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INTERVENTION PROGRAM: WHOLE-FOOD DIET AND PHYSICAL EXERCISE IN THE REDUCTION OF ANTHROPOMETRIC PARAMETERS IN SALVADOR DE BAHIA, BRAZIL

PROGRAMA DE INTERVENCIÓN: DIETA INTEGRAL Y EJERCICIO FÍSICO EN LA REDUCCIÓN DE PARÁMETROS ANTROPOMÉTRICOS EN SALVADOR DE BAHIA-BRASIL

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ABSTRACT

Introduction: High rates in anthropometric parameters such as excess weight, body fat, visceral fat, hypertension generate serious problems that affect the health of the general population. **Objective:** To identify the effects produced by the intervention program "integral diet and physical exercise" on anthropometric parameters and blood pressure in a community in Salvador de Bahia. **Methodology:** Experimental intervention study lasting 40 days in which 31 adults participated, carried out in a neighborhood of the municipality of Salvador (Bahia), Brazil. The study consisted of administering a whole-food diet based on whole grains, oilseeds, legumes, fruits, vegetables and total abstinence from foods of animal origin, refined, industrialized flours, sugar, following the "Healthy Plate" and Physical Exercise model. **Results:** The participants who followed the program of wholef-food diet and physical exercise obtained significant changes in the anthropometric values (weight, BMI, waist contour, percentage of body fat, abdominal fat, biological age, and systolic and diastolic blood pressure, ($p < 0.01$), body mass did not show significant changes ($p < 0.57$). **Conclusion:** The intervention program with a whole-food, plant-based diet and physical exercise can reduce the rates of obesity, abdominal fat, anthropometric perimeters and blood pressure and contribute to reducing potential problems of chronic non-communicable diseases.

Keywords: Anthropometric parameters, comprehensive diet, physical exercise, lifestyle, blood pressure. (Source: MeSH NLM).

RESUMEN

Introducción: Los índices elevados en los parámetros antropométricos como exceso de peso, grasa corporal, grasa visceral, hipertensión generan graves problemas que afectan la salud de la población en general. **Objetivo:** Identificar los efectos que produce el programa de intervención "dieta integral y el ejercicio físico" sobre los parámetros antropométricos y la presión sanguínea de una comunidad de Salvador de Bahía. **Metodología:** Estudio experimental de intervención con duración de 40 días en el cual participaron 31 adultos, realizado en un barrio del municipio de Salvador (Bahía), Brasil. El estudio consistió en administrar una dieta integral a base de cereales integrales, oleaginosas, leguminosas, frutas, vegetales y abstinencia total de alimentos de origen animal, harinas refinadas, industrializados, azúcar, siguiendo el modelo de "Plato Saludable" y Ejercicio Físico. **Resultados:** Los participantes que siguieron el programa de dieta integral y ejercicio físico, obtuvieron cambios significativos en los valores antropométricos (peso, IMC, contorno de cintura, porcentaje de grasa corporal, grasa abdominal, edad biológica, y presión sanguínea sistólica y diastólica, ($p<0.01$), la masa corporal no presentó cambios significativos ($p<0.57$). **Conclusión:** El programa de intervención con dieta integral basada en plantas y ejercicio físico es capaz de reducir los índices de obesidad, grasa abdominal, perímetros antropométricos y presión sanguínea y contribuir a disminuir problemas potenciales de enfermedades crónicas no trasmisibles.

Palabras claves: Parámetros antropométricos, dieta integral, ejercicio físico, estilo de vida, presión arterial. (Fuente: DeCS BIREME).

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INTRODUCTION

The World Health Organization[1] informs that over 50% of the existing world population is obese or overweight, with an increasing annual incidence. It is estimated that over 1900 million people are overweight and 650 million are obese, with an approximate body mass index (BMI) of 25 for overweight people and approximately 30 for obese people, which corresponds to approximately 45% of adults in the world [2].

The WHO also refers that the early emergence of chronic diseases have the population on alert. The Instituto Brasilero de Geografía y Estadística [3] recently showed an inadequate dietary pattern by the majority of Brazilians, characterized by a high consumption of fat-rich, industrialized, dairy, sugar, sodium foods and poor in micronutrients from fruits, vegetables, whole grains, oilseeds and legumes.

