Effect of Nutritional Education Program Based on Social Cognitive Theory on Sodium Intake among Housewives

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Abstract

Background: Sodium is essential for normal physiological functioning in human being. Prolonged high salt intake increases the risk of hypertension and cardiovascular diseases. **Aim:** To assess the effect of nutritional education program based on Social Cognitive Theory on sodium intake among housewives. **Methods:** A quasi-experimental research design was conducted in four randomly selected villages in Minia district. **Sampling:** A systematic random sample of 133 housewives. **Tools:** Five data collection tools were used, reflecting the Social Cognitive Theory construct. Tool No. (1): assessed the sociodemographic characteristics and situational awareness related to salt reduction. Tool No. (2) assessed salt reduction's positive outcome expectations and barriers. Tool No. (3) assessed the cognition and self-efficacy of reducing sodium intake. Tool No. (4) and Tool No. (5) assessed the nutritional knowledge and dietary behaviors regarding sodium intake**. Results:** Post-intervention, situational awareness concerning salt reduction and the experience of low- sodium products increased. The advantages expected to decrease sodium intake increased, while the barriers decreased. All items of cognition and self-efficacy significantly improved post-intervention (p-value <0.001). All knowledge items significantly increased in correct responses post-intervention (p-value <0.001). Post-intervention, 70% had low-risk behavior related to salt consumption compared to 10% pre-intervention. **Conclusion**: Social Cognitive Theory based educational program was effective in enhancing situational awareness, expected positive consequences, cognition and self-efficacy related to salt reduction, while it decreased the related difficulties expected. Moreover, the intervention increased the level of knowledge and improved the behaviors related to salt intake**. Recommendations**: Engaging families in future studies can foster a supportive atmosphere at home to adjust sodium intake.

Keywords: Housewives, Nutritional Education Program, Social Cognitive Theory, Sodium intake

Introduction

Sodium is a main electrolyte in the human body that has essential roles in stabilizing physiological homeostasis, including muscle function, nerve activity, and metabolic regulation **(Minegishi et al., 2020).** The amount of daily intake of sodium to sustain these functions is very little (<0.5g) and can simply be taken through a well-balanced diet of plant- or animal-based sources. Still, the worldwide average consumption of sodium is 3,950 mg/day, nearly double the required daily intake**.** Likely 1.89 million deaths annually are related to the consumption of excessive sodium, a well-known cause of hypertension and higher risk of cardiac disease **(World Health Organization *(WHO), 2025).***

The World Health Organization has urged for a 30% decrease in salt consumption among the global population by 2025, with a specific goal of keeping intake below 5 grams per day for adults and even lower for children. Many advanced nations have begun initiatives aimed at reducing salt intake. For instance, both Finland and the UK have successfully lowered their salt levels, which have been linked to decreases in average blood pressure and cardiovascular disease mortality rates. Unfortunately, many developing countries have not yet made similar progress **(He et al., 2019).**

Persistent intake of high sodium can affect the kidney's function and the fluid regulating system and the functions of, heart, and central nervous systems, causing the occurrence of

hypertension. Hypertension is the primary cause of the load of cardiovascular disease (CVD), the principal cause of mortality worldwide, at nearly 17.9 million lives annually. So, excessive sodium intake is a result of numerous aspects, encompassing genetic susceptibility and lifestyle; it is a principle origin to hypertension and CVD. Approximately 10% of all CVD-associated mortality worldwide annually (1.8 million lives) can be caused by high sodium consumption **(Khalesi et al., 2022).**

Considering the well-documented correlation between high sodium intake and a greater likelihood of non-communicable diseases (NCDs), lowering sodium consumption within the population has become a central focus for both global and national policy efforts. Decreasing salt intake among the general populace is not only a practical measure to avert negative health effects, such as elevated blood pressure, but it is also an achievable and cost-efficient approach to alleviate the increasing burden of NCDs and lessen healthcare expenditures for both governments and individuals **(Rito et al., 2020)**.

In purchasing and preparing food for the family, housewives play a crucial role. They have a substantial effect on the development of children's eating behaviors and beliefs. Moreover, they can lead change socially by employing active impact on the market, so changes in housewives' awareness and actions can be a very effective way of applying consumer methods to decrease sodium intake **(Ahn et al., 2022**).

Nurses have a vital role in saving the health of individuals and families, particularly when motivating them to consume a low-salt diet **(Himmelfarb, Commodore-Mensah, & Hill, 2016)**. They can educate individuals and families about how high salt intake causes hypertension, while reducing sodium intake can prevent dangerous health problems like strokes and cardiovascular diseases. Nurses encourage their clients by providing practical plans, such as reading food labels, applying herbs instead of salt to improve the taste, and avoiding processed foods **(Stephen et al., 2022).**

Theoretical framework

To decrease salt intake, diverse behavioral approaches, including face-to-face and online intervention have been developed **(Trieu et al., 2017).** A key example of these approaches is the utilization of behavioral change theories to plan intervention strategies that can lead to higher effective and significant results. One of the most common theories applied is Social Cognitive Theory (SCT) (**Hidayanty et al., 2016).**

