DIETARY SODIUM REDUCTION TO REDUCE BLOOD PRESSURE IN PATIENTS WITH HYPERTENSION: EVIDENCE-BASED NURSING

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ABSTRACT

Hypertension is a non-communicable disease that is escalating in incidence as a medical and public health problem worldwide. According to previous studies, dietary sodium has been found to be associated with hypertension.

The present study was conducted to summarize current evidence on dietary sodium reduction to reduce blood pressure in hypertensive patients and draw conclusions on recommendations based on the evidence obtained. The search strategy followed PICO frame work of Melnyk and Fineout-Overhold 2015. The relevant evidence from 2006 to 2015 came from various electronic databases in the Mahidol University library system.

The author's search yielded three systematic reviews (Level-I) and three RCTs (Level-II). The author appraised the evidence and drew conclusions based on recommendations about dietary sodium reduction in hypertensive patients. The recommendations are as follows: 1) dietary sodium reduction is an effective intervention to reduce blood pressure for all groups of hypertensive patients; 2)patients should reduce sodium intake to 3-5 g/day for at least four weeks for lower systolic and diastolic BP; 3) dietary advice should be provided for patients and their families by trained nurses; 4) descriptions of high blood pressure, risk factors and complications should be given in addition to the importance of and strategies for sodium reduction and 5) sources of foods with low sodium content, alternative foods and DASH diet eating plans should also be provided.

Based on the findings, clinical practice guidelines should be developed on dietary sodium reduction as suitable for the Bangladeshi context. Nurses should be trained in dietary sodium reduction. Further research is recommended to evaluate the effectiveness of sodium reduction within the context of Bangladesh with clinical practice guidelines for nurses.

KEY WORDS: HYPERTENSION/DIETARY SODIUM REDUCTION / EVIDENCE-BASED NURSING

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CHAPTER I
INTRODUCTION

1.1 Background and significance of the problem

Hypertension is a major public health problem in developed and developing countries as the most significant cause of consequent disability and death worldwide. Hypertension is a disease that causes premature disabilities and fatalities, and cannot be cured completely during a person's lifetime. Hypertension is also a silent killer and the most important public risk for heart disease, chronic renal disease and stroke. More than one fourth of adults currently suffer from hypertension. Approximately 80% of the deaths occurring in developing countries are due to hypertension (Biswas, Islam, & Islam, 2015). According to Kearney and colleagues (2005), 972 million mortalities are estimated to be caused by hypertension worldwide. Among these, 333 million were in developed countries and 639 million were in developing countries (Kearney et al., 2005). The prevalence of hypertension has been proven to be higher in developed countries than developing countries (Ibrahim & Damasceno, 2012). Thus, hypertension is a major cause of death in which calculations show 9.4 million deaths to occur every year due to hypertension and complications (Erkoc, Isikli, Metintas, & Kalyoncu, 2012; Rahman, Gilmour, Akter, Abe, Saito, & Shibuya, 2015). Globally, 26% of all adults have hypertension, 13% have cardiovascular disease, 62% suffer strokes and 49% have ischemic heart disease (Aburto, Ziolkovska, Hooper, Elliott, Caappuccio, & Meerpohl, 2013). These events are attributable to elevated blood pressure (Geaney et al., 2015; He, Campbell, & MacGregor, 2012; He & MacGregor, 2009).

Hypertension is a global disease burden. In the United States, 65 million American adults are estimated to be hypertensive and the prevalence rate is nearly 30%, among the population with 29.7% incidence in men and 28.5% in women (Nwankwo, Yoon, Burt, & Gu, 2013). The prevalence of hypertension in India has been rising. In 2009, hypertensive patients in India totaled 118.2 million. Among

these, 60.4 million were males and 57.8 million were females who tended to live in urban areas more than in rural areas (Chaturvedi, Jindal, & Kumar, 2009). The incidence of hypertension in Sri-Lanka is 43.5% with 18.8% incidence in men and 19.3% in women (Katulanda et al., 2014).

According to a study by Islam and colleagues (2012), approximately 20% of adults and 40–65% of elderly people in Bangladesh suffer from hypertension. Based on findings, the incidence of hypertension in Bangladesh is 17.9%. Among these, 18.5% are men and 17.3% are women. Similar to other countries, hypertension in Bangladesh is more common in elderly people. Hypertension is a major chronic health problem and the fifth most significant risk factor for death and disability in Bangladesh as in other countries worldwide (Islam & Majumder, 2012; Rahman, Gilmour, Akter, Abe, Saito, & Shibuya, 2015).

The ultimate goal in treating hypertensive patients is to control blood pressure at an acceptable level. As a result, complications such as cardiovascular disease, stroke, and chronic kidney disease can be reduced. A patient with hypertension can reduce 25–40% of risk for cardiovascular mortality by reducing 10 mmHg in blood pressure (Rahman, Gilmour, Akter, Abe, Saito, & Shibuya, 2015). Generally, low sodium intake is recommended to lower blood pressure.

However, many risk factors related to hypertension have been identified in literature. The author reviewed literature and described the risk factors as follows:

Risk factors related to hypertension

The risk factors associated with hypertension are categorized into intrapersonal or non-modifiable risk factors (e.g. age, sex, heredity, and genetic) and extrapersonal or modifiable risk factors (e.g. excess dietary sodium intake, excess body weight, reduced physical activity, smoking and excess alcohol intake and stress) (Chistensen & Kockrow, 2003).

Intra personal or non-modifiable risk factors are as follows:

1) Heredity: Family history of hypertension has been used as an indicator influencing the epidemiology of hypertension. Genetic predisposition factors seem to be an important part in salt sensitivity with hypertension (Ibrahim & Damasceno, 2012).

2) Ethnicity: African Americans suffer from a higher incidence and prevalence of hypertension than Caucasian Americans. Additionally, hypertension is a major cause of high rates of coronary heart disease, stroke and kidney disease in African Americans compared to Caucasian Americans (Wang, Tiwari, & Wang, 2014).

3) Age: Age has a positive correlation with hypertension, because aortic dispensability decreases with age. This results in increased arterial vascular resistance. More than half of people aged 60-90 years old and approximately three-fourths of those aged over 70 years are diagnosed with hypertension. The incidence of hypertension increases with age in both men and women (Neupane et al., 2014; Thawornchaisit et al., 2013). In addition, aging is mainly responsible for an increase in both the incidence and prevalence of hypertension (Wang, Tiwari, & Wang, 2014).

4) Genetic: Angiotension II and angiotensinogen in a renninangiotensin system are the most important factors that are genetic abnormalities associated with hypertension (Lifton, Gharavi, & Geller, 2001; Wang, Tiwari, & Wang, 2014). The effects of angiotension II induce peripheral vascular constriction and increase peripheral vascular resistance resulting in high blood pressure. Moreover, hypertension is related to the release of norepinephrine, epinephrine and catecholamines in addition to sodium potassium pump. However, among individuals with no family history of hypertension, there are joint contributions to these genetic mutations with the effect of increasing blood pressure levels (Beeks et al., 2001; Bray, Li, Turner, Kardia, & Boerwinkle, 2000; Wang, Tiwari, & Wang, 2014).

Extra personal risk factors or modifiable risk factors are as follows:

High dietary sodium intake, smoking, obesity, excessive lipid intake, stress, limited physical activity, excessive alcohol and caffeine intake are the modifiable risk factors for hypertension. At present, the incidence rate of hypertension has been increasing dramatically due to these factors. High dietary sodium intake is the most common modifiable risk factors (Ibrahim & Damasceno, 2012).

High dietary sodium intake as a factor in blood pressure with much greater influence than other factors (Ibrahim & Damasceno, 2012). High dietary sodium consumption is associated with hypertension leading to more than 7.6 million premature deaths and 92 million disabilities every year (He, Campbell, & MacGregor,

2012). Hypertension accounts for nearly 13% of all mortalities worldwide (Mohan & Prabhakaran, 2012). It's also a cause of 92 million disabilities every year. Hypertensive patients with lower levels of blood pressure can significantly decrease cardiovascular risks with a significant decrease in cardiovascular mortality and morbidity. Reduced dietary sodium intake is a major guideline as one of the first line interventions in the treatment of hypertensive patients (He, Campbell, & MacGregor, 2012; Matyas et al., 2011).

In Bangladesh, rice and fish are the basic foods in daily dietary plans. A meal with rice is very common. Rice, fish, poultry, other meats vegetables and spicy curry (torkari) are cooked with different kinds of sauces such as tomato sauce, soya sauce and chili sauce, containing cumin, coriander, cloves, cinnamon, garlic and other spices with added salt. Among the common foods items, dried fish (suri sutki, hilsha sutki and shamudrik sutki) and sea fish are more salty. Puffed rice (muri) and chira vaja are another kinds of rice preparation containing high amounts of salt. A well-known food item is ruti (a whole wheat circular flatbread) is one in which people who made ruti use more salt. Furthermore, important snacks are tea, pretzels biscuits (salty biscuits), chanachur, jal muri, fried peas, fried dal, cheese, crackers and puffs. Popcorn also contains high amounts of salt.

