



Food and Nutrition Education in Primary Health Care for Individuals with Chronic Diseases: A Clinical Trial¹

Educação Alimentar e Nutricional na Atenção Primária com Pessoas com Doenças Crônicas: Ensaio Clínico

Educación Alimentaria y Nutricional en la Atención Primaria con Personas con Enfermedades Crónicas: Ensayo Clínico

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ABSTRACT

Objective: To evaluate the effectiveness of Food and Nutrition Education (FNE) workshops based on the principles of the Dietary Guidelines for the Brazilian Population and community gardening activities as health promotion strategies for individuals with Noncommunicable Diseases (NCDs). **Method:** This parallel quasi-experimental clinical trial was conducted in São Paulo, Brazil. The intervention group participated in three in-person workshops integrating FNE, community gardening, and food tasting sessions. In addition, participants received vegetable seedlings, printed educational materials, and weekly mobile phone reinforcement for three months. The control group received a book on healthy eating. The assessed outcomes included food consumption frequency, adherence to the dietary guidelines, whole-food utilization, food security, quality of life, and physical activity. Shapiro–Wilk, Student's *t*, Mann–Whitney, and χ^2 tests, as well as intention-to-treat analyses, were performed using a 5% significance level. **Results:** 3-month study retention was 71/90 (79%) in the intervention group and 50/90 (56%) in the control group. Most participants self-identified as having non-White skin color (57%), with a median age (IQR) of 59 (50–66) years, and 47% had completed high school. No significant differences were observed between groups except for a higher proportion of women in the intervention group (93%) than in the control group (74%) ($p = 0.004$). Following the intervention, participants in the intervention group were less likely to consume soft drinks ($p = 0.009$) and maintained their adherence score to the Dietary Guidelines for the Brazilian Population, whereas the control group showed a decline ($p = 0.004$). No between-group differences were observed in food access, whole-food utilization, quality of life, or physical activity. **Conclusion:** Food and Nutrition Education, combined with weekly reinforcement of educational content delivered via mobile phone over three months, was effective in maintaining healthy eating practices.

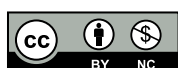
Descriptors: Effectiveness; Food and Nutrition Education; Healthy Eating; Primary Health Care.

RESUMO

Objetivo: Avaliar a efetividade de oficinas de Educação Alimentar e Nutricional, baseadas nos princípios do Guia Alimentar para a População Brasileira, e da atividade em horta comunitária como estratégias de promoção da saúde em pessoas com Doenças Crônicas Não Transmissíveis. **Método:** Ensaio clínico quasi-experimental paralelo conduzido em São Paulo – SP. O grupo de intervenção participou de três oficinas presenciais que integraram Educação Alimentar e Nutricional, horta e degustação. Além disso,

¹ Article derived from the master's dissertation entitled 'Controlled Clinical Trial of Food and Nutrition Education Actions in Primary Health Care for People with Non-Communicable Chronic Diseases: An Effectiveness Study', written by master's student Mariana Correia Stevenson Braga, presented at the Federal University of São Paulo in August 2024, with 128 pages.

* This study is the pilot phase of a clinical trial registered with the Brazilian Registry of Clinical Trials (ReBEC) under registration number RBR-5v6bkky.



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os participantes receberam mudas de hortalíça, impressos e reforço semanal por celular durante três meses. O controle recebeu um livro sobre alimentação saudável e foram avaliadas a frequência de consumo alimentar, a adesão ao guia, o aproveitamento integral dos alimentos, a segurança alimentar, a qualidade de vida e a atividade física. Testes Shapiro-Wilk, *t* de Student, Mann-Whitney, χ^2 e análises de Intenção de Tratar, nível de significância de 5%, foram adotados. **Resultados:** Adesão ao estudo após três meses: 71/90 (79%) intervenção e 50/90 (56%) controle. Maioria de cor de pele não branca (57%), idade mediana (IQ) de 59 (50;66) anos, Ensino Médio completo (47%), sem diferença entre os grupos, exceto maior participação das mulheres no grupo intervenção (93%) versus controle (74%) ($p = 0,004$). Após a intervenção, identificou-se menor chance no consumo de refrigerante ($p = 0,009$) e manutenção do escore de adesão ao Guia Alimentar no grupo intervenção, enquanto o grupo controle apresentou piora ($p = 0,004$). Não houve mudanças no acesso aos alimentos, no consumo integral dos alimentos, na qualidade de vida e na atividade física entre os grupos. **Conclusão:** A Educação Alimentar e Nutricional, acompanhada de reforço semanal das informações por celular durante três meses, mostrou-se positiva para a manutenção das práticas alimentares saudáveis.

Descritores: Efetividade; Educação Alimentar e Nutricional; Alimentação Saudável; Atenção Primária à Saúde.

