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The Effect of Sleep Quantity and Quality on Adults' Blood Pressure: Yazd, 2014-2015

Hossein Fallahzadeh[1], Mohammad Hassan Lotfi[2], Jabbar Shafiei [3]

1. Prevention and Epidemiology of Non-communicable Disease Research Center, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
2. Department of Biostatistics and Epidemiology, Health Faculty, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
3. Department of Statistics and Epidemiology, Shahid Sadoughi University of Medical Sciences, International Campus, Yazd, Iran

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Corresponding Author:
Jabbar Shafiei;
kamiar.shafiei@gmail.com

ABSTRACT

Introduction: Sleep is an essential part of life and is of utmost importance in preserving human health and performance. The quantity and quality of sleep can affect blood pressure. The objective of this paper was to determine the relationship of sleep quantity and quality with high blood pressure.

Methods: This profile study utilized the data of Health Study Program in Yazd. The population contained 6964 adults in the age range of 20 to 70 years, selected using cluster sampling method. The data were analyzed using chi-squared (X^2) and Logistic Regression tests via SPSS (ver. 18) software.

Results: Generally, 50.3% of the participants were female, 28.6% of them had high blood pressure; 31.3% of men and 25.9% of women had high blood pressure. The lowest rate of blood pressure happened within participants with 20-29 years of age, i.e., 9.9%, while the highest rate was related to individuals of 60-69 years old, i.e., 49.6%. X^2 test yielded significant results for sleep duration ($p<0.001$) and nightmare frequency ($p=0.016$). The adjusted chance of sleep duration, gender, age groups, educational levels, and body mass index (BMI) had significant effects on blood pressure ($p<0.001$). Half of the participants showed sleep dysfunctions in terms of quantity and quality, and one-third were likely to come down with high blood pressure.

Conclusion: It can be concluded that the sleep quantity and quality of the studied people were not at a desirable level; it needs high attention. It can be maintained that the findings of the current study indicated the importance of paying attention to the quality and quantity of sleep in preventing the incidence of high blood pressure.

Keywords: Sleep Quantity, Sleep Duration, Sleep Quality, Blood Pressure

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Introduction

Sleep is an essential part of the life and is of high importance for body performance and health. Adults need 8 to 9 hours of night sleep; otherwise, their performance and social activities will weaken and the odds ratio (OR) of hypertension and cardiovascular conditions increase [1]. Sleep quality is a complicated clinical construct whose assessment is mental and cannot be carried out in a laboratory [2]; sleep mental parameters include the feeling after wake up and the satisfaction rate with sleep [3].

Sleep problems cause inadequate sleep qualitatively and quantitatively, and this in turn, foments dangerous behaviors such as belligerence, quarrel, smoking, and risky sexual activities [4]. While a series of various factors cause sleeplessness, studies have shown that socio-economic status, drugs' side effects, mental issues, and sleep environment are deemed to be important factors which cause defective sleep [5]. According to epidemiological surveys, rate of sleep dissatisfaction on the part of adults is 15 to 35% [6]; other studies estimated prevalence rate of sleep malfunctions as15 to 42% [7]. A study showed that the rate of sleeplessness prevalence in urban population of Iran is 35 to 39% [8].

As mentioned earlier, sleep disorder results in many important problems such as hypertension. Hypertension is the most central reason for cardiovascular diseases; based on statistics, 1.25 billion people around the world will have come down with blood pressure condition by 2025. The global prevalence of blood pressure among adults has been estimated as 40% [9]; this figure is 25 to 35% in Iran [10]. Blood pressure disease is usually asymptomatic and as statistics show just 34% of Iranians are aware of their blood pressure. Studies in Iran have revealed that blood pressure is in a direct relation with risk factors like old age, female gender, Body Mass Index (BMI) increase, little exercise, and Turkmen race, but it has an inverse link with drinking black tea and socioeconomic status [11].