As in the majority of countries in South America, overweight and obesity are the greatest dangers to health in general, for example, in Peru close to 70% of adults, women and men, are affected, which is why it is necessary to promote healthy eating habits and lifestyle, for this reason, the Instituto Nacional de Salud [4] promotes educational messages within the Dietary Guidelines for the Peruvian population.

In the context of the health our current world is undergoing during this time, studies suggest that people with obesity have a greater risk of developing disease by coronavirus, being a risk factor for hospitalizations, and admissions to intensive care units. People who present obesity or metabolic syndrome have a greater probability of suffering from fatal illnesses through various pathways because the normal body physiological processes are altered [5] and for an overactivation of the renin-angiotensin-aldosterone system, the immune response is deficient, the intestinal microbiome is altered, as well as hyper-coagulants among other factors, which is attributed to presenting an inadequate immune response [6].

Obesity is described as an increase in the number and size of adipocytes that promote the aggregation of lipid and induce a high level of inflammation. Exercise and physical activity are strongly correlated with beneficial effects in metabolic (metabolic syndrome, obesity anddiabetes) and immunologic (cellular response, immunization effectiveness and cellular senescence) factors. In fact, physical exercise strategies have clearly demonstrated the capacity of decreasing the risk of complications modulating inflammation, increasing immune response, and strengthening vaccine results in people of advanced age [7].

A healthy diet, in addition to providing pleasure should also provide energy that the body needs for its adequate function. The high consumption of foods of high caloric concentration, promoted by the food industry in a society that cannot resist the tasty and tempting offers and relatively low costs, compared to healthy foods is evident. The dietary practices have become an object of concern for epidemiology when it began to note that the health state of people is directly related with their dietary habits [8].

We observed in the Brazilian population, especially in the state of Salvador de Bahía which is characterized by a monotonous diet of rice and beans every day, with other sources of foods rich in refined flour, saturated fats such as butter, margarine, use of oils, milk, eggs, cheese in the preparation of their main meals such as breakfast, lunch and dinner, in addition it is a habit to prepare desserts with refined and industrialized foods. Furthermore, in the majority of people the frequency of feedings in a day is 5 to 6 times, inactivity has been added to this especially due to the health restrictions in these times of the pandemic, all these factors contribute to overweight and obesity, which would be predisposing factors for chronic non-communicable diseases and other health complications[9].

Therefore, under this situation we propose carrying out the following study, evaluate the effectiveness of the intervention program in 40 days composed of nutritional education sessions, with a supervised whole-food and physical exercise plan, on different anthropometric parameters and arteria pressure.

METHODOLOGY

Study Type and Design

The study is pre-experimental type because we used an intervention program to measure the effect of a whole-food diet and practice of physical exercise in the participants. According to the design, this study is of pre-experimental character because we applied a pre-test and post-test to the sample population to measure the significant differences among them.

