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Dietary Interventions and Blood Pressure in Latin America – Systematic Review and Meta-Analysis

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Abstract

Background: High blood pressure is the major risk factor for cardiovascular disease. Low blood pressure control rates in Latin American populations emphasize the need for gathering evidence on effective therapies.

Objective: To evaluate the effects of dietary interventions on blood pressure in Latin American populations.

Methods: Systematic review. Electronic databases (MEDLINE/PubMed, Embase, Cochrane Library, CINAHL, Web of Science, Scopus, SciELO, LILACS and VHL) were searched and manual search for studies published up to April 2013 was performed. Parallel studies about dietary interventions in Latin American adult populations assessing arterial blood pressure (mm Hg) before and after intervention were included.

Results: Of the 405 studies identified, 10 randomized controlled trials were included and divided into 3 subgroups according to the proposed dietary intervention. There was a non-significant reduction in systolic blood pressure in the subgroups of mineral replacement (-4.82; 95% CI: -11.36 to 1.73) and complex pattern diets (-3.17; 95% CI: -7.62 to 1.28). Regarding diastolic blood pressure, except for the hyperproteic diet subgroup, all subgroups showed a significant reduction in blood pressure: -4.66 mmHg (95% CI: -9.21 to -0.12) and -4.55 mmHg (95% CI: -7.04 to -2.06) for mineral replacement and complex pattern diets, respectively.

Conclusion: Available evidence on the effects of dietary changes on blood pressure in Latin American populations indicates a homogeneous effect of those interventions, although not significant for systolic blood pressure. Samples were small and the quality of the studies was generally low. Larger studies are required to build robust evidence. (Arq Bras Cardiol. 2014; 102(4):345-354)

Keywords: Arterial Pressure; Hypertension; Diet; Review; Meta-analysis; Latin America.

Introduction

Systemic arterial hypertension (SAH), a complex chronic disease, accounts for approximately 45% of the cases of ischemic cardiac diseases and 51% of cerebrovascular diseases[1]. Together, those two classes of disease are the major cause of morbidity and mortality in the world[2]. Because of the linear, direct and independent association of SAH with the development of cardiovascular diseases (CVD)[3], arterial blood pressure control is fundamental to reduce cardiovascular risk.

Changes in lifestyle (CLS) are the basis for the treatment of hypertensive patients. Historically, since the 1970's, several countries have taken necessary measures to insert programs of disease prevention and health promotion in the community, emphasizing the fight against risk factors related to CVD[4].

Thus, an adequate diet, in association with increased physical activity levels, has been encouraged as a beneficial measure to reduce arterial blood pressure[5]. Such CLS are important strategies for SAH prevention and treatment[6].

The effect of dietary interventions has been described in several populations[7,8]. However, very often, the replication of effective dietary interventions in developed countries has not proven to be effective in reducing CVD in developing countries[9]. In addition, systematic reviews about the topic have not included Latin American studies[10,11]. Thus, the need for solutions to face CVD adapted to the economic and structural weaknesses of developing nations has directed the actions of international organs, governments and scientific journals[12-14]. Gathering summarized evidence with accuracy and analytical power has been increasingly important in the health sector[15]. Systematic reviews and meta-analyses have been important tools to determine preventive measures against and treatment for CVD[16].

This study was aimed at gathering and summarizing evidence about the effects of diet changes on arterial blood pressure of Latin American populations, evaluating distinctive patterns of dietary intervention and their effect on systolic and diastolic arterial blood pressures.

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Methods

Search strategy

Searches in electronic databases (MEDLINE/PubMed, Embase, the Cochrane Library, CINAHL, Web of Science, Scopus and Virtual Library on Health (BVS)) were performed by using a combination of descriptors, including terms of the Medical Subject Headings (MeSH), Descriptors in Health Sciences (DECs), and contractions of descriptors. The systematic review was not restricted to English publications, and included studies written in Portuguese and Spanish. The PRISMA protocol[17] was used as a guide for the systematic review. The terms used for the search were related to the population analyzed (*South America*[mesh] OR *South America**[tiab] OR *Latin America**[tw] OR *Central America*[mesh] OR *Brazil**[tiab]) and the lifestyle interventions combined with the following outcomes: ("*life style*" OR "*lifestyle*" OR "*diet therapy*" OR "*Sodium Restriction*" OR "*salt Restriction*" OR "*low Sodium*" OR "*low salt*" OR "*fat Restriction*" OR "*low fat*" OR "*Carbohydrate Restriction*" OR "*low carb*" OR "*Caloric Restriction*" OR "*Food, Formulated*" OR "*Formulated Food*" OR "*diet*" OR "*dietary*" OR "*weight loss*" OR "*losing weight*" OR "*Weight Reduction*" OR "*Disease Management*" OR "*social support*" OR "*Social Network*" OR "*Tobacco Use Cessation*" OR "Smoking cessation" OR "*Alcohol Drink*" OR "Alcohol consumption" OR "Drinking Alcohol" OR "*Alcoholi*" OR "*non pharmacol*" OR "*magnesium*") AND ("*Blood pressure*" OR "*Hypertension*"). References present in the articles identified via the search strategy were also manually sought to add to the study and literature review. Experts, as well as the authors of unpublished studies, were contacted.

