

## ORIGINAL ARTICLE

## EFFECT OF EXCESSIVE SALT CONSUMPTION ON NIGHT'S SLEEP

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**Background:** Low sodium chloride intake may play a role in the treatment of insomnia and tension states. The objective of this study was to evaluate the effect of excessive amount of salt consumption on night's sleep. **Methods:** Twenty volunteer students having no sleep problems were selected for this study. Five nights before salt consumption, the volunteers recorded the time of going to bed and the time of rising next morning and the quality of night's sleep. On the 6<sup>th</sup> day, each volunteer consumed 0.5 g salt per 10 Kg of body weight at 8.00 PM and filled a questionnaire with queries on the time of going to bed and the time of rising next morning, depth of sleep, frequency of awakening at night, presence of any sleep disturbances, amount and times of drinking water during the night, and general condition in the next day. **Results:** Salt consumption delayed the time of going to bed and awakened the subjects earlier. During sleep, students awakened several times and they had 2–3 hours of sleep disturbances during that night. The normal pattern of sleep was disrupted and the depth of sleep was decreased. Students repeatedly got up to drink water. On the next day of salt consumption, students felt drowsy and fatigued and were not satisfied with last night's sleep. **Conclusion:** Excessive amount of salt consumption could affect the pattern and duration of sleep. Role of a healthy diet in habitual sleep duration represents a largely unexplored pathway linking sleep and health.

**Keywords:** Disturbance, Sleep, Salt, Thirst, Polydipsia

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## INTRODUCTION

Sleep accounts for one third of human life, yet scientific inquiry in this area is limited compared with other aspects of neuroscience. Additionally, studies suggest that poor sleep contributes to ill health.<sup>1</sup> The importance of sleep quality has only begun to be understood. It has been known for many years that a good night's sleep is important, 7–8 h for adults. New data reinforces the increased risks associated with insufficient sleep.<sup>2</sup> Sleep disorders have become a global issue. Sleep abnormalities occur in 17–22% Japanese, while sleep disorders are estimated to range from 7% to 50% in people living in Portugal and Finland. In the United States, more than 70 million people suffer from a sleep disorder, and modern lifestyles have led to Americans sleeping approximately 2 h less per night than 100 years ago.<sup>3</sup> As a consequence, during the past decade, much attention has been focused on the need to treat these conditions and thus on the neurophysiology of sleep and wakefulness.<sup>4</sup> In normal subjects, sleep is characterized by important physiological changes in respiratory and cardiovascular functions. With the exception of rapid eye movement (REM) sleep stage, these include an increase in parasympathetic cardiac modulation and a reduction in sympathetic drive to cardiac and vascular targets, leading to a pronounced reduction in blood pressure and heart rate levels and to changes in blood pressure and heart rate variability patterns, in association with an increase in arterial baroreflex sensitivity.<sup>5</sup> Insomnia is a common complaint that can lead to inappropriate prescribing of sedative-hypnotics. For some patients, insomnia is a symptom of a significant

medical problem and should be addressed by treating the primary disorder.<sup>6</sup> A number of foods can stimulate the body and make it difficult to sleep. Depending on how your body metabolises caffeine, drinking coffee, energy drinks, or similar drinks can keep your heart rate and blood pressure elevated for hours. You might also want to watch your intake of foods high in salt near bedtime, especially from packaged foods which commonly have high levels of sodium. High levels of sugar near bedtime can also increase energy levels and make it difficult to fall or stay asleep. Tracking your diet throughout the day can help you see if you are taking in high levels of sugar, sodium, or caffeine and reveal potential dietary changes to improve your sleep.<sup>7</sup> There is often a connection between the composition and size of your daily meals, and your sleep. Everyone responds differently to different meals, with some people reporting a high whole grain meal helps them fall asleep, while others report a high protein and/or high fat meals helps them sleep.<sup>8</sup> The findings of Pimenta *et al* study suggest that dietary salt is related to the severity of Obstructive Sleep Apnoea (OSA) in patients with resistant hypertension and hyperaldosteronism. Their results support dietary salt restriction as a treatment strategy for reduction of OSA severity in these patients.<sup>9</sup> About 30% of the population suffer from OSA and it is moderate to severe (more than 15 apnoeas/hour of sleep) in 16.9% of adults. OSA is observed in 30% to 80% of hypertensive patients.<sup>10</sup> The current US dietary guideline for sodium for the general public is no more than 2.4 g/d, equivalent to 110 mmol Na/d or 6.0 g NaCl. This is approximately two-thirds of the average dietary sodium intake of US adults, so that an overall