Population and sample

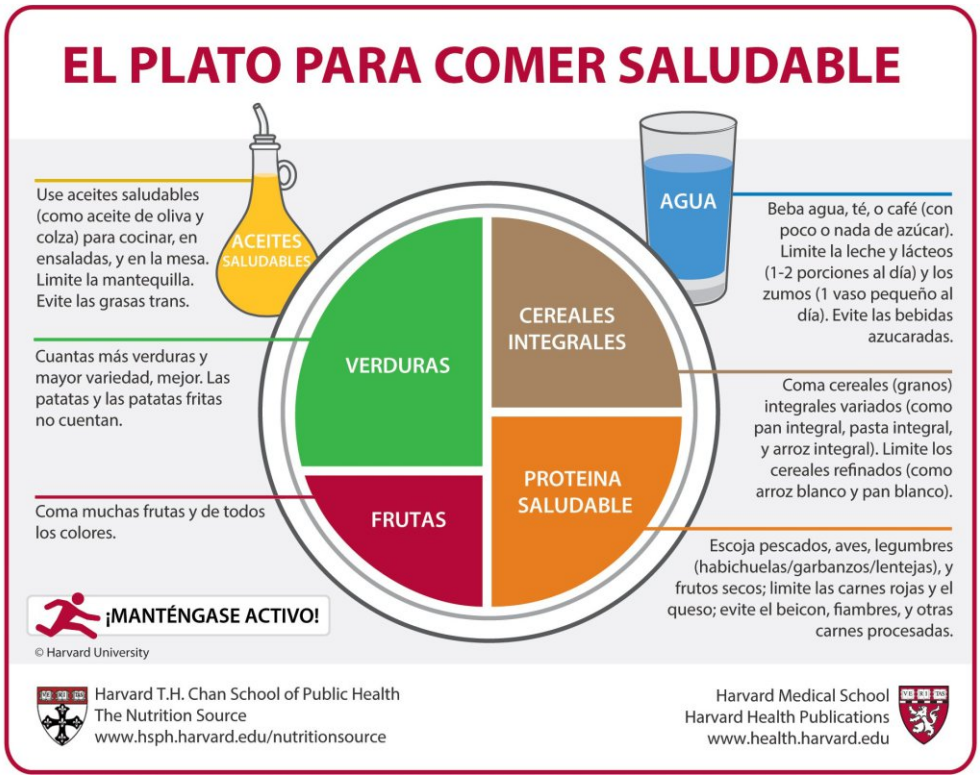
The population was made up of all who accepted voluntarily to participate in the program during 40 days. A non-probability convenience sampling was carried out, made up of 31 participants of both genders, adult residents of the district of Castelo Blanco from the city of Salvador de Bahia (Brazil). We included all the participants, the only exclusion criteria were under 18 years of age.

This accompaniment study sought to determine the effects of the whole-food and physical exercise program, suspending the intake of industrialized, refined wheat-based foods, sugar, and foods of animal origin. In the first week, we provided a hypocaloric whole-food diet, followed by 5 weeks of a complete diet based on whole grains, proteins of vegetable origin such as oilseeds, legumes and vegetable and fruit intake.

Procedure

6 live educational sessions were developed in the 40 days of intervention, where weekly theoretical-practical workshops were developed on the importance of a whole-food diet, each session had a duration of 90 minutes, 45 minutes of theory and 45 minutes of elaboration and preparation of a healthy recipe. The subjects covered during each education session were: 1) Healthy diet,, 2) Importance of vegetable proteins 3) Nutrition of whole grains, 4) Role of vitamins and minerals in the prevention of diseases, 5) Importance of a healthy breakfast, 6) Development of a balanced and healthy plate according to the "Healthy Plate" model whose distribution of macronutrients was 50% vegetables and fruits, 25% energy foods, 25% proteins of vegetable-origin, divided in the three main meals, according to the recommendations by Harvard University [10]. Figure 1.

Figure.1 Healthy Plate



Source: https://www.hsph.harvard.edu/nutritionsource/healthy-eating-plate/translations/spanish/

Weekly, we shared a recipe made by the researcher, to help in the preparation of breakfast, lunch, and dinners for 40 days, and to evaluate the recommended diet intake, a private WhatsApp group was created where the participants interacted and shared photos of their recipes and healthy plates during 7 days of the week. Furthermore, this tool served for feedback, clear up doubts, and answer questions.

The physical exercise plan directed and supervised by the same researcher, who recommended 5 weekly sessions of 45 minutes, worked the proposal of the FITT method (frequency, intensity, time, and type of exercise) plan according to the procedure (11) in table 1. These exercises were directed through the Instagram social network due to the confinement and participant biosecurity state of health context.

Table 1. Aerobic and anaerobic training plan

Plan de entrenamiento aeróbico y anaeróbico				
Sesión No.	1	Semana No.	3	
Fase	Fase 1 tiempo	Área de trabajo Descripción del ejercicio	Series	general repeticiones
Fase inicial	5´	Movilidad articular	1	12
	5´	Estiramiento	1	20´´
Fase central	10´	Caminata Intervalo 50 a 60 %		
	30´	50 metros	3	4
		100 metros	3	2
		200 metros	3	1
Fase final	10´	Estiramiento	1	20´´

Source: http://repositorio.uts.edu.co:8080/xmlui/handle/123456789/3488

Techniques and instruments

The technique was daily observation of the plates with whole-food, following the "Healthy Plate" model (10).

