



Effect of the ‘Bijak Garam’ meal program on nutrient intake, frailty, biomarkers, and quality of life in older adults

Dampak program makan ‘Bijak Garam’ terhadap asupan gizi, kerapuhan, biomarker, dan kualitas hidup pada lansia

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Abstract

Older adults are a vulnerable group prone to degenerative diseases and decline in quality of life, often characterized by geriatric syndromes such as frailty. Nutritional intervention plays an important role in addressing these challenges. However, evidence of the effectiveness of dietary programs combined with structured nutrition education in nursing homes remains limited. This study aimed to evaluate the “Bijak Garam” program, a combination of a low-salt diet and nutrition education, on the dietary intake, blood biomarkers, physical function, and health status of older adults. A quasi-experimental study was conducted using a pre-post, one-group design with purposive sampling involving 100 participants. Dietary intake was assessed using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), physical function was measured using handgrip strength and the FRAIL scale, and blood biomarkers were analyzed using standard laboratory methods. Data were analyzed using paired t-test or Wilcoxon signed-rank test. The Bijak Garam intervention effectively improved dietary intake and reduced HbA1c, total cholesterol, LDL, triglyceride, and diastolic blood pressure ($p < 0,05$), while HDL levels increased significantly ($p < 0,05$). Most of the participants preferred plant-based protein sources. These findings demonstrate that the Bijak Garam program can improve dietary patterns and several health indicators among older adults, with the potential to be implemented more widely in geriatric nutritional interventions and public health policies.

Keywords: Diet intervention, nursing home, nutrition intervention, older adults, salt reduction

Abstrak

Lansia merupakan kelompok yang rentan mengalami penyakit degeneratif dan penurunan kualitas hidup, salah satunya ditandai dengan sindrom geriatrik seperti kerapuhan (*frailty*). Intervensi gizi terbukti berperan penting dalam menghadapi masalah tersebut. Namun, bukti mengenai efektivitas program diet yang disertai edukasi gizi terstruktur di panti wreda masih terbatas. Penelitian ini bertujuan mengevaluasi program “Bijak Garam”, yaitu kombinasi diet rendah garam dan edukasi gizi, terhadap pola konsumsi, biomarker darah, fungsi fisik, dan status kesehatan lansia. Penelitian menggunakan desain kuasi-eksperimen dengan pendekatan *pre-post one-group design* dan teknik *purposive sampling* pada 100 lansia. Asupan makanan diukur dengan Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), fungsi fisik dengan kekuatan genggam tangan serta FRAIL scale, dan biomarker darah melalui pemeriksaan laboratorium standar. Analisis data dilakukan dengan uji *paired t-test* atau Wilcoxon Signed Rank Test. Hasil menunjukkan program Bijak Garam efektif meningkatkan asupan makanan dan menurunkan kadar HbA1c, kolesterol total, LDL, trigliserida, serta tekanan darah diastolik ($p < 0,05$). Sementara itu, kadar HDL meningkat signifikan ($p < 0,05$). Mayoritas lansia menyukai sumber protein nabati. Kesimpulan, temuan studi membuktikan bahwa program Bijak Garam

mampu memperbaiki pola konsumsi dan indikator kesehatan lansia, serta berpotensi diadopsi lebih luas dalam intervensi gizi geriatri dan kebijakan kesehatan masyarakat.

Kata Kunci: Intervensi diet, intervensi gizi, lansia, panti wreda, pengurangan garam

Introduction

The global population is currently entering an era of an aging population. An aging population has become a demographic phenomenon in developing countries (Ismail et al., 2021). The growth of the elderly population in Indonesia is expected to occur in the coming years because of demographic transitions (Bappenas, 2019). The percentage of elderly people in Indonesia has increased by 4% over the last decade (2010–2022), reaching 11,75% by 2023. The Yogyakarta Special Region (DIY) is the province with the highest percentage of elderly people in Indonesia at 16,02%, positioning Yogyakarta as a critical area for elderly health research and intervention.

The elderly population requires special attention owing to their high risk of developing degenerative diseases and experiencing a decline in quality of life (Sihite et al., 2021), and frailty is one of the most pressing geriatric syndromes (Gallucci et al., 2019 in Suffian et al., 2020). Frailty is a syndrome of physiological decline characterized by health vulnerability, defined as meeting three out of five criteria: weakness, slowness, low physical activity, fatigue, and unintentional weight loss (Chen et al., 2019 in Sukkriang & Punsawad, 2020). The prevalence of frailty among the elderly is approximately 7% among those aged ≥ 65 years and 30% among those aged ≥ 80 years.