average reduction of 40–60 mmol/d is being recommended. This recommendation has been widely made by multiple scientific and governmental agencies and is supported by a large body of evidence. However, an increasingly aggressive campaign was recently mounted against this recommendation in the belief that no benefit will occur if it is accomplished. The evidence supporting the need for a reduction in dietary sodium intake is convincing and supports the appropriateness of the current US dietary guideline. As noted, this guideline may not be set low enough to prevent the development of hypertension, but it is almost certainly as much as is attainable under current conditions. If this goal can be reached, perhaps even greater reductions will be feasible in the future, particularly if food processors are cooperative.<sup>11</sup> Most people think they follow a low salt intake but in fact are wrong. On average 90% of our salt intake comes from packaged foods, while only 10% comes from the salt shaker. Cutting way back on salt involves not only avoiding the salt shaker but avoiding packaged food and cooking meals from scratch. Check labels of foods to see if they contain salt. Some people feel unwell on a very low salt intake, for example feeling fatigued and light headed. People with CFS and adrenal problems should not attempt a low salt diet.<sup>8</sup> The objective of this study was to determine whether that an increase in salt intake could affect the quality and duration of night's sleep and even general condition and behaviour of individual.

## MATERIAL AND METHODS

This study was conducted at the Department of Physiology, Faculty of Medicine, Zanjan University of Medical Sciences, all work was conducted in accordance with the principles of the Declaration of Helsinki as well as to Title 45, US Code of Federal Regulations, Part 46, Protection of Human Subjects. Sampling was done by easy non-probability sampling. Questionnaire forms were filled by students. Twenty volunteer who had normal pattern of night sleep and no sleep disorders were selected, informed consent was acquired from students. General conditions of students who were selected as our subjects include: no history of insomnia, OSA, respiratory diseases, cardiovascular diseases, hypertension, consuming cigarette and tobacco product, renal diseases, and any serious medical problems. All volunteers were male, aged 18–22 years, weighed 60–100 Kg, and their BMI was 18–30. Questionnaire forms were filled by students during 5 nights before consumption of additive salt. The time of going to bed in the evening, rising in the morning and the duration of night's sleep was recorded. The amount of salt for each student was calculated on the basis of 0.05 g/Kg body weight. As the consumption of this amount of salt was unpleasant, in one sub-group 1% salt solution was prepared and volunteers drank this salt

solution. In the other sub-group the calculated salt was used during eating tomato.

On the 6<sup>th</sup> day, each volunteer consumed 0.5 g salt per 10 Kg of body weight at 8.00 PM. A questionnaire was filled on following queries: Time of going to bed, time of getting up, existence or absence of sleep disturbance, frequency of awakening at night, depth of sleep, amount and frequency of drinking water, frequency of micturition at night, satisfaction of night's sleep, and the general condition of individual on the following day. Drowsiness, restlessness, and weakness on the next day after the night of salt consumption were recorded.