Inclusion and exclusion criteria

The inclusion criteria were as follows: randomized clinical trials, clinical trials and community trials, in which an intervention group is compared with a control group; studies conducted in adults; studies reporting, in the same trial, arterial blood pressure levels before and after intervention, in both control and intervention groups; and studies assessing the effect of dietary interventions on arterial blood pressure.

The exclusion criteria were as follows: studies involving drug therapy; studies involving pregnant women; studies on animals; interventions shorter than eight weeks; letters, abstracts, annals of conferences, observational studies, and crossover and conglomerate studies.

Identification and selection of studies

Two independent pairs of authors read separately the titles and abstracts of the pre-selected studies to identify those that correctly met the inclusion criteria. Then, such studies were read separately by four authors, to assure that the systematic review criteria were met. Any disagreement between the authors was solved via discussion in the presence of a fifth author.

Data extraction

Three authors used a predefined collection form. One fourth independent author reviewed the data extracted. The characteristics of the studies extracted included the following:

publication date; geographical origin; title; study definition; intervention duration; intervention type; supervision; and funding. Each study informed data on participants, such as number of participants, sex, age, residence region (urban or rural), use of medications, and co-morbidities. In addition, blood pressure levels before and after the intervention, with respective variances, were measured.

The quality of each study was assessed by use of the Cochrane Collaboration's tool for assessing risk of bias[18], comprising the following criteria: proper randomization; allocation of participants; blinding of participants; blinding of the examiner of the results; result integrity; incomplete data; selective reports of results; and other sources of bias, such as the effect of small studies.

Statistical analysis

The primary outcome variables, systolic and diastolic blood pressure, were recorded as continuous variables in mmHg. The sizes of the effects of each study were calculated as the difference of the mean between the pre- and post-intervention measures[19]. When absent, the variances of the pre- and post-intervention differences between the intervention and control groups[20-27] were inputted following the methodology previously described[19].

For the meta-analysis of the results, the fix and random effects with 95% confidence interval (95% CI) were used. The I-squared was used to assess the heterogeneity of the articles[28]. The studies were separated according to the type of dietary intervention to assess the possible differences between the subgroups as follows: hyperproteic diet; mineral replacement diet, which gathered studies that recommended a low-sodium diet or calcium supplementation; and complex pattern diet, which recommends a reduction in the intake of saturated fat, red meat, fried food and sweets, as well as an increase in the intake of olive oil, fruits, vegetables and skim dairy products.

Publication bias was assessed by using funnel plot. The effect of small studies was tested with the Egger test[28]. The influence of one single study on the group effect was assessed by analyzing sensitivity in the three subgroups of different dietary interventions[19]. The significance level adopted was 5%. All analyses were performed with the 12.0 version of the Stata software (StataCorp LP, CollegeStation, Tex, USA).

Results

Identification and selection of the studies

Of the 405 references identified in the search strategy, 24 complete texts were obtained. Of those 24, the following studies were excluded: one due to lack of a control group; one due to lack of blood pressure measurement; one due to its irrelevance; four reporting non-dietary interventions; two of the crossover type; two cross-sectional studies; and one whose full version could not be obtained even after attempting contact with the authors. Finally, 12 studies met the inclusion criteria proposed for the systematic review and ten for the meta-analysis (Figure 1). The reasons for excluding two trials from the meta-analysis were as follows: one[29] had no control
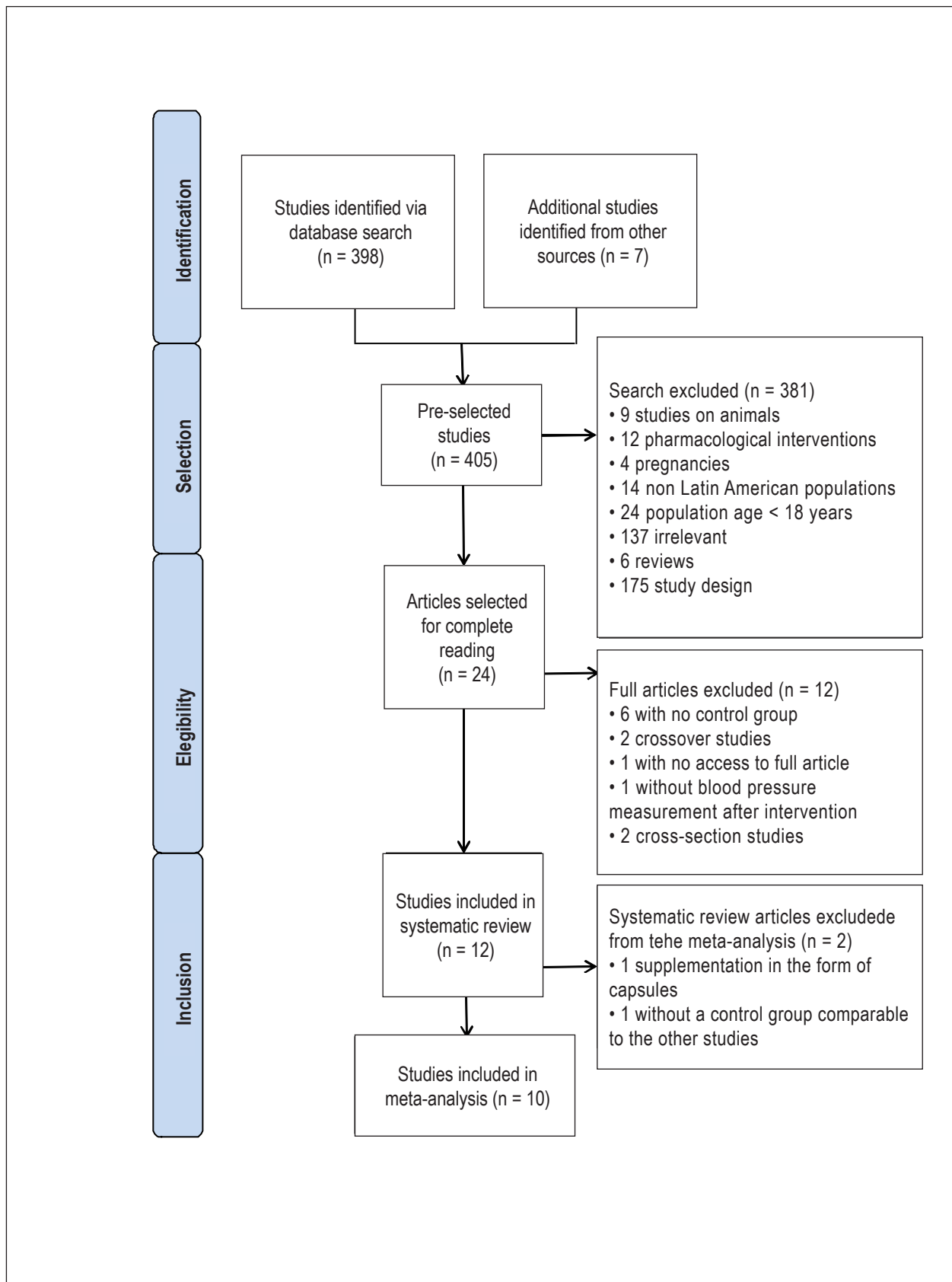
Figure 1 - *Flowchart of the process of study selection.*

