Is It Still Possible to Reduce Population Salt Intake in Absence of Adequate National Policies and Regulations? A Randomized Field Trial, Social Marketing Intervention

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Abstract

Background: High salt intake is one of the most important causes of some serious health problems. This study aims to evaluate the effects of a salt intake reduction intervention based on social marketing model in Ahwaz city, Iran.

Methods: In this field trial experimental study, two similar residential complexes were selected using purposive sampling technique, and randomly assigned into intervention or control groups. In each residential complex, 130 women were selected using systematic random sampling. SMART model was applied as the social marketing planning tool. A formative research including audience, market, and channel analysis were conducted through two focus group discussions, a survey to identify cognitive and behavioral determinants of salt intake, and a salt intake assessment using 24-hour urine test for both groups. Based on the results of the formative research phase, an intervention plan was developed and implemented for 1 month in the intervention group. Post intervention assessment was conducted 1 month after the intervention by repeating the survey and the urine test. Statistical tests including independent T-Test and paired T-Test were used to compare the experimental and control groups.

Results: Mean salt intake level before the intervention was 8574.41 mg/d in the intervention group and 8282.23 mg/d in the control group. Mean total scores of cognitive and behavioral factors was 25.32 and 26.41 out of 59 for the intervention and the control group respectively. After the intervention, daily salt intake decreased significantly by 1558.83 mg/d (16%) ($P<0.001$) and mean total scores of cognitive and behavioral factors increased significantly by 10.73 ($p<0.001$) in the intervention group.

Conclusions: Despite the lack of public policies to decrease population salt intake, interventions based on social marketing can significantly reduce salt intake. However, long-term effect of such interventions will require further investigation.

Background

High salt consumption (> 5 grams/day, equivalent to 2 gr sodium/day) is the most important behavioral risk factor for hypertension (1) and one of the most important cause of mortality in the world (2). High salt intake can also increase the risk of some other serious health problems, including left ventricular hypertrophy, kidney disease, kidney stones, osteoporosis, gastric cancer, asthma severity, and obesity (3–6). Attributable deaths to dietary salt intake in the world are estimated 1.65 million in 2010 (7). World health organization (WHO) recommend daily salt intake should be limited to less than 5 grams per day for healthy adults (8). However, data from many countries show that population mean sodium intake is well above the body's minimum physiological need and in many countries is more than WHO recommended maximum daily value (9). In Iran, Salt intake is estimated two times more than the recommended maximum level of intake (9, 10).

Reducing population salt intake is one of the most cost-effective and efficient interventions to decrease mortality and morbidity burden due to non-communicable disease (NCDs) (11), which is possible. WHO

recommends 5 key strategies for reducing population salt intake (12): 1.government policies to ensure that food manufacturers and retailers produce healthier food; 2.working with the private sector to make low-salt products more available and accessible; 3.Consumer awareness raising and population empowerment through social marketing; 4.creating an enabling environment to reduce salt intake through local policy interventions and promoting "healthy food" settings e.g. schools, workplaces, communities, and cities; 5.monitoring of population sodium consumption levels, salt sources in diet, and salt-related knowledge, attitude, and behaviors to inform policy decisions. The first two strategies require national level policy changes. However, the other strategies still are feasible at local levels. In addition, successful consumer awareness and population empowerment (strategy 2) requires deep understanding of the main sources of salt consumption, consumer's knowledge, attitude and behavior, their true salt consumption levels and monitoring these changes overtime (strategy 5).

As adding salt while cooking and at the table (consumer behavior) are the main sources of salt intake in low income countries (13), increasing consumer's knowledge and population empowerment related to salt seems to be very important in such a countries. But the question is, in absence of some key strategies, which is a common problem in these countries, is it still possible to reduce population salt consumption significantly?

In Iran, trying to decrease salt intake started in 2001 through Iranian National Program to Reduce Salt, Sugar, and Fat Intake aimed to promote healthy nutrition of Iranians through decreasing consumption of fat, salt, and sugar through processed food; increasing low-fat diet; increasing population knowledge; and mandating product labeling (14). Two main policies in this area was adapted: First, ban of advertising for unhealthy foods, and second, taxing on unhealthy foods (15). None of these policies were successful in Iran (16).