The Social Cognitive Theory, in its original or modified form, has been utilized by numerous investigators to describe human health behavior. It is a model of mutual connection between individual factors, conduct, and the external environment, all of which are in continuous interaction **(Tchoua et al., 2024)**. Individual factors for explaining conduct include skills and awareness to accomplish the behavior, self-efficacy, and the consequences expected from doing the behavior. Environmental parts affect the person's behavior by supplementing suitable modeling for demonstrating the conduct and existing resources to use **(Ahn et al., 2017).**

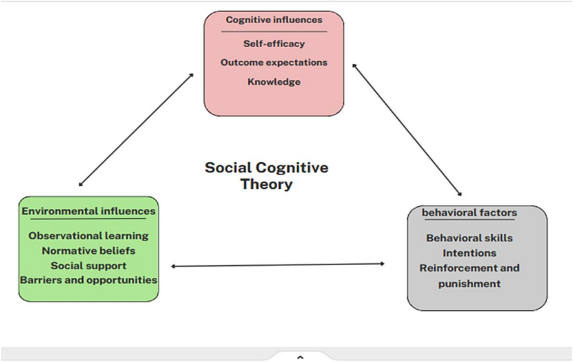

Figure (1): Constructs of SCT (Hosseini et al., 2023)

Significance of the Study

An Egyptian study accomplished between Egyptian women aged 19–30 years in urban areas to evaluate day-to-day intake of sodium shown that, ninety three percent of the women had consumptions of sodium in surplus of recommendations: on average, twofold the recommended amount of sodium intake was taken (2787 ± 1065 mg/d instead of 1500 mg/d) and eighty eight percent of women consumed ≥2300 mg/d. Increased intakes of sodium (2500–2700 mg/d) have already been noticed in teenagers (12–18 yrs old) with and without hypertension from Sohag city in Upper Egypt (**Brouzes et al., 2020).**

Grounded on WHO policy direction and suggested actions for salt decrease, Egypt has developed multispectral national committees, with the leadership to direct and follow the application of salt reduction efforts **(Al Jawaldeh et al., 2018).** The national action plans or programs for salt reduction developed by the Ministry of Health and Population (MOHP) involved achieving a target of 20% relative salt decrease by 2021 and 10% relative decrease (9 g/day) by 2025 for adults **(WHO,2017).**

Results of earlier reviews declared that teaching and awareness-raising initiatives at the population level were successful in diminishing salt intake, principally when applied via the behavioral change theories (**Trieu et al., 2017).** Additionally, improving young women's dietary intake has the potential to enhance the health of both women and future children (**Brouzes et al., 2020).** Thus, the current study sought to evaluate the effect of nutritional education program based on SCT on sodium intake among housewives.

Aims of the study:

To assess the effect of nutritional education program based on Social Cognitive Theory on sodium intake among housewives.

Subject and Methods

Study design: A quasi-experimental research design (pre- and post-tests) was used in the study

Setting:-

The study was conducted in four randomly selected villages in the northern region of Minia district

Sample size

The G*Power software, version 3.1, was used to determine the study's projected sample size. The computation was based on a power (1-β error probability) of 0.80, an effect size of 0.3, and α-error probability of 0.05. According to these parameters, the software specified that a total of 111 housewives would be included in the study. Considering 20% drop-out factors, the sample size was increased to 133.

Sample size and technique

Minia district is divided into four zones (North, South, Middle and New Minia City). To conduct the study, one zone is selected randomly by the lottery method from these zones, which is the north zone. The north zone includes fifteen villages, of which four villages have been chosen by the lottery method to be included in the study. The selected villages are Damarees Village, Zohra Village, El Borgaya Village, and Saft Ellabn Village. Based on the statistical report of the Central Agency for Public Mobilization and Statistics (CAPMAS) in Minia governorate in 2024, the total number of housewives in the selected villages was 40202. The number of housewives that was chosen from each village was calculated by dividing the number of housewives in each village by the total number of housewives at all the selected villages, and then multiplied by the estimated sample size.

No	Village	Total Number of housewives	Sample taken
1	Damarees	6130	21
2	Zohra	7840	26
3	El Borgaya	17928	59
4	Saft Ellabn	8304	27

As there was no sampling frame in the selected villages, the participants were selected using systematic random sampling, with a randomly selected sampling interval of (3). The first home of participants was randomly selected to be the starting point for the subsequent systematic selection of participants, and then every 4th subject was included in the research.

Inclusion criteria

1. Being the main housewife responsible for handling and preparing food
2. Free from any medical condition requiring sodium restriction

Tools of data collection:

Five data collection tools reflecting the elements of the SCT were designed by the investigators following revising the following literature **(Ahn et al., 2015; Ahn et al., 2022; and Cheikh Ismail, et al., 2022)**.

Tool No (1): included two parts. Part I assessed the sociodemographic characteristics of the participants, including age, education, average monthly income, marital status, and working status.

Part II: included 4 questions in the form of yes or no to assess the perception of environmental factors (situational awareness) related to salt reduction and experience of low sodium product such as recognizing any environmental effort for reducing sodium intake, previous observation of nutrition labeling of sodium for processed foods, and if participants ever used or purchased low-sodium food and specification of that type of food.

Tool No (2): A five-point Likert-type scale included 11 questions to assess cognitive factors related to practicing sodium reduction, including the positive outcome expectations (5 questions) and barriers (6 questions).

