IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 23, Issue 9 Ser. 6 (September. 2024), PP 06-12
www.iosrjournals.org

The Effect Of Changes In Lifestyle Measures On Weight And Body Mass Index Among Adult Pre-Hypertensive Patients In A Tertiary Hospital In North Central Nigeria

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Abstract:
Background: *Results from several clinical trials show that comprehensive behavioral intervention programs improve lifestyle behaviors and lower weight and BMI. The study was undertaken to determine the effect of structured changes in lifestyle measures on weight and BMI among pre-hypertensive adults presenting it the GOPC of JUTH.*
Study Design/Setting*: The study was a randomized controlled experimental study involving pre-hypertensive adults aged 18 years and above presenting in GOPC of JUTH.*
Methods: *Participants were consecutively selected and randomized to a control and an intervention group. The intervention group was offered a structured lifestyle modification counseling while routine advice only was offered to the control group. Data was collected about patients' socio-demographic, medical and lifestyle habits that included dietary and exercise history. Physical examination was done to include height, weight and BMI. Participants were followed up monthly for twelve weeks during which physical examination was routinely carried out and changes in their lifestyle habits reported. The outcome measures were reduction in weight and BMI. The difference in the means of the outcome measures at pre- and post-intervention were determined using the independent and paired student t-tests at 95% confidence interval. Data were analyzed on an intention to treat basis. A p-value of ≤ 0.05 was considered statistically significant in all analyses.*
Results: *On completing the study, independent t-test showed that the mean weight difference between the two study groups was 0.17kg (p=0.96; -5.77, 6.12, 95% CI) and the mean BMI difference was 0.32kg/m² (p=0.79; -2.07, 2.71, 95% CI). These were not statistically significant. However, significant improvement in healthy lifestyle habits were notably more in the intervention group. Desirable changes in the mean weight and BMI were more evident among participants of the intervention group after the 12 weeks study, although there were no statistically significant differences in the two groups.*
Conclusion: *Findings from the study showed that although individuals with pre-hypertension can make and sustain, during a period of 12 weeks, multiple lifestyle modifications which can significantly control or reduce weight and BMI, structured changes on lifestyle measures may not be better than routine verbal advice only among pre-hypertensives in the study setting. There is a need for improved lifestyle intervention programs, including those appropriate for delivery in the clinical setting, that enable individuals at risk for hypertension to adopt long-term healthier lifestyles.*

Keywords: Lifestyle Changes, Weight, Body Mass Index, Pre-hypertension

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Date of Submission: 07-09-2024 Date of Acceptance: 17-09-2024

Introduction:

The prevalence of obesity is increasing worldwide and it has been identified as a major risk factor contributing to the overall burden of disease worldwide.[1-3] Obesity was once reckoned to be a problem restricted to high-income countries, but due to globalization with its accompanying pattern of changing lifestyle, it is now on the increase in low- and middle countries[4-7] and Nigeria has not been left out.[8,9] This trend of emerging obesity in poorer countries is seen more in urban dwellers and rates have reportedly increased over time. [10,11]

The prevalence of obesity has reached epidemic levels over the past few decades, and concurrent with this rise are increases in numerous obesity-associated diseases including heart disease, certain types of cancer, and diabetes.[1] Given the health impacts of the obesity epidemic and the research suggesting that weight loss can

ameliorate these problems, there have been numerous calls for optimal obesity treatment strategies including lifestyle changes. However, there is a paucity of data in developing societies like Nigeria where research including these lifestyle changes among these group have been done.

The cornerstone of therapeutic interventions to treat or prevent diseases associated with obesity is weight loss via lifestyle modification, including hypocaloric diet and/or increased physical activity along with behavioral techniques to support these changes.[2] Typical weight loss resulting from lifestyle change is between 5–10% of baseline weight, so such approaches rarely bring an obese individual to a normal body weight.[3] However, losing even this modest amount of weight brings health benefit.[4] Multiple non-randomized interventions have demonstrated improvements in biomarkers relating to hypertension, diabetes, cardiovascular disease, and cancer risk.[3,5] Smaller-scale randomized studies of lifestyle change to induce weight loss have shown improvements in prehypertension, hypertension and metabolic syndrome.[6,8]