There are numerous models, theories and tools which can be or have been used to understand and/or measure determinants of high salt consumption behavior (17). They often focus on individual cognitive factors such as knowledge and attitude. But environmental factors such as exposure to high salt food and advertisement, availability and access to low salt food also matter (17). Social marketing model, recommended by WHO to be used in salt-related interventions (12), is a comprehensive approach that also considers environmental factors. Kotler and Lee, define social marketing as "process that applies marketing principles and techniques to create, communicate, and deliver value in order to influence target audience behaviors that benefit society (public health, safety, the environment, and communities), as well as the target audience" (18). Social Marketing Assessment and Response Tool (SMART) is one of the social marketing planning tools which provides 7 program phases including preliminary planning, audience analysis, channel analysis, market analysis, development, implementation, and evaluation (19).

The present study aimed to develop a local salt consumption reduction program, implementing 3 of 5 WHO key recommended strategies, and evaluate its effects on salt intake levels at the population level based on social marketing model.

Methods

This field trial experimental study with control group was conducted in Ahwaz city, the capital of Khuzestan province in the southwest of Iran. SMART model was applied as a planning tool of social marketing to guide the implementation steps, including 7 stages:

Stage 1: Preliminary Planning and Site Selection

Two residential complexes belonging to the National Iranian Oil Company were selected. These two residential complexes were socioeconomically similar but located in distance and far enough to prevent transferring intervention's effects. The residential complexes assigned into control and intervention groups randomly. In each complex, 130 households were selected using systematic random sampling (allocation ratio was 1:1). A woman in each household, who was responsible for the family food shopping and cooking, was chosen to participate in the study in case of her informed consent. Women are usually the ones who bring the nutritional messages to the table and are in a position to make changes in family nutrition and nutrition habits (17). Regarding a previous study in Iran (20), in which Standard deviation (SD) in a two continued measuring were 7.68 and 6.82, with confidence level of 95%, and statistical power of 90%, to reach 1unit difference in salt intake after the intervention, the least sample size was estimated 100 for each residential complex. The study sample included 260 people. According to the WHO Protocol for Population Level Sodium Determination in 24-Hour Urine Samples, a representative sample of 120 to 240 individuals is needed to estimate population-level sodium intake (21). The age of the youngest participants was 18 years. Exclusion criteria were being pregnant, following any special diet, suffering from any sodium-related disease, heart disease, hypertension, and diabetes.

Stages 2, 3, 4: Data Collection (Audience, Channel, and Market Analysis)

A formative research including customer analysis, market analysis, and channel analysis was conducted. Women and the owners of local supermarkets and restaurants were identified as the key customers. Customer analysis was performed through qualitative and quantitative methods. In the qualitative part, two focus group discussions (FGD), each included 10 participants, were held with 2 groups of women in the intervention group to investigate their perspectives, viewpoints, needs, demands, experiences, perceived costs and benefits, and other factors related to salt intake and salt intake reduction. Participants were invited to the FGD meetings by telephone call. FGD guide was used for instructing the sessions. Voices were recorded during the sessions with participants’ consent. Each session was continued until saturation. In addition to FGDs with the women, semi-structured interviews were conducted with the owners of local supermarkets and restaurants in the intervention residential complex (8 people). Voices were recorded during the interviews and FGDs. Recordings were transcribed upon finishing the meetings and interviews. The data were analyzed by identifying the key themes related to salt intake.

In the quantitative part, two baseline assessment were conducted in both experimental and control groups: A KAP Study to identify cognitive and behavioral determinants of salt intake, and a 24-hour urine

sample collection to determine salt intake levels.