In addition to frailty, chronic diseases such as hypertension are prevalent and often poorly managed among the elderly. According to the 2023 from Indonesian Health Survei (IHS), the prevalence of hypertension among individuals aged ≥ 60 years was 22,9%. However, only 11,9% regularly took medication and 11% attended follow-up visits (Kementerian Kesehatan RI, 2023). The prevalence of hypertension in the elderly aged 60–64 years is recorded above 75 years was 45,9 %, 65–74 years at 57,6 %, and 63,8%, respectively (Pramitasari & Cahyati, 2022). These data show that as age increased, the prevalence of hypertension also increased. DI Yogyakarta ranks second in the region with the highest

number of hypertension cases in Indonesia (Silvianah & Indrawati, 2024).

Nutrition plays an important role in preventing and managing these conditions. Health management for the elderly can be achieved through nutritional interventions. Improving nutrition in the elderly should consider appropriate nutrient requirements based on a balanced diet and recommended dietary allowances (RDA). Additionally, blood lipid profiles and HbA1c levels can be used to assess the nutritional and health status of elderly individuals. However, existing literature and policies often focus on geriatric nutrition on a general basis, with limited emphasis on integrated salt reduction strategies in institutional care settings. This gap is significant, given the role of sodium intake in the development of hypertension.

Several elderly care homes in Yogyakarta, such as the Budi Dharma Nursing Home, Madania Nursing Home, and Hanna Nursing Home, exhibit various health issues such as hypertension, gout, cognitive disorders, and depression. Nursing homes provide physical, spiritual, and social care services to enhance the well-being of the elderly. However, structured dietary modifications have not been provided. The “*Bijak Garam*” program combined with education for food handlers, offers a targeted approach to reduce salt intake while improving overall diet quality. This study seeks to address policy or practice gaps by evaluating such interventions in elderly nursing homes with the aim of improving the health, nutritional status, and quality of life of the elderly to remain healthy, resilient, and productive.

Methods

This study aimed to analyze the effectiveness of the “*Bijak Garam*” — a low-salt diet program combined with nutritional education — on elderly health status, frailty, blood biomarkers, food intake, and meal preferences in nursing homes. A quasi-experimental pre-post one-group design with purposive sampling was used,

involving 100 elderly residents from Budi Dharma, Madania and Hanna Nursing Homes. This study was conducted from October 2024 to December 2025.

The “*Bijak Garam*” nutrition advocacy consisted of six sessions (30-60 minuted each) targeting the nursing home staffs with the aim of equipping participants to prepare and distribute meals according to redced-salt guidelines. Sessions are delivered by trainer-certified speakers with expertise in nutrition. Training materials included the application of “*Bijak Garam*” concept in menu planning, portioning, and food texture delivered using a PowerPoint presentations. After the six sessions concluded, the trained food handlers applied the skills learned in the TOT sessions during the three-month implementation phase, preparing meals with reduced salt combined with MSG to lower sodium intake in the elderly.

After the intervention, health, nutritional, and physical function data were collected. Anthropometric measurements, including blood samples (3 cc) for fasting glucose, lipid profile, and hemoglobin levels, as well as blood pressure and heart rate, were collected. Physical function was assessed using the FRAIL scale, handgrip strength, and IPAQ scores. Food intake was

measured using the Comstock visual method, whereas preferences were assessed using an organoleptic questionnaire.

Statistical analysis was performed using paired t-tests for normally distributed data and Wilcoxon signed-rank test for non-normal data to assess pre-post differences. The results are presented in tables and narrative summaries.

This study also involved four undergraduate nutrition students with different thesis focuses, contributing to this broader project while pursuing individual research goals. Ethical approval was granted by the Ethics Committee of the Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada (Ref: KE/FK/1364/EC, approved on 4th September 2024).

Result and Discussion

A total of 100 elderly respondents were recruited from three nursing homes. There were 25 respondents were from Hanna, 41 from Budi Dharma, and 34 from Madania. The characteristics of the respondents, including age, sex, and physical activity level, are presented in the following table (Table 1).

