

# The Effect of Range of Motion Exercise on Blood Pressure, Pulse and Sleep Quality among Hypertensive Patients

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Range of motion exercise is a simple nursing action that has many benefits and is easy to do independently. The purpose of this study was to determine the effect of range of motion exercise on the blood pressure, pulse and sleep quality of hypertensive patients. This study used quantitative research with a quasi-experimental research design, including pre-test and post-test with a control group approach. The total population was 139 patients. A sample of 70 respondents was determined by stratified random sampling according to the inclusion criteria. The independent variable was the range of motion exercise conducted for seven consecutive days. The dependent variables were blood pressure, pulse and sleep quality. Data was obtained through the Insomnia Severity Index (ISI) instrument and observation sheet. Research data were analysed using paired t-test and MANOVA. The results showed that the differences between the treatment and control groups were changes in blood pressure ( $p = 0.00$ ), pulse ( $p = 0.00$ ) and sleep quality ( $p = 0.00$ ). MANOVA hypothesis test results obtained  $p = 0.00$ . Range of motion exercise affects the blood pressure, pulse and sleep quality of hypertensive patients at Primary Health Care.

**Key words:** *Blood pressure, hypertension, pulse, range of motion exercise, sleep quality.*

## Introduction

Hypertension is considered to be a chronic disease but non-contagious; it is one of the major challenges for the global population (Amboni, Ceretta & Tuon, 2015). Hypertension is a

cause of major cardiovascular diseases and of premature death throughout the world (Hartzell, K., Avis, K., Lozano, D. & Feig, 2016). Indonesia Basic Health Research 2018 showed that the prevalence of hypertension experienced a rise when compared with Indonesia Basic Health Research 2013 (25.8% to 34.1%). In 2016, the National Health Indicator Survey (SIRKESNAS) stated that the percentage of the population with hypertension had increased to 32.4%. In 2018, Nanga Mahap Primary Health Care Profile stated that hypertension is among the ten major diseases, with 556 people admitted with hypertension in the past year. Research on the influence of range of motion exercise on the strength of muscles, the decreasing of pain, prevention of delirium and blood pressure in the elderly has already been carried out, but the influence of range of motion exercise on blood pressure, pulse and the quality of sleep among pre-elderly patients with hypertension has not been investigated (Guan, Fang, Wu & Liu, 2014).

Hypertension causes anxiety, which causes emotional disorders. In addition, due to the blood pressure being high, the symptoms that arise are headache, tachycardia, difficulty breathing and the body feeling tired, which creates difficulty in waking from sleep. This lack of sleep will eventually have an impact on one's activities during the day (Black & Hawks, 2014). In physiological terms, poor quality of sleep can lead to low levels of health in individuals and increasing fatigue or quicker onset of fatigue. Patients with hypertension experiencing a poor quality of sleep will find this having an impact on their overall quality of life (Xu et al., 2016). Abnormalities of sleep occur in a large percentage of the population and this is usually not discussed until the medical part of the evaluation is complete. If patients with hypertension have good quality sleep, this can decrease the risk of occurrence of cardiovascular diseases (Wennman et al., 2014).

Lack of sporting activity or other forms of exercise in patients with hypertension also affects the quality of sleep (Ogeil & Phillips, 2015), so people with hypertension need to preserve their blood pressure, pulse and quality of sleep by becoming more active. Activities or sports are conducted as a method of self-care by the patient, as a kind of behaviour to maintain life, health, development and lives in the vicinity. Patients take part in activities and sports by moving their muscles and joints in order and one of the activities that can be carried out by the patient on their own is range of motion exercise. Range of motion exercise can: prevent the occurrence of contractures and atrophy of muscles; increase circulation of blood to the extremities; reduce paralysis vascular; and provide comfort to the client. Contractions that occur in the muscles will increase muscle metabolism (Muris et al., 2014). The principal component that is needed for metabolism is oxygen. The muscle's oxygen needs will increase during contraction compared to a state of rest, thus causing an increase in the supply of blood to the muscles, which is activated to meet the needs of the oxygen network (Galindez-Ibarbengoetxea et al., 2017). The fulfillment of oxygen needs in the tissues will be relaxed so that the burden of work affecting the heart in patients with hypertension will decrease and

cause the blood pressure and pulse to decline. In addition, relaxed conditions will cause activity in the reticular activating system (RAS) to decrease so that the mechanism for the release of the serum serotonin from cells is specified in the pons and the stem of the central brain to last longer, so that the duration of sleep can be longer (Afriwardi, 2010).

