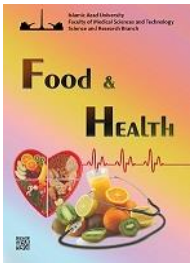

Food & Health Journal
Journal homepage: fh.srbiau.ac.ir

Association between sodium intake and anthropometric indices in patients with acute heart failure in Shahid Rajaei Hospital, Tehran

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ARTICLE INFO

Original Article

Article history:
Received 11 July 2022
Revised 22 October 2022
Accepted 18 November 2022
Available online 20 December 2022

Keywords:
Sodium intake
Acute heart failure
Anthropometric indices

ABSTRACT

Heart failure occurs when the heart is unable to pump enough blood to the body's organs. Sodium intake has many side effects but is also necessary for health. Previous studies on sodium intake have shown inconsistent results, and to our knowledge, no studies have been conducted on this topic in Iran. Therefore, we decided to study the relationship between sodium intake and anthropometric indices in patients with acute heart failure in Tehran in 2021. The study was conducted on 114 patients with acute heart failure aged 16 to 80 admitted to Shahid Rajaei Hospital in Tehran. Demographic information and data related to sodium intake were collected using questionnaires, and anthropometric measurements were made using standard methods. More than half (54.4%) of the patients were men, and 45.6% were women, with an average age of 62. SPSS version 26 software was used for data analysis, and a P-value <0.05 was considered statistically significant. Spearman's correlation test measured the relationship between sodium intake and anthropometric indices. There were no statistically significant differences or correlations between sodium intake and anthropometric indices in patients with acute heart failure.

1. Introduction

Heart failure is a severe condition affecting millions of people worldwide. It is a chronic and progressive disease that reduces the ability of the heart to pump blood effectively to the organs and tissues of the body. This can lead to various complications and impair the patient's quality of life. According to the World Health Organization, heart failure affects about 23 million people globally. In the United States, heart failure is one of the most common causes of hospitalization and death among adults. About 4.7 million people (1.5-2% of the total population) have heart failure, and about 550000 new cases are diagnosed each year (1, 2). The situation is similar in Europe, where the prevalence of heart failure ranges from 0.4% to 2%, depending on the country and the age group (3). However, there is a lack of data on the prevalence and burden of heart failure in developing countries, where only a few studies have been conducted (4, 5). Heart failure occurs when the heart muscle becomes weak or stiff and cannot pump enough blood to meet the body's needs for oxygen and nutrients. The most common causes of heart failure are coronary artery disease, high blood pressure, diabetes, and valvular heart disease. The signs and symptoms of heart failure include shortness of breath, especially when lying down or exercising, extreme fatigue, leg swelling or fluid retention, coughing or wheezing, rapid or irregular heartbeat, and reduced appetite or nausea (6). One of the factors that can affect the development and progression of heart failure is dietary sodium intake. Sodium is an essential mineral that helps regulate fluid balance, blood pressure, and nerve and muscle function in the body. However, excessive sodium intake can cause fluid retention, increase blood pressure, and worsen heart failure symptoms. The evidence shows that there is a significant linear relationship between dietary sodium intake and the risk of cardiovascular disease. The risk of cardiovascular disease increases by 6% for every 1-gram increase in sodium intake in the diet (7). Therefore, a low-sodium diet is recommended for preventing and managing cardiovascular disease. A low-sodium diet means limiting the intake of salt and processed foods that contain high amounts

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of sodium. The current daily guidelines limit humans to 2.4 grams of sodium (8). However, some people may need to restrict their sodium intake even more, especially those with obesity or metabolic syndrome. Obesity is defined as having a body mass index above 30 and is associated with increased inflammation and oxidative stress in the body. Metabolic syndrome is a cluster of conditions that increase the risk of cardiovascular disease and diabetes. It includes high blood pressure, high blood sugar, high triglycerides, low HDL cholesterol, and abdominal obesity. Suppose people with obesity or metabolic syndrome do not follow a low-sodium diet. In that case, the increase in adiponectin leads to an increase in stress and cortisol secretion, which causes insulin resistance and metabolic syndrome (7). Insulin resistance is a condition where the cells do not respond well to insulin, a hormone that regulates blood sugar levels. This can result in high blood sugar levels and damage to various organs. However, there is no consensus on sodium intake in patients with heart failure. Different guidelines have suggested further recommendations for sodium intake in this population. The American Heart Failure Association guidelines 2010 recommend 2 to 3 grams of sodium per day for patients with heart failure (9). In 2017, the Academy of Nutrition and Dietetics issued an evidence-based dietary practice guideline for heart failure that recommends 2 to 3 grams of sodium per day for these patients (10). However, these recommendations are based on limited and inconsistent evidence from different studies. Moreover, there is no research on this topic in Iran, where the prevalence and characteristics of heart failure may differ from other countries. Therefore, we decided to investigate the association between sodium intake and anthropometric indices in Iran's patients with acute heart failure.