Cross-sectional studies have represented that low sleep duration is related to prevalence and incidence of hypertension. Yet, surveys show that this is not the only reason behind hypertension prevalence and a combination of inadequate sleep and sleep disorders affect blood pressure. These findings indicate that there may be a relationship between sleep quality and blood pressure, but this relationship has not been fully detected yet. Therefore, it seems necessary to study the potential relation between hypertension prevalence and global status of sleep which has both quantitative and qualitative sides [12-14]. There have been some researches in Iran on status of sleep and blood pressure, but these small population studies merely focus on either quantitative [13] or qualitative [14] state of sleep. Consequently, there is a necessary need to survey the relationship of sleep quality and quantity with blood pressure in a large population randomized from Yazd people.

Methods

This cross-sectional study utilized the Yazd Health Study (YAS) data, gathered within the years 2014-2015 under the supervision of Yazd University of Medical Sciences. Population of this study included all Yazd people in the age range of 20-70 years and the population of interest contained 6964 people out of the total 10000 people of YAS study. The control groups were divided into five age groups: 20-29 years, 30-39 years, 40-49 years, 50-59 years, and 60-69 years with the same frequency in all groups and genders. Being 20 to 70 years old, living in Yazd, holding official documents such as national ID card for Iranian Citizens and Residence Card for foreigners living in Iran made up the study inclusion criteria. In addition, the enrolled participants were interviewed after they expressed deliberate satisfaction to take part in the interview. Those who stopped to cooperate after 3 appointments at the interview center and did not complete the interviews were excluded from the study. The sampling method used in this study was a multi-stage layered clustering. At the first stage, based on zip codes and urban clusters, 200 clusters

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made up of 50 people were randomly selected from Yazd regions. Head clusters were chosen in each block according to family listing agenda of the year 2013; then interview started from the right hand and in a serial order. In the case of several families living within the same block (e.g., a residential complex), the interview started from the first flat and moved on continuously to the next ones. Written consents were gathered from all participants. Questionnaires were filled by personal interviews. At the same time, blood pressure, weight, height, and BMI were measured. This study's questionnaire was extracted from validity assessment device of YAS study. Sleep questions of YAS study were adapted from a part of Pittsburgh Questionnaire (PSQI=Pittsburgh Sleep Quality Index) [(2)]. After consultation with experts, some of the items were reformed and the validity of new version was approved. On carrying out the pilot plan of the questionnaire, over 200 people living in Yazd were selected randomly with Alpha Cronbach = 0.8, it was vindicated in terms of content and faithfulness and the final version of the questionnaire was issued. According to this questionnaire, sleep duration less than 6 hours was evaluated as short sleep duration, 6-8 hours of sleep was normal, and sleep duration over 8 hours was long sleep duration [(15)]. Because the questionnaire used in this study was a part of Pittsburg's questionnaire, the score for sleep quality [(15)] could not be calculated, however, to study the relationship between sleep quality and high blood pressure the variables including sleeping pills consumption, nightmare frequency, unwanted waking-up, falling asleep duration were investigated. Also, people with more than two disorders in sleep quality or quantity (sleeping less than 6 hours or more than 10 hours, having experience of taking 3 or more sleeping pills, having nightmares 3 or more times in a week, and falling asleep period of over 60 minutes) went under the category of people with inappropriate sleep quality [(16)]. Blood pressure was also measured by Richter Automatic Device (Model Ri-champion-1725, made in Germany). Upon observance of all required rules before measuring blood pressure, each person's blood pressure was measured 3 times with an interval of 3 minutes; the average of the 2nd and 3rd measurements was considered as the person's blood pressure. The figure equals to or more than 140 was systolic blood pressure and the one equals to or more than 90 was regarded as diastolic blood pressure. If both or one of the systolic and diastolic blood pressures was more than these figures, the person was considered to have high blood pressure [(17, 18)]. Data were then entered to the $SPSS_{18}$ software to be analyzed. To describe the information, descriptive statistics such as frequency and percentage came to use. X^2 test was applied to check the relationship between qualitative variables in the form of univariate data; univariate logistic regression was used to determine the strength of the variables' connection and multivariate logistic regression was utilized for the final modeling. Variables were inserted into the model one by one and their significance was calculated; those variables which were significant at less than 0.2 alpha level were put in the equation and others were ruled out.