RESUMEN

Objetivo: Evaluar la efectividad de talleres de Educación Alimentaria y Nutricional, basados en los principios de la Guía Alimentaria para la Población Brasileña, y de la actividad en huerta comunitaria como estrategias de promoción de la salud en personas con Enfermedades Crónicas No Transmisibles. **Método:** Ensayo clínico cuasi-experimental paralelo realizado en São Paulo – SP. El grupo de intervención participó de tres talleres presenciales que integraron Educación Alimentaria y Nutricional, huerta y degustación. Además, los participantes recibieron plántulas de hortalizas, impresos y refuerzo semanal por celular durante tres meses. El control recibió un libro sobre alimentación saludable y se evaluaron la frecuencia de consumo alimentario, la adhesión a la guía, el aprovechamiento integral de los alimentos, la seguridad alimentaria, la calidad de vida y la actividad física. Se adoptaron las pruebas Shapiro-Wilk, *t* de Student, Mann-Whitney, χ^2 y análisis de Intención de Tratar, con nivel de significancia del 5%. **Resultados:** Adhesión al estudio después de tres meses: 71/90 (79%) en intervención y 50/90 (56%) en control. Mayoría de color de piel no blanca (57%), edad mediana (RI) de 59 (50;66) años, Enseñanza Media completa (47%), sin diferencias entre los grupos, salvo mayor participación de las mujeres en el grupo intervención (93%) frente a control (74%) ($p = 0,004$). Después de la intervención, se identificó menor probabilidad de consumo de refresco ($p = 0,009$) y mantenimiento del puntaje de adhesión a la Guía Alimentaria en el grupo intervención, mientras que el grupo control mostró empeoramiento ($p = 0,004$). No hubo cambios en el acceso a los alimentos, en el consumo integral de los alimentos, en la calidad de vida y en la actividad física entre los grupos. **Conclusión:** La Educación Alimentaria y Nutricional, acompañada de refuerzo semanal de la información por celular durante tres meses, se mostró positiva para el mantenimiento de las prácticas alimentarias saludables.

Descriptores: Efectividad; Educación Alimentaria y Nutricional; Alimentación Saludable; Atención Primaria de Salud.

INTRODUCTION

Noncommunicable diseases (NCDs), including cardiovascular diseases (CVDs), chronic respiratory diseases, cancer, and type 2 diabetes mellitus (T2DM), are the leading causes of death worldwide, accounting for approximately 70% of all annual deaths, with the greatest burden occurring in low- and middle-income countries⁽¹⁾.

NCDs are associated with four lifestyle-related risk factors: tobacco use, physical inactivity, excessive alcohol consumption, and unhealthy dietary habits, characterized by high intakes of salt, saturated and trans fats and low consumption of fruits, vegetables, and dietary fiber⁽²⁾. Diets low in fiber and fruit and high in salt constitute the leading dietary risk factor for mortality and Disability-Adjusted Life Years (DALYs) attributable to CVDs, cancer, and T2DM, accounting for 22% of the global burden of deaths⁽³⁾.

Ultra-processed foods (UPFs), as defined by the NOVA classification adopted in the Dietary Guidelines for the Brazilian Population (DGBP), are industrial formulations ready for consumption that are rich in sugars, fats, starches, and proteins and contain cosmetic additives designed to enhance color, flavor, aroma, and texture. Consumption of UPFs has been positively associated with Crohn's disease, abdominal obesity, overweight, dyslipidemia, T2DM, depression, chronic kidney disease, all-cause mortality, CVDs, and hypertension⁽⁴⁾.

In countries with marked social inequalities, the food environment varies across geographic regions. Areas with greater social vulnerability tend to have a higher density of establishments selling UPFs and a lower availability of outlets offering fresh and minimally processed foods than regions with higher Human Development Index values. Beyond the environments where individuals live, work, or study, other social determinants — including income, educational attainment, housing conditions, employment, and access to health services — also constrain access to healthier foods^(5,6).

These challenges are particularly relevant in Brazil, where the annual prevalence of overweight among adults has increased by approximately 1% since 2006, reaching 61.4% in 2023, with 24.3% classified as having obesity. During

the same year, the prevalence of hypertension and T2DM reached 27.9% and 10.2%, respectively⁽⁷⁾. In addition to the growing burden of NCDs, food insecurity affected 50.5% of the population of the city of São Paulo in 2024⁽⁸⁾.

In response to these challenges, the World Health Organization (WHO) has promoted social prescribing as a health promotion strategy for individuals with NCDs⁽⁹⁾. Social prescribing is a low-cost approach centered on non-clinical interventions designed to reduce unnecessary medicalization. Among its recommended activities is vegetable gardening, which aims to improve access to healthy foods while helping individuals overcome social and behavioral determinants of health⁽¹⁰⁾.

Given the increasing burden of NCDs and their relationship with the food environment and lifestyle, integrated, low-cost strategies are essential within the Brazilian Unified Health System. Therefore, this study aimed to evaluate the effectiveness of Food and Nutrition Education (FNE) workshops based on the principles of the DGBP, combined with community gardening activities, as health promotion strategies for individuals with NCDs.

METHOD

This pilot parallel quasi-experimental clinical trial was conducted among individuals with NCDs receiving care at six Primary Health Care Centers (PHCCs) in São Paulo, Brazil, between August 2022 and June 2023.

The six PHCCs were selected by administrators of the Green and Healthy Environments Program (PAVS) of the São Paulo Municipal Health Department, which promotes environmental health in collaboration with professionals from the Family Health Strategy. For the intervention group, only PHCCs with an on-site or nearby community garden were eligible. Accordingly, three PHCCs with community gardens were allocated to the intervention group, whereas three PHCCs without gardens, located within the same administrative district, constituted the control group.