2. Materials and methods

The project was a cross-sectional study that aimed to investigate the association between sodium intake and anthropometric indices in patients with acute heart failure in Iran. The project was registered in the Ministry of Health and Medical Education, which is the authority that oversees health research in Iran. The research method was reviewed and approved by the Ethics Committee of the Faculty of Medical Sciences and Technologies, which is the body that ensures the ethical standards and principles of research involving human subjects. The approval code was IR.IAU.SRB.REC.1400.380. The questionnaires and data collection instruments (scales, stadiometer, etc.) were prepared according to the objectives and design of the study. The questionnaires included demographic information and sodium intake data. The data collection instruments were used to measure the weight and height of the patients. Patients with heart failure in this center were selected by a simple random sampling method, which is a technique that ensures an equal chance of selection for every patient who meets the inclusion criteria. Written consent was obtained from each patient with heart failure who participated in the study, which means that they agreed to participate voluntarily and after being informed about the purpose, procedures, risks, and benefits of the study. At the beginning of the study, anthropometric measurements (weight, height) were made according to the standards and the body mass index was calculated based on them. Anthropometric measurements are measurements that reflect the body size, shape, and composition of an individual. They can provide information about an individual's nutritional status and health risks. Body mass index is a measure of body fat based on weight and height. It is calculated by dividing weight in kilograms by height in meters squared. Weight was measured with minimal possible clothing and without shoes using a Seca scale model DT602E with an accuracy of 0.1 kg, a digital scale displaying weight in kilograms. Height was measured without shoes and in a standing position using a Seca wall caliper model 216, with an accuracy of 0.5 cm, a device that measures height in centimeters using a sliding headpiece attached to a wall-mounted ruler. Data on sodium intake were collected using a valid and reliable questionnaire (11), which is a tool that assesses the amount of sodium consumed by an individual from different sources such as salt, processed foods, and beverages. The questionnaire has been tested for its validity and reliability in previous studies (11). Data analysis on food's sodium content was done using Nutritionist IV software (Esha Inc., USA, 1993). This software program calculates the nutritional value of foods based on their ingredients and portion sizes. The software can provide information on the sodium content of foods and other nutrients such as calories, protein, fat, carbohydrate, fiber, vitamins, and minerals. Finally, the collected data were analyzed by a statistician using SPSS software version 26 and Spearman statistical tests. SPSS software version 26 is a software program that performs various statistical analyses such as descriptive statistics, inferential statistics, regression analysis, correlation analysis, and hypothesis testing. Spearman statistical tests are non-parametric tests that measure the strength and direction of the relationship between two variables that are not normally distributed or have ordinal scales. The group members and the researchers who conducted the study prepared the final work report.

3. Results

The study sample consisted of 114 acute heart failure patients admitted to Shahid Rajaei Hospital in Tehran. Most of the patients were men (54.4%), and the mean age of the patients was 62 years. Other demographic characteristics of patients, such as education level, occupation, smoking status, and NYHA* functional class, are shown in Table. 1. NYHA* stands for New York Heart Association, a classification system that describes the severity of heart failure symptoms. In the analytical part, Mann-Whitney and Kruskal Wallis tests were used to compare the variables in Table No. 1 between different groups of patients, such as men and women, smokers and non-smokers, and different NYHA* classes. These non-parametric tests do not assume a normal distribution of the data. A p-value <0.05 was considered statistically significant, which means

that the difference or the association between the variables was unlikely to occur by chance. Spearman's correlation test measured the relationship between sodium intake and anthropometric indices (Table 2).

Table 1. Demographic characteristics of the subjects.

Variable	Frequency (percentage)	P value
Gender		
Male	52 (45.6)	0.198
Female	62 (54.4)	
Marital status		
Single	2 (1.75)	
Married	110 (96.5)	0.083
Widow	2 (1.75)	
Job		
Homemaker	74 (47.37)	0.396
Employees and freelancers	60 (52.63)	
Chronic kidney disease		
Has	18 (15.8)	0.932
Doesn't have	96 (84.2)	
Hypertension		
Has	33 (28.95)	0.682
Doesn't have	81 (71.05)	
Hypothyroidism		
Has	10 (8.77)	0.092
Doesn't have	104 (91.23)	
Diabetes		
Has	36 (31.86)	0.951
Doesn't have	77 (68.14)	
NYHA		
II	22 (19.6)	0.869
III	60 (53.6)	
IV	30 (26.8)	

The marital status and NYHA* were analyzed using Kruskal wallis test and the other variables of the table were analyzed using Mann-Whitney test.

Table 2. Comparing the relationship between anthropometric indices, age and sodium intake.

Variable	Sodium Spearman's correlation coefficient	P value
Weight (kg)	-0.006	0.952
Height (cm)	-0.094	0.318
Body mass index (kg/m2)	0.016	0.870

A questionnaire assessed sodium intake and measured anthropometric indices by scales and stadiometer. Anthropometric indices include weight, height, body mass index, waist circumference, hip circumference, waist-to-hip ratio, and body fat percentage. These indices can provide information about an individual's body size, shape, and composition. Spearman's correlation test is a non-parametric test that measures the strength and direction of the relationship between two variables that are not normally distributed or have ordinal scales. SPSS version 26 software was used for data analysis. P-value <0.05 indicated statistical significance, meaning the relationship between the variables was unlikely to occur by chance. In Table 3, the associations between the blood sodium level and background variables are adjusted for potential confounders. A blood test measured blood sodium level and background variables include age, sex, education level, occupation, smoking status, and NYHA* functional class.