For the KAP survey, a questionnaire was developed by the research team, after conducting a comprehensive literature review on influencing factors of salt intake (22–26), as well as analysis of relevant questionnaires (21). The first draft of the questionnaire included 30 questions. Content and face validity investigated by estimating Content Validity Index (CVI) and Content Validity Rate (CVR), and Item Impact Score respectively. Also, reliability investigated by doing test-retest and estimating Interclass Correlation Coefficient (ICC). The final questionnaire included 26 questions (4 demographic questions, 4 questions on knowledge, 7 attitudes, 5 behaviors, 3 intentions, and 3 self-efficacy). Researcher attended at each selected household in the intervention and control groups and explained the study aims. Then the respondents were asked to complete the questionnaire after signing the informed consent form.

To determine salt intake level, 24-hour urine samples were collected from women in both groups who completed the questionnaire. Each participant was given a urine container. Also, a date was determined to collect the urine sample. They were educated face-to-face, also, were given a written instruction explaining how to collect the urine sample throughout a whole 24-hour day based on the WHO protocol for population level sodium determination in 24-h urine samples (21). Based on the protocol, If volume of the urine sample was less than 250 ml, the participant was asked to repeat the urine collection or she replaced with another volunteer (21).

The urine samples were delivered to the laboratory by the researcher as soon as they were ready. Sodium level in each urine sample was calculated using film-photometry method (20). Based on the sodium urinary excretion level, daily salt intake levels were estimated. As the main way of body sodium excretion is through urine (21), 24-hour urine sample collecting is known as the gold method for population mean salt intake assessment (22–23).

For market analysis, 4Ps including Product, Price, Place, and Promotion were investigated in the intervention residential complex. For channel analysis customers were asked about their preferred communicating channels in the FGD sessions during the audience analysis step.

Stage 5: Planning, Material Development and Pre-testing

Based on the formative research results, basic principles of the social marketing campaign (Product, Price, Place, and Promotion) were outlined and behavioral objectives of the campaign were described. The audience were specified, including: the participant women as the primary audiences, school children as the secondary audiences, and the local community. The other family members (i.e. Husbands of the women and non-schooling members) were not in access to be included as the intervention direct audiences due to some administrative obstacles, therefore, they got targeted in the local community. A brand was created. Campaign slogans and key messages were determined. Communicating memorable messages and trying to make the salt-related behaviors more attractive were considered. Materials, including 1 video, 2 posters, and 1 leaflet, were produced, finalized, and prepared after pretesting with 10 women of the target population by interview. A website and 3 channels in popular social media, including

Telegram channel, WhatsApp, and Instagram, were initiated as the main program communication channels. Table 1 demonstrated the campaign implementation plan.

Table 1
Implementation plan to reduce participants' salt intake

Intervention Strategy	Target Audience	Activity
Direct Education	Women participated in the study	Individual education
		Group education
	Schools' children	School education sessions
Awareness Raising	Local community	Environmental advertising
Market Intervention	Local community	Interfering to remove a brand of sea salt from the local shops which contained unrealistic information about sea salt health benefits

Stage 6: Implementation

The intervention was implemented for 1 month in the intervention residential complex. Key messages of the program were delivered to the primary and secondary audiences and local community during the campaign through the audience preferred communication channels and the other accessible ways such as community events. Numbers of reached audience and distributed materials during the campaign are shown in Table 2 and 3 respectively.

Table 2
-Frequency of the reached audience through the campaign

Education	Target Population	Number of the reached audience
Group sessions	Women participated in the study	89
	Schools' children	400
Face-to-face	Women participated in the study	14
Telephone-call	Women participated in the study	6

Table 3
Numbers of distributed materials through the campaign

Educational Material	Target Population	number
Brochure	Women participated in the study	2000
	Schools' children	
	Local community	
Poster	Local community	50
Video	Local community	1

Stage 7: Evaluation

One month after the intervention implementation, post assessment was conducted by completing the same questionnaire and collecting the urine test. The results were compared with the baseline assessments. Data were analyzed using SPSS software Edition 16. Independent T-Test was used to compare Intervention and control groups' variable mean changes before and after the intervention, and paired T-Test was used to compare the intervention or control groups' variable mean changes before and after the intervention.