Eligibility criteria included individuals aged 18–75 years receiving care at the participating PHCCs who had been diagnosed with T2DM, hypertension, dyslipidemia, and/or overweight, with one or more of these conditions. Exclusion criteria comprised cognitive impairment, pregnancy or breastfeeding, and inability to participate in the in-person activities. Individual matching was not performed because it would have compromised participant recruitment logistics. Instead, comparability between groups was achieved by selecting control PHCCs from the same administrative district as the intervention PHCCs, thereby ensuring similar socioeconomic, demographic, and environmental characteristics.

Potentially eligible participants were recruited through referrals from health care professionals, invitations extended to individuals attending NCD follow-up groups (physical activity or integrative and complementary health practices), and direct invitations in waiting rooms while individuals were awaiting medical appointments. After eligibility screening, all participants provided written informed consent.

The sample size was estimated based on previous studies evaluating gardening and horticultural therapy interventions, which included approximately 75 participants in the intervention group and 50 in the control group. Accordingly, a target sample of 90 participants per group was established. In addition, because this was a pilot study, a recruitment target of 30 participants per PHCC was defined to assess intervention feasibility and generate estimates for future sample size calculations.

The primary outcomes were food consumption and the dietary practices score. Secondary outcomes included physical activity and food security, whereas tertiary outcomes comprised quality of life and anthropometric measures.

Participants in the intervention group attended three in-person FNE workshops based on the recommendations of the DGBP and received weekly reinforcement through WhatsApp® messages for three months. The workshops were held over three consecutive weeks, with one 60-minute session per week conducted either in a group activity room or in an outdoor area adjacent to the community garden. At the end of each session, participants received printed educational materials summarizing the content. Each workshop also included a practical community gardening activity, resulting in three integrated theoretical and practical sessions (Figure 1).

The workshops began with guided group discussions designed to elicit participants' prior knowledge, following the Freirean educational approach. The topics addressed in each workshop were as follows: 1) Food processing levels, sugar content of sugar-sweetened beverages and sweets, salt content of UPFs, and their health effects. During the gardening activity, participants were introduced to natural herbs and spices, received herbal salt as a strategy to reduce salt intake, and sampled flavored water as an alternative to sugar-sweetened beverages; 2) Food label reading and identification of UPFs. Participants learned to interpret nutrition labels to support healthier food choices, with emphasis on identifying UPFs based on ingredient lists, additives, serving sizes, and nutrition facts panels, as well as critically evaluating marketing strategies such as health claims and promotional packaging. The practical gardening activity focused on garden maintenance, harvesting, and vegetable sanitation, followed by

demonstrations, preparation methods, and tasting of unconventional food plants (UFPs) and recipes using whole-food utilization (e.g., carrot and beet leaves and stems) to promote food security and environmental sustainability. At the end of the session, participants received vegetable seedlings for home cultivation and future consumption, as well as sodium hypochlorite for sanitizing vegetables, fruits, and household water; 3) Comparison of meal costs and nutritional quality. Participants compared the average cost of meals prepared with fresh and minimally processed foods with meals predominantly based on UPFs, while also discussing strategies to reduce meal costs, including seasonal food choices and whole-food utilization. Practical activities included tasting recipes prepared with banana peel and a crumb mixture made from leaves and stems, discussions on commensality, meal planning, and home cooking. During the gardening session, participants were introduced to composting concepts and vermiculture as sustainable approaches to garden management and organic food waste disposal. At the conclusion of each workshop, printed educational materials summarizing the content were distributed.