Based on findings from the World Health Day 2013, the average per-head salt intake of every country is too high and ranges from 9 g/day to 12 g/day (He, Campbell, & MacGregor, 2012; He & MacGregor, 2009; Rasheed et al., 2014). In Bangladesh, daily intake of dietary sodium is 15 to 21 g/day (Rahman, Gilmour, Akter, Abe, Saito, & Shibuya, 2015). Salt intake in Bangladesh appears to be much higher recommended by the World Health Organization or Dietary Guidelines for Americans (Islam & Majumder, 2012). The World Health Organization dietary guideline (2012) suggests that less than 2,000 mg sodium or 5 gm salt be consumed per day for adults. Recently, salt consumption was reduced to 3 g/day as recommended by the National Institute for Health and Clinical Excellence (NICE) (2010).

Although, low salt intake is recommended global life styles have changed dramatically. In today's world, people are more dependent on processed and preservative foods containing high amounts of sodium. Sodium content is high in

processed foods at estimates of 100 g with some foods containing excessive sodium such as 250 mg of sodium in 100 g of bread: 1,500 mg in processed meats and snack foods such as popcorn, pretzels and cheese: 7,000 mg in soya sauces and 2,000 mg in bouillon or stock cubes. A reduction in salt intake is one of the most cost-effective interventions for reducing blood pressure, cardiac disease and stroke as shown in several studies (World Health Organization, 2012). However, hypertension can silently damage the human body before developing symptoms. The impacts of this damage are addressed below:

Impacts of hypertension

Hypertension is a risk factor for heart disease which has turned into one of the major global disease burdens. Additionally, chronic diseases such as diabetes mellitus and renal diseases are strongly correlated with hypertension. Globally, the burden of hypertension has been increasing rapidly with 30% of all mortalities reported to be associated with hypertension (Wang et al., 2009). This disease has not only physical, but also psychological and economic impacts as described below.

1) Physical impact

Hypertensive affects patients by loss of ability to perform the activities of daily living (ADL) and low self-confidence as patients suffer the lifelong effects of hypertensive complications associated with chronic disease. High blood pressure does not always produce obvious symptoms, but leads to renal, cardiovascular, ophthalmological (retinopathy or optic neuropathy) and problems with the central nervous system identified by memory loss, personality changes, trouble concentrating, irritability or progressive loss of consciousness (encephalopathy). Hypertension may also cause a number of medical emergencies such as stroke, severe damage to main arteries, preeclampsia or eclampsia in pregnant women and acute kidney damage. Furthermore, hypertension may also cause cardiac and respiratory emergencies such as unstable chest pain, heart attacks occurring due to sudden impaired pumping of the heart leading to excessive fluid in the lungs resulting in shortness of breath and pulmonary edema (Gomibuchi, Okazaki, Iwai, Kumai, Kobayashi, & Oguchi, 2007; Thornton, Dadelszen, Makris, Tooher, Ogle, & Hennessy, 2011).

2) Psychological impact

Hypertension is a stressful life event for many individuals and their families. Patients with hypertension increase the burden of family members in taking care of these patients. Stress may also increase patients' blood pressure, heart rate, muscle tone and alertness as breathing becomes deeper and more rapid. Hypertensive patients may also suffer anxiety, fear and severe depressive symptoms (Cousineau & Domar, 2007).

3) Economic impact

Patients with hypertension frequently spend out-of-pocket money for their treatment purposes. In addition to magnificent substantial economic burden, this frequently forces numerous families into poverty particularly those with chronic conditions such as hypertension involving lifelong care. If the patient is the main source of family income, lengthened hospitalization can cause loss of family income and financial status. In 2004, the American Heart Association (AHA) estimated the direct and indirect costs of hypertension to be $USD 55.5 billion. Nearly half of this expenditure can be attributed to drugs and other medical costs (Gerin et al., 2007).

Hypertension is also a disease that affects quality of life. It is important to note that patients with hypertension have lower quality of life if they have high distress levels, more co-morbidities and complications from the disease. Therefore, everyone should take necessary action toward preventing hypertension.

Hypertension-related complications

Persistently high blood pressure can damage the body and cause complications. According to the National Institute of Health (2015) common complications have been identified as follows:

1) Aneurysms: Hypertension contributes to the thickening of the arterial walls, which can cause atherosclerosis and form abnormal bulges in the walls of the arteries. Subsequently, aneurysms can increase in size, press on body parts and obstruct the blood flow. These anomalies can develop over years without clinical manifestations until ruptured. The clinical features of aneurysms depend on the location of the aneurysms (Bakris & Ritz, 2009).

2) Chronic Kidney Disease: When blood vessels narrow in the kidneys, renal risks appear with vascular lesions in the kidneys primarily affecting the preglomerular arterioles with consequential ischemic changes in the glomerular structures. Glomerular damage can be an outcome of direct damage to the glomerular capillaries possibly leading to kidney failure (Bakris & Ritz, 2009).

3) Cognitive Changes: Over time, hypertension can have effects on cerebral function marked by memory loss, trouble finding words and losing focus on conversations (Bogaard, Abe, Noordegraaf, & Voelkel, 2009; NHS, 2015).

4) Eye Damage: Severe hypertensive patients usually experience symptoms such as rapid occlusion of the capillaries and constructions at specific sites, retinal bleeding and papilledema, which will cause scotomata, blurred vision and possible blindness (Woods, 2002).

5) Heart Attack: This cardiac symptom develops due to sudden blockage of the oxygen-rich blood in a section of the heart muscle. As a result, the heart does not received sufficient oxygen. Heart attacks can be identified by symptoms of chest pain or discomfort, upper body discomfort and shortness of breath (Bogaard, Abe, Noordegraaf, & Voelkel, 2009).

6) Heart Failure: This cardiac condition develops when the heart is unable to pump the necessary amount of blood to meet the body’s needs. This disease can be identified by symptoms such as shortness of breath or dyspnea; fatigue; and edema in the ankles, feet, legs, abdomen and veins in the neck (Bogaard, Abe, Noordegraaf, & Voelkel, 2009; NHS, 2015).

7) Peripheral Arterial Disease: This is related to a circulatory problem with a narrowing of the arteries in the legs as plaque formations appear and affect blood flow. People have symptoms including pain, cramping, numbness, aching or heaviness in the legs, feet and buttocks after walking or climbing stairs (Yu, Zhou, & Cai, 2011).

8) Stroke: This condition occurs when there is a reduction or disruption in oxygenated blood flow to the brain or parts of the brain. This disease can be identified with symptoms such as sudden weakness or numbness in the patients’ arms, legs, and face; trouble in brain function such as memory loss, speaking, understanding words and visual defect (Yu, Zhou, & Cai, 2011).

To prevent these complications, blood pressure needs to be controlled in hypertensive patients. According to the NICE guideline for the management of hypertension, normal systolic blood pressure at rest is within the range of 100–140 mmHg and diastolic blood pressure ranges between 60–90 mmHg. For most adults, hypertension is diagnosed when systolic blood pressure is persistently high at or above 140 mmHg and diastolic blood pressure is 90 mmHg (Krause, Lovibond, Caulfield, McCormack, & Williams, 2011). The dietary sodium reduction in hypertensive patients is the first line intervention for controlling blood pressure (Matyas et al., 2011).

Dietary sodium reduction in hypertensive patients

Salt is a vital nutrient. This vital nutrient is essential for maintenance of plasma volume, acid base balance, spread of nerve impulses and normal cell function (Aburto et al., 2013). Salt intake and increasing blood pressure have a strong positive correlation (Cook et al., 2007). Reduced dietary salt intake decreases blood pressure and prevents hypertension.

At present, public health recommends reducing salt intake from 9-12 g/day to 5-6 g/day. Furthermore, the World Health Organization (2014) recommends reduced salt intake from 9-12 g/day to 5 g/day. The United States Institute of Medicine (2010) recommends a sodium intake reduction to less than 2,300 mg/day (salt intake of 5.75 g/day) while the United Kingdom’s government health advisory agency (2010), recommends a reduction in the population’s salt consumption to 3 g/day by 2025. The American Heart Association (2014) has provided dietary guidelines for daily intake of sodium at less than 6 g/day, the equivalent of 2,400 mg of sodium, to achieve and maintain normal blood pressure. The US Department of Agriculture and the US Departments of Health and Human Services recommend daily intake of less than 6 grams of salt /2,300 mg of sodium (Dietary guidelines for Americans, 2010).

In daily diets, several dietary elements contain high salt and dietary habits are recognized as the most important contributors to a patient’s sodium intake. Sodium is also found in shellfish and sea food. Many condiments such as soya and fish sauces, as well as prepackaged foods, canned foods such as bread, crackers, pretzels, cheese, puffs popcorn, meats and snacks foods contain high amounts of salt. Fresh fruits and

vegetables contain lower amounts of sodium with much higher sodium content in processed foods (Aburto et al., 2013). Salt is used for the preservation of meat and fish, during seasoning, in sauces used in food preparation and at the table as common practices in low and middle economically developed countries (He & MacGregor, 2009).