Range of motion exercise consists of several types of movements in parts of the body. Such movements are simple and do not require tools to support the activities, so the patient will find it easy to remember and practice the range of motion exercise independently at home (Denyes, Orem & Bekel, 2001; Orem & Taylor, 2011). Based on these phenomena and problems, the authors are interested in researching the effect of range of motion exercise on the blood pressure, pulse and sleep quality of hypertensive patients, with Dorothea E. Orem's self-care theory approach as an independent treatment action by and for patients with hypertension.

## **Literature Review**

### ***Range of Motion***

ROM (Range of Motion) is the maximum amount of motion that a joint can do on one of the three body planes namely sagittal, transverse and frontal. Another understanding of ROM is joint movement exercises that allow for contractions and muscle movements, where the client moves each joint according to normal movements both actively or passively (Andersen, Andersen, Mortensen, Zebis & Sjøgaard, 2011; Halberg et al., 2013). (ROM exercises are exercises that are done to maintain or improve the level of perfection of the ability to move joints normally and completely to increase muscle mass and muscle tone. ROM is a movement in a normal state that can be done by the joints concerned. ROM training is a standard term for expressing the limits of normal joint motion and as a basis for establishing abnormalities or for expressing abnormal joint motion limits (Fong, Blackburn, Norcross, McGrath & Padua, 2011; Konor, Morton, Eckerson & Grindstaff, 2012).

There are two types of ROM namely passive and active. Active ROM is a movement carried out by a person (patient) using his own energy. The nurse provides motivation and guides the client in carrying out joint movements independently according to the range of normal joint motion (active client), 75% muscle strength. This trains the flexibility and strength of muscles and joints by actively using the muscles. Passive ROM is the energy expended for training which comes from other people (nurses) or mechanical devices. Nurses do the joints of the client according to the normal range of motion (passive client), 50% muscle strength (Fong et al., 2011; Mohr, Long & Goad, 2014). Patients with limited mobilisation are unable to do some or all ROM exercises independently for example total bed rest patients or patients with total external paralysis. This passive range of motion is useful for maintaining the

flexibility of muscles and joints by passively moving other people's muscles such as nurses lifting and moving the patient's legs (Konor et al., 2012).

### ***Sleep Quality***

Sleep is an unconscious state so that perception and reaction to the environment disappears or decreases and can return if awakened with appropriate stimulation. Nearly one third of life is used for sleep. Sleep is a period to rest the body and mind after being used for one full day. Sleep itself is a process of changing consciousness that occurs repeatedly during a certain period, which consists of periods of shallow sleep (NREM) and deep sleep (REM) (Chennaoui, Arnal, Sauvet & Léger, 2015; Karadag, Samancioglu, Ozden & Bakir, 2017a).

During sleep there are physiological changes in the body such as decreased blood pressure and pulse, peripheral vascular dilatation, increased activity of the gastrointestinal tract, skeletal muscle relaxation and a decrease in BMR (Basal Metabolic Rate) by 10-30%. Sleep quality is a condition that results from the sleep process experienced by an individual so as to produce freshness and fitness when awakened the next morning. Sleep quality includes several aspects: sleep latency; sleep duration; sleep dysfunction during the day; sleep habits; sleep efficiency; sleep disorders; and the use of sleeping pills (Karadag, Samancioglu, Ozden & Bakir, 2017b).

Sleep quality is a condition experienced by the elderly. Most of the elderly experience problems related to sleep patterns due to changes in body systems and the aging process. Some of the factors that affect sleep quality in the elderly are age, gender, environment, stress conditions, health conditions, food and medication. Poor sleep quality in the elderly will cause them to: be stressed; prone to illness; be confused or disoriented; experience mood disorders; feel less fresh; and have decreased concentration (Kamdar et al., 2013).

### ***Hypertension, Blood Pressure and Pulse***

Hypertension is an increase in blood pressure in someone ( $> 140/90$  mmHg) and is measured at least twice in different measurement periods (Evangelou et al., 2018; Warren et al., 2017). Hypertension is a major risk factor for cardiovascular and kidney disease. Even though treatment for hypertension is available, only about 25% of people with hypertension are under controlled with their blood pressure. Effective management in patients with hypertension is recommended to assess the asymptomatic target organ damage and the risk of secondary causes. Management of hypertension depends not only on the level of blood pressure, but also on the risk of cardiovascular disorders. The goal of hypertension management is to maintain blood pressure in a controlled manner and prevent complications (Evangelou et al., 2018; Warren et al., 2017).