Results

In this study, 3475 people (50.3%) were female and 3433 people (49.7%) were male. Most of participants were married (5839 people = 84.6%). The percentages of distribution frequency for 5 age groups were close and in the range of 18.7% - 21.2%. Among the participants, 9.1% had less than 5 sleep hours; 43.2% had 6 to 7 sleep hours; 40.8% had 8 to 10 sleep hours; and 6.9% had a sleep duration of more than 10 hours. Further, 54.1% of participants had appropriate sleep while 45.9 had inappropriate sleep. In addition, 4729 people (71.4%) did not have hypertension and 1891 people showed relatively high prevalence of more than 28.6% of high blood pressure.

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Table 1. Relationship between sleep qualitative and quantitative variables and blood pressure in the studied people (n = 6964)

Variable			OR(CI 95%)	Hypertension frequency (percent)		p-value
				Yes	No	
Quantity	Sleep duration	Less than 5 hrs.	1 (Base group)	184 (%31%)	410 (69%)	<0.001*
		6 to 7 hrs.	0.916 (0.756-1.11)	812 (29.1%)	1975 (70.9%)	
		8 to 10 hrs.	0.782 * (0.644-0.95)	697 (26%)	1985 (74%)	
		More than 10 hrs.	1.27 (0.99-1.65)	171 (36.5%)	298 (63.5%)	
Quality	Sleeping pills consumption (in a week)	No experience	1 (Base group)	1558 (28.3%)	3956 (71.7%)	0.204
		Less than once	0.995 (0.79-1.25)	107 (28.2%)	273 (71.8%)	
		One or two times	0.972 (0.737-1.28)	72 (27.7%)	188 (72.3%)	
		Three times or more	1.29* (1.01-1.64)	108 (33.8%)	212 (66.2%)	
Quality	Nightmare frequency (in a week)	No experience	1 (Base group)	1292 (29.4%)	3102(70.6%)	0.016*
		Less than once	0.921 (0.802-1.05)	350(27.7%)	912(72.3%)	
		One or two times	0.904 (0.739-1.10)	145 (27.4%)	385 (72.6%)	
		Three times or more	0.64* (0.479-0.855)	61 (21%)	229 (79%)	
Quality	Unwanted waking-up	No experience	1 (Base group)	1025(28.8%)	2537 (71.2)	0.803
		Less than once	0.991 (0.86-1.13)	433 (28.6%)	1082 (71.4%)	
		One or two times	0.974 (0.82-1.14)	283 (28.2%)	643 (71.8%)	
		Three times or more	0.901 (0.73-1.11)	135 (26.7%)	371 (73.3%)	
Quality	Falling asleep duration	Immediately	1 (Base group)	661 (28.5%)	1656 (71.5%)	0.685
		Less than 15 min	1.02 (0.89-1.18)	454 (29%)	1109 (71%)	
		15-30 min	0.938 (0.808-1.08)	373 (27.2%)	996 (72.8%)	
		30-60 min	1.005 (0.84-1.2)	225 (28.6%)	561 (71.4%)	
		More than 60 min	1.10 (0.889-1.36)	144 (30.6%)	327 (69.4%)	

* Significant

As seen in Table 1, the highest frequency of hypertension happens for people with sleep duration of less than 5 hours or more than 10 hours, i.e., 31% and 36.5%, respectively. It also occurs to people who take sleeping pills 3 times or more in a week (33.8%). Hypertension frequency among individuals with no nightmares was 29.4%, while it is 28.8% for those with no unwanted waking-ups. This figure was 30.6% for people who had a delay of more than 60 minutes for falling into sleep. Among the mentioned variables, X^2 test (CI 95%) approved with significance of sleep duration and nightmare frequency.