Prehypertensives are more likely to have hypercholesterolaemia, obesity and diabetes mellitus than those without it. It is associated with a decreased life expectancy, increased hospitalizations, increased health care costs and serves as a precursor to hypertension.[15,16] Questions still remain regarding the best approach for weight loss from lifestyle change for this group in particular, and randomized, controlled studies are the best way to demonstrate effectiveness of interventions that could influence public health recommendations. We conducted a 12 weeks study to examine the effect of lifestyle modification on weight and BMI on prehypertensive adults and we hypothesized that the participants randomized to the intervention group would experience greater weight loss and improvements in BMI than those randomized to the control group.

Pre-hypertension is defined as systolic blood pressure (SBP) of >120mmHg to 139mmHg or diastolic blood pressure (DBP) of >80mmHg to 89mmHg, based on "two or more properly measured seated blood pressure (BP) readings on each of two or more office visits".[12] Current recommendations for the prevention and treatment of high BP emphasize non-pharmacological therapy, also termed "lifestyle modification". JNC-7 recommends lifestyle modification for all patients with hypertension and prehypertension.[13,14] These modifications include:

Reducing dietary sodium to less than 2.4g per day.

Increasing exercise to at least 30 minutes per day, four days per week.

Limiting alcohol consumption to two drinks or less per day for men and one drink or less per day for women. One standard drink contains 10g of alcohol and one bottle of beer contains 26g of alcohol (One bottle of beer = 2.6 standard drinks).

Following the dietary approaches to stop hypertension (DASH) eating plan (high in fruits, vegetables, potassium, calcium and magnesium, low fat and salt).

Achieving a weight loss goal of 4.5kg or more.

Cessation of smoking (not recommended in JNC 7).

Methodology:

The study was conducted between September to December 2019 among pre-hypertensive individuals aged 18 years and above presenting in the General Outpatients Clinic (GOPC) of Jos University Teaching Hospital (JUTH). The study was a randomized control study, comprising an intervention group that received structured counseling on lifestyle modification and a control group that was only advised on lifestyle modification. Using the Power of 80% and a 95% confidence level, the sample size for means was used for the study and 60 participants were recruited, with thirty in each group. The sampling method involved using a sampling frame, a sample interval and simple randomization in selecting the first participant. Computer generated random numbers was the method of randomization to either group. Allocation was by means of sealed opaque numbered envelopes. Patients with a systolic blood pressure of >120mmHg to139mmHg and/or diastolic blood pressure of >80mmHg to 89 mmHg were included. Information collected included the participants' socio-demographic data, weight, BMI, alcohol intake and smoking, current exercise activity and a 24-hour dietary recall.

Each Subject had a focused physical examination. The physical examination included the height, weight and body mass index (BMI). Height was measured in centimetres (cm) using a wall-mounted stadiometer. The subjects were without shoes and head gears while they stood erect with their hands at their sides. Their heads, buttocks and feet touched a vertical wall with the head level in the horizontal plane. Weight was measured in kilograms (kg) to the nearest 100g without shoes and with minimal clothing using a digital bathroom scale that was regularly calibrated with a known weight. Body mass index (BMI) was calculated as weight (in kg) divided by height (in metres) squared (kg/m2).

All patients in the intervention group were counseled and advised concerning diet and exercise using a structured format. They were given written dietary and exercise instructions in either English or Hausa and asked to keep an exercise diary. They were asked to return for follow up at four, eight and twelve weeks. At each follow up visit, the instructions were reviewed and repeated according to the structured format to reinforce

them. The blood pressure was recorded at each follow up visit. The control group were only given general advice on exercise and a healthy diet.

Data were analyzed using SPSS 23.0.[15] Background descriptive analysis was done to compare both groups. The primary outcome variables of interest were weight and BMI. The proportions of categorical variables were compared using the χ^2 test and the Fisher's exact test. A p value of 0.05 was considered significant in all analyses. Analyses were carried out on an intention to treat basis.