Table 1. Respondent characteristics

Characteristics	Category	Nursing Home					
		Hanna (n= 25)		Budi Dharma (n= 41)		Madania (n= 34)	
		n	%	n	%	n	%
Sex of Elderly	Male	0	0	16	39	18	53
	Female	25	100	25	61	16	47
Physical Activity	Low	22	88	18	44	8	24
	Moderate	3	12	23	56	16	47
	High	0	0	0	0	10	29

The total number of respondents in Hanna was 25, all of whom were elderly (100 %). The average age of respondents in Hanna was 78 years. This nursing home had the lowest level of physical activity, which was influenced by residents’ age, health conditions, and limited mobility within the facility. There were 41 respondents at Budi Dharma, with 61% female and 39% male. The average age of the respondents was 73 years and their level of physical activity ranged from low to moderate. Meanwhile, Madania had a total of 34 respondents, consisting of 47% females and 53% males. The average age of respondents in Madania was 61 years.

This facility showed a moderate to high level of physical activity, as many residents were still actively working outside the nursing home.

Health Status of Older Adults

Among the three nursing homes, hypertension was the most common illness among elderly residents. This aligns with the focus of the conducted study, titled “*Bijak Garam*,” which aimed to reduce sodium intake by limiting the use of regular salt and partially substituting it with low-sodium seasoning products. This intervention is expected to gradually reduce the prevalence of hypertension.

Table 2. Frailty, nutritional status, and handgrip strength of older adults

Variable	Category	Before:	After:	p-value
		n (%) / Mean	n (%) / Mean	
Frailty	Robust	17 (17,0)	20 (20,0)	0,209
	Pre-Frail	49 (49,0)	50 (50,0)	
	Frail	34 (34,0)	30 (30,0)	
Handgrip Strength (kg)	Overall	10,9	11,6	0,106
	Hanna	6,3	7,4	
	Budi Dharma	10,4	10,5	
	Madania	13,9	16,2	
Nutritional Status	Underweight	30 (33,7)	29 (33,0)	0,257
	Normal	41 (46,1)	41 (46,6)	
	Overweight	18 (20,2)	18 (20,5)	

Physical Function Analysis of Older Adults

This study used frailty status, handgrip strength, and physical activity level to assess the physical capacity of older adults living in nursing homes. Physical activity was measured using an International Physical Activity Questionnaire (IPAQ). In Hanna, physical activity levels among older adults are generally low. This was mostly due to limited mobility and heavy reliance on wheelchairs among residents, which restricted their physical activity. Additionally, the facility had a smaller area than other homes, further limiting movement. At Budi Dharma, the physical activity levels were moderate to low. This could be attributed to the elderly's participation in regular programs and activities organized by the nursing home, which helped to keep them relatively active. In contrast, the majority of residents in Madania demonstrated moderate to high levels of physical activity, as many were still physically active and productive in various jobs, such as construction work, farming, and other light to moderate labor.

Frailty in older adults is a geriatric syndrome that can be categorized into three groups based on the FRAIL scale: non-frail (robust), prefrail, and frail. The numbers of elderly individuals according to their frailty levels before and after the intervention are presented in Table 2. The results of the Wilcoxon signed-rank test indicated that the intervention did not have a significant effect on changes in the respondents' frailty levels ($p = 0,209$). Although 18 out of 100 respondents showed an improvement in their frailty status, 10 respondents experienced an increase in frailty, while the majority (72 respondents) remained stable.

Frailty is influenced by factors such as age, nutritional status, comorbidities, functional capacity, and psychosocial status (Chen et al., 2014; Corpas 2020). Older adults at Budi Dharma retained good physical functional capacity, as reflected in their moderate to low activity levels and relatively stable handgrip strength. This stability in handgrip strength indicates that muscle mass and function are maintained during the intervention, which is crucial for preventing frailty (Martin & Ranhoff, 2020). Improved intake and significant changes in nutritional status may also contribute to these outcomes (Lochlainn et al., 2021). These combined factors were consistent with the significant reduction in frailty observed in Budi Dharma. However, the same intervention may yield different outcomes depending on the initial condition of the elderly, implementation quality, social support, and the environment in each nursing home.