In the same manner, to measure physical exercise practice we observed attendance and performance of exercises according to the model in Table 1[11].

Data collection

Anthropometric data

Each participant's weight was obtained with a portable digital bioimpedance Master scale and height was measured with a portable Leicester Height Measure stadiometer (seca Hamburg, Germany), waist perimeter measurements were taken with a seca 201 tape, to evaluate the anthropometric state we used the bioimpedance scale, that measures body mass index, body fat, abdominal fat, chronological age, according to age, height, and weight. The systolic and diastolic blood pressure measurement was taken with a Riester Duplex Anestophon sphygmomanometer. We used a worksheet to register the pre and post-intervention data to later tabulate in Excel to be submitted for statistical analysis.

Statistical analysis

Data analysis process

The statistical management of data was carried out with the IBM SPSS Statistics statistical package for social

sciences, the data cleansing criteria was the elimination of cases that presented incomplete measurements, of the 31 initial cases 2 were eliminated, the assumptions of normality were tested for the score differences for each variable, the variable that adjusted to the normal distribution was weight, the other variables did not meet with this assumption. The normality test for the differences in scores was caried out through Shapiro Wilk. To determine the statistical significance between pretest and posttest scores of the variables, we used the Student's t-test for samples related for the variable that met the assumption of normality and for the remaining variables we used Wilcoxon signed-ranked test. The relative risks were calculated using the Poisson regression with robust variances. ranges. The statistical significance considered was 5%.

Ethical aspects

With relation to ethical aspects, the participation was voluntary and confidential which is why an informed consent was signed. The Helsinki Declaration guidelines for research on human beings were followed.

RESULTS

The sample was made up of 31 adults, 28 women and 3 men, the following results corresponded to the 29 cases included, excluding two for not participating in the posttest evaluation. The participants had an average age of 48 years, with a minimum age of 31 years and a maximum age of 63. The average height was 1.60±0.06 meters.

The normality test for the differences in scores proved the normal distribution adjustment in the weight variable (S-W=0.958, p=0.290), we could not evidence the normal distribution in the variables body mass index (S-W=0.813, p=0.000), body fat (S-W=0.699, p=0.000), muscle mass (S-W=0.789, p=0.000), biological age (S-W=0.750, p=0.000), visceral fat (S-W=0.673, p=0.000), waist contour (S-W=0.804, p=0.000), systolic blood pressure (S-W=0.918, p=0.027) and diastolic blood pressure (S-W=0.911, p=0.018).

Table 2. Normality tests

Variables	S-W*	p
Weight	0.958	0.290
BMI	0.813	0.000
Body fat	0.699	0.000
Muscle mass	0.789	0.000
Biological age	0.750	0.000
Visceral fat	0.673	0.000
Waist contour	0.804	0.000
Systolic blood pressure	0.918	0.027
Diastolic blood pressure	0.911	0.018

*shapiro wilk

The bivariate analysis was performed comparing study the variables before and after, results are shown in table 3.