People with hypertension must be responsible for taking care of themselves every day. This treatment includes blood pressure monitoring, diet management, maintaining physical activity, maintaining weight, stress management and medication adherence. Appropriate treatment and lifestyle modification will help to prevent and slow down complications. Blood pressure that is not well controlled will contribute to heart and kidney disease. Therefore self-regulation to achieve the desired blood pressure level is very important (Warren et al., 2017). Hypertension has a big relationship with blood pressure, which is also vital because it delivers white blood cells and antibodies for immunity and hormones such as insulin. Just as important as providing oxygen and nutrients, the fresh blood that gets delivered is able to pick up the toxic waste products of metabolism, including the carbon dioxide we exhale with every breath and the toxins we clear through our liver and kidneys. Blood itself carries a number of other properties, including temperature. It also carries one of our defenses against tissue damage, the clotting platelets that prevent blood loss following injury (Evangelou et al., 2018).

### **Methodology**

This research used quantitative research methods with a quasi-experimental research design, including pre-test and post-test with a control group approach. This research was conducted at the Primary Health Care facility from November 7 to 17, 2019. The independent variable was range of motion exercise and the dependent variables were blood pressure, pulse and sleep quality in hypertensive patients. The target population was 556 people and the affordable population was 139 people. Inclusion criteria were: hypertension patients who experience sleep disorders (based on interviews); early elderly hypertensive patients; an age range of 46–55 years; hypertensive patients with blood pressure >140/90 mmHg over the past year; and hypertensive patients with the ability to move. Exclusion criteria were: patients who are not cooperative; total and partial care patients; patients taking sleeping pills; patients taking diuretic drugs; and patients with comorbidities outside hypertension.

### ***Samples***

This study used a stratified random sampling technique. The determination of sample size was based on the formula according to Sastroasmoro dan Sofyan Ismael (2010), with a minimum number of 27 people for each group.

### ***Instruments***

The instrument used in this study is the ISI questionnaire, which is a measure to subjectively assess symptoms of sleep disorders or the severity of the disorder in a person experiencing

insomnia. As well as measurement of pulse and blood pressure used in vivo data collection in the form of observations by standard operational procedures for the measurement of vital signs with normal values.

### ***Data Analysis***

The stages of data analysis were descriptive and inferential analysis. Descriptive analysis is used to describe data scientifically in the form of tables or graphs (Nursalam, 2015). Demographic data, such as gender, respondent age, education, occupation, duration of suffering from hypertension, consumption of hypertension drugs and time of examination at the primary health care facility, are expressed in numbers and percentages. Statistical test data is normally distributed with parametric tests, while those that are not normally distributed use nonparametric tests (Dahlan, 2004). The normality test used was the Kolmogorov–Smirnov test and the homogeneity test used was the Levine test. A paired t-test was used to determine which variables among blood pressure, pulse and sleep quality of patients with hypertension are most affected by range of motion exercise. A MANOVA test was used to determine the effect of range of motion exercise on blood pressure, pulse and sleep quality of hypertensive patients, establishing whether there is a difference before and after the patient is given an intervention. If any influence was found, then the data-processing SPSS software was used. If the p-value = 0.05 and a significant value  $\leq 0.05$  is obtained, then the hypothesis is accepted, namely: there is an effect of range of motion exercise on the blood pressure of hypertensive patients, there is an effect of range of motion exercise on the pulse of hypertensive patients, and there is an effect of range of motion exercise on the sleep quality of hypertensive patients.

### ***Ethical Considerations***

This research received ethical approval for health research from the Health Research Ethics Commission of the Faculty of Nursing, Airlangga University with No: 1792-KEPK.

### ***Results and Findings***

Table 1 shows that the majority of respondents are aged 51–55 (62.85%) and are male (57.14%). In terms of occupation, the majority of respondents are farmers (37.14%). Most of the patients (51.42%) have had hypertension for more than five but less than ten years. The majority of research respondents (94.28%) said they were taking hypertension drugs.

**Table 1:** Respondents' characteristics

Characteristics	Treatment		Control	
	N	%	N	%
Age				
1. 46–50 years	13	37.14	14	40
2. 51–55 years	22	62.85	21	60
Sex				
1. Male	20	57.14	18	51.42
2. Female	15	42.85	17	48.57
Employment				
1. Farmers	13	37.14	9	25.71
2. Private employees	10	28.57	11	31.42
3. Civil Servant	7	20	8	22.85
4. Jobless	5	14.28	7	20
Duration suffering from hypertension				
More than two years	10	28.57	9	25.71
More than five years	18	51.42	21	60
More than ten years	7	20	5	14.28
Consuming hypertension medication				
Yes	33	94.28	34	97.14
No	2	8.57	1	2.85
Schedule for check-up				
1. Per week	3	8.57	5	14.28
2. Twice per week	5	14.28	5	14.28
3. Per month	7	20	6	17.14
4. Twice per month	6	17.14	10	28.57
5. Seldom	14	40	9	25.71

Table 2 shows the blood pressure, pulse and sleep quality variables in the treatment group improved after being given a range of motion exercise treatment. The results of the paired t-test showed that the blood pressure, pulse and sleep quality saw a significant change and the value obtained was  $p < 0.05$ .

