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Analysis of the Relationship Between Sleep Quality and Hypertension Levels in the Elderly: A Study in Pejeng Tampaksiring Village

Anak Agung Risma Mayuni[1*], Putu Ayu Sita Saraswati[2], Nila Wahyuni[3], I Putu Yudi Pramana Putra[4]

[1]Bachelor and Profession of Physiotherapy Study Program, Faculty of Medicine, Udayana University, Denpasar, Bali
[2,4]Department of Physiotherapy, Faculty of Medicine, Udayana University, Denpasar, Bali
[3]Department of Physiology, Faculty of Medicine, Udayana University, Denpasar, Bali
*Corresponding author: rismamayuni06@gmail.com

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ABSTRACT

Introduction: Individuals aged 60 years and above, defined as the elderly, undergo physical and neurological changes due to degenerative processes, often associated with health problems. The risk of hypertension is common among the elderly due to their tendency to have high blood pressure. One factor contributing to hypertension is sleep quality, defined by how well a person sleeps and is characterized by feelings of freshness and vigour upon waking.
Methods: An observational analytic study with a cross-sectional approach was chosen for this research. The sampling technique used was purposive sampling. A total of 98 older women were obtained through Lemeshow's sample calculation. Data collection included measuring the sleep quality of the elderly using the Indonesian version of the Pittsburgh Sleep Quality Index (PSQI) questionnaire and measuring hypertension levels using a sphygmomanometer and stethoscope.
Results: Hypothesis analysis using Spearman's rho test showed a significant relationship between sleep quality and hypertension levels among the elderly in Pejeng Tampaksiring Village, with a p-value of 0.000 (<0.05).
Conclusion: It can be concluded that there is a significant relationship between sleep quality and hypertension levels among the elderly in Pejeng Tampaksiring Village.

Keywords: sleep quality, hypertension levels, elderly

INTRODUCTION

Older people are individuals in the final phase of life, typically those aged 60 years and above. According to the World Health Organization (WHO), older people are categorized into three groups: 60-70 years as elderly, 75-90 years as old, and over 90 years as very old. According to the Central Bureau of Statistics, the elderly population in Indonesia reached 11.75% in 2023, while the proportion of older people in Bali reached 13.97%. The population of Gianyar Regency is 515,344 people, or 11.94% of the total population of Bali Province, with older people making up 13.87% of this population.[1] The high number of elderly individuals requires special attention in terms of their welfare and how they can maintain their quality of life.

The elderly population has a higher risk of health problems. Older adults often experience health issues, including hypertension, which is a risk factor for cardiovascular diseases. Therefore, better blood pressure control can improve life expectancy.[2] Blood pressure exceeding 140/90 mmHg is classified as hypertension. The prevalence of hypertension among the elderly in Indonesia tends to be high, with rates of 45.9% in individuals aged 55 to 64 years, 57.6% in individuals aged 65 to 74 years, and 63.8% in individuals aged 75 years and older.[3] According to data from the Bali Provincial Health Office (2021), there are 555,184 individuals aged 15 years and older with hypertension in Bali. Of the nine regencies/cities in Bali, Gianyar Regency ranks third, with 77,998 cases of hypertension.[4]

Many factors influence blood pressure, including age, gender, heredity, physical activity, obesity, salt intake, smoking habits, and sleep quality. Among these factors, sleep quality is considered a dominant influence on the occurrence of high blood pressure.[5] As individuals age, the quality of their sleep changes, often accompanied by various issues such as difficulty falling asleep, waking up in the middle of the night, and taking a long time to fall back asleep. Ageing causes changes in physiological functions, including sleep activity.[6] A common sleep disorder among the elderly is insomnia. The prevalence of insomnia among the elderly in Indonesia is very high, approximately 67%. Data from the Geriatric Polyclinic at Sanglah Hospital Denpasar indicates that 42.5% of elderly patients have mild insomnia. Sleep disorders significantly impact the quality of an individual's sleep.[7,8]