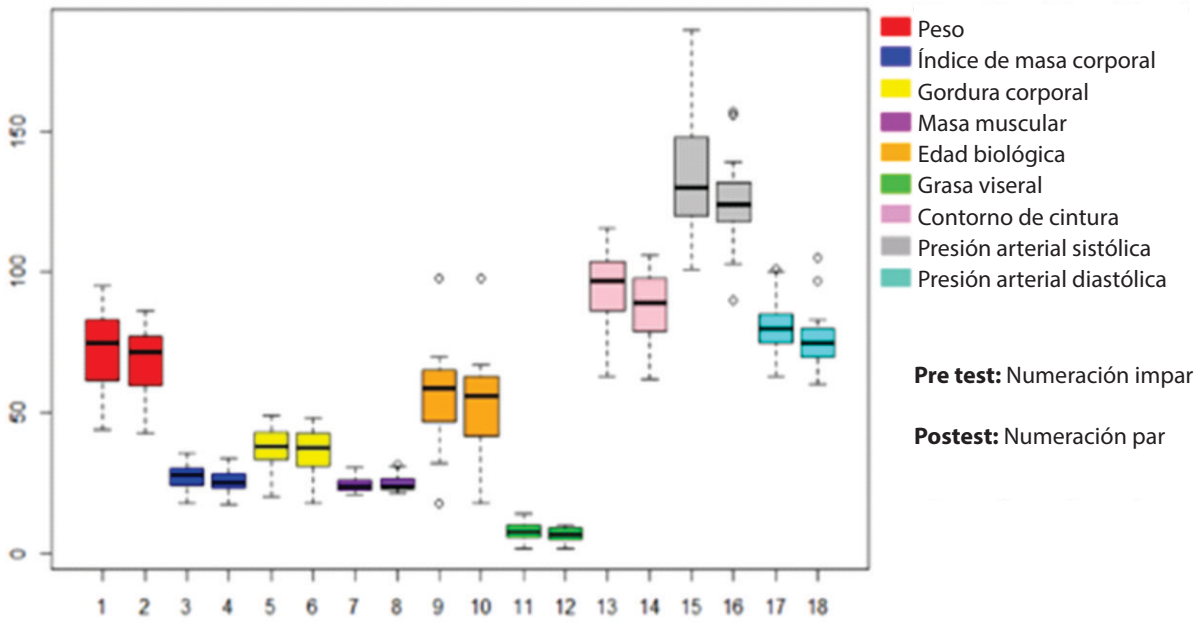
Table 3. Comparison of the pretest and posttest measures for the study variables.

Variables	Min	Max	X	S	Me	RI	Statistical	p
Age	31	63	48.48	9.41	47	16	-	-
Height	1.51	1.78	1.60	0.06	1.60	0.07	-	-
Weight-Pretest	43.90	95.00	71.76	13.30	74.80	22.65	t=8.022	0.000
Weight -Postest	42.60	86.20	68.19	12.08	71.70	18.85		
BMI-Pretest	17.70	36.00	27.70	4.66	28.00	6.40	Z=-4.459	0.000
BMI-Postest	17.20	34.00	26.16	4.20	25.30	5.50		
Body fat-Pretest	20.10	49.00	37.54	7.94	38.20	10.70	Z=-3.468	0.001
Body fat -Postest	18.10	48.10	36.30	8.39	37.70	12.20		
Muscle mass-Pretest	21.10	30.80	24.84	2.75	23.90	3.65	Z=-1.901	0.057
Muscle mass -Postest	21.60	31.80	25.13	2.93	23.90	3.35		
Biological age-Pretest	18.00	98.00	54.97	16.29	59.00	18.50	Z=-3.932	0.000
Biological age -Postest	18.00	98.00	51.00	17.22	56.00	22.50		
Visceral fat-Pretest	2.00	14.00	7.90	2.89	8.00	4.00	Z=-3.719	0.000
Visceral fat -Postest	2.00	10.00	6.86	2.37	7.00	4.00		
Waist contour-Pretest	63.00	116.00	94.28	12.88	97.00	17.75	Z=-3.717	0.000
Waist contour -Postest	62.00	106.00	88.48	11.42	89.00	19.00		
Systolic blood pressure-Pretest	101.00	186.00	134.00	19.45	130.00	28.00	Z=-3.967	0.000
Systolic blood pressure -Postest	90.00	157.00	124.21	14.05	124.00	16.50		
Diastolic blood pressure -Pretest	63.00	101.00	81.24	8.72	80.00	11.50	Z=-3.826	0.000
Diastolic blood pressure -Postest	60	105.00	75.45	9.42	75.00	10.00		

Regarding the tests carried out to determine the statistically significant differences between the pretest and posttest variable scores, variable differences were reported for the weight (t=8.022, p=0.000), body mass index (z=-4.459, p=0.000), body fat (z=-3.468, p=0.001), biological age (z=-3.932, p=0.000), visceral fat (z=-3.719, p=0.000), waist perimeter (z=-3.717, p=0.000), systolic blood pressure (z=-3.967, p=0.000), and diastolic blood pressure (z=-3.826, p=0.000) variables. On the other hand, the variable that did not present significant differences was the muscle mass variable (z=-1.901, p=0.057).