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group comparable to the other studies; and another[30] provided dietary supplementation in the form of capsules.

General characteristics of the studies selected

Table 1 shows the major characteristics of the studies included in the systematic review. The samples ranged from 18 to 142 participants (total n = 642), with a mean age of 49.67 ± 10.3 years. Two studies have assessed exclusively women[21,22], and the others have included individuals of both sexes, one of which[24] has reported a greater proportion of men. Regarding co-morbidities, three articles have not reported the presence of associated diseases[21,22,27], one has assessed only seropositive patients[24], and another has reported patients with polycystic ovarian syndrome[22]. The other trials have considered individuals with metabolic syndrome or with at least one of its components (diabetes, hypertension or obesity). The mean duration of the interventions was 5.2 ± 3.4 months, ranging from two months to one year. Appendix 1 shows the quality of the studies assessed according to the Cochrane tool[18], and the description of studies with intention to treat[24,26,27,29,31].

Effects of diet changes on blood pressure

All studies were randomized clinical trials and were separated into three subgroups according to the diet proposed as intervention (mineral replacement, hyperproteic and complex pattern diets). Table 2 shows the pre- and post-intervention blood pressure means of the groups included in the meta-analysis. The effect of the dietary interventions (in mm Hg) was assessed in each subgroup (Figure 2) for systolic and diastolic blood pressure. Except for the evaluation of diastolic blood pressure in the subgroup of hyperproteic diets (I^2 = 71.4%, p = 0.030), no heterogeneity was observed among the subgroups with I^2 = 0% for all. The effect of the small studies was not identified, as indicated by the funnel plot (Appendix 2) and confirmed by the Egger test (p = 0.893).

Mineral replacement diets and effects on arterial blood pressure

Two trials with 61 participants have assessed the effect of diets with sodium[20] and calcium[23] replacement on arterial blood pressure. The combined effect of both studies was protective for systolic blood pressure (-4.82; 95% CI: -11.36 to 1.73; I^2 = 0.0%, p = 0.760), although not significant. On the other hand, the interventions significantly reduced diastolic blood pressure (-4.66; 95%CI: -9.21 to -0.12; I^2 = 0.0%, p = 0.616).

Hyperproteic diets and effects on arterial blood pressure

The subgroup of hyperproteic diets comprised two studies (n = 70). One[22] has assessed the impact of a diet supplemented with 30% of proteins, 40% of carbohydrates and 30% of lipids on two different populations, one of previously healthy pregnant women and another of women with polycystic ovary syndrome. On global assessment, they were considered distinct studies. Contrary to other subgroups, the intervention was associated with an increase in systolic arterial blood pressure (4.95; 95%CI: -1.25 to

11.15; I^2 = 0.0%, p = 0.648), but that had no significance. Although the global effect of the intervention was a reduction of 3.27 mm Hg in diastolic arterial blood pressure, that result had no statistical significance (-3.27; 95%CI: -13.70 to 7.16; I^2 = 71.4%, p = 0.030).