Sleep disturbances in older people are caused by changes in the nervous system, resulting in a decrease in the size and number of neurons in the central nervous system. This affects neurotransmitter function and reduces the secretion of norepinephrine, a hormone that stimulates sleep. Research by Martini, Roshifanni, and Marzela (2018) found that among several factors, sleep quality is a dominant influence on high blood pressure compared to age and gender. Individuals with poor sleep patterns are nine times more likely to experience high blood pressure or hypertension than those with good sleep patterns. There is no decrease in sympathetic nerve activity during disturbed sleep,

increasing the likelihood of high blood pressure due to the blood pressure not decreasing during sleep. This is supported by research from Fazriana (2023), which found a significant relationship between sleep quality and susceptibility to hypertension in the elderly.[9]

Many studies have examined the correlation between sleep quality and hypertension levels in the elderly. However, this research takes into account the history of stroke, heart attack, and Body Mass Index (BMI) as confounding variables, as well as a more detailed classification of hypertension, including normal tension, pre-hypertension, stage 1 hypertension, and stage 2 hypertension. This study selected a group of elderly individuals in Pejeng Tampaksiring Village as the research sample because interviews with the Chairman of the Elderly Association of Pejeng Village revealed that several elderly individuals complained of various sleep disturbances, such as difficulty falling asleep, waking up in the middle of the night, and taking a long time to fall back asleep. Additionally, the researcher believes that older people in this area are more cooperative, and there is a larger elderly population. This prompted the researcher to study the condition of the elderly in Pejeng Tampaksiring Village to demonstrate that poorer sleep quality is associated with higher hypertension levels among the elderly in Pejeng Tampaksiring Village.

METHOD

The research method employed was observational analytic using a cross-sectional approach conducted in Pejeng Village, Pejeng Kelod Village, and Pejeng Kangin Village, Tampaksiring District, Gianyar Regency, from April to August 2023. The sampling technique utilized was purposive sampling. The sample size in this study was 89 individuals, determined through the Lemeshow formula and meeting the research criteria, both inclusion and exclusion. The researcher added 10% to the sample size to anticipate dropouts, resulting in 98 individuals. The inclusion criteria for this study were elderly females aged 60-74 years with average Body Mass Index (BMI) who were willing to provide informed consent. Exclusion criteria included individuals with hypertension complications (stroke and heart disease), currently taking sleeping pills, and having hearing or psychiatric (psychological) disorders based on brief interviews conducted with family members and village officials.

The research was conducted in SD Negeri 1 Pejeng classrooms, the Community Hall of Pejeng Kelod Village, and the Pura Jurit Pesalakan in Pejeng Kangin. The researcher began by providing information on the research's location, timing, objectives, and benefits. The process of obtaining informed consent and conducting anamnesis, including name, age, gender, smoking habits, physical activity, and medical history, was performed with the assistance of a physiotherapist. Medical histories, such as stroke and heart attacks, were considered confounding factors and controlled by the researcher to minimize bias. The research continued with the measurement of height (cm) using a stadiometer and weight (kg) using a scale to calculate the Body Mass Index (BMI), which was categorized following the national classification reference of the Indonesian Ministry of Health. BMI measurement was another effort by the researcher to control confounding variables that could affect sleep quality. Blood pressure measurements were taken while sitting and assisted by medical personnel (a doctor and a nurse) using a sphygmomanometer and stethoscope. The results were classified according to the JNC-8 classification: normal, pre-hypertension, stage 1 hypertension, and stage 2 hypertension.

The researcher used the Pittsburgh Sleep Quality Index (PSQI) to collect data on sleep quality in older people. The PSQI questionnaire has been tested for reliability and validity, showing reliability with a Cronbach's alpha value of 0.805 and significant validity with $p < 0.001$. This questionnaire also has a sensitivity value of 1 with a specificity value of 0.81. The examination scored seven components ranging from 0 to 3, where 0 indicates no sleep disturbances, and 3 indicates severe sleep disturbances. The total score ranged from 0 to 21, with scores below 5 indicating good sleep quality and above 5 indicating poor sleep quality.

The researcher conducted A direct interview using the Global Physical Activity Questionnaire (GPAQ) questionnaire. The researcher asked about the 16 items in the questionnaire to assess physical activity and then determined the total MET score. The total MET score was adjusted according to the existing categories and presented as research data.