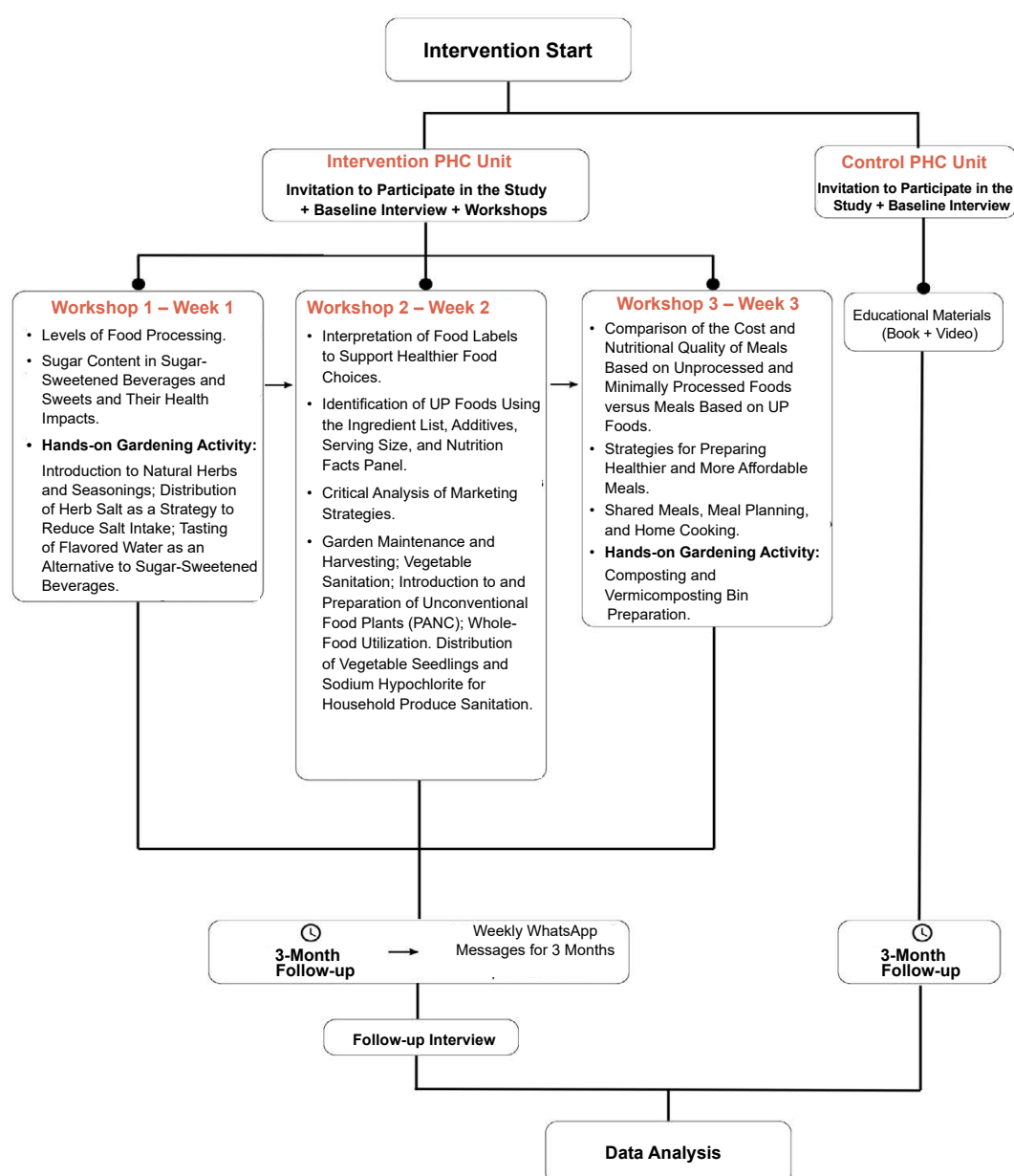


Figure 1. Study flow according to study groups and intervention activities, São Paulo, Brazil, 2022–2023.

Additionally, participants received one weekly WhatsApp® message for three months covering the following topics: strategies to increase vegetable consumption, front-of-package food labeling, reducing sugar intake, encouraging water consumption, differences among diet, light, and zero products, identification of UPFs, meal planning, commensality,

strategies to manage cravings for sweets, recommendations for reducing salt intake, healthy eating during weekends, cost-saving tips for grocery shopping, information on cooking oils and fried foods, and appropriate food storage in refrigerators (Supplementary Material).

Participants in the control group received a book on healthy eating for older adults entitled *The Best Food for the Best Years: Tips and Recipes*, published by the São Paulo State Department of Agriculture and Supply (2017)⁽¹¹⁾. The book was provided regardless of participants' age because it offers practical healthy eating recommendations in accessible language. In addition, participants received a link to a Pan American Health Organization (PAHO) video presenting the 10 recommendations of the DGBP, available at: <https://www.youtube.com/watch?v=x5EwVBmVk8o>.

Outcome assessments were performed at two time points: before the intervention (baseline) and three months after study initiation. The same assessment procedures and data collection instruments were applied to both groups.

Body weight was measured using a Plenna® Sport digital scale (150-kg capacity; 100-g precision), and height was measured using a wall-mounted Soehnle® stadiometer. All anthropometric measurements were obtained in duplicate, and the mean values were used for analysis. Body mass index (BMI) was calculated, and nutritional status was classified according to WHO criteria⁽¹²⁾: normal weight (BMI 18.5–24.9 kg/m²), overweight (BMI 25.0–29.9 kg/m²), and obesity (BMI ≥ 30.0 kg/m²). For older adults, nutritional status was classified according to Pan American Health Organization criteria⁽¹³⁾: normal weight (BMI 23.0–27.9 kg/m²), overweight (BMI 28.0–29.9 kg/m²), and obesity (BMI ≥ 30.0 kg/m²).

Waist circumference was measured at the midpoint between the lowest rib and the iliac crest⁽¹⁴⁾. The following cutoff values were adopted: ≤ 80 cm for women and ≤ 94 cm for men, indicating no increased cardiovascular risk, and > 80 cm for women and > 94 cm for men, indicating increased cardiovascular risk⁽¹⁵⁾.

Dietary intake was assessed using the Vigitel Food Frequency Questionnaire, a dietary screener that evaluates the weekly frequency of consumption of beans, cooked vegetables, raw salads, fruits, vegetables, and sugar-sweetened beverages. Response options ranged from one to two days per week to almost never or never⁽⁷⁾.

Whole-food utilization was assessed by asking participants the following question: "Do you usually prepare your meals using vegetable stems, fruit peels, and fruit seeds?"