Notably, the average handgrip strength of the elderly participants across all three nursing homes increased after the intervention (Table 2), and the lowest average handgrip strength was recorded. Budi Dharma showed relatively stable outcomes, while Madania had the highest average handgrip strength. Following the intervention, 40 respondents experienced an increase in handgrip strength, 31 showed a decrease, and 11 showed no change. However, based on the results of the Wilcoxon signed-rank test ($p = 0,106$), these changes were not statistically significant.

Handgrip strength is influenced by age and sex characteristics of the elderly in the three nursing homes (Wearing et al., 2018). Lower handgrip strength was commonly found in older age groups and among female residents, as

observed in Hanna. Although there was an increase in average handgrip strength from 6,3 kg to 7,4 kg, Hanna still had the lowest average. Most residents of this home experienced limited physical mobility or hand weakness. In addition, physical activity level and protein intake are known to influence handgrip strength in older adults (Choi, 2023).

At Madania, a notable increase in handgrip strength was recorded from 13,9 kg to 16,2 kg after the intervention. This nursing home had the highest average handgrip strength both before and after the intervention, likely due to the higher activity and productivity levels of its residents. The addition of more diverse and nutritious foods, especially protein sources, also likely contributed to this improvement. Meanwhile, Budi Dharma showed variations in handgrip strength with some residents improving and others declining, but the overall average remained stable between 10,4 kg and 10,5 kg.

Nutritional Status of Older Adults

Nutritional status can be categorized into three groups: underweight, normal weight, and overweight. The numbers of elderly individuals in each category before and after the intervention are presented in Table 2. Overall, based on the Wilcoxon Signed Ranks Test analysis, there was no significant difference in nutritional status before and after the implementation of the "Bijak Garam" program among the elderly across the three research

locations ($Z = -1,134$, $p = 0,257$). However, when the statistical test was analyzed according to nursing home location, varied results were observed. At Budi Dharma, there was a significant difference in nutritional status before and after the intervention ($p = 0,046$ and $p < 0,05$, respectively), although weight changes occurred only in a small number of participants. No significant differences were observed between Hanna and Madania.

Differences in nutritional status may be attributed to variations in individual characteristics across nursing homes, which influenced the effectiveness of the intervention. These characteristics include baseline nutritional status and overall health of the elderly. Prior to the intervention, 46,1% of the elderly had a normal nutritional status. As most residents began in the normal nutritional category, the likelihood of changes in nutritional status was relatively small. After the intervention, only two elderly individuals experienced a decline in nutritional status, 80 maintained their status, and seven showed improvement.

Comstock Analysis of Older Adults

A total of 99 individuals had measurable percentages of stocks. The Comstock percentage is divided into two categories: low (0–20%) and high (> 20%) (Farapti et al., 2023). The frequency of each category by month is presented in table below:

Table 3. Descriptive and frequency analysis of Comstock each month

Food Items	Comstock 1 st month			Comstock 2 nd month			p-value
	Mean $\pm$ SD	Category	%	Mean $\pm$ SD	Category	%	
Carb	14,20 $\pm$ 17,88	Low	72,7	7,72 $\pm$ 12,15	Low	89,7	< 0,001
		High	27,3		High	10,3	
Animal Protein	21,50 $\pm$ 22,86	Low	57,6	5,82 $\pm$ 8,67	Low	90,7	< 0,001
		High	42,4		High	9,3	
Plant-based Protein	24,97 $\pm$ 23,33	Low	53,1	9,38 $\pm$ 12,58	Low	83,2	< 0,001
		High	46,9		High	16,8	
Vegetable	16,91 $\pm$ 19,50	Low	70,4	11,95 $\pm$ 13,55	Low	72,2	0,003
		High	29,6		High	27,8	
Fruit	13,31 $\pm$ 22,17	Low	76,8	4,95 $\pm$ 8,78	Low	91,9	< 0,001
		High	23,2		High	8,1	

The percentage of stocks for carbohydrates, animal protein, plant-based protein, fruits, and milk in the high category decreased over the course of the intervention period.

Normality was assessed using the Kolmogorov-Smirnov test, which is appropriate for sample sizes exceeding 50. In all three months (October, November, and December), the Comstock percentage data for

all food items exhibited a non-normal distribution, as indicated by significance values consistently below 0,05. Consequently, the Wilcoxon signed-rank test was employed for further analysis because of the non-normality of the data (Rachmawati, 2018).