Table 3. Adjusted association between the blood sodium concentration and other predictors (multiple linear regression).

Variable	Coefficient ± SE	P value
Education	-188.214±208.701	0.383
Body mass index	24.23±989.038	0.281
Hospitalization frequency	-178.133±736.510	0.184
Chronic kidney disease	22.363±857.027	0.950
Hypertension	-170.288±173.009	0.555
Hypothyroidism	-564.454±406.026	0.217
Diabetes	330.288±294.066	0.254

Potential confounders are variables that may affect both the blood sodium level and the background variables and thus distort the true association between them. To control for potential confounders, statistical methods such as regression analysis or stratification are used. The marital status and NYHA* were analyzed using Kruskal Wallis test, and the other variables in the table were analyzed using Mann-Whitney test. The results are reported based on Spearman's correlation coefficient, which ranges from -1 to 1 and indicates the direction and magnitude of the relationship between two variables. A positive coefficient means that the variables move in the same direction, while a negative coefficient means that they move in opposite directions. A coefficient close to 0 means that there is no linear relationship between the variables.

4. Discussion

This study investigated the relationship between sodium intake and anthropometric indices in patients with acute heart failure in Shahid Rajaee Hospital in Tehran in 2021. The study's results indicate no significant association was found between sodium intake and anthropometric indices in patients with acute heart failure. Aune et al. (12), in a review study of twenty-three prospective studies with 647,388 participants, investigated the incidence of heart failure by examining anthropometric indices similar to our research and analyzing body mass index. They have shown that a body mass index above 30 is a key risk factor for the occurrence of heart failure in several populations, which is different from our findings, which also examined abdominal obesity and did not find a significant relationship. Alves et al. (13) randomly divided 46 patients with heart failure into two control and experimental groups. One group was given a low-sodium diet and training about following a healthy diet. After 6 weeks of follow-up, they measured the amount of sodium and checked the anthropometric indices. Like the results of our study, they did not find a significant relationship between sodium intake and anthropometric indices. Nakasato et al. (14) investigated the

relationship between sodium intake and anthropometric indices in patients with heart failure, with the difference from our study that they conducted a prospective study on fifty stable outpatients with mild to moderate HF who reported previously consuming 6.6 g table salt/day. In Phase 1, all patients were submitted to a diet with 2 g of salt for 7 days, followed by randomization into 2 subgroups (Phase 2): one to receive 6 g of salt (subgroup 1) and the other, 2 g of salt/day for 7 days (subgroup II). As a result, they found that a diet with 2 grams of salt per day for patients with heart failure increased the neurohormonal activation associated with the progress of heart failure. They also found that the body mass index can influence the response to the neurohormonal activation in a low-sodium diet in patients with heart failure (14). Heo et al. (15), in a descriptive-analytical study similar to our research, examined sodium intake and anthropometric indices in patients with heart failure, with the difference that they examined the symptoms of depression. They observed that people with a higher body mass index have higher sodium intake and more depression. Anupam Basuray et al., in a study, examined 305 patients with heart failure, with the difference that they measured 24-hour urine sodium and urine creatinine. Similar to other studies, they also stated that sodium consumption was higher in people with a higher body mass index (16).

5. Conclusion:

This study aimed to explore how sodium intake and body measurements, such as weight and waist size, are related in patients with sudden heart failure. Premature heart failure is when the heart suddenly cannot pump enough blood for the body's needs. Sodium intake is one of the food factors that may affect how well patients with heart failure do by affecting blood pressure, fluid levels, and heart function. However, the study found no significant relationship between sodium intake and body measurements in patients with sudden heart failure. This suggests that other factors, such as genes, lifestyle, inflammation, and oxidative stress, may be more important for how well patients with heart failure do. This study adds to the existing knowledge on sodium intake and heart failure by providing new evidence from a study examining a large and diverse group of patients with sudden heart failure. The study shows that sodium intake may have different effects on heart failure depending on other factors such as how bad, how long, and what kind of heart failure they have, as well as their BMI, age, gender, medication use, and food patterns. The study means that sodium intake may not be a significant risk factor for how well patients with heart failure do in terms of death, hospital stay, or quality of life. However, this does not mean that sodium intake should be forgotten or not cared about in caring for patients with heart failure, as it may still affect blood pressure, fluid levels, swelling, and quality of life. Therefore, patients with heart failure should still follow the advice for sodium intake (less than 2 g/day) and check their sodium intake often. Some ways for future research are to do studies that follow patients with sudden heart failure over time with bigger groups of people and more places to see if sodium intake and body measurements are related in a cause-and-effect way. Also, more studies are needed to see how sodium intake affects how well patients with heart failure do through inflammation, oxidative stress, neurohormonal activation, and heart changes.

Acknowledgment

We are grateful to all the patients who participated in this study.

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