Scoring system

The items of this section were scored on a Likert scale with five points as follows: strongly

disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5). All statements of this part were added together to determine the final score, and the total score, which was greater than 60% indicating a higher level of positive expectation or expected barriers, while combined scores equal to or less than 60% indicated a lower level of positive expectation or expected barriers.

Tool No (3): A five-point Likert-type scale included 8 questions to assess the cognition and self-efficacy of reducing sodium intake.

Scoring system

The items of this section were scored on a Likert scale with five points as follows: strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5). All statements of this part were added together to determine the final score, and the total score, which was greater than 60% indicated a higher level of cognition and self-efficacy, while combined scores equal to or less than 60% indicated a lower level of cognition and self-efficacy.

Tool No (4): included 27 questions to assess the nutritional knowledge related to sodium intake, 10 questions in the form of yes, no, or I don't know and 17 multiple choices questions to specify the sodium content in 17 selected foods as either high or low, or I do not know

Scoring system

The scores of this tool were estimated using one point (1) for the correct answer and zero (0) for the wrong answer or don't know, respectively. Knowledge scores ranged from 0 to 27 based on the number of correct answers. As a result, the contributors were regarded as having a satisfactory level of knowledge if the total score was >60 %, and an unsatisfactory level of knowledge if the total score was ≤ 60%

Tool No (5): A three-point Likert scale to assess dietary behaviors regarding sodium consumption, comprising 14 queries. The first eight queries concentrated on detecting risky behaviors related to salt consumption, while the following six queries assessed salt related protective behaviors. Participants could select from three possible responses: often, sometimes, or never for each behavior query.

Scoring system

Participants received 2 points for answering "often," 1 point for "sometimes," and 0 points for "never.", for the first eight risky behavior queries related to salt consumption. Conversely, for the following six protective behaviors, scores were allocated as follows: 2 points for "never", 1 point for "sometimes" and 0 points for "often". Built on the entire scores, participants were classified into three groups: low risk for an entire score of 0, moderate risk for scores ranging from 1 to 14, and high risk for scores from 15 to 28.

Validity and Reliability:

By five professionals in Community Health Nursing, the study tools' content validity was appraised. They judged numerous features such as content completeness, arrangement of questions, simplicity, relevance, word length, applicability, and overall appearance. Modifications were made to improve the tools after their comment and recommendations. To assess the reliability of the research instruments, Cronbach's alpha was employed. The analysis showed a coefficient alpha of 0.821 for the situational awareness assessment tool, 0.869 for the cognitive factors assessment tool, 0.774 for the cognition and self-efficacy assessment tool, 0.852 for the nutritional knowledge related to salt intake assessment tool, and 0.942 for sodium dietary behavior consumption assessment tool.

Pilot study

Ten percent (13) of the entire sample set was used in a pilot study. The primary objective was to appraise the validity of the questionnaire and to gauge participants' acceptability of the research topic. The findings from this pilot study were incorporated into the final results, as no significant changes were made to the study tools.

Data collection procedures:

Before conducting the study, official permission was obtained from the Directorate of Health and Population in Minia city. Another official permission was obtained from the directors of health units of the selected villages to facilitate the implementation of the nutritional education by agreeing to conduct the educational sessions at the health units, and assisting the researchers in conducting home visits to the villages with the help of the rural pioneers to recruit the housewives to participate in the research. During the home visits, every housewife was provided with a complete explanation of the purpose of the research, then invited to participate in nutritional education by

coming to the health unit every Saturday and Sunday weekly from 12-2 pm in Zohra and Saft El labn village and every Wednesday and Thursday from 12-2pm in damaress and El borgaya village. The educational program started from February 2025 to the med of June 2025 through the following three phases: the assessment phase (pretest), implementation phase, and the evaluation phase (posttest).

Assessment phase

On the agreed upon date scheduled during the home visit, housewives who consented to participate in the research were welcomed to attend the educational program in the health unit, and then the researcher asked them to complete the pretest questionnaire. To reassure the housewives, the researchers provided them with a detailed explanation of the tools of data collection and its purpose for obtaining baseline data and assessing their situational awareness, positive outcome expectations, barriers, self-efficacy, knowledge, and dietary behavior related to sodium intake, before and after the nutritional education. The housewives who can read and write completed the questionnaire by themselves, while the researchers completed the questionnaire for those who cannot read or write. The time required to fill questionnaire ranged from 10-15 minutes based on the needed explanation. Based on the results of the pretest, a specific educational content that takes into account the elements of the SCT was designed. This phase started from the beginning to the end of February 2025.

Implementation phase

The interventions were designed and implemented through five educational sessions, based on the constructs of the SCT theory, as a behavioral change strategy to decrease salt intake among housewives. Each session ranged from 60 to 90 minutes. The educational sessions were intended to improve knowledge, behavior, self-efficacy, and situational awareness related to decreasing sodium intake. This phase started from the beginning of March to the end of May 2025. The program sessions were implemented simultaneously in the villages of Zohra and Saft El Laban, from the beginning of March 2025 until mid-April 2025 then in the villages of Damaris and El Borgaya from mid-April until the end of May 2025. The housewives in each village received the educational sessions as single group, except in El Borgaya village. The number of participants was 21 in Damarees village, 26 in Zohra, and 27 in Saft El Labn. As the number of housewives in El Borgaya village was 59, they were divided into two groups to facilitate more effective understanding.