In addition, as it is shown in Table 1, univariate logistic regression indicates that the Odds Ratio (OR) of hypertension in people with a sleep duration of 8-10 hours was 0.782 times more than the OR of those with a sleep duration of less than 5 hours; this was statistically significant. The OR of coming down with hypertension in people with experience of taking sleeping pills 3 times or more was 1.29 more than the OR of those who did not take sleeping pills; this was also statistically significant. Additionally, the OR of hypertension in those with nightmare experience of 3 times or more was 0.64 times higher than those who did not suffer from nightmare, which was statistically significant. However, the rates of unwanted waking-ups and delay in falling asleep were not significant.

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Table 2. The relationship between blood pressure and demographic information of participants (n = 6964)

Variable		OR (CI %95)	Hypertension frequency (percent)		P-value
			Yes	No	
Age group	20-29 years of age	1 (Base group)	184 (31%)	410 (69%)	<0.001*
	30-39 years of age	2.09 (1.63-2.58)	812 (29.1%)	1975 (70.9%)	
	40-49 years of age	3.59 (2.9-4.46)	697 (26%)	1985 (74%)	
	50-59 years of age	5.44 (4.4-6.73)	171 (36.5%)	298 (63.5%)	
	60-69 years of age	8.97 (7.25-11.09)	618 (49.6%)	629 (50.4%)	
Gender	Male	1 (Base group)	1026 (31.3%)	2247 (68.7%)	<0.001*
	Female	0.764 (0,.686-0.85)	857 (25.9%)	2458 (74.1%)	
Marital status	Married	1 (Base group)	1655 (29.4%)	3966 (70.6%)	<0.001*
	Single	0.455 (0.368-0.561)	111 (15.9%)	585 (84.1%)	
	Widowed	2.04 (1.57-2.65)	111 (46.1%)	130 (53.9%)	
	Divorced	0.496 (0.205-1.19)	6 (17.1%)	29 (82.9%)	
Educational level	Under high school	1 (Base group)	798 (43.4%)	1040 (56.6%)	<0.001*
	High school to GCSE	0.488 (0.425-0.560)	501 (27.2%)	1339 (72.8%)	
	GCSE & Associate's	0.339 (0.294-0.392)	393 (20.7%)	1519 (79.3%)	
	Bachelor's	0.288 (0.236-0.353)	146 (18.1%)	660 (81.9%)	
	Master's & Ph.D.	0.369 (0.252-0.541)	36 (22.1%)	127 (77.9%)	
Socioeconomic status	Low	1 (Base group)	666 (32.3%)	1399 (67.7%)	<0.001*
	Mid	0.822 (0.727-0.931)	786 (28.1%)	2008 (71.9%)	
	High	0.535 (0.429-0.667)	120 (20.3%)	471 (79.7%)	
Body Mass Index (BMI)	<18.5	1 (Base group)	19 (10.6%)	160 (89.4%)	<0.001*
	18.5-24.9	2.08 (1.28-3.39)	415 (19.8%)	1676 (80.2%)	
	25-29.9	3.71 (2.28-6.01)	744 (30.6%)	1688 (69.4%)	
	30-39.9	5.22 (3.21-8.5)	616 (38.3%)	922 (61.7%)	
	>40	4.59 (2.36-8.02)	71 (35.3%)	130 (64.7%)	

* Significant

As you can see from Table 2, the highest rates of blood pressure were in the age group of 60-69 years (49.6%), among male (31.3%), widowed (46.1%), in educational level under high school (43.4%), low socioeconomic status (32.3%), and in people with BMI over 40. The significance of results has been approved by X^2 test (CI 95%).