Complex diets and effects on arterial blood pressure

The complex pattern of diets was defined according to established guidelines on healthy diets, such as the Dietary Approaches to Stop Hypertension (DASH), rich in carbohydrates originating from vegetables, little fat and lean meat, and the Mediterranean that includes large consumption of monounsaturated fats, fruits, vegetables, grains and nuts, in addition to a moderate daily intake of alcohol and reduced intake of red meat. In that subgroup, six studies were assessed with a total of 511 participants. Of those, two studies have reported combined interventions[26,31], which encourage healthy diets in association with the practice of physical exercises. Although not statistically significant, the grouped effect of the interventions proved to be solid, with a reduction in systolic arterial blood pressure (-3.17; 95% CI: -7.62 to 1.28; I^2 = 0.0%, p = 0.995). On the other hand, diet change had a significant effect on diastolic arterial blood pressure (-4.55; 95% CI: -7.04 to -2.06; I^2 = 0.0%, p = 0.990).

Discussion

In this meta-analysis involving ten studies and 642 participants, a homogeneous effect of dietary interventions on arterial blood pressure was found in Latin American populations. Although the diets showed a reduction effect on arterial blood pressure, it was not significant when only systolic arterial blood pressure was analyzed. The major reason for that was the reduced sizes of the study samples when compared to those of studies at developed countries. On the other hand, diastolic arterial blood pressure was significantly reduced, except for the subgroup of hyperproteic diets.

The subgroups were analyzed according to the differences in the diets. In addition to a better understanding of the results, that analysis evidenced the homogeneity of the effects according to the intervention types, such as the complex pattern and sodium replacement diets.

Systematic reviews about specific dietary interventions in different populations from those studied here have evidenced a beneficial effect on arterial blood pressure[10,32]. A meta-analysis about the Mediterranean diet comprising 50 studies has shown a combined effect of -2.35 mmHg (-3.51 to -1.18 mmHg) on systolic arterial blood pressure, in addition to benefits on other metabolic syndrome components[8]. The DASH diet also has a reducing effect on arterial blood pressure[33], and according to a meta-analysis of six studies, it was able to reduce the risks of CVD, stroke, coronary artery disease, and heart failure by 20%, 19%, 21% and 29%, respectively[33]. In Brazil, no studies on the mentioned cardiovascular outcomes were found, because of the short follow-up period.

Regarding the mineral replacement diets, the reductions of 4.82 mmHg and of 4.66 mmHg in systolic and diastolic arterial blood pressures, respectively, were smaller than those reported by other studies. A meta-analysis with 34 studies has confirmed

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Table 1 - Characteristics of the randomized clinical trials of the systematic review

Reference	Country, year	Sample size	Mean age (years), sex	Co-morbidities	Intervention	Duration (months)
Pereira et al.[20]	Brazil, 2005	22	45.4 ± 13.2, M/F	SAH, overweight/obesity	50% KCl replacement in salt, hypocaloric diet	3
Simão et al.[21]	Brazil, 2010	30	42 ± 9.8, F	General population*	Addition of 25 g of soy protein/day	3
Toscani et al.[22]	Brazil, 2011	18	22.72 ± 5.68, F	POS	Hyperproteic diet (30% of proteins, 40% of carbohydrates, 30% of lipids)	2
Toscani et al.[22]	Brazil, 2011	22	29.35 ± 5.74, F	General population*	Hyperproteic diet (30% of proteins, 40% of carbohydrates, 30% of lipids)	2
Torres et al.[23]	Brazil, 2010	39	39.9 ± 2, M/F	BMI > 30	Calcium-rich diet (1200-1300 mg/day) with skim milk (60 g/day)	4
Almeida et al.[24]	Brazil, 2011	42	----, M/F	HIV**	Increased intake of olive oil, fruits, vegetables and skim dairy products; reduced intake of saturated fat, red meat, fried food and sweets	12
Siqueira-Catania et al.[25]	Brazil, 2013	142	54.7 ± 12.5, M/F	Pre-DM and/or MS	Healthy diet	9
Cezaretto et al.[37]	Brazil, 2012	135	55.4 ± 12.5, M/F	High risk for DM2	Low fat intake	9
Goldhaber-Fieber et al.[31]	Costa Rica, 2003	61	57 ± 10, M/F	DM2	Healthy diet and physical activity	3
Mujica et al.[26]	Chile, 2010	51	51.1 ± 5.3, M/F	MS	Reduced salt (0.6-6 g/day) and saturated fat intake; increased intake of fruits, vegetables and fiber-rich food; physical activity	4,5
Sartorelli et al.[27]	Brazil, 2005	79	46 ± 10, M/F	General population*	Increase intake of olive oil, fruits, vegetables and skim dairy products; reduced intake of saturated fat, red meat, fried food and sweets	6
Fortes and Novaes[30]	Brazil, 2011	56	59.14 ±12.95, M/F	Large bowel cancer	Supplementation with *Agaricus sylvaticus* mushroom (dried extract tablet - 30 mg/kg/day)	6
Weber et al.[29]	Brazil, 2012	79	62 ± 11, M/F	Atherothrombotic vascular disease and high risk for CVD	Diet associated with regional food (rice, beans, soy oil, and Brazilian fruits and vegetables); to avoid food with high energetic density (1 kcal/g)	3

*No reference to any co-morbidity in the article; ** HIV-positive patients on highly active antiretroviral therapy (HAART). M: male; F: female; SAH: systemic arterial hypertension; POS: polycystic ovary syndrome; BMI: body mass index; DM: diabetes mellitus; MS: metabolic syndrome; DM2: type 2 diabetes mellitus; CVD: cardiovascular diseases.

that a low-sodium diet significantly reduces systolic arterial blood pressure independently of ethnicity, sex and presence of hypertension[34]. Calcium supplementation, discussed in a meta-analysis with 40 studies, proved to reduce systolic blood pressure, and that effect was even higher in individuals with a calcium-deficient diet[35]. Those differences can be explained by the small number of studies included in this subgroup (only two), whose samples were also reduced.