The 1st session (Salt and Sodium) (Sodium and Health): This session built cognitive readiness for salt behavioral change by targeting knowledge, situational awareness, and expected consequences related to salt intake. It included the difference between salt and sodium, and the role of sodium in the human body. To increase the responsiveness of situations, participants learned about the WHO daily recommendation of salt for an adult person(less than 5 grams/day), the current sodium intake status in Egypt, along with national efforts to decrease sodium consumption. In this session, lectures, statistical data, questions and answers, and group discussions were used as teaching strategies.

The 2nd session (Expected positive and negative consequences): This session focused on health risks associated with excessive sodium intake, the prevalence of hypertension in Egypt and the benefits of a low-sodium diet. The topics included in the session were discussed using both lectures and group discussions.

The 3rd session (Reducing sodium intake): This session included teaching how to decrease sodium intake in three areas related to food handling, including when selecting and purchasing food, cooking, and eating food. In addition, this session included how to decrease salt gradually to adapt to a new taste. Further, participants were taught how to read nutrition labels and identify sodium levels across various food groups. An important focus of this session is the cooking techniques designed especially for low-sodium diets. Participants knew flavorful alternatives, including herbs and seasonings that enhance taste without relying on salt. Lectures, videos, worksheets, and pamphlets were used as teaching methods. The targeted factors for change in this session were knowledge, skills, and self-efficacy to decrease or adjust sodium intake.

The 4th session (Tasting low salt diet)**:** This session aimed to let the participants taste certain cooked food with salt alternatives and ask them to compare the flavors with high salt food. In addition, the participants learned ways to decrease salt in processed food**.** Demonstration was used as a teaching method in this session.

The 5th session (Further education about low-sodium cooking): This session relied on increasing self-efficacy and confidence through individualized action planning to decrease salt intake. Participants were allowed to identify specific challenges to decrease their salt intake and how they will overcome them. Moreover, participants were provided with low-sodium recipe pamphlets and informative websites on how to decrease sodium intake. Group discussion and worksheets were used as teaching methods.

Evaluation phase

Recognizing that behavior changes related to salt consumption take time, This part of the post intervention questionnaire was assessed two weeks after the intervention, while the remaining parts of the questionnaire were evaluated immediately after ending the intervention including participants' awareness of the situation, expectations of positive outcomes, barriers they might face, self-efficacy, and nutritional knowledge related to sodium intake.

Ethical considerations:

Before participation in the study, informed consent was acquired from all participants to guarantee their support. This consent included information about the study's aim, strategy, length of time, and the tools used. Before beginning the study, ethical approval was assigned with the code number (REC20241210) by the Ethics and Research Committee at the Faculty of Nursing, Minia University. Housewives were informed of their right to pull out from the study at any time based on their own will.

Statistical analysis:

By the SPSS 24.0 statistical software, Data entry and statistical analysis were employed. The findings are shown using descriptive statistics, including frequencies and percentages for qualitative variables, while quantitative variables are described with means and standard deviations. To decide the significance of changes between quantitative data in pre and after the nutritional educational program, the Student t-test was conducted, while the chi square test was used to decide the significance of changes between qualitative data. Findings were considered statistically significant when the p- value was less than 5% ($p < 0.05$).

Results

Table (1): Distribution of sociodemographic data among the studied housewives (n=133):

Demographic characteristics	No.	%
Age		
20-30	20	15.0
<30-40	**70**	**52.6**
<40-50	30	22.6
<50	13	9.8
Mean ±SD	**35.9 ±3.1**	
Educational Qualification		
Illiterate	**73**	**54.9**
Read and Write	20	15.0
Primary Education	25	18.8
Secondary Education	8	6.0
High Education	7	5.3
Marital status		
Married	**125**	**94.0**
Widow	5	3.8
Divorced	3	2.2
Working status		
Employee	40	30.1
Not employed	**93**	**69.9**
Monthly income of family		
Enough and save	25	18.8
Enough	20	15.0
Not enough	**88**	**66.2**

SD= Standard Deviation

Table (1) presents the demographic characteristics of the studied housewives. Among them, 52.6% were aged between 30 and 40, with a mean age of 35.9 years (mean ± SD: 35.9 ± 3.1). Additionally, 54.9% of the participants were illiterate, and 94% were married. 69.9% of the studied women were not employed, and 66.2% reported having insufficient income.