As mentioned earlier, dietary sodium intake may have direct harmful effects on blood pressure and increase the risk of cardiovascular death in a strong correlation proven between dietary sodium intake and greater risk for stroke, cardiovascular disease (such as coronary artery diseases, heart failure, left ventricular hypertrophy) and renal disease (He & MacGregor, 2009). Therefore, reducing sodium intake is essential to controlling blood pressure.

Dietary sodium reduction is an important and effective intervention for decreasing systolic (SBP) and diastolic blood pressure (DBP) in hypertensive and normotensive persons. The findings of a study by MacGregor (1989) showed that salt reduction in patients with hypertension could reduce SBP and DBP. The aforementioned study also found that patients who took salt at 11.2 g/day were able to reduce SBP from 163 to 155 mmHg and DBP from 100 to 95 mmHg. And when salt intake was further reduced to 6.4 g/day, SBP was reduced from 155 to 147 mmHg while DBP was reduced from 95 to 91 mmHg. The aforementioned researcher also used 2.9 g/day in the same group and found the aforementioned adjustment to reduce SBP by 8 mmHg and DBP by 4 mmHg. Thus, it can be concluded that further reductions in dietary salt intake may result in greater decreases in blood pressure. There is also evidence to support that people with hypertension whose blood pressure is well controlled by a single antihypertensive medicine and for those assigned to sodium reduction intervention, decrease in SBP and DBP (Biswas, Islam, & Islam, 2015; He, Li, & MacGregor, 2013). In another study, reducing salt intake by at least 2.3 g/day resulted in decreased SBP at 5.0 mmHg and DBP at 2.7 mmHg among hypertensive patients with a median reduction in salt intake of 4.6 g/day. Then SBP was reduced to 2.0 mmHg and DBP was reduced to 1.0 mmHg (Mohan & Campbell, 2009). Dietary sodium reduction can be done successfully by lowering salt intake in processed foods with high sodium content. This reduction can be accomplished by lowering the salt content of preserved foods and condiments by manufacturers with a

sustained mass-media campaign goal to encourage dietary modification within families and communities (Asaria, Chisholm, Mathers, Ezzati, & Beaglehole, 2007). It is clear that salt reduction has tremendous effect on blood pressure control.

Furthermore, the Dietary Approach to Stop Hypertension (DASH) diet that is rich in fruits, vegetables and low-fat dairy products can decrease blood pressure. The results of reducing salt intake were greater for those who ate typical diets as compare to those on the DASH diet (He, Campbell, & MacGregor, 2012; He, Li, & MacGregor, 2013; Matyas et al., 2011).

Based on the literature review, controlling blood pressure is clearly an important issue in persons with hypertension. A reduction in salt intake is needed as the first line of intervention to decrease SBP and DBP in these patients. Therefore, methods for facilitating low salt intake in hypertensive patients are essential. Education and consciousness are considered key components in reducing dietary salt intake. Providing education to the patients and their families is also necessary for nurses and health care professionals who need to know about effective dietary salt reductions based on evidence to reduce blood pressure in hypertensive patients.

1.2 Clinical problem of the study

As previously stated, high dietary sodium intake can increase blood pressure. High blood pressure is a serious condition that can lead to serious complications such as hypertensive cardiovascular disease, hypertensive kidney disease and atherosclerotic complications including stroke, coronary artery disease, kidney insufficiency as well as heart failure, kidney failure and other health problems. This problem affects patients with physical, psychological, emotional social and economic impact. The number of patients suffering due to hypertension increases daily in Bangladesh. Bangladesh is a developing country where most of the people live in rural areas and immediate access to medical facilities is unavailable. Simple dietary salt reduction can be prevent a larger disease burden incurred in the cost of treatment for families and the nation.

The author works at 850 bed Shaheed Suhrawardy Medical College Hospital. This hospital is a tertiary level government hospital under the Dhaka

Division. Approximately 12 million people are dependent on this facility for health care. Many patients come with different complexities and numerous health problems. Based on this hospital records (2015) hypertension is the first in top ten diseases requiring treatment at the hospital. Among the total admission rate of 12,545 patients, hypertension has the highest admission rate at 1,520 patients. This hospital has OPD visits daily from 8 am to 2 pm with approximately 90-100 hypertensive patients and 50-60 follow-up patients.

According to a study by Ibrahim & Damasceno (2012) many factors have been found to affect chronic hypertension e.g. high dietary sodium intake, smoking, obesity, fatty foods, preserved foods, excessive alcohol intake, dyslipidemia, diabetes mellitus and inadequate physical exercise (Ibrahim & Damasceno, 2012). Based on the perspectives of Bangladesh and the author's experiences in the aforementioned clinical setting, most hypertensive patients have limited knowledge about dietary sodium intake and low awareness about the disease (Alam, Chowdhury, Siddiquee, Ahmed, & Niessen, 2014).They continue to include foods with high salt intake with extra salt on the table and too much salt in cooking foods. Even though they have hypertension, they do not modify behaviors. They do not change dietary habits such as eliminating preserved foods or canned foods.

The clear indication is that more salt reduction is required. Hypertensive patients need to acquire essential knowledge, change dietary habits and modify behaviors to prevent the severity and complications of hypertension. Nevertheless, nurses also have limited knowledge about appropriate sodium intake for hypertensive patients to reduce blood pressure. Therefore, nurses do not provide sufficient advice about reducing dietary sodium intake, monitoring daily salt intake, amounts of salt to use in cooking and methods for reducing salt intake in daily life to their patients during hospital visits, admission or discharge as a means of reducing blood pressure and minimizing the severity of hypertension. Although recommendations regarding dietary sodium intake for hypertensive patients from evidence-based guidelines are available, nurses do not utilize research-based evidence or do not follow any evidence-based guidelines to improve health for hypertensive patients. In Bangladesh, no well-established evidence-based dietary salt reduction programs are available for patients with hypertension.

Therefore, the author would like to review the best available evidence and summarize content regarding dietary salt reduction. As a result, the aforementioned setting in Bangladesh will obtain an effective dietary sodium reduction based on research evidence for improving health among adult patients with hypertension.

1.3 Purpose of the study

To summarize all related evidence in regard to dietary sodium reduction to reduce blood pressure in patients with hypertension and draw conclusions on recommendations based on the evidence obtained.

1.4 Expected benefits of the study

1) After completion of the study, the contents synthesized from the evidence can be used as recommendations for dietary sodium reduction for improving health among patients with hypertension.

2) Guidelines on dietary sodium reduction to reduce blood pressure in patients with hypertension can be further developed and implemented in the clinical setting in Bangladesh.

CHAPTER II
METHODOLOGY

This study aimed to review evidence related to dietary sodium reduction to reduce blood pressure in patients with hypertension. The review was based on the related evidence available in the Mahidol University electronic databases. The method employed in searching for the best available evidence was the strategy for searching and selecting the evidence. Each evidence was appraised for quality and feasibility by the proposed appraisal method for considering the setting and circumstances, health care resources, preferences and values of dietary sodium reduction.

In this chapter, the searching strategy, appraisal methods and levels of evidence are described as follows:

2.1 Search Strategy

The author searched for evidence on reducing dietary sodium intake in patients with hypertension by employing the following search strategy:

2.1.1 Search framework: The author searched for evidence on dietary sodium reduction to reduce blood pressure in patients with hypertension by using the PICO framework (Melnyk & Fineout-Overholt, 2015) as follows:

P (Population)	=	Patients with hypertension.
I (Intervention)	=	Dietary sodium reduction.
C (Comparison)	=	None.
O (Outcome)	=	Blood pressure.

2.1.2 Scope of searching: The search for the evidence on dietary sodium reduction to reduce blood pressure in patients with hypertension was conducted based on the following scope:

1) Keywords used in the search according to the PICO framework: The search used a Boolean operator. For each PICO element, the author collected any synonyms by linking terms with “OR”, then located citations relevant to all of the PICO elements by linking with “AND”

P (Population)	=	Hypertension patients
		High blood pressure
		Uncontrolled blood pressure
I (Intervention)	=	Dietary sodium reduction
		Salt reduction
		Low sodium diet
		Low salt diet
C (Comparison)	=	None
O (Outcome)	=	Blood pressure.

2) The databases/sources used for the search: The author used the electronic databases / sources of the Mahidol University library system. The author searched for systematic reviews on the Cochrane Database of Systematic Reviews and Joanna Briggs Institute Systematic Reviews Database. In addition, Blackwell Synergy, Cumulative Index to Nursing and Allied Health (CINAHL), High Wire, Ovid Full Tex, Pro Quest nursing, Pub Med, Science Direct, and Springer Link were used to search for single research studies. The author also conducted a manual search by looking for citations from reference lists for systematic reviews.

3) Type of evidence: The author searched for systematic reviews and high quality single randomized controlled trials (RCTs) acquired from full text studies published in English from 2009 to 2015.