In graph 1 the box and whisker plot shows the before and after comparison of the variables of interest

Graph 1. Box and whisker plot for the study variables for the pretest and posttest evaluations



Finally, table 4 shows the relative risk calculation for the study variables regarding presenting favorable changes with the intervention.

Table 4. Bivariate analysis with relative risk for presenting favorable changes with the intervention program of whole-food diet and physical exercise.

Variables and categories	After intervention		Before intervention		RR	CI 95%
	n	%	n	%		
BMI						
< 24.9Kg/m2	12	41.4	8	27.6	1,500	0.722-3.118
≥ 24.9 Kg/m2	17	58.6	21	72.4		
Body fat						
<24.9(H) y <35.9(M)	11	37.9	9	31.0	1.222	0.598-2.498
≥24.9(H) y ≥35.9(M)	18	62.1	20	69.0		
Muscle mass						
>33.3(H) y >23.3(M)	17	58.6	14	48.3	1.214	0.747-1.973
≤33.3(H) y ≤23.3(M)	12	41.4	15	51.7		
Biological age						
Cronológica<Biológica	15	51.7	16	55.2	0.938	0.580-1.516
Cronológica≥Biológica	14	48.3	13	44.8		
Visceral fat						
<9	24	82.8	21	72.4	1.143	0.864-1.511
≥9	5	17.2	8	26.7		
Waist contour						
<108(H) y <88(M)	17	58.6	12	41.4	1.417	0.834-2.407
≥108(H) y ≥88(M)	12	41.4	17	58.6		
Systolic blood pressure						
<119 mmHg	8	27.6	6	20.7	1.333	0.529-3.362
≥119 mmHg	21	72.4	23	79.3		
Diastolic blood pressure						
<79 mmHg	19	65.5	9	31.0	2.111	1.155-3.860
≥79 mmHg	10	34.5	20	69.0		

DISCUSSION

The study was carried out in a health crisis scene due to the coronavirus SARS-CoV-2 Virus pandemic, and in an epidemiological context characterized by high indices of obesity and chronic non-communicable diseases (NCD) by intervening in this program and observing the results we see significant values in almost all study variables, meaning the participants experimented a significant decrease in their anthropometric measures after the intervention program, the same findings were discovered by [12] in their study of 12 weeks after intervention, the participants experienced weight loss, and excess body fat with a significance of (<0.05). dietary habits and physical exercise have a positive impact on the normalization of anthropometric measures [13].

Regarding the anthropometric variables when we compare pretest and posttest, we observe that the intervention program produced a decrease before and after, of minimum weight as well as maximum weight, with a significant (p<0.01).

Regarding weight, minimum values as well as maximum values showed a significant decrease in minimum value of 43.90 to 42.60 and in maximum value of 95.00 to 86.20 with a p-value of (p<0.01).

Regarding BMI, we detected that the minimum BMI decreased (minimum value from 17.60 to 17.20 and maximum value from 36.0 to 34.0) with a p-value (p<0.01). Body fat and abdominal decreased in the minimum (20.10 to 18.10) and in the maximum (49 to 48.10), with result as significant (p<0.01). Muscle mass in people of the study, in addition that diet coupled with physical activity could explain a slight increase in muscle mass before and after, in their minimum value (21.10 to 21.60) as well as in their maximum value (30.80 to 31.80), however, there is no significance (p<0.05) here but there is a slight tendency of improving muscle mass.

Biological age maintains the values, in the minimum (18, to 18) as well as in the maximum (98 to 98), however, in the results we found that there to be a significant value of ($p<0.01$). Waist contour had differences in the minimum of (63 to 62) and in the maximum of (116 to 106) with very significant results in this variable ($p<0.01$).

Regarding the variable of systolic blood pressure there was a variation in the minimum of (101.00 to 90.00) the maximum values of (186 to 157) with a significance of ($p<0.01$). In the diastolic blood pressure, the minimum of (63 to 60) in the maximum value we can see there is slight increase due to two people with overweight who participated in healthy diet but not in physical exercise (101 to 105), however, the total value was significant ($p<0.01$).