Table (2): Distribution of studied sample regarding their situational awareness related to salt reduction and the experience of low sodium product in pre- and post-test (n=133):

Items	Pre	Post	X2	p-value
Do you recognize any effort (nutrition education program, campaign or events) for reducing sodium intake in schools, government, food service industries, TV, radio, advertisement, and newspaper? **yes**	40(30.1)	103(77.4)	14.32	0.001*
Have you seen nutrition labeling of sodium for processed foods? **yes**	53(39.8)	100(75.2)	12.13	0.001*
Do you know about the nutrition labeling of sodium in restaurants or highway rest areas? **yes**	25(18.8)	79(59.4)	8.21	0.001*
Please check the list of low-sodium food ever used or purchased. (multiple answers possible)				
Fresh fruits	53(39.8)	70(52.6)	11.31	0.001*
Cereals	27(20.3)	50(37.6)	11.06	0.001*
Starchy vegetables such as potatoes and sweet potatoes	50(37.6)	79(59.4)	10.13	0.001*
Less salty cheese	48(36.1)	53(39.8)	10.12	0.001*
Nuts and seeds are not salted	30(22.6)	48(36.1)	11.03	0.001*
Low sodium drinks, such as tea, coffee, and water	25(18.8)	40(30.1)	5.11	0.001*

***: Significant at P ≤0.05 **: Highly Significant at P ≤0.01, t = t: Student t-test**

Table (2) shows a highly statistically significant improvement in situational awareness related to salt reduction and the experience of low-sodium products following the intervention in all items. The highest increase was in the recognition of efforts to decrease sodium intake through various media and institutions increased markedly (from 30.1% to 77.4%, p=0.001). Similarly, the visibility of nutrition labeling for sodium in both processed foods (from 39.8% to 75.2%) and restaurant/highway rest areas (from 18.8% to 59.4%) significantly improved (p = 0.001 for both).

Table (3): Distribution of studied sample related to their positive outcomes expectations and barriers regarding sodium reduction in pre and post-test (n=133):

Advantages expected by reducing sodium intake.	pre	post	X^2	p-value
Decrease of blood pressure	84(63.2%)	130(97.7%)	2.311	0.001**
Prevention to stroke and heart disease	53(39.8%)	110(82.7%)	3.746	0.001**
Reduction of swelling in body	79(59.4%)	117(88.0%)	2.175	0.001**
Prevention of renal diseases	70(52.6%)	113(84.9%)	2.682	0.001**
Prevention of osteoporosis	40(30.1%)	100(75.2%)	4.153	0.001**
Difficulties expected to practice low-sodium diet due to.				
Bad taste	80(60.2%)	30(22.6%)	2.751	0.001**
Time-consuming and inconvenient process of cooking	75(56.4%)	25(18.8%)	1.672	0.001**
Limitation to choose food, menu, and restaurant	90(67.7%)	40(30.1%)	1.132	0.001**
Limited knowledge and skills to practice	69(51.9%)	33(24.8%)	0.417	0.001**
Interrupting social relationships when dining with family or friends	84(63.2%)	35(26.3%)	2.913	0.001**
Preference for salted diet	93(69.9%)	45 (33.8%)	3.157	0.001**

***: Significant at P ≤0.05 **: Highly Significant at P ≤0.01, X^2 = chi square test**

Table (3) Clarifies that in comparison to the pre- and post-nutritional educational program, there are highly statistically significant differences (p-value = 0.001) concerning all items of the advantages expected by reducing sodium intake and the difficulties expected to practice a low-sodium diet. The highest increase in the positive expectations was noted in the belief that osteoporosis can be prevented by reducing sodium intake, which rose from 30.1% to 75.2%. Regarding the barriers to decrease sodium intake, before the nutritional program, the highest percentage (69.9%) reported preference for a salty diet as a barrier, which decreased to 33.8% following the intervention.

Table (4) Mean distribution of cognition and self-efficacy of reducing sodium intake in pre and post-test among the studied housewives (n=133):

Cognition	pre	post	t	p-value
I feel fulfilled or satisfied when eating foods with less salt	5.21 ±1.21	7.34 ±1.34	2.641	0.001**
I usually concerned about sodium contents in food or dish.	4.34 ±0.32	6.25 ±2.67	3.572	0.001**
Practicing a low-sodium diet will improve my health.	3.25 ±1.54	6.36 ±1.42	3.637	0.001**
I think consumer's sodium reduction can induce the change of social surroundings.	5.47 ±2.37	6.21 ±2.64	4.741	0.001**
Self-efficacy				
I can buy fresh food rather than processed or instant food	6.47 ±0.41	8.24 ±1.87	3.142	0.001**
I can request less salty when eating-out	7.39 ±1.27	9.37 ±1.76	2.371	0.001**
I can choose dishes with native flavor and taste rather than hot, salty, spicy ones.	5.15 ±2.68	6.54 ±1.28	2.621	0.001**
I will have concern for low-sodium recipe.	4.67 ±0.91	7.31 ±2.34	3.317	0.001**

**** Highly statistically significant difference at P ≤ .001, t: Student t-test, SD (Stander Deviation)**

Table (4) indicates that there were highly statistically significant differences (p-value <0.001) between pre- and post-implementation of the nutritional education program concerning all items of cognition and self-efficacy of reducing sodium intake. Among the cognition statements, the highest increase in the mean score was in the statement of "Practicing a low-sodium diet will improve my health" increasing from 3.25 ± 1.54 to 6.36 ± 1.42**.** Regarding self-efficacy, the highest variation was observed in the statement of "I will have concern for low-sodium recipe" increasing from 4.67 ±0.91 to 7.31 ±2.34

Table (5): Comparison of the percentage of correct answers of the nutritional knowledge related to sodium intake in pre and post-test among the studied housewives (n=133):