Results:

Sixty subjects fulfilled the inclusion criteria and participated in the study – 30 each in the control and intervention groups. Fifty-two completed follow-up (86.67%) while eight (13.33%) did not complete the study. Out of eight that did not complete the study, five were in the control group while three were in the intervention group.

Table 3: Sociodemographic Characteristics of the study participants

	Intervention Group (N=30)	Control Group (N=30)	p value
Mean Age (years)	33.97±9.69	34.73±11.56	0.49*
Height (metres)	1.63±0.07	1.62±0.06	0.23*
Age category(years)			0.54*
18-27	8 (26.7%)	12 (40.0%)	
28-37	10 (33.3%)	6 (20.0%)	
38-47	10 (33.3%)	8 (26.7%)	
48-57	2 (6.7%)	3 (10.0%)	
58-67	0 (0.0%)	1 (3.3%)	
Gender:			0.80"
• **Male**	12 (40.0%)	14 (46.7%)	
• **Female**	18 (60.0%)	16 (53.3%)	
Educational Level:			0.92*
• **None**	1 (3.3%)	2 (6.7%)	
• **Primary**	8 (26.7%)	9 (30.0%)	
• **Secondary**	8 (26.7%)	7 (23.3%)	
• **Tertiary**	13 (43.3%)	12 (40.0%)	
Marital Status:			0.79"
• **Married**	20 (66.7%)	19 (63.3%)	
• **Single**	10 (33.3%)	11 (36.7%)	
Religion:			0.44"
• **Christian**	16 (53.3%)	13 (43.3%)	
• **Muslim**	14 (46.7%)	17 (56.7%)	
Ethnicity			0.19"
• **Plateau Indigenes**	20 (66.7%)	15 (50.0%)	
• **Non-Indigenes**	10 (33.3%)	15 (50.0%)	
Occupation			0.37"
• **Sedentary Type**	6 (20.0%)	9 (30.0%)	
• **Non-Sedentary Type**	24 (80.0%)	21 (70.0%)	

: 8 (26.7%) in the control group and 11 (36.7%) in the intervention group. Only one (3.3%) participant had a previous history of alcohol consumption in the control group.

Lifestyle Habits:

Alcohol consumption: At baseline, eight (26.7%) participants in the control group and 11 (36.7%) in the intervention group had a current history of alcohol consumption in the form of beer, wine, whisky and local brew, of more than two standard drinks per day and a duration of at least one year. Post intervention, 7 (23.3%) participants in the control group and 7 (23.3%) in the intervention group had reduced alcohol consumption (p=0.04).

Cigarette smoking: No participant in either the control group or the intervention group had a current history of cigarette smoking, and none had resumed or started smoking during the study.

Exercise: At enrollment, nine participants (15%) from the control group and ten (16%) from the intervention group were involved in some form of regular aerobic exercise. The control group exercised for an average of two days per week for an average of 34.5 minutes per day while the intervention group also exercised for an average of two days per week but for an average of 37 minutes per day. Among those that exercised, the most common exercise undertaken was brisk walking in both groups, comprising seven (77.7%) participants in the control group and five (50%) in the intervention group. At the end of the study, 25 (54.3%) participants from the control group and 22 (47.8%) from the intervention group were involved in some form of regular aerobic exercise (p=0.18). The control group exercised for an average of three days per week for an average of 32 minutes per day while the intervention group exercised for an average of four days per week for an average of 35 minutes per day. The most common exercise undertaken was brisk walking in both groups, with 13 (43.3%) participants in the control group and 15 (50%) in the intervention group (p=0.68). Jogging, skipping, climbing staircases, cycling, tennis, football and other forms of aerobic exercises made up the remaining.

Dietary pattern: Based on a 24-hour dietary recall and estimated from the average equivalent of the DASH diet, the dietary pattern of participants in the study groups were compared. All patients in both groups had less than the expected daily servings of fruits with 63.3% and 70% of participants having less than the expected daily servings of fruits and vegetables in the control and intervention groups respectively. Of the total study participants, 93.3% of the participants in the control group had more than the expected daily servings of fats and oils versus 96.7% in the intervention group while 70% of the control group had more than the expected daily servings of grain and grain cereals versus 76.7% in the intervention group. Only 13.3% of the control population had the expected value for lean meat, poultry or fish against 10% of the intervention population. Only 10% of the control population had some form of nuts, seeds or legumes and in required daily amounts at enrollment versus 6% in the intervention group. All participants in the study group were taking more than the expected daily servings of more than one teaspoon full of salt either in prepared meals or on the table or both.