Results

Participants' demographic characteristics are shown in Table 4. Mean age of the participants was about 37 years (varying from 19 to 66 years old) in the control group, and 36.5 years (varying from 18 to 63 years) in the intervention group.

Table 4
Participants' demographic characteristics (n = 260)

Variable		Control group (n = 130)	Intervention group (n = 130)
		Number (percent)	Number (percent)
Education level	High school and less	29 (22.3)	29 (22.3)
	Bachelor	98 (75.4)	82 (63)
	Postgraduate	3(2.26)	19 (14.6)
Marital status	Married	130 (100)	128 (98.5)
	No response	0 (0)	2 (1.5)
Employing status	Employed	83 (63.8)	68 (52.3)
	Unemployed	47 (36.2)	62 (47.7)

Effect Of Intervention On Cognitive And Behavioral Variables

Table 5, compares the results of before and after intervention assessments among 260 women in both groups. As the table demonstrates, mean score changes of cognitive and behavioral variables was significantly different between intervention and control group after the intervention.

Table 5
Comparing of mean score changes of knowledge, attitude, intention, self-efficacy, and behavior between control and intervention groups after the intervention

Variable	Control group (n = 102)	Intervention group (n = 108)	P-Value
	Mean (SD)	Mean (SD)	
Knowledge	0.058 (0.83)	3.46 (1.69)	< 0.001
Attitude	-0.029 (0.36)	3.19 (2.35)	< 0.001
Intention	-0.039 (0.31)	1.03 (2.15)	< 0.001
Self-efficacy	-0.039 (0.28)	0.95 (1.85)	< 0.001
Behavior	-0.029 (0.3)	2.1 (2.95)	< 0.001

Table 6, presents the mean scores of cognitive and behavioral factors in the intervention and control groups. There is a significant increase in all the measured variables in the intervention group.

Table 6
Comparing of mean scores of knowledge, attitude, intention, self-efficacy, and behavior before and after the intervention in the Intervention and control groups

Variable	Intervention group		P-Value	Control group		P-Value
	Before the intervention (n = 130)	After the intervention (n = 108)		Before the intervention (n = 130)	After the intervention (n = 102)	
	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Knowledge	4.07 (1.27)	7.5 (1.37)	< 0.001	3.1 (93.21)	3.1 (95.18)	0.476
Attitude	9 (2.36)	12.26 (2.42)	< 0.001	9.2 (49.58)	9.2 (31.54)	0.408
Intention	2.93 (1.76)	3.85 (1.47)	< 0.001	3.2 (70.07)	2.2 (91.03)	0.207
Self-efficacy	3.06 (1.76)	3.93 (1.29)	< 0.001	3.2 (13.06)	3.2 (11.04)	0.158
Behavior	6.2 (2.51)	8.19 (2.57)	< 0.001	6.2 (76.74)	6.2 (61.64)	0.320

Before the intervention, mean total scores of cognitive and behavioral factors were 24.99 and 25.99 out of 54 in the intervention and control groups respectively, which was increased significantly by 10.73 in the intervention group after the intervention ($p < 0.001$). It was not significant in the control group ($P = 0.468$).

Effect Of Intervention On Salt Intake Level

Table 7, compares mean salt intake level of the intervention and control groups before and after the intervention. There was no significant difference between the groups before the intervention (P-Value = 0.514), but the difference was significant after the intervention (P-Value < 0.001).

Table 7
Mean daily salt intake in control and intervention groups before and after the intervention

	Before intervention		After intervention	
	Control group (n = 130)	Intervention group (n = 130)	Control group (n = 102)	Intervention group (n = 108)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Daily salt intake (mg/d)	8282.23 (3511.79)	8574.41 (3699.9)	8321.78 (3694.36)	7203.51 (3129.08)

Also, difference between mean daily salt intake before and after the intervention was not significant in the control group (P-value = 0.12), but was significant in the intervention group (P-Value < 0.001).

As Table 8 and Graph 1 show, there was a significant difference between the two groups after the intervention, as mean changes of daily salt intake were significantly higher in the intervention group. The intervention had resulted in about 1.5grams reduction in daily salt intake in the intervention group (8.5 to 7.2 grams) which means that mean daily salt intake was reduced by 16%.