Item	pre	post	X^2	p-value
Excess sodium intake can increase the risk of osteoporosis.	55(41.4%)	125(94.0%)	6.314	0.001**
The amount of sodium and salt in a food are the same.	53(39.8%)	103(77.4%)	11.121	0.001**
Two tablespoons of salt are the recommended goal intake of salt in a day.	73(54.9%)	130(97.7%)	14.011	0.001**
Sodium is necessary to maintain the balance and equilibrium of body fluids	50(37.6%)	113(84.9%)	12.374	0.001**
Sufficient intake of fruits and vegetables helps sodium excretion	79(59.4%)	127(95.5%)	12.265	0.001**
Sodium exists in various food additives such as baking powder and preservatives.	70(52.6%)	129(97.0%)	10.547	0.001**
For nutrition labeling, salt content is indicated in the wrapping paper.	48(36.1%)	117(88.0%)	11.642	0.001**
Salt is used as a food preservative	103(77.4%)	131(98.5%)	13.741	0.001**
The amount of salt allowed for children daily shouldn't exceed 2 grams.	40(30.1%)	110(82.7%)	11.012	0.001**
Those who suffer from high blood pressure and are over 50 years old should consume only 2.5 grams of salt daily.	80(60.2%)	130(97.7%)	9.214	0.001**

***: Significant at P ≤0.05 **: Highly Significant at P ≤0.01, X^2 = chi square test**

Table (5) highlights a highly statistically significant improvement in participants' knowledge about sodium-related health facts after the intervention. All knowledge items showed statistically significant increases (p = 0.001) in correct responses post-intervention. The highest change was in the correct response about the awareness that excess sodium intake can increase the risk of osteoporosis (41.4% vs 94.0%). However, the lowest increase was in the awareness that salt is used as a food preservative (77.4% vs 98.5%)

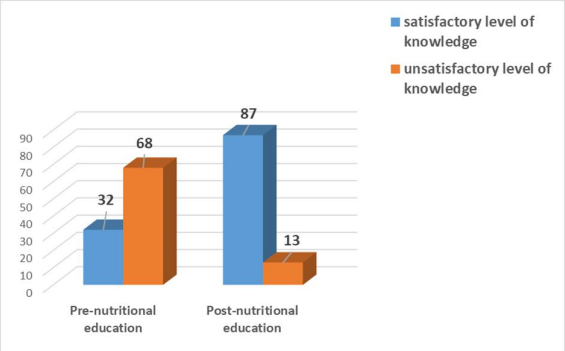

Figure (2): Total levels of knowledge related to sodium intake pre and post the nutritional education among the studied housewives (n=133).

Figure (2) shows that, regarding nutritional knowledge about sodium intake among the housewives studied, 68% had an unsatisfactory level of knowledge before receiving nutritional education. After the education was applied, this improved significantly, with 87% of the housewives demonstrating a satisfactory level of knowledge related to sodium intake.

Table 6: Comparison of the percentage of correct behaviors related to salt consumption pre and post the nutritional education among housewives (n=133).

Behavior	Pre N (%)	Post N (%)	X2	p-value
I consume canned or processed food. **Never**	43(32.3%)	100(75.2%)	2.143	0.001**
I eat out (including delivered meals) more than two or three times per week **Never**	35(26.3%)	90(67.7%)	2.647	0.001**
I consume very much of pickles. **Never**	40(30.1%)	93(69.9%)	3.191	0.001**
I eat crackers or potato chips or as a snack. **Never**	25(18.8%)	80(60.2%)	3.287	0.001**
During cooking, I add salt to food **Never**	45 (33.8%)	48(42.5%)	2.154	$0.614^{N.S}$
During cooking, I use stock cubes. **Never**	75(56.4%)	80(60.2%)	4.612	$0.721^{N.S}$
At the table, I add salt to food. **Never**	30(22.6%)	103(77.4%)	2.418	0.001**
Prior to tasting the food, I add salt **Never**	73(54.9%)	117(88.0%)	1.271	0.001**
I drink water from filter **Often**	48(42.5%)	120(90.2%)	0.917	0.001**
I consume plenty of vegetables and fruits.. **Often**	95(71.4%)	128(96.2%)	1.831	0.001**
I examine or check labels specifically for salt content. **Often**	33(24.8%)	105(78.9%)	2.913	0.001**
Salt/sodium content on label influence my purchasing decisions. **Often**	45 (33.8%)	107(80.4%)	4.162	0.001**
I attempt to buy foods low in salt **Often**	55(41.4%)	112(84.2%)	4.341	0.001**
I attempt to buy "no added salt" foods. **Often**	48(42.5%)	110(82.7%)	4.733	0.001**

***: Significant at P ≤0.05 **: Highly Significant at P ≤0.01, N.S= not significant at p= >0.05, X^2 = chi square test**

Table (6) demonstrates significant positive behavioral changes following the intervention, as indicated by high p-values ($p < 0.001$), suggesting strong statistical significance. For example, the percentage of participants who never eat canned food increased from 32.3% to 75.2%. Those who often check labels for sodium content rose from 24.8% to 78.9%. Participants also reported healthier general eating habits, including drinking filtered water (from 42.5% to 90.2%). However, no significant improvement was noted in adding salt to food or using stock cubes during cooking after the intervention.