On completing the study, 47.2% of the control group had the expected daily servings of fruits against 67.8% of the intervention group (p=0.03). The control and intervention groups comprised 47.7% and 56.3% of participants who had the expected daily servings of vegetables respectively (p=0.035). In the control group, 11.4% had the expected daily servings of fats and oils versus 18.3% in the intervention group (p=0.58). The control group was made up of 27.8% who had the expected daily servings of grain and grain cereals which was comparable with 34.9% in the intervention group (p=0.41). Only 41.1% of the control group had the expected servings for lean meat, poultry or fish against 38.9% of the intervention group (p=0.63). On completion of the study, 9.3% of the control group had some form of nuts, seeds or legumes versus 11.4% of the intervention group (p=0.29). All participants in both study arms had reduced their salt intake at the end of the study. Based on a 24-hour dietary recall and estimated from the average equivalent of the DASH diet, the dietary pattern of participants in the study groups were compared at baseline and on completing the study (Figures 1 and 2).

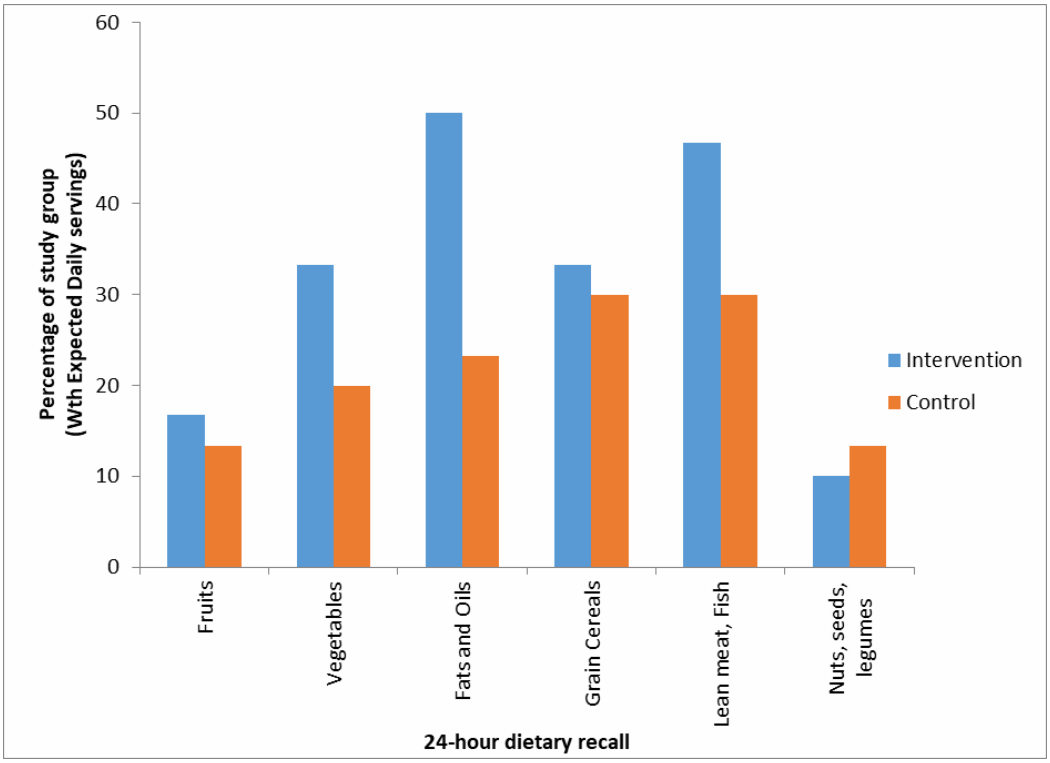

Fig 1: **Baseline dietary pattern of the intervention and control groups based on a 24 hour dietary recall**