Table 8
Comparing of daily salt intake mean changes in control and intervention groups after the intervention

Variable	Control group (n = 102)	Intervention group (n = 108)	P-value
	Mean (SD)	Mean (SD)	
Daily salt intake	-217.18 (1398.05)	-15158.83(2086.03)	< 0.001

Discussion

Participants' mean daily salt intake pre-intervention was, similar to other studies in Iran (10, 27–29), much higher than the maximum recommended value of 5 grams per day. This calls for action.

This community-based intervention was resulted in a significant reduction in daily salt intake by 16% in a community setting. Considering the fact that 10% reduction in Iranian population salt intake would save 0.01 quality-adjusted life years (QALY) and 67.5 dollars per person (30), such level of reduction could save 1.3 QALY and 8775 dollars for 130 people. This can be considered clinically significant, as salt intake is an important risk-factor for non-communicable disease (6, 31) which are responsible for 76% of all death in Iran (32).

Although, multi-component strategies involving population-wide policies such as regulation and mandatory reformulation could make the greatest results in population salt reduction (33), the present study showed that in the absence of adequate or effective national policies, which is a common problem in many low and middle income countries, it is still possible to reduce salt intake through focusing on consumer's special needs, viewpoints, and living conditions.

Following WHO recommendation as the guide of the present intervention, this study was able to capture more of salt-related factors and determinants varying from individual cognitive factors to market factors such as customer's preferences, accessibility, cost, and promotion. In Iran, very limited interventions have attempted to reduce salt intake (20, 34, 35), while one have used social marketing framework (36). Therefore, the present study is one of the first community-based interventions in Iran using a holistic approach through which multiple factors playing role in peoples' salt intake was taken into account by

employing social marketing framework. The significant effects of the present intervention on reducing salt intake was similar to those reported by other studies (36–40).

Also, this intervention had positive effects on cognitive and behavioral determinants of salt intake in the target population. Regarding inadequate salt-related knowledge, attitude, and other cognitive and behavioral factors in Iran (41, 42), awareness raising trough social marketing seems to be a key strategy to help reducing population salt intake.

Based on a systematic review, social marketing interventions have resulted in positive changes in other nutritional behaviors such as fruit and vegetables intake, healthy choices, low-fat food consumption, and children snack selection (40). This calls for greater attention to implement social marketing interventions as one of the cost-effective approaches to be applied across the countries to promote healthy eating.

Despite this, few studies have clarified how social marketing framework was applied in their settings. On the other hand, there are effective interventions to reduce population salt intake which have used other strategies such as food reformulation (43–47). Overall, considering the effectiveness of social marketing interventions (40), it seems logical to put more emphasis on the application of this framework in nutrition and health related community programs.

One of the unique features of the present study is assessment of sodium intake by 24-hour urine test. As the main way of body sodium excretion is through urine (48), 24-hour urine sample collecting, is known as the gold standard for population mean salt intake assessment (21, 49). Collection of 24-hours urine samples have been rarely used by previous studies (10) in Iran.

Study Limitations

Due to sodium excretion fluctuations in different days and/or different people, estimating sodium excretion based on one-day sample, may have bias. Still, 24-hour urine test is the most effective method to estimate population mean salt intake (21) which is used in this study.

Conclusion

This social marketing intervention, despite the lack of related policies and regulations, was effective in reducing salt intake in a community setting. Initiation of policies and regulations along with community level intervention together can have a much greater impact in reducing population salt intake.

Abbreviations

WHO
World health organization
NCDs
Non-communicable disease

SMART
Social Marketing Assessment and Response Tool
SD
Standard deviation
FGD
Focus group discussions
QALY
Quality-adjusted life years

Declarations

Ethics approval and consent to participate: This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the Research Ethics Committee of School of Public Health and Neuroscience Research Center - Shahid Beheshti University of Medical Sciences (Specific Cod: IR.SBMU.PHNS.REC). Written informed consent was obtained from all subjects.

Consent for publication: Not applicable.