A subset of the Scale for Assessing Adherence to the Recommendations of the Dietary Guidelines for the Brazilian Population (DGBP)⁽¹⁶⁾ was used. Additionally, two domains of the original instrument — meal planning and household organization — were included, resulting in a total of 13 items. These items corresponded to the topics addressed during the workshops and were selected to assess changes in the prevalence of responses. Participants responded using a Likert scale. To facilitate comprehension, the response options were adapted from the original scale as follows: "never" instead of strongly disagree, "rarely" instead of disagree, "sometimes" instead of agree, and "always" instead of strongly agree, while preserving the original Likert scoring. This adaptation was implemented because participants experienced difficulty interpreting the original response categories during the pilot study. The total score was calculated as the simple sum of the 13 items, yielding a possible range from 0 to 39.

Household food access over the previous three months was assessed using the short version of the Brazilian Household Food Insecurity Scale (EBIA)⁽¹⁷⁾, which consists of five questions. Each affirmative response received one point, and a total score greater than two indicated household food insecurity.

Quality of life was assessed using the World Health Organization Well-Being Index (WHO-5), which has been validated in Portuguese and consists of five questions referring to the previous two weeks⁽¹⁸⁾. The instrument evaluates perceptions of feeling cheerful and in good spirits, calm and relaxed, active and vigorous, rested upon waking, and interested in daily life. Responses were recorded on a Likert scale ranging from 0 to 5, resulting in a total score between 0 and 25.⁽¹⁸⁾ Scores ≤ 13 were considered indicative of possible impaired well-being, according to the instrument's recommended interpretation⁽¹⁹⁾.

The International Physical Activity Questionnaire (IPAQ), short version translated into Portuguese⁽²⁰⁾, was used to assess participants' habitual physical activity levels. The instrument estimates weekly time spent in physical activities of different intensities and classifies individuals as: (i) sedentary, (ii) insufficiently active, (iii) active, or (iv) highly active.

All interviewers received standardized training before data collection. The same interviewer conducted both the baseline and follow-up interviews for each participant.

Descriptive analyses included absolute and relative frequencies, as well as measures of central tendency and dispersion. Variable categories were defined according to established cutoffs reported in the literature. For physical activity, participants were classified into two categories: inactive (sedentary or insufficiently active) and active (active or highly active).

For baseline descriptive analyses, continuous variables were assessed for normality using the Shapiro–Wilk test. Variables with a normal distribution were compared between groups using Student's *t* test, whereas variables

with non-normal distributions were compared using the Mann–Whitney test. Categorical variables were analyzed using Pearson's chi-square test.

Intervention effects were evaluated using an intention-to-treat (ITT) approach. Generalized Estimating Equations (GEEs) were applied within the ITT framework. This statistical method is appropriate for repeated measures collected over time from the same participants and includes all randomized participants regardless of adherence to the intervention.

Within-subject conditional transition analyses were also performed to estimate intervention effects based on baseline status. Unlike the ITT analyses, these conditional transition analyses compared changes within the same individual according to four possible patterns: (1) participants who presented the condition at baseline and remained with the condition at follow-up (yes → yes); (2) participants who presented the condition at baseline but no longer presented it at follow-up (yes → no); (3) participants who did not present the condition at baseline and remained without it at follow-up (no → no); and (4) participants who did not present the condition at baseline but developed it during follow-up (no → yes).

All statistical analyses were performed using Stata version 18.0 (StataCorp LP, College Station, TX, USA). Statistical significance was set at $p < 0.05$.

The study was approved by the Research Ethics Committee of the Federal University of São Paulo (Approval No. 5,317,663) and by the São Paulo Municipal Health Department (Approval No. 5,474,176). This study represents the pilot phase of a clinical trial registered with the Brazilian Registry of Clinical Trials (ReBEC) under registration number RBR-5v6bkky.

The manuscript was prepared in accordance with the Consolidated Standards of Reporting Trials (CONSORT) reporting guideline⁽²¹⁾.

RESULTS

Most participants were older adults and self-identified as having non-White skin color. The sample included 19 Black and 83 Brown participants, most of whom had completed only elementary education, had a per capita household income close to one Brazilian minimum wage (BRL 1,302.00), and lived in food-secure households. The most prevalent comorbidities were hypertension, T2DM, dyslipidemia, and increased cardiovascular risk (Table 1). Participants in the two study groups had generally similar baseline characteristics, except that the intervention group included a higher proportion of women, homemakers, individuals with obesity, and physically active participants ($p < 0.05$).

Overall, participants were comparable at baseline, with a median age (P25, P75) of 59 (50, 66) years. Most participants self-identified as non-White and had relatively low educational attainment. The only significant differences between groups were a higher proportion of women and homemakers in the intervention group compared with the control group ($p < 0.05$). Most participants lived in food-secure households. Regarding health status, there was a high prevalence of increased cardiovascular risk based on waist circumference and obesity. Hypertension was the most frequently reported condition, followed by T2DM and dyslipidemia. The prevalence of obesity was higher in the intervention group (61%) than in the control group (48%), and a greater proportion of participants in the intervention group were physically active (58% vs. 41%, respectively) (Table 1).