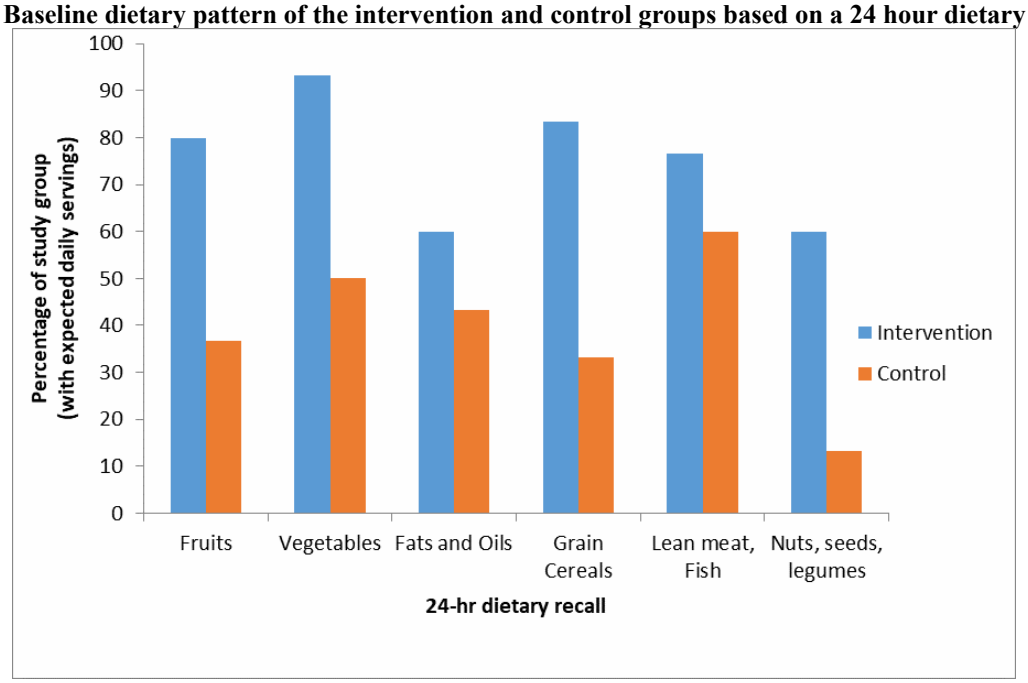

Fig 2: Post-intervention dietary pattern of the intervention and control groups based on a 24 hour dietary recall.

Clinical Characteristics:

Weight: The mean weights of the control and intervention groups were 70.80±11.98 kg and 74.20±11.25kg respectively. In the control group, the least weight was 50kg and the maximum was 95kg while in the intervention group, the least weight was 52kg and the maximum, 97kg. Post intervention, the mean weights of the control and intervention groups were 69.77±11.69 kg and 69.93±11.28kg respectively. In the control group, the least weight remained 50kg and the maximum weight was also 95kg while in the intervention group, the least weight reduced to 50kg and the maximum weight reduced to 95kg. Thirty-one participants (51.7%) lost at least 3kg after the study, six (20.0%) in the control group and 25 (83.3%) in the intervention group.

Body Mass Index: The mean BMI of the control group at the start of the study was 26.91± 4.52kg/m^2 while that of the intervention group was 28.03±4.70 kg/m^2**.** At the end of the study, the mean BMI of the control group was 26.27±4.59 kg/m^2 while that of the intervention group was 26.59±4.68kg/m^2. Thirty-eight participants had at least 0.5kg/m^2 decrease in BMI in the study group, 12 (40.0%) in the control group and 26 (86.7%) in the intervention group.

Changes in weight between the control and intervention groups: At the beginning of the study, Independent t test analysis showed a mean weight difference of 3.4kg (p=0.26; -2.61, 9.41, 95% CI). This was not statistically significant. On completing the study, the mean weight difference between the two study groups was 0.17kg (p=0.96; -5.77, 6.12, 95% CI). This was also not statistically significant.

Changes in Body Mass Index between the control and intervention groups: At the beginning of the study, Independent t test analysis showed a mean BMI difference of 1.12 kg/m^2 (p=0.35; -1.26, 3.50, 95% CI). This was not statistically significant. On completing the study, the mean BMI difference between the two study groups was 0.32kg (p=0.79; -2.07, 2.71, 95% CI). This was also not statistically significant.