Availability of data and material: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: N.K-M., M.S., A.R., and N.O. designed the study. M.S. implemented the intervention. F.Z. conceived the statistical methodology. M.S., N.K-M., and N.O. contributed to drafting the manuscript.

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Figures

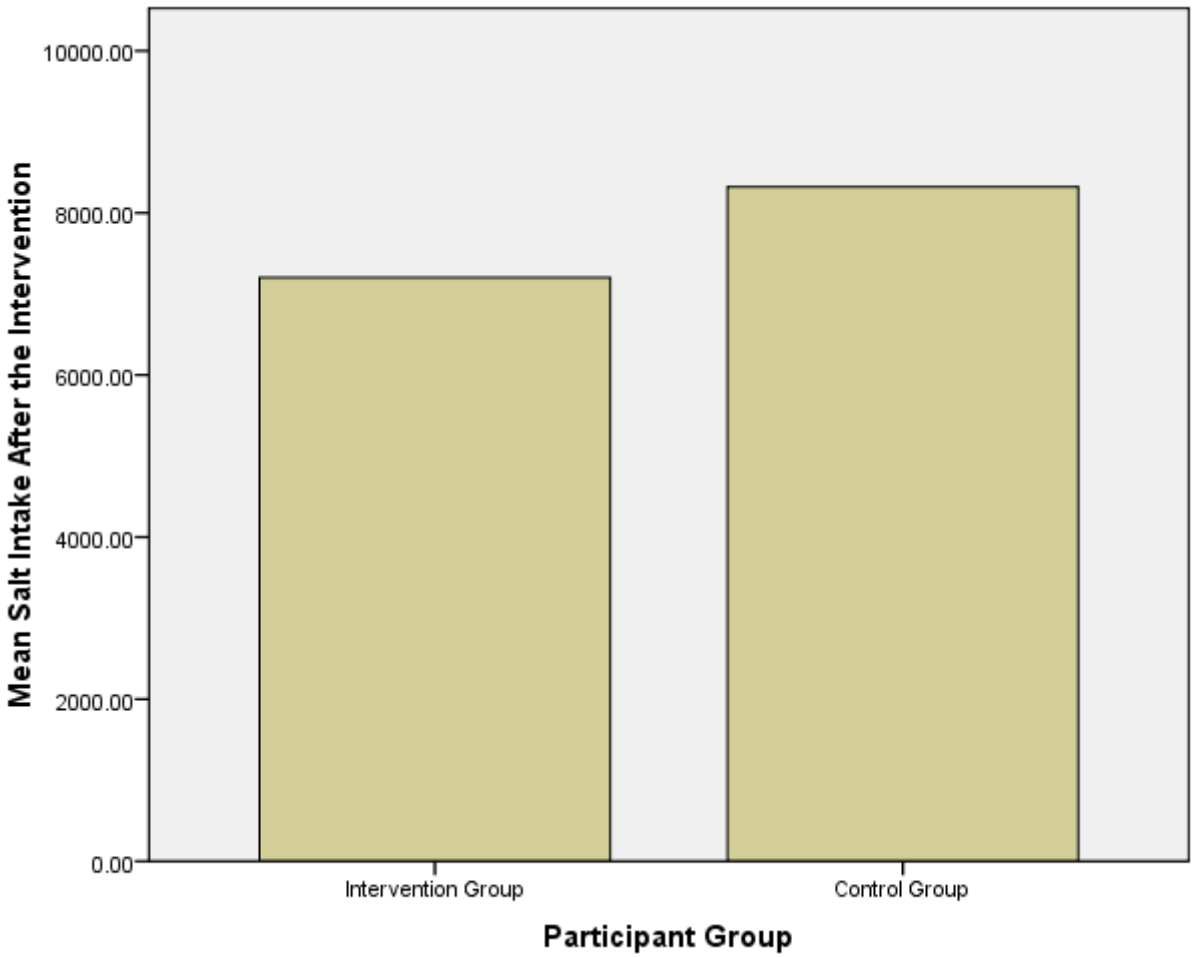

Figure 1