**Table 2:** Distribution of the values of blood pressure, pulse and sleep quality (pre-test and post-test) in the treatment and control groups.

Variable	Treatment		P value	Control		P value
	Pre-test	Post-test		Pre-test	Post-test	
	Mean± SD	Mean± SD		Mean± SD	Mean± SD	
Systole	167.42± 13.137	154.00± 14.183	0.000	162.00± 10.516	169.71± 11.753	0.000
Diastole	103.71± 6.896	94.85± 7.017	0.000	98.00± 8.677	99.71± 7.853	0.263
Nadi	104.77± 7.104	97.00± 5.687	0.000	104.20± 7.884	106.40± 7.604	0.005
Sleep	21.14± 3.309	18.28± 2.640	0.000	17.91± 2.627	18.60± 2.415	0.000

**Table 3:** Results of multivariate tests for range of motion exercise in the treatment and control groups.

Effect		Sig
Intercept	Pillai's trace	0.000
	Wilks' lambda	0.000
	Hotelling's trace	0.000
	Roy's Largest Root	0.000
Patient Group	Pillai's trace	0.000
	Wilks' lambda	0.000
	Hotelling's trace	0.000
	Roy's Largest Root	0.000

As can be seen in Table 3, the multivariate tests showed that the number of signs in the test results in Pillai's trace, Wilks' lambda, Hotelling's trace and Roy's Largest Root are  $0.000 < 0.05$ , which means range of motion exercise affects the blood pressure, pulse and quality of sleep variables in both the treatment group and the control group.

The results showed that systolic blood pressure and diastolic blood pressure differed after seven days of intervention. Systolic blood pressure and diastolic blood pressure in the treatment group decreased after the intervention of ROM was given. This study is in line with research with the title "Effect of ROM exercise on changes in blood pressure in the elderly after stroke in the elderly at Tulus Kasih Bandung" (Hosea Jory, 2016). Hypertension patients have a condition of high blood pressure, which involves elevated blood pressure in the arteries that are abnormal (Irianto, 2014). Range of motion is an activity to move bones and

joints, so it can be used as a form of exercise that if done regularly, can provide health benefits for the body (Ogeil & Phillips, 2015). Range of motion consists of 12 types of simple movements and does not require supporting activities. Consequently, it is easy for the patient to remember and practice independently as a form of patient awareness and concern for self-care and as a form of patient behaviour to maintain life, health and development (Muris et al., 2014).

In this study, the range of motion given to the patient is an active range of motion, where the motion is carried out by the patient independently with her own energy. Patients will feel more comfortable because the range of motion is easier to practice compared to exercise that requires supporting tools. As well they can use it as a nonpharmacological therapy or adjunct therapy to anti-hypertensive drugs in maintaining blood pressure to remain stable.

With the intervention of range of motion the patient gets several benefits, including having adequate and optimal breathing, smooth blood circulation and increased blood flow to muscles and tissues (Orem & Taylor, 2011).

High blood pressure puts an extra burden on the work of the heart and blood vessels, which can cause poor blood circulation (Lo, Woo, Martin & Wilson, 2018). Regular physical activities such as exercise can reduce peripheral resistance, which can reduce blood pressure and train the heart muscle so that it becomes accustomed to heavier work because of certain conditions. Also, regular exercise will stimulate the release of endorphins (endogenous morphine), which cause euphoria and muscle relaxation, thereby preventing an increase in blood pressure (Medications & Changes, 2014; Poulter, Prabhakaran & Caulfield, 2015). Range of motion is the activity of moving muscles and joints as a whole in every part of the body. Muscles and joints that are moved regularly can help in increasing the ability of blood vessels to be more flexible or elastic, so that they can carry out their function of dilation more effectively. Maximal vasodilation allows the process of maximum blood circulation, which causes the heart to decrease the pumping of blood throughout the body so that blood pressure decreases (Amboni et al., 2015).