All collected data were statistically processed using the IBM SPSS 27.0 data processing application. The researcher conducted univariate analysis to determine each variable's characteristics and frequency distribution, including age, smoking habits, physical activity, sleep quality, and hypertension levels. The researcher also conducted a bivariate analysis to assess the correlation between sleep quality and hypertension levels and the direction of the relationship between the two variables. The Ethics Commission of Udayana University approved the research feasibility under number 625/UN14.2.2.VII.14/LT/2023.

RESULTS

In this study, the subjects were elderly females aged 60 to 74 years out of 147 elderly individuals reachable in Pejeng Tampaksiring Village. The selection of subjects met the research criteria using a purposive sampling technique, totalling 98 subjects, shown in Figure 1.

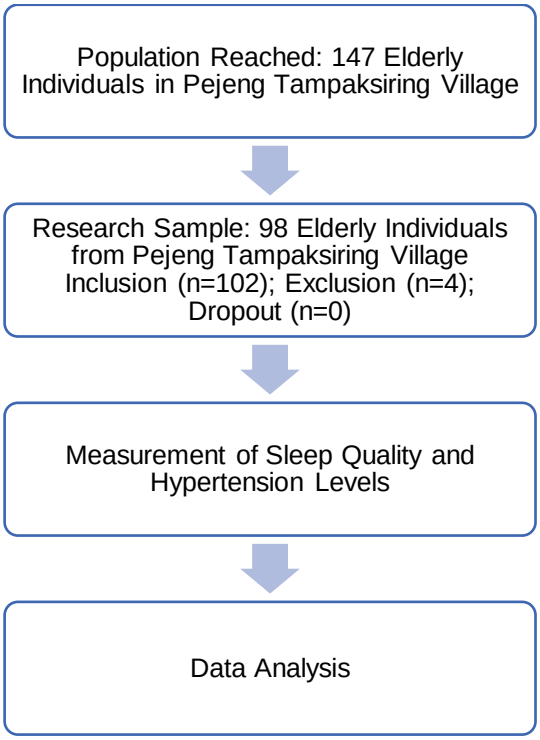

Figure 1. Research Flowchart

Given that there are 147 elderly individuals reachable in Pejeng Tampaksiring Village, 102 meet the inclusion criteria, while four are excluded. The reasons behind this are that subjects with hypertension have a history of stroke and heart disease (n=3), and one subject has a hearing impairment that could hinder further measurement processes.

The characteristics of the subjects in this study are based on age, smoking behaviour, and physical activity, as shown in Table 1.

Table 1. Characteristics of Research Samples

Variable	Frequency (n)	Percentage (%)
Age		
60-64	40	40.8
65-69	30	30.6
70-74	28	28.6
Smoking Habits		
Smoker	0	0
Non-smoker	98	100
Physical Activity		
High	12	12.2
Moderate	52	53.1
Low	34	34.7

Table 1 shows that the sample consists of 98 individuals, with 40 individuals aged 60-64 years, 30 individuals aged 65-69 years, and 28 individuals aged 70-74 years. Among the 98 elderly females in Pejeng Tampaksiring Village, none of them have a smoking habit (100%). More than half of the total sample have moderate physical activity (n=52), while the remaining are categorized as having low (n=34) and high (n=12) physical activity levels.

Subsequently, a more precise distribution regarding the frequency of subject characteristics based on sleep quality and hypertension is displayed in Table 2.

Table 2. Characteristics of Samples Based on Sleep Quality and Hypertension

Variable	Frequency (n)	Percentage (%)
Sleep Quality		
Good	49	50
Poor	49	50
Hypertension		
Normal	16	16.3
Pre-hypertension	26	26.5
Stage 1 Hypertension	35	35.7
Stage 2 Hypertension	21	21.4

Table 2 shows an equal proportion between good and poor sleep quality, with 49 individuals each (50%). Most subjects have difficulty initiating sleep and tend to wake up in the middle of the night. They also report difficulty sleeping due to frequent nightmares. Thirty-five individuals have stage 1 hypertension, and 21 individuals have stage 2 hypertension, while the rest have normal blood pressure (n=16) or are in the pre-hypertension stage (n=26).