Other diets, such as the hyperproteic diet, seem to have an adverse effect on arterial blood pressure[36], which has not favored the implementation of that type of diet in the primary or secondary prevention of high arterial blood pressure.

The distribution of the studies on the funnel plot indicated the lack of publication bias in the studies included in this meta-analysis. However, when assessed separately, by using

the Cochrane tool, all met the criteria for a high risk of bias. On the other hand, the use of the Egger test showed no effect of the small studies on the results. It is worth considering that all studies involved small samples, emphasizing the need for larger studies of that type.

The results of diet changes and specific dietary interventions have been widely studied in developed countries[8,33]; however, in developing countries with lower socioeconomic levels, that has not occurred. The low efficacy of dietary interventions of developed countries replicated in developing countries has been discussed[9]. In addition, in Latin American countries, there are high prevalence of risk factors for CVD and a reduced number of population studies, which result in an insufficient number of prevention programs aimed at reducing cardiovascular risks[25,37].

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Appendix 1 - *Assessment of the risk of publication bias – Cochrane tool (adapted).*

Table 2 - Means (standard deviation) of systolic and diastolic arterial blood pressure, before and after intervention, in the intervention and control groups of the studies included in the meta-analysis

| Reference | n | Control Group | | | | n | Intervention Group | | | |
| | | Systolic (mmHg) | | Diastolic (mmHg) | | | Systolic (mmHg) | | Diastolic (mmHg) | |
		Pre	Post	Pre	Post		Pre	Post	Pre	Post
Pereira et al.[20]	13	139.6 (11.95)	130.1 (10.5)	92.3 (5.12)	87.4 (10.3)	15	136.1 (6)	120.92 (13.17)	93.83 (4.39)	82.5 (6.6)
Simão et al..[21]	15	137 (27.5)	127.58 (23.67)	87.33 (18.86)	89.25 (15.57)	15	135.8 (14.2)	132.43 (14.25)	91 (11.8)	80.07 (10.4)
Toscani et al.[22]	9	119.1 (16.4)	119.36 (15.38)	78 (11.83)	77.82 (12.02)	9	125.7 (19)	126 (23.1)	77.9 (10.75)	80 (11.2)
Toscani et al.[22]	9	116.43 (10.3)	110.71 (7.32)	75.14 (9.6)	72.57 (7.72)	13	116.1 (10.41)	117.85 (10.18)	74.6 (8.46)	74 (8.8)
Torres et al.[23]	25	113.8 (1.9)	109.8 (1.9)	71 (1.8)	67.8 (1.3)	25	117.5 (2.6)	108.9 (2.5)	76 (2)	68.9 (2.1)
Almeida et al.[24]	28	111.1 (12.2)	112.5 (15.6)	74.8 (7.9)	74.3 (10.2)	25	111 (11)	110.7 (10.9)	75.6 (6.5)	71.8 (9.3)
Siqueira-Catania et al.[25]	83	134.3 (17.8)	134.7 (18.9)	80.3 (9.9)	79.7 (8.1)	97	136.3 (17.4)	132.2 (19.1)	84.2 (10)	79.6 (8.5)
Cezaretto et al.[37]	80	135.8 (17.6)	136.2 (19.2)	80.5 (9.9)	80 (8.2)	97	136.4 (17.7)	131 (17)	84 (10.7)	76.8 (12.5)
Goldhaber-Fiebert et al.[31]	35	134 (17)	130 (16)	82 (10)	79 (8)	40	138 (19)	133 (23)	84 (10)	77 (9)
Mujica et al.[26]	30	138 (15)	137.6 (12.5)	82.7 (12.3)	82.9 (10.5)	30	135.4 (12.9)	132.5 (13.4)	85.4 (10.4)	79.6 (10.4)
Sartorelli et al.[27]	53	118.1 (20.4)	123.4 (18.1)	77.6 (23.3)	80.9 (11.6)	51	115.1 (14.2)	116.9 (14.1)	77.6 (23.3)	76.3 (8.9)