2.2 Appraisal method and levels of evidence

After conducting the search for evidence related to dietary sodium reduction among patients with hypertension. The author evaluated the quality and strength of the evidence according to appraisal methods and levels of evidence. The critical evaluation of the evidence is as described below:

2.2.1 Evidence appraisal method

All experimental research and systematic reviews were read, analyzed and synthesized for content, objectives, research methodology, strength of evidence, research setting, sample group, instrumentation for evaluating intervention outcomes and findings. To appraise each evidence, the following three questions will be evaluated (Melnyk & Fineout-Overholt, 2015).

1) Are the results of the study valid?

Evidence validity means whether or not the evidence was conducted with scientific method and able to scientifically answer the questions in the study. Therefore, evaluating the quality of the study methodology is essential. The author needs to determine whether or not the study was properly conducted. Moreover, validity must be ascertained. To evaluate research validity, possible sources of bias need to be identified. In addition, the potential for confounding variables in the study design needs to be evaluated.

For randomized controlled trials, randomization is an important step for the validity of an intervention and increases the likelihood that the results will be valid. Because randomization can minimize bias and potential impact on confounding variables, randomization also minimizes the differences among groups by equally distributing people with particular characteristics among all trials. The random assignment process is necessary to minimize bias and ensure the research validity for experimental study. In addition, measurement tools can introduce measurement bias, while the researcher must be verified to have employed appropriate measurement tools.

For systematic reviews, clear description should be considered concerning the databases accessed with searching years, strategies and search terms used. Inclusion criteria for the studies are to be kept in the analysis. The data of the articles

should be extracted by using a standard procedure regarding target population, sample size, program provider, program content, intervention components, processes and outcomes. This quality assessment research process should be performed by at least two independent members of the team. Systematic reviews should clearly report how the process was conducted and what criteria were used for evaluation. A clear description of the basis for quality assessment should be included in the review.

2) What are the results?

The main concerns in the results of each study are the size of the reported intervention effect and how precisely the effect was estimated.

For randomized controlled trials, the results are credible when the findings have been tested by trials and conformed to statistically significant differences between the intervention and comparison groups. It should be noted, therefore, that statistically significant and clinically meaningful differences are not always equivalent. The effect size of the outcomes in terms of the differences between the interventions and comparison groups need to be observed. In addition, researchers should measure population parameters and the attrition rate of participants during the follow-up.

For systematic reviews, the interpretations of results should be reasonable and presented based on the strength of the reviewers. The effectiveness of the intervention in a statistical summary should be compared across the study. It is important to evaluate whether the results of systematic reviews are clinically and statistically significant.

3) Will the results help in caring for patients?

Applicability means the usefulness of the results in a given situation. The goal of any research evidence is to apply the results to patient individually or in groups. During application of the results, usefulness for clinical decision making is considered. Regarding this critical appraisal question, the question of whether or not the subjects in the study are similar to the patients for whom care will be provided must be considered in addition to whether or not the benefits are greater than the risks of treatment, whether or not the treatment is feasible for application in the practice setting and whether or not the patients and family prefer the treatments.

2.2.2 Levels of evidence: The studies were assessed for level of evidence to evaluate the strength of the evidence. The evidence was classified in six levels as follows (Melnyk and Fineout- Overholt, 2015):

Table 2.1 Levels of evidence

Level of evidence	**Source of empirical evidence**
Level I	Evidence from systematic reviews.
Level II	Evidence from randomized controlled trials (RCTs).
Level III	Evidence from controlled cohort studies.
Level IV	Evidence from uncontrolled cohort studies.
Level V	Evidence from case studies and case series, qualitative studies & descriptive studies, EBP implementation & qi projects.
Level VI	Evidence from expert opinions.

CHAPTER III
FINDINGS

The results of the search and the summary of evidence are explained in this chapter in order to describe the interventions concerning dietary sodium reduction to reduce blood pressure in patients with hypertension. The details are as follows:

3.1 Search results

The author searched for available evidence from difference databases by using Mahidol University databases. In completing the screening of the evidence, the author found various types of evidence, including experimental research and systematic reviews. Based on the search framework and scope of search, the author found 13 evidence-based on dietary sodium reduction to reduce blood pressure in patients with hypertension. After the screening, seven studies were excluded because some did not focus on dietary sodium reduction for patients, while others did not provide sufficient information on dietary sodium reduction and still others yielded outcomes that did not concur with outcome of interest in the present study. Therefore, a total of six studies were included in this study comprising 3 systematic reviews and 3 RCTs published in English from 2006-2015. The author then appraised the evidence based on the proposed appraisal methods.

The list of the selected evidence with type and level of evidence is indicated in table 3.1. The evidence included three systematic reviews (Level-I) and three RCTs (Level-II).

Table 3.1 List of the evidence studied:

	Authors/year and Title	**Type of evidence**	**Level of evidence**
1	He, FJ., Li, J., & MacGregor, G. A. (2013). Effect of longer term modest salt reduction on blood pressure: Cochrane systematic review and meta-analysis of randomized trials.	Systematic review	I
2	Matyas, E., Jeitler, K., Horvath, K., Semlitsch, T., Hemkens, L. G., Pignitter, N., & Siebenhofer, A. (2011). Benefit assessment of salt reduction in patients with hypertension: Systematic overview.	Systematic overview	I
3	Aburto, N. J., Ziolkovska, A., Hooper, L., Elliott, P., Cappuccio, F. P., & Meerpohl, J. J. (2013). Effect of lower sodium intake on health: Systematic review and meta-analyses.	Systematic review	I
4	He, F. J., Marciniak, M., Visagie, E., Markandu, N. D., Anand, V., Dalton, R. N., & MacGregor, G. A. (2009). Effect of modest salt reduction on blood pressure, urinary albumin, and pulse wave velocity in white, black, and Asian mild hypertensive.	Randomized controlled trial study	II
5	Pimenta, E., Gaddam, K. K., Oparil, S., Aban, I., Husain, S., Dell'Italia, L. J., & Calhoun, D. A. (2009). Effects of dietary sodium reduction on blood pressure in subjects with resistant hypertension results from a randomized trial.	Randomized controlled trial study	II
6	Barrors, C. L. D. A., Sousa, A. L. L., Chinem, B. M., Rodriges, R. B., Jardim,T. S. V., Carneiro, S. B., Souza, W. K. S.B.D., & Jardim, P. C. B.V. (2014). Impact of light salt substitution for regular salt on blood pressure of hypertensive patients.	Randomized controlled trial study	II

3.1.2 The author included six evidence and briefly summarized each evidence as follows:

Evidence No. 1

1.1 Title: Effect of longer term modest salt reduction on blood pressure: Cochrane systematic review and meta-analysis of randomized trials.

1.2 Authors/year: He, F. J., Li, J., & MacGregor, G. A. (2013).

1.3 Publication source: *British Medical Journal*, *346*. 1-15.

1.4 Objectives: The objective of this systematic review were as follows: 1) to determine the effects of long-term modest reduction in salt intake on BP in both hypertensive and normotensive cases; 2) to assess dose-response in decreased amounts of salt; 3) to determine salt reduction effects in ethnic and gender groups with plasma renin activity; aldosterone, noradrenaline, adrenaline, cholesterol, LDL, HDL and triglycerides.

1.5 Design: Systematic review.

1.6 Population: 34 trials included 3,230 adults aged 18 years or older with normal or elevated blood pressure.

Inclusion criteria:

- Adult hypertensive and normotensive people.
- Age: 18 years or older.

Exclusion criteria:

- Children.
- Child bearing women.
- Patients with diabetes or heart failure.

Duration: At least 4 weeks.

Outcome measurement: The main outcome was measured based on systolic and diastolic blood pressure, and 24-hour urinary sodium excretion. Other outcomes were measured based on plasma renin activity.

1.7 Methodology

The study was based on a systematic review research design. The reviewers searched for various electronic databases such as the Cochrane Hypertension Group Specialized Register, the Cochrane central register of controlled

trials, Ovid, MEDLINE, and EMBASE to select studies. The researchers used key words such as dietary sodium reduction, low sodium diet, low salt diet, salt reduction, hypertension and blood pressure in the search. The authors also checked the reference lists of relevant original and review articles, while applied the inclusion and exclusion criteria in the selection of 34 trials with 23 crossover designs and 11 paralleled comparisons including 3,230 adult patients. These studies were published in all languages. Two reviewers extracted the data using a standard data extraction form and checked. Any discrepancies were resolved through discussion. The reviewers analyzed the data by using Cochrane Collaboration Review Manager 5.2 software.

1.8 Findings

1) In both hypertensive and normotensive individuals, a modest reduction in salt intake of 4 weeks or more significantly reduced SBP 4.18 mmHg (95% Cl: -5.18-3.18), $p < 0.00001$ and DBP 2.06 mmHg (95% Cl: -2.67-1.45), $p < 0.00001$.

2) In hypertensive patients, sodium reduction significantly reduced SBP-5.39 mmHg (95% Cl: -6.62to -4.15), $p < 0.00001$ and DBP -2.82 mmHg (95% Cl-3.54 to -2.11), $p < 0.00001$.

3) SBP and DBP were significantly reduced in men and women with Caucasian and African ethnicities.

4) Reducing salt intake to 5-6 g/day will lower blood pressure, while further reduction in salt intake to 3 g/day will even more significantly reduce SBP and DBP.