Table 1. Sociodemographic and economic characteristics and health conditions of participants by study group at baseline, São Paulo, SP, Brazil, 2022–2023 ($n = 180$)

Variables	n (%), median (P25; P75)		p-value*
	Intervention (n = 90)	Control (n = 90)	
Sex			
Female	84 (93%)	67 (74%)	0.001
Male	6 (7%)	23 (26%)	
Age, years	59 (51; 64)	60 (48; 68)	0.675
Race/ethnicity			
Non-White	51 (57%)	51 (57%)	1.000

Education			
Up to elementary school	50 (56%)	46 (51%)	0.554
Completed high school	37 (41%)	38 (42%)	
Completed higher education	3 (3%)	6 (7%)	
Occupation			
General services	29 (26%)	39 (44%)	0.038
Homemaker or retired	64 (71%)	50 (56%)	
Per capita income (BRL)	842 (500; 1302)	1206 (625; 1650)	0.101
Food insecurity			
Food secure (EBIA ≤ 1)	60 (67%)	70 (78%)	0.096
Food insecure (EBIA ≥ 2)	30 (33%)	20 (22%)	
Smoking status			
Never smoked	63 (70%)	59 (66%)	0.523
Nutritional status			
Normal weight/Underweight	4 (5%)	13 (18%)	0.023
Overweight	29 (34%)	29 (34%)	
Obesity	52 (61%)	35 (48%)	
Waist circumference			
At risk for CVD	71 (97%)	67 (92%)	0.146
Physical activity			
Physically active	52 (58%)	37 (41%)	0.025
Quality of life			
Impaired well-being	47 (66%)	44 (49%)	0.351
No impairment in well-being	37 (44%)	46 (51%)	
Self-reported morbidities **			
HAS	68 (76%)	57 (64%)	0.093
DM2	49 (54%)	52 (58%)	0.591
Dyslipidemia	31 (34%)	34 (38%)	0.601
Whole-food utilization			
Yes	34 (38%)	35 (39%)	0.878
No	56 (62%)	55 (61%)	

Note: *Pearson's chi-square test was used for categorical variables, and the Mann–Whitney U test was used for continuous variables. **The intervention group included 89 participants for analyses of self-reported morbidities.

Fieldwork was completed over a 10-month period, with baseline and follow-up interviews conducted simultaneously in both study groups. The mean (standard deviation) interval between baseline and follow-up assessments was 5 (2) months. Follow-up data were obtained from 71 of 90 participants (79%) in the intervention group and 50 of 90 participants (56%) in the control group. After baseline assessment, losses to follow-up occurred in both groups, affecting 19 of 90 participants (21%) in the intervention group and 40 of 90 participants (44%) in the control group. The primary reasons for loss to follow-up were inability to contact participants (14/90 [16%] in the intervention group and 35/90 [39%] in the control group) and participant withdrawal (5/90 [6%] in both groups) (Figure 2). In the intervention group, loss to follow-up was more frequent among employed participants than among retirees or homemakers ($p = 0.010$).

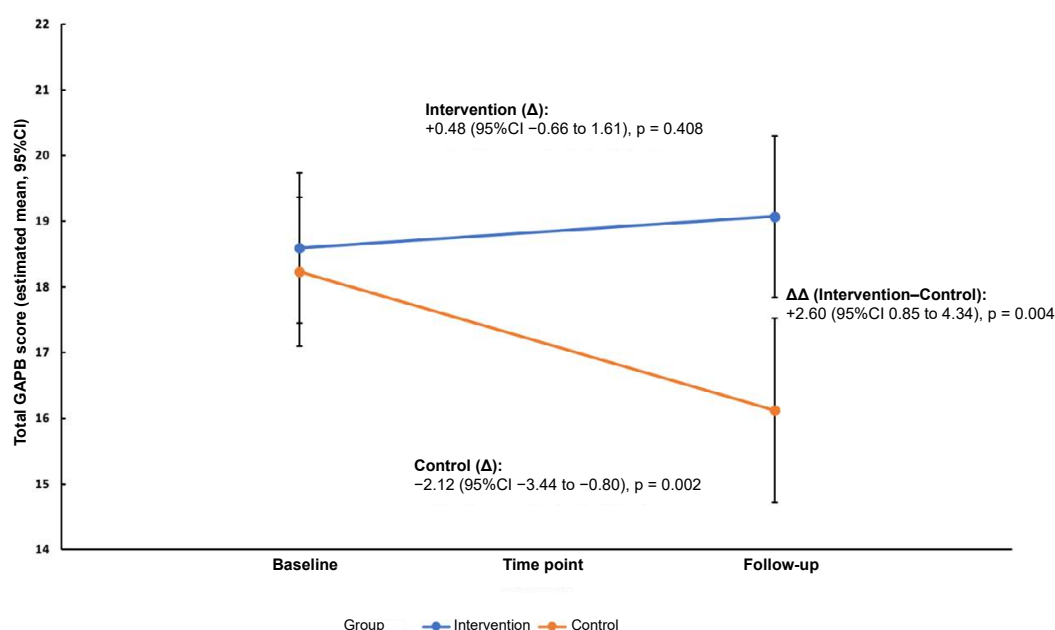
All participants in the intervention group attended at least one workshop. Attendance rates according to the number of workshops completed were 86%, 11%, and 3% for three, two, and one workshop(s), respectively.