The Comstock results for all institutions showed a significant decrease each month for all food items, with p-values less than 0,05. The monthly decrease in the Comstock percentage can be calculated using the geometric growth formula for decline as follows:

$$r = 1 - (1 + \text{Comstock decrease}/100)^{1/t}$$

The Comstock score reduction during the three-month intervention is represented by r , the average monthly decrease, and t , the frequency of the reduction events. In this study, two reductions were observed in three months ($t = 2$), illustrating both the magnitude and occurrence of change. Based on the formula, the results showed that carbohydrates decreased by 24,53% each month, animal protein 45,24%, plant-based protein 37,57%, vegetable 15,37%, and fruit 38,30%.

The Relationship Between "Bijak Garam" and the Decrease in Comstock Percentage

The "Bijak Garam" program is a salt reduction initiative that replaces part of the salt with MSG, which contains significantly less sodium compared to regular salt (Ajinomoto, 2024). A comparison between the sodium intake and visual stock assessments is presented in the following table:

Table 4. Comparison between Sodium Intake and Visual Comstock

Variable	1 st month	2 nd month
Carbohydrate (%)	14,2	7,72
Animal Protein (%)	21,5	5,82
Plant-based Protein (%)	24,97	9,38
Vegetable (%)	16,91	11,95
Fruit (%)	13,31	4,95
Natrium Intake/day (mg/day)	1737,82	1593,9

According to research findings, a decrease in the Comstock percentage correlates positively with a reduction in salt (sodium) intake. However, statistical analysis of this relationship could not be performed

because of insufficient data. The "Bijak Garam" program is a movement aimed at reducing salt usage by incorporating a small amount of MSG (Monosodium Glutamate) into daily meals, initiated by the Ajinomoto Group Indonesia (Ajinomoto, 2024). Salt is a natural flavor enhancer used in cooking to make food more appetizing (Wang et al., 2023).

In this study, the salt content was reduced by approximately 50% and MSG was substituted. MSG provides an umami taste that resembles that of saltiness. Similar to salt, MSG is used as a flavor enhancer and can stimulate appetite (Sun et al., 2022; Ma et al., 2024). This aligns with the research conducted by dos Santos et al. (2014), who found that reducing salt and substituting it with MSG does not diminish the taste or palatability of food. According to previous research, MSG not only provides an umami taste similar to saltiness but also enhances the overall flavor profile of dishes, making them more appealing, enjoyable, and appetizing. An increased appetite can help reduce food leftovers among the elderly (Giesthafanny, 2022; Doktriana et al., 2024).

Elderly's Food Intake from All Nursing Homes

Elderly food intake was estimated by converting stock percentage data into nutrient values using the "Daftar Bahan Makanan Penukar (BMP)" from the Indonesian Ministry of Health in 2020. Animal protein intake was calculated using the average values of low- and moderate-fat animal proteins as both types were consumed. Only Group B vegetables were included, reflecting the types of vegetables served. Standard food weights before consumption were as follows: 100 g (carbohydrates, vegetables, and fruits), 50 g (animal protein), and 60 g (plant-based protein).

These weights are based on the average portions that are typically used. Plant-based protein sources included tofu and tempeh (1 exchange $\approx$ 60 g), whereas animal protein sources included chicken, eggs, and meat (1 exchange $\approx$ 50 g). Monthly intake data are presented in the following table:

Table 5. Mean of food intake from all Nursing Homes

Nutrients	1 st month	2 nd month	Difference (Mean ± SD)	p-value
	Mean ± SD	Mean ± SD		
Carbohydrate (g)	53,94 ± 10,55	58,91 ± 10,34	4,97 ± 0,21	< 0,001
Protein (g)	13,39 ± 3,25	15,60 ± 2,72	2,21 ± 0,53	< 0,001
Fat (g)	7,42 ± 2,14	8,95 ± 1,56	1,53 ± 0,58	< 0,001
Energy (kcal)	427,60 ± 88,06	471,56 ± 78,83	43,96 ± 9,23	< 0,001

It can be seen from the table that the nutrient intake of the elderly across all nursing homes significantly increased over the course of the intervention, as evidenced by the Wilcoxon Signed Rank Test. To calculate the monthly increase in nutrient intake in the elderly, the geometric growth formula for the increase can be used as follows:

$$r = (1 + \text{intake increase}/100)^{1/t} - 1$$

Parameter *r* indicates the average monthly increase in nutrient intake, whereas *t* reflects the frequency of intake improvements during the intervention. In this study, nutrient intake increased twice within three months (*t* = 2),

showing both the magnitude and occurrence of intake improvements. Based on this formula, the monthly increases in carbohydrates, protein, fat, and energy were 4,14%, 6,86%, 8,19%, and 4,56%, respectively.