## RESULTS

Consumption of salt (0.05 g/Kg) was an unpleasant experience for most subjects. Consumption of this amount of salt had similar effects on the sleep pattern in both sub-groups consuming salt in solution or with salt shaker and lead to sleep disturbance. Analysis of the questionnaire forms on the time of going to bed in the evening and the time of rising in the morning showed that consumption of this amount of salt delays the time of going to bed about 1–2 hours in different volunteers. They had also difficulty getting up in the morning and still felt tired after night's sleep while they did not have this problem on previous nights. The duration of night sleep was about 8–9 hours in different volunteers based on the average of 5 nights. The duration of night sleep in the same person reduced by about 2–3 hours. Most subjects stated they were not satisfied with the duration of night sleep after salt consumption. All subjects reported sleep disturbance and were not satisfied with their sleep quality. They experienced cycles of waking and light sleep and their depth of sleep was affected with no period of deep sleep. Sleep continuity tended to suffer as subjects woke up frequently and then found difficulty getting to sleep. Repeated awakenings were reported for need to drink water and micturition and they had an average 2 hours of disturbances in night sleep. During the night the subjects awakened several times and most subjects reported 2–3 times of drinking water while they never got up for drinking water during previous nights. There were instances of nocturia after salt consumption while none of the subjects had history of nocturia. The next day after salt consumption, subjects were not satisfied with the quality of night sleep, they missed out periods of deep sleep. During day time they felt drowsy and needed several refreshing to keep up with daily work. They were fatigued during the day, and they had no fresh and lively feeling. Subjects' orientation and concentration, precision in doing daily work and ability to doing accurate work was also reduced. Restlessness, weakness, indisposition and some instances of misbehaving were recorded in individuals.

## DISCUSSION

This study presented several key findings in relation with the role of consuming 0.05 g. salt additive to normal daily salt consumption on night sleep. Consumption of this amount of salt delays the time of going to bed about 1–2 hours in comparison with previous nights, and decreases the duration of night sleep. Most of the subjects did not have full satisfaction with the duration of night sleep and all had no satisfaction regarding quality of sleep. They awakened repeatedly at that night and it was very difficult to fall asleep again and they had no period of deep sleep. Subjects got up for drinking water repeatedly and some instances of nocturia were recorded. The quality and the duration of night sleep affected the general condition and behaviour of the subjects next day, they felt drowsy and had no fresh and lively feeling. Subjects' orientation, concentration, and precision in daily work was reduced. Some instances of restlessness, weakness, indisposition, fatigue, and misbehaving were recorded. Adding this amount of salt consumption affected the quality of daily life, general condition, behaviour and ability of individuals for doing daily work.

There are a few studies about the effects of daily salt intake on the night sleep. One study looked at the sleep of nine 23-year-old men who were placed on low-, normal- and high-sodium diets. When they were on low-sodium diet, about 500 mg a day, the men woke up during the night nearly twice as often and got about 10% less sleep than when they were on normal diets, which included 2,000 mg daily. When they were on a high-sodium diet, 5,000 mg a day, the men slept longer and with slightly fewer night time waking than when they were on normal diets.

Low level of sodium in the blood causes blood volume to decrease, and the sympathetic nervous system becomes more active in order to compensate. That causes sleepers to wake-up more often and have difficulty going back to sleep.<sup>12</sup> In a long forgotten study from the Journal of the American Medical Association in 1945, a group of patients with insomnia were treated with a severely restricted salt intake. After 4–7 days the majority of individuals began to fall asleep easier. A few weeks later most noticed big differences in their ability to fall asleep.

Most people think they follow a low salt intake but in fact are wrong. On an average, 90% of our salt intake comes from packaged foods, while only 10% comes from the salt-shaker. Cutting way back on salt involves not only avoiding the salt-shaker but avoiding packaged food and cooking meals from scratch. Check labels of foods to see if they contain salt. Some people feel unwell on a very low salt intake, for example feeling fatigued and light headed. People with CFS and adrenal problems should not attempt a low salt diet.<sup>8</sup>

Stene *et al* demonstrated that several factors may have an important influence on the daily regulation of NE secretion. Chronic, but not acute, changes in sodium balance alter basal and postural NE secretion. The administration of glucocorticoids suppresses basal and posture-stimulated NE. Since ACTH does not alter plasma NE, this could represent a direct inhibitory effect of glucocorticoids on NE secretion. NE is released in secretory bursts and displays a circadian biorhythm that is not sleep associated but correlates with changes in mean arterial pressure.<sup>13</sup>

