … Lorenzi-Filho, G. (2012). Cardiovascular effects of partial sleep deprivation in healthy volunteers. *Journal of Applied Physiology, 113*(2), 232–236. doi:10.1152/japplphysiol.01604.201

Dimsdale, J. E., Irwin, M. R., Keefe, P. T. & Stein, M. B. (2009). Stress and psychiatry. In B. Saddock, V. Saddock, & P. Ruiz (Eds.), *Kaplan and Saddock's comprehensive textbook of psychiatry* (9th ed., pp. 2407–2408). Philadelphia, PA.

Dodds, C. M., Bullmore, E. T., Henson, R. N., Christensen, S., Miller, S., Smith, M., … Nathan, P. J. (2011). Effects of donepezil on cognitive performance after sleep deprivation. *Human Psychopharmacology: Clinical and Experimental, 26*(8), 578–587.

Doupis, J., Papanas, N., Cohen, A., McFarlan, L. & Horton, E. (2016). Pulse wave analysis by applanation tonometry for the measurement of arterial stiffness. *Open Cardiovascular Medical Journal, 10,* 188–195. doi:10.2174/1874192401610010188).

Grandner, M. A., Jackson, N. J., Pak, V. M. & Gehrman, P. R. (2011). Sleep disturbance is associated with cardiovascular and metabolic disorders. *Journal of Sleep Research, 21*(4), 427–433. doi:10.1111/j.1365-2869.2011.00990.x

Kecklund, G. & Akerstedt, T. (2004). Apprehension of the subsequent working day is associated with a low amount of slow wave sleep. *Biological Psychology, 66*, 169–176.

Laurent, S., Cockcroft, J., Van Bortel, L., Boutouyrie, P., Giannattasio, C., Hayoz, D., … Struijker-Boudier, H. (2006). Expert consensus document on arterial stiffness: methodological issues and clinical applications. *European Heart Journal, 27*, 2588–2605. doi:10.1093/eurheartj/ehl254

Mullan, B. A. (2014). Sleep, stress and health: a commentary. *Stress Health, 30*, 433–435.

Nagai, M., Hoshide, S. & Kario, K. (2010). Sleep duration as a risk factor for cardiovascular disease- a review of the recent literature. *Current Cardiology Reviews, 6*(1), 54–61. doi:10.2174/157340310790231635

Nunes da Silva, J. M., Martins Costa, A. C., Waquim Machado, W. & Lopes Xavier, C. (2012). Avaliacao da qualidade de sono em idosos nao institucionalizados. *ConScientiae Saude, 11*(1), 29–36. doi:10.5585/conssaude.v11n1.2940

Okun, M. L., Tolge, M. & Hall, M. (2014). Low socioeconomic status negatively affects sleep in pregnant women. *Journal of Obstetric, Gynecologic, and Neonatal Nursing, 43*(2), 160–167. doi:10.1111/1552-6909.12295

Papaioannou, T. G., Karatzis, E. N., Papamichael, C. M., Karatzi, K. N., Zakopoulos, N. A., Lekakis J. P., … Stefanadis, C. (2006). Circadian variation of arterial pressure wave reflections. *American Journal of Hypertension, 19*(3), 259–263. doi:10.1016/j.amjhyper

Parmeggiani, P. (1994). The autonomic nervous system in sleep. In M. H. Kryger, T. Roth & W. C. Dement (Eds.), *Principles and practice of sleep medicine*. (pp. 194–200). Philadelphia, PA: WB Saunders.

Qureshi, G., Brown, R., Salciccioli, L., Qureshi, M., Rizvi, S., Farhan, S. & Lazar, J. (2007). Relationship between aortic atherosclerosis and non invasive measures of arterial stiffness. *Atherosclerosis, 195*(2), e190–e194. doi:10.1016/j.atherosclerosis.2007.06.02

Sabanayagam, C. & Shankar, A. (2010). Sleep duration and cardiovascular disease: results from the National Health Interview Survey. *Sleep, 33*(8), 1037–1042.

Stewart, A. L. & Ware, J. E. (Eds.). (1992). *Measuring functioning and well being. The medical outcomes study approach.* London, UK: Duke University Press.

Sullivan, J., Edgeley, K. & Dehoux, E. (1990). A survey of multiple sclerosis. Part I: perceived cognitive problems and compensatory strategy used. *Canadian Journal of Rehabilitation, 4*, 99–105.

Townsend, R. R., Wilkinson, I. B., Schiffrin, E. L., Avolio, A. P., Chirinos, J. A., Cockcroft, J. R., … Weber, T. (2015). Recommendations for improving and standardizing vascular research on arterial stiffness: a scientific statement from the American Heart Association. *Hypertension, 66*(3), 698–722. doi:10.1161/HYP.0000000000000033)

Tsai, T. C., Wu, J. S., Yang, Y. C., Huang, Y. H., Lu, F. H. & Chang, C. J. (2014). Long sleep duration associated with a higher risk of increased arterial stiffness in males. *Sleep, 37*(8), 1315–1320.

Wang, Y., Mei, H., Jiang, Y. R., Sun, W. Q., Song, Y. J., Liu, S. J. & Jiang, F. (2015). Relationship between duration of sleep and hypertension in adults: a meta-analysis. *Journal of Clinical Sleep Medicine, 11*(9), 1047–1056. doi:10.5664/jcsm.5024

Zimmerman, M. E., Bigal, M. E., Katz, M. J., Brickman, A. M. & Lipton, R. B. (2012). Sleep onset/maintenance difficulties and cognitive function in nondemented older adults: the role of cognitive reserve. *Journal of the International Neuropsychological Society, 18*(3), 461–470.