For a more detailed overview, a cross-tabulation based on sleep quality and hypertension is performed in Table 3.

Table 3. Cross-tabulation of Sleep Quality with Hypertension Distribution

Sleep Quality	Hypertension								Total	
	Normal		Pre-hypertension		Stage 1 Hypertension		Stage 2 Hypertension			
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Good	15	15.3	18	18.4	10	10.2	6	6.1	49	50
Poor	1	1	8	8.2	25	25.5	15	15.3	49	50
Total	16	16.3	26	26.5	35	35.7	21	21.4	98	100

Based on Table 3, most subjects with good sleep quality have blood pressure in the pre-hypertension category, with 18 individuals (18.4%), while subjects with poor sleep quality mostly experience stage 1 hypertension, with 25 individuals (25.5%).

Bivariate analysis using non-parametric Spearman's rho analysis was conducted to test the correlation between sleep quality and hypertension level. The results of the study are presented in Table 4 below.

Table 4. Relationship between Sleep Quality and Hypertension Level through Spearman's Rho Correlation Test

Variable	Correlation	P-Value
Sleep Quality with Hypertension Level	0.480	0.000

Based on Table 4, the correlation test results using Spearman's rho between the variables of sleep quality and hypertension level in the elderly in Pejeng Tampaksiring Village are significant with a p-value of 0.000 ($p < 0.05$), accompanied by a correlation coefficient of 0.480, which is positive. The level of correlation strength is considered moderate as it falls within the range of values from 0.26 to 0.50.

DISCUSSION

Based on the research results presented above, it is known that the research subjects consist of 98 elderly females in Pejeng Tampaksiring Village, with the majority falling in the age range of 60-64 years (40.8%). The research findings are consistent with previous studies by Saraswati et al. (2020), where most older people were aged 60-64 (38.3%). With increasing age, the sleep quality of older people changes, leading to various issues such as difficulty falling asleep, waking up in the middle of the night, and spending a long time trying to fall back asleep. Ageing causes physiological changes, including alterations in sleep patterns. Sleep quality is influenced by age and is associated with their diseases.[10]

Research by Musni (2019) explains that there is no significance in the correlation between smoking habits and the risk of hypertension occurrence in an individual. This is consistent with the results of this study, where the number of non-smokers (n=98) is greater than the number of smokers (n=0). This is because the majority of the respondents are females.[11]

Based on the research results in Table 1, most elderly individuals engage in moderate physical activity, with 52 individuals (53.1%). A significant correlation between physical activity and sleep quality in elderly individuals with hypertension was found in a study by Fajri et al. (2024). This is consistent with the results of this study. Previous research also states that regular physical activity helps maintain homeostatic balance. Physical activity stimulates hormone secretion, including endorphins, which support organ regeneration during rest. Vasodilation occurs, leading to better-controlled blood pressure and optimization of sleep when blood circulation is smoother.[12]

Based on the research on sleep quality in older people, an equal proportion is observed between good and poor sleep quality, with 49 individuals each (50%). This is supported by a study by Harsismanto et al. (2020), which revealed that 11 respondents (50%) of older people had good sleep quality, while the remaining 11 respondents (50%) had poor sleep quality. Despite the balanced number of respondents regarding the characteristics of sleep quality, the sleep quality of older people in that study fell into the poor category.[13]

The sleep patterns of elderly individuals vary widely. Older people often complain about the sleep process they experience. For instance, difficulty sleeping at night is usually caused by comorbidities or psychological stress. Elderly individuals not only struggle to sleep at night but also experience increased daytime drowsiness due to frequent awakenings at night caused by various complaints such as trips to the bathroom, nightmares, or sudden awakenings. Changes in sleep patterns in older people are related to dysfunction in the central nervous system, which impacts the sensitivity of sensory nerves to maintain circadian rhythms.[14] In addition, external factors such as lifestyle, environment, and physical activity can influence the sleep quality of older people.[15,16,17]