High salt intake and a severe reduction in daily salt intake is associated with a lot of medical problems. Severe reduction in daily salt intake leads to an increase in NE secretion and this change is associated with sleep disturbances. The INTERSALT Study provided standardised data on 24-hour urinary sodium excretion among 52 population samples in 32 countries, in the mid to late 1980s. The highest mean 24-hour urinary sodium excretion ranged from 260 mmol/d (6.0 g) in men and 230 mmol/d (5.3 g/d) in women in China and to 1 mmol/d (23 mg/d) among the Yanomamo Indians of Brazil.<sup>14</sup> The 2010 Dietary Guideline for sodium is: Reduce daily sodium intake to less than 2,300 mg and further reduce intake to 1,500 mg among persons who are 51 and older and those of any age who are African American or have hypertension, diabetes, or chronic kidney disease. The 1,500 mg recommendation applies to about half of the US population, including children, and the majority of adults.<sup>15</sup>

There is no lack of books emphasising a low-salt diet regimen, and exactly how the over wealth of sodium chloride in our everyday diet regimen is connected to heart problem, osteoporosis, Alzheimer's and other persistent diseases. But a small quantity, as much as a teaspoon a day, of raw sea salt to the diet regimen adds an assortment of vital minerals essential for human wellness. These minerals, including calcium, magnesium, potassium, sulphur, iron, phosphorous, iodine, copper, and zinc, are important for our entire body metabolic rate. They are not, other than the iodine added after the table salt is mined and improved, offered in salt. Sea salt promotes sleep by promoting healthy blood sugar levels and lowering high blood pressure. More and more we are realising that a healthy diet includes adequate quantities of all essential nutrients. When we eliminate an element of good nutrition through a salt-free diet, we actually undermine the successful metabolism of blood sugars as well as production of the neurotransmitter serotonin.

Sea salt aids while table salt destroys as it lacks the calcium and phosphorous so important to a good night sleep. A great night sleep is taken into consideration a main to human health, and the widespread sleeping disorders experienced by many can be relieved by taking small quantities of among the most

famous dietary additives, all-natural and raw sea salt. Making use of sea salt as rest assistance opens a door to better nourishment and general health and wellness, not the common salt.<sup>16</sup>

The current study demonstrated that better cognitive function, but not depressive behaviour and sleep disturbance, is related to decreased sodium intake as evaluated by 24-h urinary sodium excretion. Studies are needed to highlight the mechanisms regarding the relationship between cognitive function and sodium intake.<sup>17</sup> Short sleep duration is associated with weight gain and obesity, diabetes, cardiovascular disease, psychiatric illness, and performance deficits. Likewise, long sleep duration is also associated with poor physical and mental health. The role of a healthy diet in habitual sleep duration represents a largely unexplored pathway linking sleep and health.<sup>18</sup>

Accidents related to sleep deprivation have been estimated to have an annual economic impact of \$43 to \$56 billion. Motor vehicle accidents related to fatigue, drowsy driving, and falling asleep at the wheel are particularly common but often underestimated. Increased time awake, nocturnal circadian phase, reduced sleep duration, prolonged driving duration, and use of soporific medications have all been found to contribute to the occurrence of drowsy-driving and fatigue-related motor vehicle crashes. Studies of shift workers, truck drivers, medical residents, and airline pilots show an increased risk of crashes or near misses due to sleep deprivation.<sup>19</sup>

Previous work has established that a high dietary salt intake lead to sleep disturbance and severe reduction in daily salt intake is associated with an increase of NE secretion and sleep disturbance too. The results of this study coincide with similar findings released by other researchers. In agreement with some earlier studies our study revealed that excessive amount of salt consumption affected night sleep, reduced the duration of night sleep, and disrupt the pattern of sleep, therefore, the role of a healthy diet in habitual sleep duration represents a largely unexplored pathway linking sleep and health.

## CONCLUSION

An increase in salt consumption could disrupt the pattern of night sleep, reduce the duration of night sleep, and disrupt the pattern of sleep. The role of a healthy diet in habitual sleep duration represents a largely unexplored pathway linking sleep and health.

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