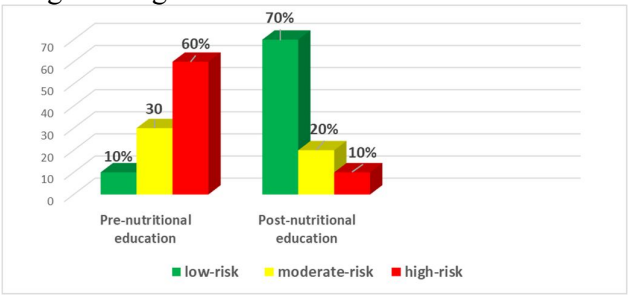

Figure (3): Total levels of risky behavior related to sodium intake pre and post the nutritional education among the studied housewives (n=133).

Figure (3) illustrates the level of risky behaviors related to salt consumption at pre- and post-nutritional education among the studied housewives. 60% of the studied housewives had a high-risk behavior pre-application of nutritional education; post-application of nutritional education, this improved to 70% of them having low-risk behavior related to salt consumption.

Discussion

Education and communication to empower individuals to eat less salt: raising awareness of the health impact of high salt consumption and the major sources of sodium in diets will influence consumer behavior and increase demand for lower-salt food products, a key objective of a sustainable reduction in salt consumption. Successful education and communication strategies can lead to changes in social norms related to salt in foods, increased demand for healthier, lower-salt products, and consequently improvements in overall health for individuals and communities **(Al Jawaldeh et al., 2018).** So the current study aimed to assess the effect of nutritional education program based on SCT Theory on sodium intake among housewives.

Regarding the situational awareness related to salt reduction, the current study revealed that, following intervention, there was an increase in the subjects' awareness of social effort related to salt reduction, while pre intervention less than one thirds were aware of efforts, such as strategies, campaigns, or events for reducing sodium intake, compared to more than two thirds became aware by such efforts following the nutritional education.

These findings are in the same line with a Korean study done **Ahn et al., (2022**) to evaluate an education program for housewives to reduce sodium intake based on the SCT, while it was stated that following the education program, there was a notable increase in the awareness of social initiatives focused on sodium reduction and labeling, along with greater familiarity with low-sodium products.

The change in recognizing social effort related to salt reduction can be a critical foundation for successful decision making related to adjusting sodium intake, which could have a positive effect on the purchase intention. In the unfolding of events, an individual's situational awareness is a dynamical process as one's mind continuously adapts to the changing reality **(Godbout, 2023)**.

Concerning the advantages expected to practice a low-sodium diet, the current study clarified that in comparison to the pre- and post-nutritional educational program, there were highly statistically significant differences (p-value <0.001) concerning all items of the advantages expected to decrease sodium intake. Among the positive expectations, a significant increase was observed in the belief that sodium reduction can help prevent osteoporosis, which rose from less than one-third before intervention to three-qarters after education.

This finding indicates that this particular health gain was formerly not known among the housewives, reflecting the value of the educational program in increasing awareness regarding the long-standing effects of excess sodium intake on the health of bone, which is less known compared to the effect of sodium on blood pressure or cardiovascular health.

This result is in the same line with **Ahn et al., (2022**), who stated that the expectation for preventing osteoporosis through sodium reduction has significantly risen ($p < 0.001$). Furthermore, this finding is consistent with **Ahn et al., (2014**) in a Korean study to reduce sodium intake among consumers using a nutritional education intervention based on focus group interviews, while it was reported that reducing sodium intake is expected to yield positive results, particularly in preventing chronic diseases like osteoporosis.

Concerning the difficulties expected to practice a low-sodium diet, the current study clarified that in comparison to the pre- and post-nutritional educational program, there were highly statistically significant differences (p-value <0.001) concerning all items of the difficulties expected to decrease sodium intake. This result is consistent with **Ahn et al., (2022**). Similarly, **Fathi et al., (2017)** showed that the nutrition education program was effective in decreasing the score of perceived barriers to reduce the consumption of unhealthy snacks among primary school girls.

Regarding the barriers, Pre-intervention, more than two-thirds of the participants reported that the preference for a salted diet is a barrier to reducing salt consumption. These results are consistent with an Australian study by **Khalesi et al., (2024)** to explore salt reduction barriers and enablers among hypertensive adults, while it was reported that habits, tastes and cultural norms were suggested as barriers to reducing salt intake among the participants.

The belief that the preference for a salty diet is a barrier to salt reduction can be illuminated by the fact that salty foods are deeply embedded in

Egyptian culture. Common traditional foods such as pickles, cheese (especially mish and domiati), and salted fish (feseekh and melouha) are all high in sodium. These items are not only popular but often considered essential components of meals, particularly during holidays (e.g., Sham El-Nessim).

Following the intervention, the percentage of participants who reported the preference for a salty diet as a barrier to reducing salt consumption had declined to one-third. This decline reflects an increased awareness and motivation among participants to change their dietary behavior.

Regarding the self-efficacy related to practicing sodium reduction, the current study revealed highly statistically significant differences (p-value <0.001) between pre- and post-implementation of the nutritional education program concerning all items of self-efficacy regarding reducing sodium intake. Specifically, a significant increase was observed for the concern for recipes of low-sodium, demonstrating that the educational program effectively enhanced responsiveness and enthusiasm to eat low-sodium recipes, which is a key step to long-term change in dietary behavior.