The participants were subjected to a whole-food diet rich in fiber according to the "healthy plate" model which includes 50% vegetables and fruits, 25% energy foods such as whole grains and another 25% of protein from vegetable origin, for 40 days which could contribute to a significant loss in anthropometric measures. A consensus exists in literature that the fiber content in foods is positively related with improving body fat levels and decrease in lipid profile[14].

According to expert recommendations it is better to choose a healthy diet and that could be adjusted to their caloric needs to address the realist weight loss objectives, an approach that involves the intake of all foods such as a variety of fruits, vegetable, whole grains, and healthy protein. There is growing evidence that whole-food plant-based diets increase satiety and could reduce metabolic factors and improve behaviors that sabotage weight loss and promote health recover [15], healthy eating habits and regular physical exercise[13] have a positive impact in normalizing anthropometric measures and lipid profiles in adults[9]. Obesity could result in physical inactivity and inadequate dietary habits.

Another important component to consider is the loss of waist contour measurements associated with a diet rich in whole grains such as oats, quinoa, kiwicha, sesame seeds, sunflower seeds, flaxseeds, chia. The properties of these nutrients rich in fiber promote the elimination of fat deposits, such as is shown [16] in its study with significant changes in the abdominal fat markers through a Mediterranean diet rich in vegetable proteins and complex carbohydrates.

The results of body mass with a whole-food diet and physical exercise do not reveal significant results perhaps due to the period of the program of only 6 weeks, compares to other intervention programs, such as the studies by Gil, J. et al and Argüelles R. Estrella R. et al, where there was a significant modification in the increase of muscle mass after the program intervention of 12 weeks [17,18]. Scientific evidence shows that diets based on whole grains, vegetables, and fruits, which is a high nutritional value diet and in necessary proportions, the first mechanism in the organism would be to waste fat accumulation in the organism [19], and the only necessary intake of nutrients and intense physical exercise would increase new tissue formation but in longer intervention periods[20], in the same manner[21] a research of 14 weeks was conducted including different caloric proportions together with controlled exercises to reduce body weight, achieving in significant results in muscle mass gain.

On the other hand, while evaluating the program's effectiveness on biological age, the results show significant changes, this is related to a healthy plate based on vegetables, fruits, whole grains and vegetable protein low in calories which enables prolonging health with quality of life[22], eating antioxidant rich nutrients in moderation promotes cell recovery, which promotes increasing years of quality of life, on the contrary, if you exaggerate eating foods rich in saturated fat, excess of proteins will increase the metabolic function increasing cellular aging and in consequence early aging of systems and organs entailing different pathologies. This is substantiated by [23] when they refer that through lysosomes, cells break down accumulated proteins and pathological substances.

In evaluating the effectiveness of the whole-diet and physical exercise program on systolic and diastolic blood pressure, we found a significant decrease which is related when [24] claims the whole-food, plant-based diet such as chestnuts, peanuts, chickpeas, lentils, split peas, fruits and vegetables produce high quantities of polyunsaturated fatty acids, arginine which is a semi-essential amino acid through which nitric oxide is originated despite its short life, this element plays important functions in the organism, they intervene in blood flow, regulating blood pressure, conservation of

0.001
0.057
0.000
0.000
0.000
0.000

organ perfusion, decrease inflammation of vascular endothelium, in addition it has been implicated in neurotransmission and in the immune system, which is related with this study where the majority of its participants experimented a decrease in blood pressure and reference having experienced improvement in their health.

The study presents limitations because it is unicenter, of limited sample size, no external control group, it was not possible to complete laboratory studies, but it demonstrates the feasibility and the benefits of ambulatory intervention in primary health care. Multicenter studies are necessary with greater statistical power and a short and long-term follow-up.

CONCLUSION

The results showed that the Lifestyle Medicine intervention program with a whole-food diet with whole grains, vegetable protein, fruits and vegetables and programmed physical exercise produced significant decrease in anthropometric measures and arterial pressure. We evidenced that the intervention model is capable of preventing high rates of obesity, abdominal fat and decreasing potential problems of chronic non-communicable disease.

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Authorship contributions: The authors participated in the genesis of the idea, project design, data collection and interpretation, results analysis and manuscript preparation of this research work.

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