The Knowledge of Food Handlers on Elderly Nutrition

Thirteen food handlers and nursing home staff from all the institutions participated in the education program. Their pre-test and post-test knowledge levels were categorized as poor (<56%), moderate (56–75%), or good (76–100%) (Arikunto, 2010, as cited in Rachmawati, 2018). The distribution is shown in table below:

Table 6. Frequency analysis of participant's knowledge levels and mean score of food handling test

Intervention	Category	n	%	Mean ± SD	p-value
Before	Moderate	1	7,7	92,30 ± 10,83	0,798
	Good	12	92,3		
After	Moderate	1	7,7	91,79 ± 8,24	
	Good	12	92,3		

The distributions of the pre-test and post-test scores were the same. As shown in the table, most food handlers demonstrated good knowledge.

Normality was tested using the Shapiro-Wilk test, as the sample size was < 50. The pre-test (*p* = 0,002) and post-test (*p* = 0,037) data had significance values below 0,05, indicating a non-normal distribution. Thus, the Wilcoxon signed-rank test was used for the analysis. The mean pre-test and post-test scores of the food handlers and nursing home staff are presented in Table 6. The post-test (after) results had an average score of 91,79, which was slightly lower than the pre-test average. The decrease in test scores was not statistically significant, with a significance value of 0,798 (*p* > 0,05).

Nutrition education for food handlers and nursing home staff is delivered through lectures. Posttest scores showed a non-significant decrease compared to pretest scores, in contrast

to previous studies that reported significant improvements after lecture-based interventions (Makhfirah & Hadi, 2024).

Overall, the food handlers showed a good level of nutrition knowledge. However, the lower average post-test score compared to the pre-test score may have been due to factors such as lack of focus, difficulty understanding the material, forgetting previous content, and environmental distractions during the education and testing sessions (Aviana & Hidayah, 2015; Erwiza et al., 2019; Comighud & Mae, 2021; Moges et al., 2025). Multitasking during the post-test was also observed, potentially affecting concentration and performance.

Limited attention during learning sessions may hinder material comprehension (Aviana and Hidayah 2015). Additionally, the 3-month intervention with only five topic-specific sessions and two evaluations (pre-test and post-test) may have led to decreased retention,

especially with 2–3 week gaps between sessions and a 3-month interval between tests. According to Notoadmodjo (2010, in Palupi et al., 2023), the ideal pretest–posttest interval to reduce external influences is 15–30 days. Environmental distractions during sessions may further impact learning (Sukowski, 2025). To enhance future interventions, it is recommended to reduce distractions, avoid multitasking, and maintain testing intervals within 30 days (Aviana & Hidayah, 2015; Erwiza et al., 2019; Comighud, 2021; Notoadmodjo, 2010 in Palupi et al., 2023; Moges et al., 2025).

Analysis of HbA1c, Lipid Profile and Blood Pressure

Before comparing HbA1c and lipid profile levels before and after the intervention, a normality test was conducted. The results indicated that HbA1c, LDL, and triglycerides were not normally distributed; therefore, the Wilcoxon signed-rank test was used for the analysis. Meanwhile, total cholesterol, HDL, and blood pressure were normally distributed, allowing for the use of the paired t-test.

Table 7. Paired test results for HbA1c, Lipid Profile, and Blood Pressure

Variable / Group	Outcome	p-value
HbA1c	Pre vs Post	<0,001*
Total Cholesterol	Pre vs Post	<0,001*
LDL	Pre vs Post	<0,001*
HDL	Pre vs Post	<0,001*
Triglycerides	Pre vs Post	<0,001*
All Participants	Systolic	0,179
	Diastolic	0,032*
Elderly Males	Systolic	0,101
	Diastolic	0,014*
Elderly Females	Systolic	0,055
	Diastolic	0,126
Hypertensive Elderly	Systolic	0,009*
	Diastolic	0,003*
Hypertensive Elderly (Stratified)	Systolic	0,001*
	Diastolic	0,004*
Hypertensive Elderly Males	Systolic	0,193
	Diastolic	0,026*
Hypertensive Elderly Females	Systolic	0,446
	Diastolic	0,495