1.9 Evidence appraisal

The results of the review were valid because the review clearly described the search strategies for finding relevant studies including database the searching years and search terms used, languages and selection criteria for the studies included. The study contained crossover design and paralleled comparisons. This review properly completed data extraction, methodological quality assessment and data synthesis. The results of the study were statistically and clinically significant. Thus, the author will be able to apply these results in the author’s clinical setting, because the populations were similar to the population studied. All clinically important outcomes are measured. The

benefits of the intervention are greater than the risks and the intervention is feasible for implementation in the author's clinical setting.

Evidence No. 2

2.1 Title: Benefit assessment of salt reduction in patients with hypertension: Systematic overview.

2.2 Authors/year: Matyas, E., Jeitler, K., Horvath, K., Semlitsch, T., Hemkens, L. G., Pignitter, N., & Siebenhofer, A. (2011).

2.3 Publication source: *Journal of Hypertension, 29*(5), 821-828.

2.4 Objective: This systematic review assessed the benefits and hazards of reducing salt intake in patients with essential hypertension by focusing on patient-relevant outcomes and blood pressure.

2.5 Design: Systematic overview.

2.6 Population: 4 systematic reviews and 2 RCTs included non-pregnant patients with essential hypertension.

Inclusion criteria:

- Non-pregnant patients with essential hypertension.
- Age: 18 years and up.

Duration: 4 weeks to 12 months.

Outcome measurement**:** Blood pressure.

2.7 Methodology

The study was based on a systematic overview design. The reviewers searched various in electronic databases such as the bibliographic databases of EMBASE and MEDLINE, the Cochrane library database, the Cochrane Database of Systematic Reviews (CDSR), the Database of Abstracts of Reviews of Effects (DARE), to select the study. The researcher used key words such as dietary sodium reduction, salt reduction, low sodium diet and low salt diet. Reviewers checked the reference lists of studies included and conducted study authors and organizations to identify relevant studies. The reviewers also applied inclusion and exclusion criteria and selected 4 full-text systematic reviews and 2 RCTs published in English, German, French, and Spanish during from 1997to February 2010. Two reviewers screened the data and secondary publications were assessed as full text by the same reviewers

including discussions with third reviewers if there were any discrepancies. The quality of evidence was assessed based on Oxman and Guyatt's index.

2.8 Findings

1) In all reviews, lowering salt intake for 4 weeks to 12 months significantly reduced SBP by 3.6-8.0 mmHg ($p < 0.001$).

2) In three reviews, lowering salt intake for 4 weeks to 12 months significantly reduced DBP by 1.9-2.8 mmHg ($p < 0.001$).

2.9 Evidence appraisal

The results of the review were valid, because the review clearly described the search strategies to find relevant studies including the database searching years and search terms used as well as the languages and selection criteria for the studies included. The study contained systematic reviews and RCTs. This review properly completed data extraction and methodological quality assessment. The results of the study were statistically and clinically significant. Consequently, the author will be able to apply these results in the author's clinical setting, because the populations are similar to the population studied. All clinically important outcomes were measured. The benefits of the intervention are greater than the risks and the interventions are feasible for implementation in the author's clinical setting.

Evidence No. 3

3.1 Title: Effect of lower sodium intake on health: Systematic review and meta-analyses.

3.2 Authors/year: Aburto, N. J., Ziolkovska, A., Hooper, L., Elliott, P., Cappuccio, F. P., & Meerpohl, J. J. (2013).

3.3 Publication source: *British Medical Journal, 346*, 1-20.11326

3.4 Objectives: To assess the effects of reducing sodium intake on blood pressure associated cardiovascular diseases and potential adverse side effects such as changes in blood lipids, catecholamine levels and kidney function.

3.5 Design: Systematic review and meta-analysis.

3.6 Population: 14 cohort studies, 5 randomized controlled trials including 5,508 participants who were not actually ill adults and children.

Inclusion criteria

- RCTs (both individual and cluster randomized).
- Quasi randomized trials.
- Non-randomized trials and prospectives.
- Observational cohort studies.

Exclusion criteria:

- The patients who were actually ill (including those with type I diabetes or acute heart failure).
- Positive for HIV antibodies, or
- Admitted to hospital.

Duration: 4 or more weeks.

Outcome measurement: Blood pressure.

3.7 Methodology

The design of this study was a systematic review. The reviewers searched for differences in electronic databases such as the Cochrane central register of controlled trials, MEDLINE, EMBASE, the WHO International Clinical Trials Registry Platform and the Latin American and the Caribbean Health Science Literature database to select the studies. The researcher used key words such as dietary sodium reduction, low sodium diet, low salt diet, salt reduction, hypertension and blood pressure. The reviewers examined the reference lists of studies included and contacted the researchers in the field of specialty to identify any additional studies. The reviewers applied inclusion and exclusion criteria and selected studies published in full text, which yielded 5 RCTs and 14 cohort studies. These studies were published in all languages. Two reviewers screened the data and used a standard data extraction form to extract the relevant characteristics and outcome of the population and interventions from each study with quality assessment and checking. The reviewers then analyzed the data by using Review Manager Software.

3.8 Findings

1) In adults, a reduction in sodium intake significantly decreased SBP by 3.39 mmHg (95% Cl 2.46 to 4.31) and DBP by 1.54 mmHg (95% Cl 0.98 to 2.11).

2) Reduction in salt intake significantly decreased SBP by 3.47 mmHg (95%Cl 0.76 to 6.18) and DBP by 1.81 mmHg (95%Cl 0.54 to 3.08) when sodium intake was less than 2 g/day compared with more than 2 g/day.

3) Reducing sodium intake had no significant adverse effects on blood lipids, catecholamine levels or renal function in adults ($p > 0.05$).

3.9 Evidence appraisal

The results of the review were valid because the study clearly described the search strategies to find relevant studies including the database searching years and search terms used as well as the languages and selection criteria of the studies included. However, the study contained 5 RCTs and 14 cohort studies. This review properly completed data extraction, methodological quality assessment and data synthesis. The results of the study were statistically and clinically significant. Consequently, the author will be able to apply these results in the author's clinical setting.

Evidence No. 4

4.1 Title: Effect of modest salt reduction on blood pressure, urinary albumin, and pulse wave velocity in white, black, and Asian ethnic groups with mild hypertension.

4.2 Authors/year**:** He, F. J., Marciniak, M., Visagie, E., Markandu, N. D., Neil Dalton, V. A. R., & MacGregor, G. A. (2009).

4.3 Publication source: *Hypertension,* 54(3), 482-488.

4.4 Objectives: To assess the effects of modest salt reduction on BP, urinary albumin and pulse wave velocity in mild hypertensive patients with Caucasian and African ethnicities.

4.5 Methodology

Design: Randomized double-blind cross over study.

Setting: Blood pressure unit in outpatient clinic in south London.

Population: Patients from Caucasian, African and Asian ethnicities with untreated mild hypertension.

Sample: Total 187 participants were included in the study (77 Caucasian, 75 African and 35 Asian ethnic groups).

Duration: Six weeks.

Inclusion criteria:

- Patients with hypertension.
- Age: 30 to 75 years.
- Sitting SBP 140 to 170 mmHg and DBP 90 to 105 mmHg.
- Patients who have never been treated for high blood pressure.

Exclusion criteria:

- Any secondary cause of hypertension.
- Kidney function impaired with serum creatinine > 150 mmol/L.
- Patients with history of stroke.
- Ischemic heart disease.
- Heart failure.
- Diabetes mellitus.
- Malignancy or liver disease.
- Pregnant women.

Outcome measurement: Blood pressure was monitored by using an automatic digital machine. The measurement was taken in a sitting position after taking 5 to 10 minutes to rest. Three readings were taken at 1 and 2 minute intervals and the mean of the last 2 readings was used. Space-Labs 90207 devices were used for measuring 24-hour ambulatory blood pressure.

4.6 Intervention for dietary sodium reduction

After taking the baseline BP, the trained nurse advised the participants about how to reduce salt intake to achieve an intake of 5 g/d (85 mmol/day), not to add salt at the table or during cooking and avoid foods containing large amounts of salt. The nurse also identified the food items with high salt content that the patients usually consumed and advised them to use low salt alternatives throughout the study. Family members were included, if appropriate. After 2 weeks, the intervention groups took 9 slow Na tablets/day (90 mmol/day), and the control group took placebos for 6 weeks then crossed over for 6 weeks.

4.7 Findings

1) There was a significant decrease in SBP with the low salt intake group from 146 ± 13 to 141 ± 12 mmHg and DBP from 91 ± 8 to 88 ± 9 mmHg ($p < 0.001$).

2) The average fall in SBP was 4.8 mmHg ($p < 0.001$) with a drop in DBP of 2.2 mmHg ($p < 0.001$).

3) Pulse pressure also decreased significantly.

4) SBP and DBP were reduced in all ethnic groups.