Considering the results of univariate logistic regression in Table 2, the OR of hypertension in age group of 60-69 years was 8.97 times more than the age group of 20-29 years; 0.764 times more in females compared to males; 0.822 in mid socioeconomic class compared to low socioeconomic one; 0.369 times in people with Master's and Ph.D. degrees compared to those with educational levels under high school; 2 times in people with fat BMI compared to those with normal BMI; all the mentioned figures were statistically meaningful. Moreover, the OR of hypertension for the widowed participants was 2.04 times more than the married people, in singles 0.455 times higher than the married individuals, which was statistically significant. The OR of hypertension among the divorced participant was 0.496 times higher than the married people; this was also significant in terms of statistics.

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Table 3. The risk of hypertension by independent variables

Variable	Coefficient	Standard deviation	Probability amount	OR	CI 95% for OR	
					Lower limit	Upper limit
Gender	-0.512	0.071	<0.001*	0.600	0.522	0.689
Educational level	-0.164	0.044	<0.001*	0.849	0.779	0.925
Age groups	0.455	0.029	<0.001*	1.577	1.491	1.668
BMI	0.340	0.040	<0.001*	1.404	1.300	1.518
Sleep duration	-0.088	0.027	0.001*	0.916	0.869	0.965
Marital status	0.118	0.065	0.067	1.126	0.992	1.278
Having nightmares	-0.027	0.042	0.509	0.973	0.897	1.056
Socioeconomic status	-0.004	0.065	0.953	0.996	0.877	1.132
Constant coefficient	-2.132	0.229	0.000	0.119	---	---

* Significant

In Table 3, you can observe the findings of logistic regression. Among the investigated variables, gender, educational level, age groups, BMI, and sleep duration affect hypertension significantly (P<0.05); other variables were not significant.

Discussion

The current study estimated the hypertension prevalence of the control group at 29%; different provinces had different prevalence rates. Azizi et al. estimated a prevalence of 2% among urban people of over 30 years [19]; other studies estimated the general prevalence of hypertension at 15% among Iranians [20]. The lesser rate of hypertension prevalence of other studies in comparison with the current study can be attributed to different methodologies, e.g., age difference and different definitions of hypertension. This study also showed that over 5% of the examined people (control group) had less than 8 hours of sleep on average which, in turn, represents the severe defect in sleep quantity of the studied people. In a study on bus drivers, Effatpanah calculated this figure at 45% [1]; other Iranian studies reached figures in the range of 35-39% [8]. The high rate of sleep quantity disorders in this study was indicative of severe conditions of sleep in the examined population; which in the case of paying inadequate attention can raise dangerous behaviors such as belligerence, quarrel, smoking, and risky sexual activities [21].

Investigation of the link between sleep quantity and blood pressure revealed a U shaped relationship: as the prevalence of hypertension for people with sleep duration less than 5 hours and more than 10 hours were higher than for people with sleep duration 8-10 hours s (P<0.001). Gottlieb showed that such a relationship does exist. He maintained that the blood pressure is in its lowest rate among people with 7-8 hours' sleep, and people with long sleep or inadequate sleep are more likely to suffer from high blood pressure compared to this group [22]. However, our study attributed the highest OR (1.27 hypertension to those with the longest sleep duration. The results have shown that 54% of the examined people had appropriate sleep quality, but 45% did not; this is in unison with the study of Mirzayi et al. which covered 50% of samples with sleep quality disorders [16]. In the current study, increase in taking sleeping pills has raised blood pressure, but this relationship was not significant. However, the OR of hypertension in people taking sleeping pills 3 times or more in a week was 1.29 times higher than those with no experience of taking sleeping pills; this relationship was significant. The studies have revealed that sleeping pills decrease blood pressure by affecting sympathetic and parasympathetic nervous systems [23]. In this study, increase in having nightmares lowers blood pressure significantly. Houyez showed that there is a significant relation between nightmare frequency and systolic blood pressure [24], which conforms to our study. The reason behind this relation is still