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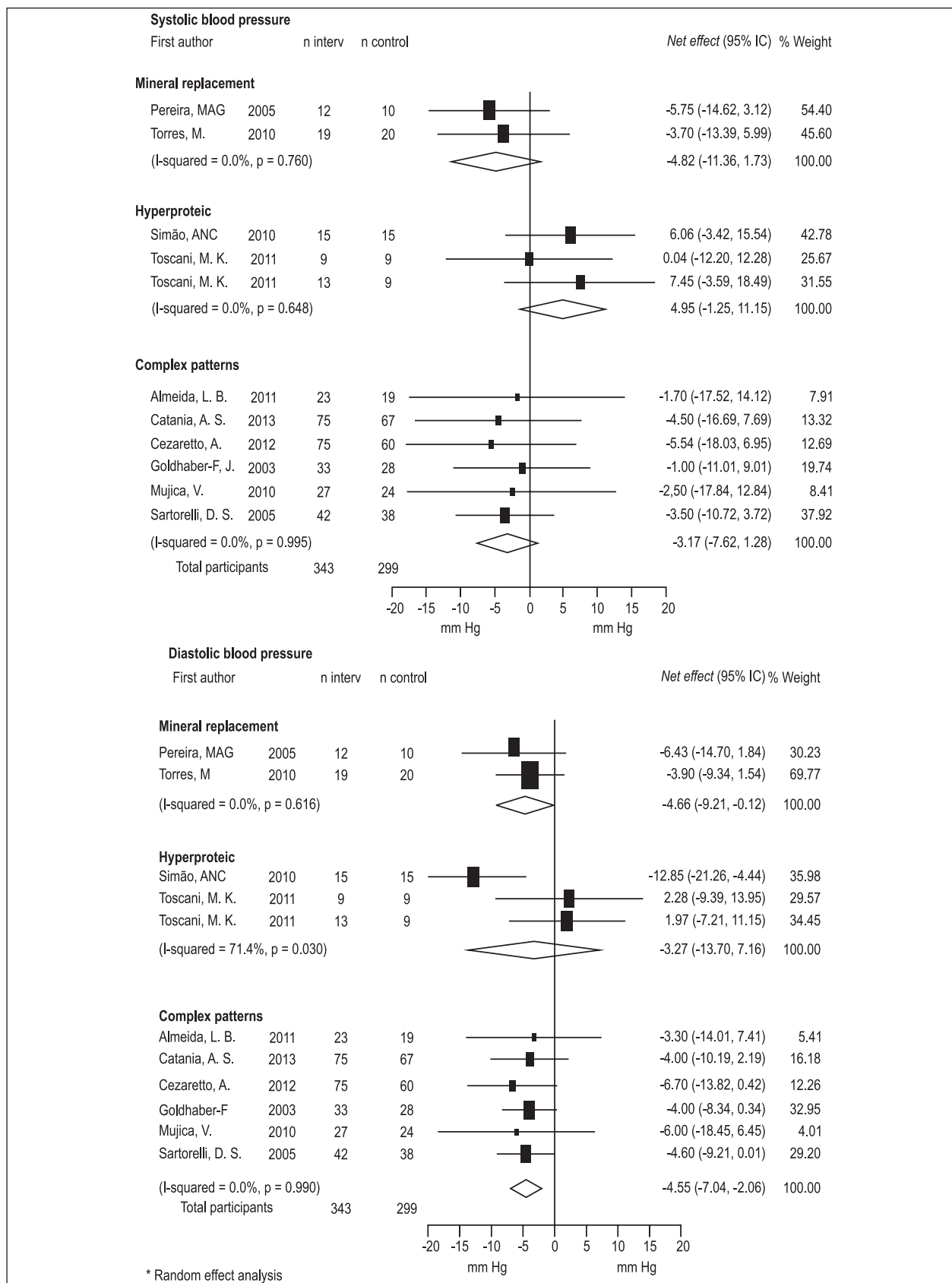
Figure 2 - *Meta-analysis of the effects of different diet changes on systolic and diastolic blood pressure of Latin American populations*

se(WMD): standard error of the weighted mean difference; WMD: weighted mean difference.
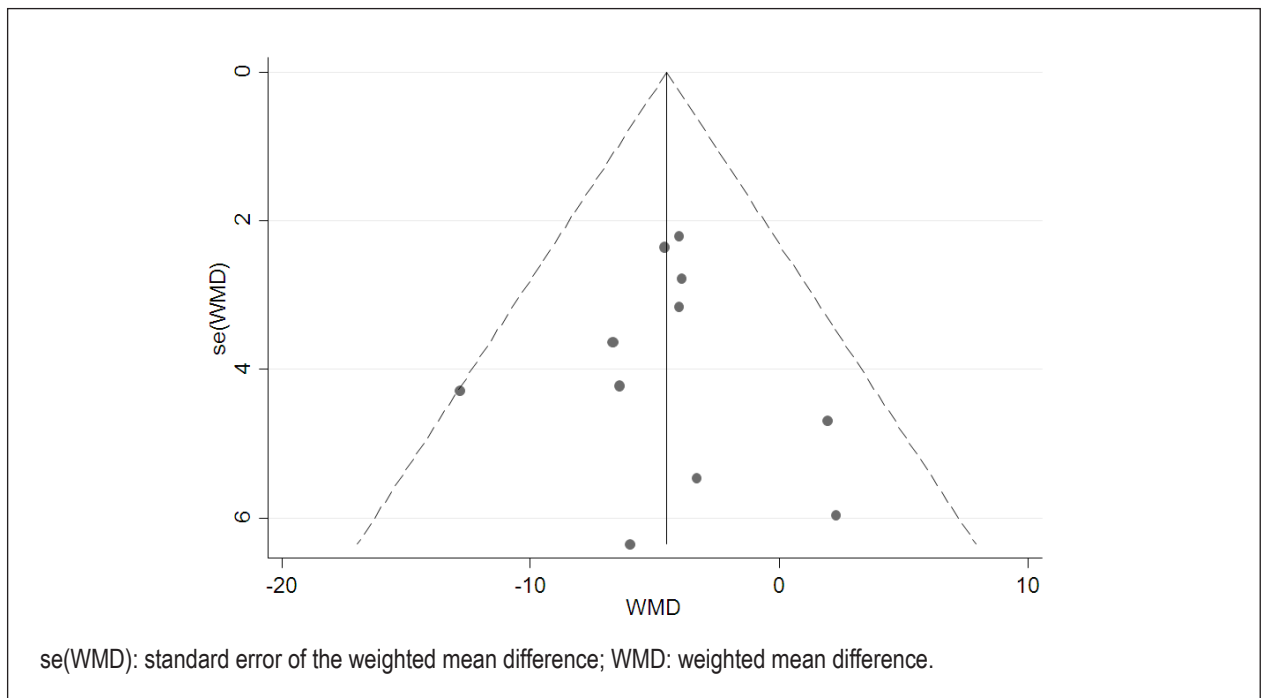
Appendix 2 - *Funnel plot of the studies included in the meta-analysis.*