4.8 Evidence appraisal

The objective of the study was clearly explained. The research design was a randomized double-blind cross over trial which was appropriate. The total sample size was appropriate. The research was approved by the Wands worth Local Research Ethics Committee. All participants provided written consent for the study. Outcome was measured with validated an automatic digital BP monitor. All statistical analyses were performed by using SPSS, and testing was use to compare the difference between slow sodium and placebo for normally distributed variables. This evidence was statistically and clinically significant. This study indicated that dietary sodium reduction was effective at decreasing blood pressure among adult hypertensive patients. Thus, the author can apply the intervention in the author's clinical setting.

Evidence No. 5

5.1 Title: Effects of dietary sodium reduction on blood pressure in subjects with resistant hypertension results from a randomized trial.

5.2 Authors/year: Pimenta, E., Gaddam, K. K., Oparil, S., Aban, I., Husain, S., Dell'Italia, L. J., & Calhoun, D. A. (2009).

5.3 Publication source: *Hypertension, 54*(3), 475-481.

5.4 Objectives: To examine the effects of dietary sodium reduction on blood pressure in subjects with resistant hypertension

5.5 Methodology

Design: Randomized, crossover evaluation.

Setting: The study was conducted at the University of Alabama Birmingham Hypertension clinic.

Population: Subjects with resistant hypertension.

Sample: Twelve males or females in the experimental group and twelve patients with African or Caucasian ethnicities in the control group.

Inclusion criteria:

- Subjects with resistant hypertension
- Age: 34-66 years.

Exclusion criteria:

- Patients with a history of atherosclerotic disease.
- Stroke (6 months previously).
- Myocardial infarction.
- Congestive cardiac failure.
- Diabetes mellitus on insulin treatment.

Duration: The protocol consisted of a 4 week program.

Outcome measurement: The mercury column sphygmomanometer was used to measure blood pressure which was taken after 5 minutes of rest with appropriate cuff size according to American Heart Association guidelines. At each visit, three readings were taken and a mean of the last two readings was used.

5.6 Intervention for dietary sodium reduction

The intervention duration was 4 weeks and the participants were given low salt diets for 1 week with high-salt diets for 1 week. Low sodium meals were provided with 50mmol of sodium per day for 7 days. Two different calorie diets were provided (2,000 or 2,500 calories). Participants resumed their regular diets during a 2-weeks washout period before crossing over to the opposite for the remaining 1 week. A high sodium diet was provided with NaCl tablets (6 g/24 hours),which were added to the regular diet with the intention of increasing dietary sodium intake to > 250mmol of sodium per day for 7 days.

5.7 Findings

1) The low sodium diet decreased office, day time, night time, and 24-hour SBP and DBP significantly.

2) Office SBP decreased by 22.7mmHg (95% Cl -33.5-11.8), p = 0.0008 and DBP decreased by 9.1 mmHg (95% Cl-15.1-3.1), p = 0.0005.

3) At 24 hours ambulatory blood pressure monitoring (ABPM) day time, SBP decreased by 20.7mmHg (95% Cl -29.1-12.4), p = 0.0002 and DBP decreased by 9.6 mmHg (95% Cl -14.0-5.3), p = 0.0005.

4) Night time SBP decreased by 20.3mmHg (95% Cl -32.3-8.3), p = 0.0034 and DBP decreased by 9.9 mmHg (95% Cl -15.0-4.8), p = 0.0013.

5) 24-hour SBP decreased by 20.1 mmHg (95% Cl -28.1-12.2), p=0.0002 and DBP decreased by 9.8mmHg (95% Cl -13.8;-5.8), p = 0.0002.

5.8 Evidence appraisal

The objective of this study was clearly identified. The research design was a randomized crossover evaluation. Although appropriate methodology was utilized, the sample size was small. The protocol was approved by UAB's Institutional Review Board for Human use and all subjects provided written informed consent before participation in the study. The participants were provided comprehensive information about low sodium diets. Appropriate reliability and validity investigated the effects of sodium reduction. Outcomes were clear and specific on blood pressure. The results were statistically and clinically significant. Dietary sodium reduction strategies are effective strategies for reducing blood pressure in patients with hypertension. This strategy is easily understandable and not expensive. Thus, these strategies are appropriate for implementation in the author's country and can be easily applied in the author's clinical setting.

Evidence No. 6

6.1 Title: Impact of light salt substitution for regular salt on blood pressure of hypertensive patients.

6.2 Authors/year: Barrors, C. L. D. A., Sousa, A. L. L., Chinem, B. M., Rodriges, R. B., Jardim,T. S. V., Carneiro, S. B., Souza, W. K. S.B.D., &Jardim, P. C. B.V. (2014).

6.3 Publication source: *Journal of the Brazilian Society of Cardiology*, *104*(2), 128-135.

6.4 Objectives: To assess the impact of high salt substitution for regular salt on blood pressure in the patients with hypertension.

6.5 Methodology

Design: Single-blind randomized controlled trial.

Setting: General Hospital of the Federal University of Goias, Brazil.

Population: Patients with uncontrolled hypertensive of both genders.

Sample: The sample size was 35 patients (19 in the intervention group and 16 in the control group).

Inclusion criteria

- Hypertensive individuals of both genders.
- Age: 20 to 65 years.

Exclusion criteria

- Patients with acute or sub-acute and unstable chronic diseases were excluded.

Duration: 28 days.

Outcome measurement: SBP and DBP were measured by using a semi-automatic digital device. Casual blood pressure was measured at least three times at 1-minute intervals until the measurements were lower than 4 mmHg and HBPM was measured twenty four times at 3 am and at 3 pm for 4 days. Additionally, the device for HBPM used a technique for instructing patients.

6.6 Intervention for dietary sodium reduction

During 4 weeks, the intervention group received light salt (3 g/d)composed 130 mg of sodium, 346 mg of potassium and of 44 mcg of iodine whereas the control group received regular salt containing 390 mg of sodium and 25 mcg of iodine. Each participant received 28 small plastic bags containing the daily salt allowance. All participants were instructed to consume only the daily recommended salt allowance of 3 g per person and reduced high sodium intake during the intervention period with particular warning about processed foods.

6.7 Findings

In terms of reduction in salt intake, the intervention group showed significantly reduced SBP and DBP on casual measurements and home blood pressure monitoring (HBPM) ($p < 0.05$), while the control group significantly reduced only casual SBP ($p = 0.032$).

Therefore, light salt substitution for regular salt significantly reduced the blood pressure of hypertensive patients.

6.8 Evidence appraisal

The research design was a single-blind randomized control trial. The objective of the study was explained clearly, and appropriate methodology was utilized but the sample size was small. The study was approved by the research ethics committee from the general hospital of the federal university of goias. Outcomes were measured by using a semi-automatic digital device. All statistical analyses were performed by using SPSS 20.0 software. The results of this study were statistically and clinically significant. The intervention indicated that dietary sodium reduction is an effective intervention among the patient group. Dietary sodium reduction is a simple technique for reducing blood pressure in patients with hypertension. Therefore, this evidence is feasible for implementation in the author's home country, Bangladesh and the author can apply the intervention in the author's clinical setting.

Table 3.2 Collective table for the six evidence

NO	Authors / Year / Title / Publication source	Study design and levels of evidence	Population / Setting	Methods / Intervention	Results
1	He et al.,/2013/ Effect of longer term modest salt reduction on blood pressure (Review)/ *The Cochrane Collaboration and publication in the Cochrane Library* 2013, Issue 4	Systematic review (Level I).	Population: 34 trials (23 crossover design and 11 paralleled comparisons), including 3,230 adults. Age: 18 years or older with normal or elevated blood pressure.	1. Search methods: Searched from electronic databases, reference lists of relevant original and review articles 2. Study selection criteria: Published in all languages, RCTs with modest reduction in salt intake and duration of 4 or more weeks. 3. Data extraction: Data extraction done independently by two reviewers using a standard form and discussion with a third reviewer if there were any discrepancies. 4. Data analysis: Data analyzed by using Cochrane Collaboration Review Manager 5.2 software.	1) In both hypertensive and normotensive individuals, a modest reduction in salt intake for 4 weeks or more significantly reduced SBP 4.18 mmHg (95%Cl: -5.18-3.18), $p < 0.00001$ and DBP 2.06 mmHg (95% Cl: -2.67-1.45), $p < 0.00001$. 2) In hypertensive patients, significantly reduced SBP-5.39 mmHg (95% Cl: -6.62to -4.15), $p < 0.00001$ and DBP -2.82mmHg (95% Cl-3.54 to -2.11), $p < 0.00001$. 3) SBP and DBP significantly reduced in white, black, men and women. 4) Reduce salt intake 5-6 g/day will lower BP, further reduction in salt intake 3 g/day or more significantly reduced SBP and DBP.

Table 3.2 Collective table for the six evidence (cont.)