This result agrees with **Grimes et al., (2018)** in Australia, in their study **"**Digital education to limit salt in the home (DELISH) program improves knowledge, self-efficacy, and behaviors among children**"** while it was reported that following participation, there was a marked enhancement in the self-efficacy scores of the participants (P < .001).

Regarding the nutritional knowledge scores related to sodium intake, the current study found that all knowledge items showed statistically significant increases in correct responses post-intervention (p = 0.001). These findings are in harmony with **Ahn et al., (2022**) in Korea **& Walsh et al., (2018)** in Lebanon to assess the effect of a hospital-centered educational program on knowledge and behavior regarding dietary salt among patients in a cardiac care unit, while it was noted that participants' understanding of salt-related topics showed a marked improvement right after the intervention.

Further findings agree with the current study declared by **Cheikh Ismail et al., (2022)** to assess the influence of a nutrition education program on university students' knowledge, attitudes, and practices regarding salt and sodium intake, while it was reported that the understanding and perspectives regarding salt showed notable improvement right after the intervention.

The significant improvements in all knowledge items pre- and post- nutritional education indicate that the intervention effectively boosted knowledge on multiple facets of sodium intake, covering everything from fundamental facts and labeling to health implications and dietary advice. These advancements play a vital role in fostering informed decision-making and promoting behavioral shifts geared towards reducing sodium in diets.

Regarding behaviors related to salt consumption, the current study demonstrated significant improvements in several salt-related behaviors two weeks following intervention. In particular, not eating canned food (p < 0.001). Consistent with this finding, **Land et al., (2016)** in Australia, in their study to assess the impacts of a community-based salt reduction program, illustrated that the number of participants avoiding processed foods significantly increased post-intervention. Moreover, **Silva-Santos et al., (2022)** reported an increase in the percentage of subjects who avoided the consumption of processed foods in a sample of adults in Portugal after intervention to reduce added salt when cooking.

Other salt-related behaviors showed significant improvement in the current study, are buying low-salt foods and not adding salt to food at the table increased significantly (P= 0.001). Similarly, **Cheikh Ismail et al., (2022)** reported that after intervention, trying to buy low-salt foods and rarely adding salt to food at the table showed significant improvements.

Moreover, assessing food labels especially for salt/sodium content and trying to low salt or no added salt food increased significantly (P= 0.001). These findings are congruent with **Baek et al., (2017**) in Korea, in a study to decrease sodium consumption among housewives using a nutritional education program tailored according to the SCT, while they reported notable advancements in the review of nutrition labels after the educational program.

These improvements in several salt-related behaviors show a greater understanding and more mindful choices when it comes to sodium consumption, which indicates a notable impact of the program on comprehending the health risks associated with excess salt consumption.

Despite the overall effectiveness of the nutrition education intervention, no significant improvement was found in other salt-related

behaviors, such as not adding salt to food during cooking and not using Stock Cubes. This could be explained by deeply entrenched cooking habits among the participants, while adding salt is essential for flavor development. As suggested by SCT, behavioral change becomes more challenging when a behavior is a routine part of daily life.

Regarding the total level of risky behavior related to salt consumption, the current study revealed that less than two-thirds of the studied housewives had a high risky behavior pre-application of nutritional education; post-application of nutritional education, this improved to more than two thirds of them having low risky behavior related to salt consumption.

Similarly, **Layeghiasl et al., (2020),** in Iran, revealed that the practice related to salt intake improved significantly after an educational intervention included educational classes to decrease salt consumption. Moreover, **Au et al., (2017),** in the USA, in a study to evaluate the effect of face to face and online nutrition teaching on salt awareness and demeanors, revealed improvements in described demeanors related to minimizing salt consumption among low income individuals.

Contradicted with the current study finding, **Ahn et al., (2022**) reported that the average score of all questions related to sodium intake did not change significantly after education. This contradiction may be attributed to addressing the high prevalence of CVD and hypertension in Egypt in the current nutritional education program, reflecting the urgent need for individuals and families to decrease their intake of sodium, so housewives became more motivated to implement the information they acquired through the intervention.

Conclusion

The findings of the current study indicate that the nutritional education program based on the SCT was effective in enhancing situational awareness, expected positive consequences, cognition and self-efficacy related to salt reduction among the studied housewives, while it decreased the difficulties expected to practice a low-sodium diet. In addition, the intervention increased the level of nutritional knowledge related to sodium intake and improved the behaviors related to salt intake.

Recommendations

1- Engaging spouses and children in future studies aimed at adjusting sodium intake can help foster a supportive atmosphere at home.
2- Share salt adjustment messages based on SCT via social media, local TV, and community centers. Use practical advice to encourage low-sodium habits.
3- Future studies focus on measuring urinary sodium levels both before and following the nutritional education could provide a more objective and precise assessment of actual sodium intake, addressing the shortcomings associated with self-reported dietary habits

Limitations of the study

1- Dietary behaviors regarding sodium consumption were assessed using self-reported Likert scales, which could induce social desirability bias, while participants often tend to minimize their unhealthy habits, like adding extra salt to their meals, while exaggerating their positive behaviors, such as checking food labels. This can result in skewed data that doesn't accurately reflect true behaviors.
2- Due to logistical and resource barriers, measuring urinary sodium levels to assess the actual sodium intake could not be done.

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