Some limitations of this meta-analysis should be considered, the first being the quality of the studies included (Appendix 1). Somes studie have not reported basic data, such as patients' sex, minimum, maximum and mean ages, and socioeconomic variables. The second limitation is the sample sizes, which have ranged from 18 to 142 participants. Although this systematic review was aimed at assessing studies conducted in Latin America, only two interventions included were not Brazilian. One of the reasons for that might be publication bias or lack of studies on dietary interventions in other Latin American countries.

The population involved in this study showed a reduction in arterial blood pressure, but a significant effect was only found in the diastolic component. Possible explanations for that might lie in the small sample sizes of the studies included as compared with others of meta-analysis of unspecific populations. Although most studies have lacked reporting data on adherence, that might be another cause. Last, but not least, it has not been clarified whether, if those interventions had lasted longer, the result would have been the same, considering that the mean duration of our studies is shorter than six months.

The following strong points of this meta-analysis are worth noting: exclusive inclusion of randomized clinical trials; lack of search restriction for publications only in the English language; and assessment of the effects of each dietary intervention regardless of the results. It is worth noting that this was the first meta-analysis carried out in Latin America gathering all studies on the implications of diet changes on arterial blood pressure.

Conclusion

This meta-analysis shows that dietary interventions, such as a reduction in salt intake and more complex diet patterns, can effectively reduce diastolic arterial blood pressure of Latin American populations. Considering the increasing levels of arterial blood pressure in the general population and the fact that CVD remain the major cause of death worldwide, efforts are required to reduce arterial blood pressure in hypertensive and non-hypertensive individuals. Health care programs can be adapted to those populations with better results regarding primary and secondary prevention.

Author contributions

Conception and design of the research and Critical revision of the manuscript for intellectual content: Mazzaro CC, Klostermann FC, Erbano BO, Guarita-Souza LC, Olandoski M, Faria-Neto JR, Baena CP; Acquisition of data: Mazzaro CC, Klostermann FC, Erbano BO, Schio NA, Baena CP; Analysis and interpretation of the data: Mazzaro CC, Klostermann FC, Erbano BO, Schio NA, Olandoski M, Baena CP; Statistical analysis: Olandoski M, Baena CP; Writing of the manuscript: : Mazzaro CC, Klostermann FC, Erbano BO, Schio NA, Guarita-Souza LC, Faria-Neto JR, Baena CP.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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References

1. World Health Organization (WHO). Regional strategy on an integrated approach to the prevention and control of chronic diseases, including diet, physical activity, and health. In: 40th Session of the Subcommittee on Planning and Programming of the Executive Committee. Washington (DC); 2006.

2. World Health Organization (WHO). Noncommunicable diseases country profiles 2011. Washington (DC): 2011.

3. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, et al. The. Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. The JNC 7 Report. Hypertension. 2003;42(6):1206-52.

4. Ribeiro AG, Ribeiro SM, Dias CM, Ribeiro AQ, Castro FA, Suarez-Varela MM, et al. Non-pharmacological treatment of hypertension in primary health care: a comparative clinical trial of two education strategies in health and nutrition. BMC Public Health. 2011;11:637.

5. Whelton PK, He J, Appel LJ, Cutler JA, Havas S, Kotchen TA, et al. Primary prevention of hypertension: clinical and public health advisory from The National High Blood Pressure Education Program. JAMA. 2002;288(15):1882-8.

6. Siervo M, Lara J, Ogbonmwan I, Mathers JC. Inorganic nitrate and beetroot juice supplementation reduces blood pressure in adults: a systematic review and meta-analysis. J Nutr. 2013;143(6):818-26.

7. Ebrahim S, Smith GD. Lowering blood pressure: a systematic review of sustained effects of non-pharmacological interventions. J Public Health Med. 1998;20(4):441-8.

8. Kastorini CM, Milionis HJ, Esposito K, Giugliano D, Goudevenos JA, Panagiotakos DB. The effect of Mediterranean diet on metabolic syndrome and its components: a meta-analysis of 50 studies and 534,906 individuals. J Am Coll Cardiol. 2011;57(11):1299-313.