Based on the blood pressure measurements, the majority of respondents are classified as having stage 1 hypertension, with 35 individuals (35.7%). This finding is consistent with a study by Fazriana et al. (2023), which showed that the majority of respondents had stage 1 hypertension, with 30 individuals (34.9%). High blood pressure is a potential health risk associated with ageing. One of the physical changes associated with ageing is increased blood pressure. Elderly individuals often suffer from increased blood pressure, putting them at risk of hypertension.[9]

Based on the findings in Table 2, it is observed that both categories of sleep quality have the same proportion. The results of the cross-tabulation in the table show that older women with poor sleep quality tend to suffer from stage 1 hypertension (n=25) and stage 2 hypertension (n=15). Meanwhile, older women with good sleep quality mostly have normal blood pressure (n=15) or pre-hypertension (n=18). Respondents with poor sleep quality show a more significant increase in blood pressure. This is supported by a study by Maulana (2021), which indicates that an increase in

hypertension levels can negatively impact sleep quality. If an individual's sleep quality deteriorates, it can increase the risk of hypertension.[18]

The relationship between Sleep Quality and Hypertension Level in the Elderly

Based on the results of the non-parametric Spearman's rho analysis (Table 4), a significance value (2-tailed) or p-value of 0.000 ($p < 0.05$), was found, indicating that both variables, sleep quality and hypertension level in the elderly in Desa Pejeng Tampaksiring, have a significant correlation. Additionally, the correlation coefficient was found to be 0.480, indicating a positive result with the meaning of a direct relationship and a moderate correlation strength as the correlation coefficient falls between 0.26 - 0.50. The direct relationship means that the blood pressure measurement tends to increase as sleep quality deteriorates.

The decline in sleep quality in older people is caused by prolonged sleep latency, reduced sleep efficiency, early awakenings, and difficulty maintaining sleep. This is related to degenerative processes associated with ageing that affect organ systems and bodily functions. Decreased neurotransmitter activity reduces melatonin production, a hormone that influences changes in the circadian cycle. As a result, older people have less overall NREM stage 3 and 4 sleep, and they hardly experience stage 4 or deep sleep.[19]

Disruption in body homeostasis, such as increased blood pressure, can be indicated by poor sleep quality. This is related to activating two central systems: the Medulla Adrenal Sympathetic System and the Hypothalamic Pituitary Adrenal-axis (HPA-axis). There is peripheral vasoconstriction in specific organs like the heart due to increased activity of the adrenal medulla, which elevates catecholamines like norepinephrine and epinephrine. This also affects myocardial contractility and conduction rate, increasing cardiac output.[20]

Sleep also has modulatory effects detected on the activity of the HPA axis. When sleep disturbances occur in older people, the pituitary gland produces corticotrophin-releasing hormone (CRH) and Arginine Vasopressin (AVP). This increases cortisol due to corticotropin initiated by CRH release from the hypothalamus. Therefore, poor sleep quality can be associated with HPA axis hyperactivity and increased cortisol hormone levels. The action of cortisol causes excessive gluconeogenesis and glycogenolysis, resulting in thickened blood due to hyperglycemia and increased cardiac workload. Other mechanisms in the body indirectly increasing cardiac output include Vasopressin or ADH (antidiuretic hormone), which induces the expression of water transport proteins in the distal tubules, thereby increasing plasma volume, as well as inflammatory responses causing endothelial dysfunction, followed by plaque activation and development into atherosclerosis, leading to hypertension.[21]

The findings of this study are further supported by the research of Rusdiana (2019), which demonstrates the significant association between poor sleep quality and increased blood pressure in hypertensive patients, with a value of $p = 0.000$ ($p < 0.05$).[22] This is consistent with the research by Ahmad Assiddiqy (2020). The study conducted on older people at the Elderly Integrated Service Post (Posyandu Lansia) RW II of Kedungkandang Community Health Center in Malang City shows a positive correlation between blood pressure and sleep quality with an obtained p-value of 0.001 ($p <0.05$), proving that inadequate sleep quality leads to increased blood pressure in older people, potentially triggering hypertension.[23]