Statistical analysis showed significant improvements ($p < 0,05$) in HbA1c, total cholesterol, LDL, HDL, and triglycerides after the “*Bijak Garam*” intervention. The diastolic blood

pressure significantly decreased ($p < 0,05$), while the systolic pressure showed no significant change ($p > 0,05$). Among males, only diastolic pressure declined significantly ($p < 0,05$); females showed no significant changes. In the hypertensive elderly group, both systolic and diastolic pressures improved ($p < 0,05$), with stronger effects in the stratified analysis. Within this group, only diastolic pressure in males showed significant improvement ($p < 0,05$), indicating a greater intervention effect on hypertensive elderly males.

Analysis of Food Preference Levels

An assessment of the respondents' food preferences revealed a generally positive attitude toward a variety of food groups.

Most participants reported favorable preferences for carbohydrate sources (98%), plant-based proteins (100%), animal proteins (85%), vegetables (93%), and milk (89%). A relatively small number of respondents expressed neutral attitudes toward specific food items such as animal protein (15%) and vegetables (6%). Notably, milk received the highest proportion of unfavorable responses, with 10% of respondents indicating a dislike of it.

Association Between Visual Comstock and Food Intake in Elderly

Food intake in the elderly can be assessed using food waste. A commonly used method is the visual stock method, which is a quick, affordable, and simple visual estimation tool. This method is particularly suitable for evaluating food intake in mass-catering settings such as nursing homes. However, it is considered less accurate than the food weighing method, which involves measuring the actual weight of the leftover food (Fadilla et al., 2020; Dewi & Djokosujono, 2022).

As shown in the table of the Comstock's mean, the Comstock percentage significantly decreased over the course of the intervention. Moreover, the nutritional intake of the elderly across all nutrients significantly increased during the same period. These results indicate a direct relationship between decreasing Comstock percentage and increasing food intake among elderly residents in all nursing homes. Comstock is a simple method for evaluating food waste (Farapti et al., 2020; Farapti et al., 2023). Food waste is closely related to food intake; a

large amount of food waste indicates reduced food intake, whereas minimal food waste reflects increased food intake. Increased intake among the elderly enhances nutrient adequacy and helps prevent malnutrition (Bernaert et al. 2025).

Association Between Body Weight and Comstock Percentage Reduction in Elderly

A decrease in Comstock scores indicated increased food intake. Kang et al. (2025) found that higher protein intake could improve body mass in older adults, and other studies have linked calorie intake to weight gain (Cordova et al., 2021). However, the findings of this study differ, possibly due to age-related physiological decline, such as reduced digestive function, which impairs nutrient absorption (Pilgrim et al., 2015). This may explain why an increased intake did not lead to weight gain in the elderly.

Generally, increased food intake leads to weight gain because higher energy intake with unchanged expenditure results in a positive energy balance. Conversely, negative energy balance causes weight loss (Downey et al., 2014; Downey et al., 2024). Excess energy is stored as glycogen or fat (Pang et al., 2014).

Effectiveness of the "Bijak Garam" Program and Nutrition Advocacy on HbA1c Levels

There was an increase in HbA1c levels among residents of Budi Dharma, Madania, and Hanna Nursing Homes following the *Bijak Garam* intervention, with Wilcoxon test results confirming the significant effect of the intervention.

However, no correlation was found between sugar intake and HbA1c changes, as institutions with varying sugar intakes (4,13 g to 81 g) showed similar average HbA1c levels (5 to 5,4 percent). These findings differ from those of Haimoto et al. (2021) and Lin et al. (2021), who reported a decrease in HbA1c levels following reduced salt intake. Despite the observed increase, HbA1c levels across all nursing homes remained within the normal range, defined as < 6 percent (Anggraini et al. 2020).

Effectiveness of the "Bijak Garam" Program and Nutrition Advocacy on Lipid Profile

The *"Bijak Garam"* intervention influenced lipid profiles including total cholesterol, HDL, LDL, and triglycerides among residents of Budi

Dharma, Madania, and Hanna nursing homes. Excess sodium intake is associated with increased blood pressure and fluid retention, especially in individuals with heart, liver, or kidney disorders, as it impairs the ability of the kidneys to eliminate fluid and raises vascular pressure (Aksan et al., 2020). According to the American Heart Association (2021), the recommended lipid levels for older adults are: total cholesterol less than 200 mg/dL, LDL less than 100 mg/dL, HDL > 40 mg/dL for men and > 50 mg/dL for women, and triglycerides less than 150 mg/dL.