In the treatment group, six respondents did not experience changes in systolic blood pressure and ten people did not experience changes in diastolic blood pressure. Blood pressure is influenced by various factors such as food or diet consumption, as well as lifestyle including the habit of consuming alcohol or cigarettes (Lo et al., 2018). Consequently, the blood pressure in these respondents was still in the same range despite them being given range of motion as an activity or sport. The results of the distribution of research in the control group showed that the respondents' blood pressure was the same as the previous measurements, and even experienced a significant increase. Respondents in both the control and treatment groups took hypertension medication. Most of the control group underwent a health check at the

primary health care facility twice a month. Respondents in the treatment group underwent a health check at the primary health care facility once a month. However, changes in blood pressure were significant in the treatment group (Williams et al., 2018).

The results of this study on the pulse indicate that there is an effect after being given the ROM exercise intervention in the treatment group, where the respondent's pulse has changed or decreased. All respondents in the treatment group experienced a decrease in pulse frequency. The pulse describes the condition of blood pressure, activity and the ability of the heart pump to distribute oxygen-rich blood systemically. High blood pressure results in the emergence of abnormal pulse conditions, which are likely to be faster than normal conditions, as an effort or attempt to provide blood supply throughout the body (Xu et al., 2016). The benefits of ROM can facilitate blood circulation and help in reducing pain, as in a study entitled "The Effects of Combination of Range Motion and Deep Breathing Exercise on Pain in Post-Orthopedic Surgery Patients" (Sasongko, Sukartini, & Wahyuni, 2019).

Hypertension patients tend to experience pain in the head, neck and shoulder to chest area caused by high blood pressure, which causes blood vessels to become stiff, with functions becoming degenerative and even affecting the brain (Lo et al., 2018). A body condition that is free from pain provides an opportunity for the body to be in a relaxed condition so that the adrenal medulla maximally produces catecholamines. Consequently, the body, feelings and mind become relax and avoid tachycardia (Robbins, Kumar, 2013).

The results of the control group showed that the respondent's pulse had an increased frequency compared to the previous measurement. According to researchers, stable blood pressure will produce stable pulse frequencies. For this reason, patients should be taught to calculate or check their pulses independently. The pulse describes the heart rhythm. By knowing the frequency of the pulse, the patient will know in general, the picture of their health and in particular, their blood pressure, so that they make appropriate decisions about health management or maintenance efforts (Medications & Changes, 2014; Poulter et al., 2015).

The results of this study on sleep quality showed that there was an improvement in sleep quality after the patient was given the ROM intervention. The improved quality of sleep shown by the treatment group is linked to the theory of self-care put forward by Dorothea E. Orem, who revealed that everyone is responsible for implementing self-care and is involved in making decisions in self-care. Self-care agency is the ability or willingness possessed by an individual to identify, determine and make decisions, and carry out self-care in the form of ROM actions. Hypertension patients are given input or learning in the form of ROM as new information media. Furthermore, patients will make their own decisions to implement ROM independently (Halberg et al., 2013).

The condition of body's relaxation is characterised by a decrease in the pulse that is obtained through ROM, causing the pineal gland to work optimally in producing melatonin. This plays an important role as a sleep hormone and a conductor in regulating the balance of hormones and cell metabolism. ROM is one form of activity that has benefits in maintaining smooth blood circulation, so that blood flow to muscles and tissues increases (Galindez-Ibarbengoetxea et al., 2017). The amount of melatonin can be increased by doing sports or activities that can provide benefits to facilitate the flow of blood and hormones from the brain throughout the body. If the production of melatonin is in maximum condition, then one's sleep needs will be met. As many as three respondents in the treatment group did not experience improved sleep quality. This was due to the quality of sleep being influenced by various factors, including psychological stress factors and the consumption of drugs and chemicals as well as the motivation to achieve deep sleep (Lin et al., 2016).

Research in the control group showed that respondents were still in a state of sleep disturbance and even experienced a change, moving in the direction of severe sleep disturbance. The control group experienced changes in the rise of blood pressure and pulse frequency, so there tended to be a low quality of sleep among the control group respondents. This is in line with a study entitled "Subjective sleep quality, blood pressure, and hypertension: a meta-analysis", which states that sleep disorders are associated with high blood pressure (Lo et al., 2018).

Researchers argue that if the patient performs routine activities every day in the afternoon or before going to sleep, this will help them to achieve quality sleep. However, it should also be noted that there are several other factors that can help to achieve adequate sleep, such as light or lighting in the bedroom, consumption of food or drinks before going to bed and clean, neat room conditions. These factors can have an effect on how fast or slow a person can achieve deep sleep and have maximum sleep duration.

## **Conclusion**

ROM exercise accelerates blood circulation and increases the elasticity of blood vessels, having an influence on blood pressure in hypertensive patients. Also, it can reduce pain and cause the body to be in a relaxed condition, which affects sleep quality in hypertensive patients.

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