Conditional transition analysis revealed a significant reduction in soft drink consumption ($p = 0.009$). Among participants in the intervention group who reported high baseline consumption, the likelihood of consuming soft drinks decreased after follow-up (Table 2).

Table 2. Complete-case (CC) analysis comparing the intervention and control groups after 3 months, stratified by baseline consumption status, São Paulo, SP, Brazil, 2022–2023

Food (weekly frequency)					Final status						
					≤ 2x		≥3x				
≤ 2x vs ≥ 3x	Baseline status	Group	Baseline (100%) n	Post-intervention (100%) n	n	%	n	%	OR	95%CI	p-value
Leafy vegetables	≤ 2x	Control	28	13	7	53.85	6	46.15	1		
		Intervention	15	12	6	50.00	6	50.00	1.17	[0.24 ; 5.62]	0.848
	≥ 3x	Control	62	37	2	5.41	35	94.59	1		
		Intervention	74	59	4	6.78	55	93.22	0.79	[0.14 ; 4.52]	0.787
Beans	≤ 2x	Control	19	7	4	57.14	3	42.86	1		
		Intervention	22	18	8	44.44	10	55.56	1.67	[0.29 ; 9.71]	0.570
	≥ 3x	Control	71	43	3	6.98	40	93.02	1		
		Intervention	68	53	5	9.43	48	90.57	0.72	[0.16 ; 3.20]	0.666
Raw salad	≤ 2x	Control	31	14	7	50.00	7	50.00	1		
		Intervention	26	19	8	42.11	11	57.89	1.38	[0.34 ; 5.51]	0.653
	≥ 3x	Control	59	36	9	25.00	27	75.00	1		
		Intervention	64	52	13	25.00	39	75.00	1	[0.37 ; 2.67]	1.000
Cooked vegetables	≤ 2x	Control	32	15	7	46.67	8	53.33	1		
		Intervention	35	28	15	53.57	13	46.43	0.76	[0.22 ; 2.67]	0.666
	≥ 3x	Control	58	35	9	25.71	26	74.29	1		
		Intervention	55	43	10	23.26	33	76.74	1.14	[0.41 ; 3.22]	0.801
Fruit	≤ 2x	Control	25	10	4	40.00	6	60.00	1		
		Intervention	13	11	3	27.27	8	72.73	1.77	[0.28 ; 11.12]	0.538
	≥ 3x	Control	65	40	5	12.50	35	87.50	1		
		Intervention	75	60	5	8.33	55	91.67	1.57	[0.42 ; 5.82]	0.499
Soft drinks	≤ 2x	Control	70	39	37	94.87	2	5.13	1		
		Intervention	78	60	53	88.33	7	11.67	2.44	[0.48 ; 12.4]	0.282
	≥ 3x	Control	20	11	1	9.09	10	90.91	1		
		Intervention	12	11	8	72.73	3	27.27	0.038	[0.003 ; 0.43]	0.009

Although the DGBP adherence score did not increase significantly in the intervention group (Δ mean = 0.48; 95% CI, -0.66 to 1.61; $p = 0.408$), in contrast to the significant decline observed in the control group (Δ mean = -2.12; 95% CI, -3.44 to -0.80; $p = 0.002$), these findings suggest a protective effect of the workshops on dietary patterns (Figure 2).

**Figure 2.** Total Dietary Guidelines Adherence Score: comparison of changes between the intervention and control groups at the second assessment, São Paulo, Brazil, 2022–2023.

No significant between-group differences were observed in household food access, whole-food utilization, quality of life, or physical activity (Table 3).

Table 3. Changes and between-group comparisons of changes in food insecurity, physical activity, well-being impairment, and whole-food utilization at the second assessment, according to study group, São Paulo, Brazil, 2022–2023*

Variables	Within-group change			Between-group comparison of changes (OR)		
	OR	IC95%	p	OR	IC95%	p
Food insecurity	0.35	[0.14 ; 0.86]	0.021	1.86	[0.66 ; 5.24]	0.238
Physically active (Physical activity)	0.98	[0.53 ; 1.80]	0.938	0.79	[0.35 ; 1.77]	0.564
Well-being impairment (Quality of life)	0.56	[0.29 ; 1.09]	0.089	0.93	[0.38 ; 2.29]	0.871
Whole-food utilization	1.42	[0.76 ; 2.62]	0.268	2.19	[0.95 ; 5.05]	0.065

Legend: *Intention to treat analysis

DISCUSSION

The present study demonstrated good feasibility, with a 79% participant retention rate following the three workshops. The participants were predominantly women, homemakers, older adults, and individuals with a per capita income equivalent to one Brazilian minimum wage. The healthy eating and community gardening workshops contributed to a reduction in the frequency of soft drink consumption and to the maintenance of adherence to the dietary practices recommended by the DGBP.