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unknown, but researchers consider psychological disorders, e.g., depression, stress, or tension, as its reason [26]. In addition, the current study showed that there is no significance relationship between hypertension, unwanted waking-ups, and falling sleep duration. Houyez, on the contrary, indicated that night waking-ups raise blood pressure [24], which was in agreement with the results of the current study. This study showed that blood pressure prevalence is significantly high in people with low socioeconomic status compared to those with high socioeconomic status. Subramanyam [27], Wu [28], and Hawkins [29] have shown this relationship in different studies. It seems that people with low socioeconomic status are more prone to hypertension because of unhealthy diet, heavy smoking, and high salt intake [27-29]. The findings have revealed that aging increases blood pressure significantly; this was in agreement with Ghaffari's study.

In Ghaffari's study, blood pressure increases in a linear fashion among people without enough sleep as they grow older; after adjustments, this relationship proved significant for disrupting variables [30]. In the present study, the highest rate of hypertension went to the 60-69 age group, which is supporting other studies which tapped the age over 60 [7, 31, 32]. It appears that age over 60 years is a man risk factor to blood pressure; in this study, the OR of hypertension in the 60-69 age group was 8.97 times more than the 20-29 age group. McEniery has estimated this at 7.01 [31]. Marital status also plays a role concerning blood pressure, though there is no certain pattern in this regard; in the current study, the hypertension prevalence among the married people was more than the singles. The widowed had the highest prevalence rate of hypertension (46.1%).

This study's results conform to Blumenthal's findings [33]. However, Holt-Lunstad showed that blood pressure is lower in the married compared to the singles [34]. The current study indicated that 31.3% of males and 25.9% of females had hypertension; this difference is significant in terms of statistics.

The OR of hypertension in women is lower than in men. Ghaffari showed the predominant prevalence of hypertension in men (39.6%) than women [30]. Many studies have proven the link between blood pressure and male gender [33, 34]. The importance of blood pressure and gender consists in that blood pressure and sleep qualitative-quantitative characteristics may be interconnected in a way that daily drowsiness is common in women with hypertension [30]. Studies showed existence of a linear connection between BMI and blood pressure [35], which is in unison with the results of the current study: as BMI increases, blood pressure also increases significantly.

In addition, studies maintained that the OR of hypertension in fat people is 2 times more than the OR of normal people [35]. It agrees with the present study wherein blood pressure in people with normal BMI is 2.08 and is 4.59 in fat people [30]. It can be claimed that the most important findings of this study are those of multivariate logistic regression; among the involved variables, age, gender, educational level, BMI, and sleep duration are in a significant relationship with hypertension within the studied people. The shape of this relationship is as follows: female gender, higher educational level, younger age group, low BMI, and longer sleep duration decrease blood pressure. Other variables did not have any significant relationships with hypertension in the participants. The relationship of effective variables such as gender [33, 34], educational level [7, 30-32], BMI [30, 35], and sleep duration have been approved in surveys and studies. Other variables did not affect per se and their effects were worn off in presence of other variables. Therefore, according to this study's findings, these variables, among others, should be considered and implemented to plan some interventionist programs in order to improve blood pressure status.

Some delimitations of the current study are self-declaration of participants about sleep quality and quantity, classification of sleep variables, and uncontrollable factors affecting sleep not reported by the people; so, it seems incumbent upon the researcher to utilize objective devices for assessing

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sleep parameters such as polysomnograph and actigraph.

Conclusion

Generally, it can be said that sleep quality and quantity of the control group were not desirable and needed special attention. Moreover, the interrelationship between hypertension and sleep poor quality and quantity is indicative of the severe condition of the population of interest. Noticing hypertension and its susceptibility to other variables like socioeconomic status, age, gender, marital status, and BMI, should be attended by Yazd health care officials, so via suitable solutions, hypertension will decrease in the society.

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Conflict of Interest

No conflict of interest reported by authors.

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