NO	Authors / Year / Title / Publication source	Study design and levels of evidence	Population / Setting	Methods / Intervention	Results
2	Matyas et al.,/2011/ Benefit assessment of salt reduction in patients with hypertension: Systematic overview/ *Journal of Hypertension 2011*, *29*(5), 821-828	Systematic overview (Level I).	Population: 4 systematic reviews and 2 RCTs included non-pregnant patients with essential hypertension. Age: 18 years or older.	1. Search methods: Searched from electronic databases, bibliographic databases, abstract of reviews and related reviews. 2. Study selection criteria: Published in English, German, French, Spanish languages during the year 1997 until February 2010, RCTs with low salt intake at least 4 weeks duration. The study interventions aimed to lower salt intake. 3. Data extraction and quality assessment: Data were screened independently by two reviewers and secondary publications were assessed as full text by the same reviewers. Discussions were held with a third reviewer if there were any discrepancies. Quality assessment was done according to Oxman and Guyatt's index.	1) In all reviews, lower salt intake for 4 weeks to 12 months significantly reduced SBP 3.6-8.0 mmHg ($p < 0.001$). 2) In three reviews, lower salt intake for 4 weeks to 12 months significantly reduced DBP 1.9-2.8 mmHg ($p < 0.001$).

Table 3.2 Collective table for the six evidence (cont.)

NO	Authors / Year / Title / Publication source	Study design and levels of evidence	Population / Setting	Methods / Intervention	Results
3	Aburto et al., 2013/ Effect of lower sodium intake on health: Systematic review and meta-analyses / *British Medical Journal*, 2013; 346:11326	Systematic review and meta-analysis (Level I).	Population: 14 cohort studies and 5 randomized controlled trials included 5,508 participant's not actually ill adults and children**.**	1. Search methods: Searched from electronic databases and reference lists of previous reviews. 2. Study selection: Published in all languages, RCTs or cohort studies on the effect of lower sodium intake had a duration of 4 or more weeks. 3. Data extraction and quality assessment: Data were screened independently by two reviewers a standard data extraction form was used to extract relevant characteristics and outcomes of the population and interventions of each study, checked by a third reviewer. 4. Data analysis: Data analyzed by using Review Manager software.	1. A reduction in sodium intake significantly reduced SBP by 3.39 mmHg (95% Cl 2.46 to 4.31), and DBP by 1.54 mmHg (95% Cl 0.98 to 2.11), in adults. 2. Reduction in salt intake significantly decreased SBP 3.47 mmHg (95%Cl 0.76 to 6.18), and compared with > 2 g/day. 3. Decreased sodium intake had no significant adverse effects on blood lipids, catecholamine levels, or renal function in adults ($p > 0.05$).

Table 3.2 Collective table for the six evidence (cont.)

NO	Authors / Year / Title / Publication source	Study design and levels of evidence	Population / Setting	Methods / Intervention	Results
4	He et al.,/2009/ Effects of modest salt reduction on blood pressure, urinary albumin, and pulse wave velocity in white, black, and Asian mild hypertensive / *Hypertension, 54*(3), 482-488.	Randomized double blind crossover trial. (Level II).	Population: 187 patients from Caucasian, African, and Asian ethnicities with untreated mild HT. Age: 30 to 75 years. Setting: Blood pressure unit in outpatient clinic in south London.	After taking the baseline BP, trained nurses advised how to reduce salt intake to 5 g/d (85 mmol/day), not to add salt at the table or when cooking and to avoid foods with high sodium content. Food items with high sodium content the patients usually consumed were identified and patients were advised to use low salt alternatives. Family members were included, if appropriate. After 2 weeks, the intervention groups took 9 slow Na tablets/day (90 mmol/day), and the control group took placebos for 6 weeks then cross over for 6 weeks.	1. There was a significant decrease in SBP with low salt intake group from 146 ± 13 to 141 ± 12 mmHg and DBP from 91 ± 8 to 88 ± 9 mmHg ($p < 0.001$). 2. Average fall in SBP was 4.8 mmHg ($p < 0.001$), and DBP was 2.2 mmHg ($p < 0.001$). 3. Pulse pressure also decreased significantly. 4. SBP and DBP were reduced in all ethnic groups.

Table 3.2 Collective table for the six evidence (cont.)

NO	Authors / Year/ Title / Publication source	Study design and levels of evidence	Population / Setting	Methods / Intervention	Results
5	Pimenta et al.,/ 2009/Effects of dietary sodium reduction on blood pressure in subjects with resistant hypertension results from a randomized trial/ *American Heart Association*, 54(3), 475-481	Randomized crossover evaluation study (Level II).	Population: 12 Subjects with resistant hypertension. Age: 34-66 years. Setting: The study was conducted at the "UAB" Hypertension clinic	The intervention duration was 4 weeks and the participants were given low salt diet for 1 week and high-salt diet for 1 week. Low sodium meals were provided 50mmol of sodium per day for 7 days. Two different calorie diets were provided (2,000 or 2,500 calorie). Participants resumed their regular diet during a 2 week washout period before crossing over to the opposite for the remaining week. High salt diets was provided NaCl tablets (6 g/24 hours) added to the regular diet with the intention of increasing dietary sodium intake more than 250 mmol per day for 7 days.	1. Low salt diet significantly decreased office, day time, night time and 24-hour systolic and diastolic BP. 2. Office SBP decreased by 22.7 mmHg (95% CI -33.5-11.8), p = 0.0008 and DBP by 9.1 mmHg (95% Cl-15.1-3.1), p = 0.0005. For 24 hours ambulatory blood pressure monitoring (ABPM) day time, SBP decreased by 20.7 mmHg (95% Cl -29.1-12.4), p = 0.0002 and DBP by 9.6 mmHg (95% Cl -14.0-5.3), p = 0.0005. For night time SBP decreased by 20.3 mmHg (95% Cl -32.3-8.3), p = 0.0034, and DBP by 9.9 mmHg (95% Cl -15.0-4.8), p = 0.0013. 24 hour SBP decreased by 20.1 mmHg (95% Cl -28.1-12.2), p = 0.0002, and DBP by 9.8 mmHg (95% Cl -13.8;-5.8), p = 0.0002**.**

Table 3.2 Collective table for the six evidence (cont.)

NO	Authors / Year / Title / Publication source	Study design and levels of evidence	Population / Setting	Methods / Intervention	Results
6	Barrors et al.,/ 2014/Impact of light salt substitution for regular salt on blood pressure of hypertensive patients / *Journal of the Brazilian Society of Cardiology*, *104*(2), 128-135.	Single-blind randomized controlled trial. (Level II).	Population: 35 patients with uncontrolled hypertension of both genders. Age: 20 to 65 years. Setting: General Hospital of the Federal University of Goias, Brazil.	During 4 weeks, the intervention group received light salt (3 g/d) with 130 mg of sodium, 346 mg of potassium and of 44 mcg of iodine where the control group received regular salt and the regular salt contained 390 mg of sodium and 25 mcg of iodine. Every patient received 28 small plastic bags containing the daily amount of salt. All patients were instructed to consume only the daily recommended salt intake of 3 g per person, and reduce sodium rich food consumption during the study period with particular warnings about processed foods.	In terms of reduction in salt intake the intervention group showed significantly reduced SBP and DBP on the casual measurements and home blood pressure monitoring (HBPM) ($p < 0.05$), and the control group significantly reduced only casual SBP ($p = 0.032$). Therefore, the light salt substitution for regular salt significantly reduced the blood pressure of hypertensive patients.

3.2 Conclusion

The following conclusions can be drawn from the selected evidence:

3.2.1 Brief summary of the evidence: As previously mentioned, the author searched and selected six evidence comprising 3 systematic reviews and 3 RCTs. It can be concluded that dietary sodium reduction is an effective intervention for reducing systolic and diastolic blood pressure for normotensive individuals and all groups of hypertensive male and female adult patients, including those with mild hypertension, essential hypertension and resistance hypertension. Moreover, it significantly reduces systolic and diastolic blood pressure in Caucasian, African and Asian ethnicities.

Low dietary sodium intake was varied in terms of evidence-to-evidence ranging between 3-5 g/day. Reductions in sodium intake equal to or less than 5 g/day with at least 4 weeks to 12 months duration significantly reduced systolic blood pressure (3 to 22.7 mmHg) and diastolic blood pressure (1.5 to 9.9 mmHg) (Pimenta et al., 2009). The findings demonstrate that further reduction in sodium intake reduces blood pressure even more. The evidence also revealed that decreased sodium intake had no significant adverse effects on blood lipids, catecholamine levels or renal function in adults (Aburto et al., 2013; He et al., 2013). These results provide strong support for dietary sodium reduction. Thus, the intervention with less than 5 gram of sodium intake per day for at least 4 weeks is more effective for reducing both systolic and diastolic blood pressure in all groups of hypertensive patients. In addition, hypertensive patients should comply with the Dietary Approach to Stopping Hypertension (DASH) diet (He et al., 2013; Matyas et al., 2011).

Only one study provided advice from trained nurses to the patients and family members about how to reduce sodium intake to less than 5 g/day (He et al., 2009). The trained nurses provided health education about low sodium diets and which foods contained high amounts of sodium. The nurses also instructed the patients to consume alternative foods with low sodium compositions and explained the benefits of sodium reduction as a means of controlling blood pressure in adult hypertensive patients. The nurses also taught the patients how to calculate the sodium content in daily meals, not to add salt at the table or during cooking, to avoid foods with high

sodium content and warned about processed foods (He et al., 2009). The results showed that the intervention group significantly reduced systolic and diastolic blood pressure.