Our findings are consistent with recent evidence, showing a lower likelihood of frequent soft drink consumption (more than three times per week) among participants in the intervention group compared with those in the control group. Furthermore, adherence to the dietary practices recommended by the DGBP declined in the control group but remained stable in the intervention group. An umbrella review⁽²²⁾ reported that healthy dietary patterns and interventions that improve overall diet quality reduce the risk of T2DM, whereas greater consumption of sugar-sweetened beverages, including soft drinks, increases this risk. In addition, a systematic review⁽²³⁾ of digital nutrition interventions suggested that engagement strategies — such as reinforcement through text messages or emails, behavioral repetition and substitution, and social support — may enhance participant engagement and improve the overall intervention experience, although the certainty of the evidence remains low. Accordingly, in the present study, the weekly WhatsApp® messages may have helped sustain participants' exposure to practical dietary guidance and supported the maintenance of eating practices consistent with the DGBP. Nevertheless, future studies should measure participant engagement using standardized methods and more rigorously evaluate the independent contribution of this intervention component.

Interventions such as the Dietary Approaches to Stop Hypertension (DASH) diet, which combines broader health promotion strategies with a healthy dietary pattern rich in fruits and vegetables, have consistently demonstrated reductions in blood pressure among both individuals with hypertension and those with normal blood pressure⁽²⁴⁾.

It is important to recognize the challenge of achieving sustained behavioral changes in dietary habits to promote health. Food-related behaviors are largely shaped by the social context and the food environment, including individual and community factors, food prices, income, culinary skills, available time, cooking facilities, and social and cultural norms. Numerous barriers hinder healthy eating, including beliefs, culture, community influences, and environmental conditions⁽²⁵⁾. Therefore, FNE interventions adopting multidimensional and longitudinal approaches, combined with reinforcement messages and community gardening activities within PHCCs or other public facilities in the local area, are likely to be more effective and sustainable because they improve access to healthy foods while creating opportunities to encourage healthy eating habits and foster social interaction.

Studies involving community gardening among individuals with CVDs, hypertension, or cancer survivors — primarily conducted in high-income countries — have reported significant increases of approximately 0.73 to 1.20 daily servings of fruits and vegetables, as well as an increase of 0.45 g/day in dietary fiber intake^(26–28). In England and several East Asian countries, community gardens have been incorporated into social prescribing initiatives to reduce demand on health care services, including hospital readmissions related to complications of NCDs, thereby lowering health care costs while addressing the social and behavioral determinants associated with poor health^(10,29). In the city of São Paulo, the PAVS has the potential to expand social prescribing through environmental health promotion activities integrated with the Family Health Strategy. These initiatives include community gardens developed through intersectoral collaboration within the Feed Cities program, an initiative of the Brazilian Ministry of Development and Social Assistance, Family, and the Fight Against Hunger aimed at addressing food insecurity in urban areas⁽³⁰⁾.

Despite the observed improvements, several limitations should be acknowledged when interpreting the intervention effects. These include the potential influence of the Hawthorne effect and adherence bias. Moreover, the absence of statistically significant differences between study arms for some outcomes may have resulted from insufficient statistical power due to the relatively small sample size, which may have attenuated the estimated effects toward the null. Although observer bias may affect the quality of clinical trials in the absence of blinding, masking was not feasible because this trial was conducted in PHCCs that had been preselected to receive the intervention. To minimize contamination, intervention PHCCs were paired with nearby control PHCCs located within the same administrative district to ensure similar socioeconomic and environmental characteristics. Furthermore, the participant profile — predominantly older women living in food-secure households with a per capita income close to one Brazilian minimum wage — suggests that the intervention primarily attracted individuals who were already engaged with PHCC activities.

Unlike highly controlled explanatory clinical trials, this study evaluated the effectiveness of the intervention under routine PHC conditions, thereby enhancing the relevance of its findings to real-world settings. Consequently, quasi-experimental studies generally offer greater external validity than tightly controlled clinical trials conducted in specialized outpatient settings⁽³¹⁾. However, they are also more susceptible to biases and methodological limitations, including the absence of blinding, selection bias resulting from voluntary participation, and limited adherence to the intervention. Additionally, some of the observed changes may reflect the Hawthorne effect, whereby participants modify their behavior because they are aware of being observed. The assessment of dietary practices and food consumption through self-report may also have reduced the precision of the estimates, particularly because monitoring indicators commonly used in health services, such as those from the Food and Nutrition Surveillance System (SISVAN), were employed. Therefore, the findings should be interpreted considering these limitations and the need for more accurate instruments to assess dietary changes in intervention studies.

A substantial proportion of expenditures within the Brazilian Unified Health System is attributable to chronic diseases associated with unhealthy dietary patterns. Given the increasing burden of diet-related NCDs, the present study proposes a low-cost, sustainable FNE strategy that encourages healthier food choices and aligns with the WHO recommendation to incorporate social prescribing into health promotion initiatives⁽⁹⁾.

CONCLUSION

FNE activities based on the themes addressed in the DGBP, combined with practical community gardening activities, contributed to reducing soft drink consumption and maintaining dietary practices aligned with the recommendations of the DGBP.

By integrating applied knowledge, skill development, and active participation, this approach reinforces health education as a tool for health promotion and may represent a feasible strategy within PHC, particularly for older women.

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Author Contributions

Tomita LY and Andreoni S conceived the study. Tomita LY and Braga MCS drafted the manuscript. Braga MCS, Tomita LY, Guerreiro NA, and Andreoni S analyzed and interpreted the data. All authors critically reviewed the manuscript and approved the final version.

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Use of Artificial Intelligence

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