The study by Pradana in 2019 found that sleep disturbances trigger hyperactivity in the nervous system and affect the cardiovascular system due to the suboptimal and imbalanced regulation of blood pressure hormones in the body. Poor sleep quality not only leads to an increase in average blood pressure and heart rate but also causes physical and psychosocial stress and persistent hypertension. Emotional changes such as being easily offended, pessimism, impatience, anxiety, and fatigue can hinder the ability to adopt a healthy lifestyle, thereby increasing the risk of high blood pressure or hypertension.[24] Other studies also support the significance of the relationship between sleep quality and hypertension. Abnormal or poor sleeping habits are said to be involved in the pathogenesis process of non-dipping pre-hypertension, which subsequently leads to hypertension.[25]

From the plethora of studies supporting the significance of the correlation between the two variables in this study, research by Meliza (2020) presents contrasting findings. The p-value between sleep quality and systolic blood pressure was found to be 0.040 ($p < 0.05$), indicating a significant relationship. However, the differing result for diastolic blood pressure, which was 0.623 ($p < 0.05$), proves the insignificance of the relationship between these two variables.[26]

This research highlights the importance of sleep quality in increased blood pressure in older people. Therefore, older people must be able to sleep quickly, not wake up frequently, and get sufficient sleep. Better sleep habits should be integrated into elderly care by caregivers and family members. It's not just the responsibility of medical professionals and families; older people should also be more mindful of their sleep habits and lifestyles to prevent increased blood pressure. Additionally, other factors such as stress management, physical activity, and nutrition must be considered to minimise the occurrence of hypertension in the elderly. Researchers suggest involving older people in active social activities, which is believed to help distract them from stress while keeping them physically active. Salt intake should also be monitored to maintain stable blood pressure in older people. The recommended salt intake is 2.4 grams of sodium or equivalent to 1 teaspoon per person.

Discussion of the relationship between the two variables in this study is clearly outlined despite the differing findings from previous research. Such discrepancies can arise due to methodological differences, data analysis techniques, study types, and researcher-selected sampling techniques. This study, like any other, has limitations that may affect the findings and generalizability of the research. Generalising the findings of this study to other populations of older women in different locations or broader elderly populations may be challenging due to demographic variations that can influence population characteristics such as physical activity, BMI, dietary habits, and smoking behaviour, among others. Moreover, the non-random sampling technique chosen by the researcher has lower generalizability strength than randomization techniques, which offer higher accuracy.

Other researchers need to consider the characteristics of the subjects in this study before generalising to similar populations. Several potential bias variables in this study may affect both sleep quality as an independent variable and hypertension as a dependent variable. Possible biases in sleep quality variables include anxiety levels, family support, lifestyle, and physical activity. Meanwhile, biases in hypertension variables include age, gender, BMI, daily salt intake, physical activity, stress levels, and smoking habits. In this study, the researcher could only control for the age, gender, and BMI of the subjects. Although the researcher measured the level of physical activity through questionnaires and conducted anamnesis related to smoking history, further investigation into the impact of these variables on the findings still needs to be carried out. This could result in a lack of understanding of the mechanisms underlying the relationship between sleep quality and hypertension in the elderly.

The researcher suggests conducting further research with more comprehensive control over confounding variables to ensure the strength of the study's data. Multivariate analysis methods are also recommended for other researchers to gain a more precise and deeper understanding of the relationship between the various data variables. Additionally, this cross-sectional study can only provide an overview of the relationship between the two study variables. Other forms of research, such as cohort studies, systematic reviews, and meta-analyses, may provide more robust and more precise evidence regarding the mechanism of the relationship between sleep quality and hypertension in the elderly.

CONCLUSION

Based on the research findings and the Spearman rho analysis conducted, it can be concluded that there is a significant relationship between sleep quality and hypertension levels among the elderly in the Pejeng Tampaksiring Village. The implication of this study underscores the need for increased collaboration among healthcare professionals, families, and the elderly to create an environment conducive to better sleep habits, thereby reducing blood pressure and improving sleep quality, especially among the elderly with hypertension.

Furthermore, researchers emphasize the importance of conducting further studies to control variables such as physical activity and smoking habits in detail, selecting study designs with higher evidential strength, employing sampling techniques with better randomization, and utilizing more comprehensive data analysis methods. The aim is to deepen the understanding of the mechanism linking sleep quality to hypertension levels and to obtain findings that can be generalized to broader populations**.**

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