3.2.2 Recommendations:

The recommendations ensuing from the studied evidence was yielded by the search for the interventions to reduce dietary sodium for adult hypertensive patients. The studied evidence comprised 3 systematic reviews (Level I) and 3 randomized controlled trials (Level II). After analysis and synthesis of 6 evidence, following recommendations can be made:

1) Dietary sodium reduction is an effective intervention for reducing blood pressure in all groups of hypertensive patients, including both male and female patients with essential hypertension, resistance hypertension, normotensive and mild hypertension. Sodium reduction can reduce both systolic and diastolic blood pressure (Aburto et al., 2013/Level I; Barros et al., 2014/Level II; He et al., 2013/ Level I; He et al., 2009/Level II; Matyas et al., 2011/Level I; Pimenta et al., 2009/Level II).

2) Patients should reduce sodium intake to 3-5 g/day for at least 4 weeks to reduce blood pressure. Further reduction in sodium intake reduces both systolic and diastolic blood pressure even more(Barros et al., 2014/Level II; He et al., 2013/ Level I; He et al., 2009/Level II; Pimenta et al., 2009/Level II).

3) Dietary advice should be provided by trained nurses to the patients and their families based on the content in order to achieve sodium reduction to 3- 5g/day (He et al., 2009/Level II).

3.1) High blood pressure, risk factors, complications and the importance of sodium reduction to reduce blood pressure in hypertensive patients should be explained to this group of patients (He et al., 2009/Level II).

3.2) Patients and family members should be advised of strategies for achieving sodium intake to 3-5 g/d, not adding salt at the table or during cooking, avoiding foods with high sodium content, identifying food items with high sodium content usually consumed by patients and advising patients to use low salt alternatives foods with warnings about processed foods which are the most common source of daily sodium intake (He et al., 2009/ Level II).

3.3) Advise patient and family members to calculate the amount of sodium in daily meals (approximately one teaspoon contained 5 gram of sodium) (He et al., 2009/Level II).

4) The patients should be advised about the Dietary Approach to Stopping Hypertension (DASH) diet as a dietary plan for reducing blood pressure. The DASH diet incorporates high fruit and vegetable intake, moderate or low-fat dairy products and low animal protein but with substantial amounts of plant protein from legumes and nuts with limited salt, sugar-sweetened beverages and sweets (He et al., 2013/ Level I; Matyas et al., 2011/Level I).

CHAPTER IV
CONCLUSION AND SUGGESTIONS

4.1 Conclusion

Hypertension is a major public health problem in both developed and developing countries. Hypertension is also the most important cause of consequent disability and death worldwide as a silent killer and the most significant public risk for cardiovascular disease, chronic kidney disease, stroke, heart attack, heart failure and kidney failure (Biswas, Islam, & Islam, 2015). Most adults suffering from hypertension are aged 20-60 years. Many lifestyle-related factors such as high sodium intake, obesity and less physical activity are important factors contributing to hypertension (Ibrahim & Damasceno, 2012). Most hypertensive patients' have limited knowledge about the disease. This problem affects patients' physical, psychological, social, economic and realistic aspects of life.

Day by day, people's life-styles change significantly. Modern people are more dependent on processed and preserved foods containing high amounts of sodium. In Bangladesh, the usual rate of sodium consumption is 15 to 21 g/day (Rahman et al., 2015) which is significantly higher than the amount of sodium recommended (5 g/day) by the World Health Organization or any other guidelines. In the author's clinical setting, most hypertensive patients have limited knowledge about dietary sodium intake and low awareness about the disease. In addition, nurses also have limited knowledge for providing advice on dietary sodium reduction for hypertensive patients to reduce blood pressure. The nurses do not provide any advice during hospital visits, admission or discharge periods. Hence, a need for more salt reduction is indicated. Several evidence support that a reduction in sodium intake is one of the most cost-effective interventions for reducing blood pressure, heart disease and stroke at the global population level. The aim of the study was to summarize the current evidence on dietary sodium reduction to reduce blood pressure in patients with hypertension.

In order to achieve the objective, the author searched for currently available evidence by using the Mahidol University Library electronic database systems and other websites to search for related evidence-based practice with the PICO format. The PICO framework was used to guide the keywords for the search. The keywords used were P = “hypertensive patient”, or “high blood pressure”, or “uncontrolled blood pressure”, I = “dietary sodium reduction”, or “salt reduction”, or “low sodium diet”, or “low salt diet”, O = “blood pressure’’. Based on the findings yielded by the search for evidence, the author obtained six evidence on dietary sodium reduction for hypertensive patients. The selected six evidence were composed of 3 systemic reviews (Level-I), and 3 randomized control trials (Level-II). Next, the author appraised the evidence by following Melnyk and Fine-Overholt (2015). The appraisal was done by answering the following three main questions: 1) Are the results of the study valid? 2) What are the results? 3) Will the result help in caring for patients?

The evidence revealed dietary sodium reduction as one of the most effective interventions for reducing blood pressure in normotensive individuals and all groups of hypertensive adults among both male and female patients, including mild hypertension, essential hypertension, and resistance hypertension patients. Moreover, the evidence was also revealed to reduce blood pressure in many ethnic groups including Caucasian, African and Asian ethnicities (He et al., 2009). Moreover, the findings confirmed that decreased sodium intake had no significant adverse effect on blood lipids, catecholamine levels or renal function in adults (Aburto et al., 2013).

According to the findings, reductions in sodium intake per day should range from 3 to 5 g for at least 4 weeks in order to reduce blood pressure (Barros et al., 2014; He et al., 2013; He et al., 2009; Pimenta et al., 2009). The aforementioned program can reduce systolic blood pressure within a range from 3 to 22.7 mmHg and diastolic blood pressure within a range from 1.5 to 9.9 mmHg (Pimenta et al., 2009). In addition, dietary sodium can be reduced by providing dietary advice. The advice should be provided by trained nurses to the patients and family members in order to achieve sodium intake 3 to 5 g/day to reduce blood pressure. The dietary advice should cover the following issue: 1) knowledge about hypertension, risk factors and

complications: 2) recommended amount of sodium intake per day for each patient: 3) importance of sodium reduction: 4) strategies for reducing salt intake and 5) sources of foods with high sodium content and alternative foods. Furthermore, dietary advice should be provided on the DASH diet plan which is to be incorporated with high intake of fruits and vegetables, moderate or low-fat dairy products and low animal protein content with substantial amounts of plant protein from legumes and nuts, while limiting salt, sugar-sweetened beverages and sweets (He et al., 2013; Matyas et al., 2011).

It can be concluded that dietary sodium reduction to 3 to 5 g/d is important, and more cost effective than pharmacological treatment for hypertensive patients to control both systolic and diastolic blood pressure. Hence, the author recommends that nurses and health care providers implement dietary sodium reduction to reduce blood pressure in patients with hypertension.

4.2 Suggestions

The study of evidence concerning dietary sodium reduction to reduce blood pressure among adult patients with hypertension suggests that implementation of dietary sodium reduction should be applied as follows:

4.2.1 Implications for practice

1) Nursing practice guidelines on dietary sodium reduction for hypertension should be developed for suitability with the cultural context and dietary habits of Bangladeshi people.

2) Nurses should be well trained before providing dietary advice about salt reduction interventions. Nurses should also gain appropriate knowledge and skills regarding hypertension, risk factors and complications, recommended amounts of sodium per day for each patient, the importance of sodium reduction, sources foods with high sodium content and alternative foods, strategies for reducing salt intake in addition to the DASH diet plan. Nurses should also gain knowledge and skills about culture, attitudes of patients' social contexts and how to advise patients and family members.

3) Educational materials should be developed and provided for the patients' and family members regarding hypertension, risk factors and complications, sources foods with high sodium content, alternative foods and the DASH diet plan.

4) Dietary sodium reduction advice should involve family members to increase the low sodium recognition in families when buying, preparing food and eating food because efficient family support for low sodium diets can result in patients feeling isolated and may even lead to family conflict. Furthermore, nurses' advice should be concrete and obvious. For example, due to one teaspoon approximately contained 5 gram of sodium, nurse should educate hypertensive patients not cooking or seasoning with salt or sauce exceed 1 teaspoon per day.

5) Nurses should provide group advice in regarding dietary sodium reduction to hypertensive patients in context of Bangladesh by means of shortage of nurses in clinical setting (1 nurse serve 50 to 100 patients). However, nurses are able to provide advice of reducing dietary sodium for individual patient as convenience. This should be emphasized the combination of taking hypertensive drugs consistency which is another factor to reduce blood pressure.

6) A pilot study should be conducted before implementing the guidelines in order to ensure effectiveness and feasibility.

4.2.2 Implications for research

1) Clinical trials should be conducted to evaluate the feasibility and effectiveness of implementing sodium reduction interventions within the context and dietary habits of Bangladeshi people.

2) More studies on dietary advice and counseling on dietary sodium reduction for reducing blood pressure in patients with hypertension should be conducted to evaluate the effectiveness of the interventions.

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