Nutrient intake varied by institution, with Budi Dharma showing overall deficiencies, Hanna having adequate fat intake, and Madania having sufficient carbohydrate intake. Budi Dharma recorded the highest levels of total cholesterol and LDL, while Madania had higher HDL and triglyceride levels. These findings suggest that there is no consistent relationship between dietary intake and lipid profile.

Effectiveness of the "Bijak Garam" Program and Nutrition Advocacy on Blood Pressure

The *"Bijak Garam"* intervention reduced sodium intake among older adults in three nursing homes by an average of 1,638,3 mg (52,7%) over three months, with the highest reduction at Madania (60%). This is consistent with Gupta et al. (2023), who reported that sodium reduction lowered blood pressure. A significant decrease in diastolic pressure was observed ($p = 0,032$), particularly among older males ($p = 0,014$), which is consistent with the findings of Octarini et al. (2023) regarding age-related changes in taste sensitivity.

In the hypertensive group, systolic pressure decreased from 150 to 142 mmHg ($p = 0,009$) and diastolic pressure decreased from 91 to 84 mmHg ($p = 0,003$). A subgroup of 29 respondents showed greater reductions: 11 mmHg systolic ($p = 0,001$) and 8 mmHg diastolic ($p = 0,004$), supporting the $\geq 140/90$ mmHg threshold (Chia et al., 2021) and sodium-diastolic pressure correlation (Yunus et al., 2023). The subgroup's preference for plant-based meals may have contributed to this effect (Fitri 2023). Sex analysis showed a significant diastolic reduction only among males ($p = 0,026$).

Effectiveness of the "Bijak Garam" Program and Nutrition Advocacy on Food Preferences

Most elderly residents at nursing homes in Budi Dharma, Madania, and Hanna preferred plant-

based proteins, followed by carbohydrates, vegetables, milk, and animal proteins. Interviews revealed that this preference was largely due to the softer texture of plant-based protein, whereas the harder textures of animal protein and fibrous vegetables were less favored. Elderly individuals are at risk of undernutrition, which may lead to malnutrition, thus requiring appropriate dietary adjustment. These adjustments should consider age-related physiological changes such as reduced olfactory function, decreased digestive efficiency, limited chewing ability, and menopause in women (Setyawan et al., 2023). Tooth loss and chewing problems often cause the elderly to avoid hard-to-chew foods such as meat, fibrous vegetables, fruits, and nuts (Bestari et al. 2023). Observations also showed that adding flavor enhancers improved food intake, which is in line with Stevens and Cain (1993), who noted that declining taste sensitivity with age increases the need for stronger flavors to stimulate appetite.

This study highlights the importance of targeted nutritional interventions in nursing homes, which not only meet elderly residents' physical and nutritional needs, but also serve as crucial social support systems. Many older adults live in such facilities because of limited family support, which makes these institutions vital for maintaining their well-being and dignity.

Conclusion

Although no significant changes were observed in the body mass index among elderly participants, most of whom presented with normal baseline values, the "Bijak Garam" intervention yielded notable health benefits. The program reduced food waste, improved dietary intake, and enhanced physical performance, particularly when it was supported by protein supplementation and structured physical activity. Furthermore, significant improvements were documented in several biochemical parameters, including reductions in HbA1c, total cholesterol, LDL, and HDL levels, whereas triglyceride levels increased. Importantly, decreased sodium intake contributes to improved blood pressure regulation in hypertensive individuals.

Recommendations, these findings underscore the potential of integrated nutrition education and dietary interventions to improve

nutritional utilization, functional capacity, and metabolic health in older adults. To sustain program effectiveness, continuous reinforcement is recommended to maintain food handlers' knowledge and adherence to food safety practices. Given the age-related decline in nutrient absorption, emphasis should be placed on the provision of high-quality protein, particularly from plant-based sources, complemented by a balanced consumption of carbohydrates, vegetables, dairy, and animal protein. The broader implementation of the "Bijak Garam" program may serve as a scalable and sustainable approach to reducing nutrition-related risks in aging populations.

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