Daily mean salt intake in control and intervention groups after the intervention

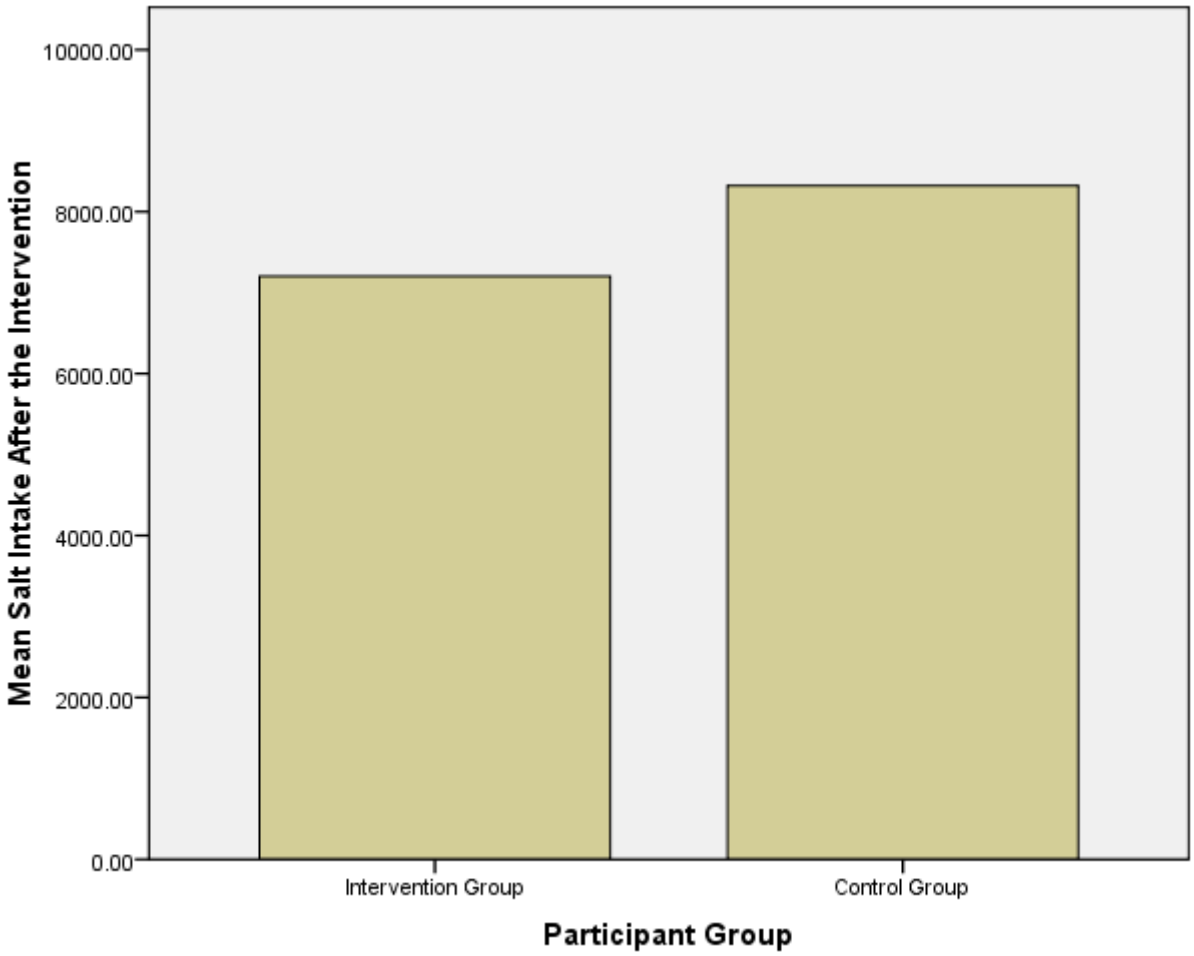

Figure 1

Daily mean salt intake in control and intervention groups after the intervention

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- AdditionalSupplementaryfileQuestionnaire.docx
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- CONSORT2010Checklist.doc
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