Discussion:

This study evaluated the cumulative benefit of multiple lifestyle interventions and the benefit that can be expected from structured therapeutic lifestyle changes. Several similar studies investigating the effect of lifestyle interventions on pre-hypertension have been done elsewhere. [16-18]

Although the average weight loss in the control group was not statistically significant when compared to the intervention group, at the end of the study, the average reduction in weight from baseline to the end of the study was higher in the intervention group, with 20.0% and 83.3% loosing at least 3kg in the control and intervention groups respectively at the end of the study. These changes may have been possible with the exercise and dietary pattern observed among participants in the study. The Trials of Hypertension Prevention (TOHP) also demonstrated a similar but larger effect.[19] In that trial, a behavioral weight loss intervention in adults with pre-hypertension led to an average reduction in body weight of 2 kg at six months. The evidence of an effect of weight loss on reduction in BP is strong and consistent as was seen in other studies.[20-24]

It may be argued that the modest average reduction in weight loss among study participants at the end of the study may have resulted from a sizeable number of individual weights being maintained rather than reduced, due to effective lifestyle changes during the period of the study. These modest reductions should be viewed in the context of public health goals that emphasize prevention of additional weight gain, rather than weight loss, because of the well-documented difficulties of sustaining weight loss.[21]

The difference in the mean BMI between the control and intervention groups was not statistically significant at the end of the study and the mean BMI was slightly higher in the intervention group than in the control group. This suggests that lifestyle changes are effective in both groups and the structured changes in the intervention group may not be different from administering verbal advice only. However, only 40% of the control group had at least a reduction of 0.5kg/m^2 versus 86.7% in the intervention group at the end of the study. This study was unlike other studies which showed a significant decrease in BMI following the period of intervention.[9,25] The inability to detect this difference may be because, the relatively short twelve-week duration of the study was inadequate to demonstrate a difference compared to at least 6 months to one year in these other studies.

The observed difference in weight loss between the two study groups may have been a probable consequence of the extent of dietary changes together with physical activity. Although all participants in the intervention group received a structured counseling on salt restriction, reduction of salt intake did not change significantly relative to the control group. In both groups the reduction in sodium intake was not sufficient to achieve the complete PREMIER (and JNC-VII) goal of no more than 100 mmol/day (≤ one teaspoon full of salt per day).[26] Palatability concerns of meals may have largely contributed to this poor adherence and this was in keeping with similar other studies.[26-29]

Either exercise alone or caloric restriction alone will reduce body weight. Despite the fact that it is reasonable to assume that the combination of caloric restriction and exercise would reduce body weight in an additive manner as was seen in this study, a few reports have shown that the combination of caloric restriction and exercise result in only a slight reduction in body weight compared to caloric restriction only. However, the addition of exercise to diet results in a greater fat loss and maintenance of lean body mass.[30] In addition, the combination of exercise and diet is associated with better weight maintenance and lower fat mass than diet alone. A longer period of study and additional research on lean body mass may have shown a similar outcome.

Unanticipated findings were the extent of lifestyle changes in the participants in the control group at the end of the study. These lifestyle changes may have led to weight and BMI reductions that attenuated pair-wise contrasts between this group and the intervention group. Of note, the participants in the control group lost

approximately one kilogram at 12 weeks, whereas in several earlier blood pressure and lifestyle trials, control groups that received usual care gained weight.[31-33] This finding may be a consequence of recruitment of highly motivated volunteers. There follow-up visits may have enhanced the awareness of their clinical measurements, and the need for adherence to information received on lifestyle changes.

Conclusion:

This study shows that changes in lifestyle measures are associated with a decrease in weight and improved BMI. Individuals with Pre-hypertension can make and sustain, during a period of 12 weeks, multiple lifestyle modifications which can help to reduce weight or improve BMI and reduce the risk for cardiovascular diseases. However, administration of structured counselling of lifestyle changes may not differ from routine verbal advice in terms of improvement of these clinical indices.

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