9. Beaglehole R, Bonita R, Horton R, Adams C, Alleyne G, Asaria P, et al. Priority actions for the non-communicable disease crisis. Lancet. 2011;377(9775):1438-47.

10. Hooper L, Bartlett C, Davey Smith G, Ebrahim S. Systematic review of long term effects of advice to reduce dietary salt in adults. BMJ. 2002;325(7365):628.

11. Salehi-Abargouei A, Maghsoudi Z, Shirani F, Azadbakht L. Effects of Dietary Approaches to Stop Hypertension (DASH)-style diet on fatal or nonfatal cardiovascular diseases—Incidence: a systematic review and meta-analysis on observational prospective studies. Nutrition. 2013;29(4):611-8.

12. Beaglehole R, Bonita R, Alleyne G, Horton R, Li L, Lincoln P, et al; Lancet NCD Action Group. UN High-Level Meeting on Non-Communicable Diseases: addressing four questions. Lancet. 2011;378(9789):449-55. Erratum in Lancet. 2011;378(9789):402.

13. Ministério da Saúde. Plano de ações estratégicas para o enfrentamento de doenças crônicas não transmissíveis (DCNT) no Brasil. Brasília; 2011.

14. Addressing global disparities in the burden of noncommunicable diseases. PLoS Med. 2012;9(12):e1001360.

15. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gotzsche PC, Joannidis JP, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. PLoS Med. 2009;6(7):e1000100.

16. Egger M, Smith GD, Altman D. (Editors). Systematic reviews in health care: meta-analysis in context. London: BMJ Books; 2008.

17. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 2009;6(7):e1000097.

18. Higgins JP, Altman DG, Gotzsche PC, Juni P, Moher D, Oxman AD, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. BMJ. 2011;343:d5928.

19. Follmann D, Elliott P, Suh I, Cutler J. Variance imputation for overviews of clinical trials with continuous response. J Clin Epidemiol. 1992;45(7):769-73.

20. Pereira MA, Galvão R, Zanella MT. Effects of potassium supplementation by salt on arterial blood pressure and insulin resistance in hypertensive obese patients on diuretic therapy. Rev Nutr. 2005;18(1):5-17.

21. Simao AN, Lozovoy MA, Simao TN, Dichi JB, Matsuo T, Dichi I. Nitric oxide enhancement and blood pressure decrease in patients with metabolic syndrome using soy protein or fish oil. Arq Bras Endocrinol Metabol. 2010;54(6):540-5.

22. Toscani MK, Mario FM, Radavelli-Bagatini S, Wiltgen D, Matos MC, Spritzer PM. Effect of high-protein or normal-protein diet on weight loss, body composition, hormone, and metabolic profile in southern Brazilian women with polycystic ovary syndrome: a randomized study. Gynecol Endocrinol. 2011;27(11):925-30.

23. Torres MR, Francischetti EA, Genelhu V, Sanjuliani AF. Effect of a high-calcium energy-reduced diet on abdominal obesity and cardiometabolic risk factors in obese Brazilian subjects. Int J Clin Pract. 2010;64(8):1076-83.

24. Almeida LB, Segurado AC, Duran AC, Jaime PC. Impact of a nutritional counseling program on prevention of HAART-related metabolic and morphologic abnormalities. AIDS Care. 2011;23(6):755-63.

25. Siqueira-Catania A, Cezaretto A, Barros C, Salvador E, Carvalho T, Ferreira S. Cardiometabolic risk reduction through lifestyle intervention programs in the Brazilian public health system. Diabetol Metab Syndr. 2013;5(1):21.

26. Mujica V, Urzua A, Leiva E, Diaz N, Moore-Carrasco R, Vasquez M, et al. Intervention with education and exercise reverses the metabolic syndrome in adults. J Am Soc Hypertens. 2010;4(3):148-53.

27. Sartorelli DS, Sciarra EC, Franco LJ, Cardoso MA. Beneficial effects of short-term nutritional counselling at the primary health-care level among Brazilian adults. Public Health Nutr. 2005;8(7):820-5.

28. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ. 1997;315(7109):629-34.

29. Weber B, Galante AP, Bersch-Ferreira AC, Torreglosa CR, Carvalho VO, Victor Eda S, et al. Effects of Brazilian Cardioprotective Diet Program on risk factors in patients with coronary heart disease: a Brazilian Cardioprotective Diet randomized pilot trial. Clinics (Sao Paulo). 2012;67(12):1407-14.

30. Costa Fortes R, Carvalho Garbi Novaes MR. The effects of Agaricus sylvaticus fungi dietary supplementation on the metabolism and blood pressure of patients with colorectal cancer during post surgical phase. Nutr Hosp. 2011;26(1):176-86.

31. Goldhaber-Fiebert JD, Goldhaber-Fiebert SN, Tristan ML, Nathan DM. Randomized controlled community-based nutrition and exercise intervention improves glycemia and cardiovascular risk factors in type 2 diabetic patients in rural Costa Rica. Diabetes Care. 2003;26(1):24-9.

32. Appel LJ, Brands MW, Daniels SR, Karanja N, Elmer PJ, Sacks FM. Dietary approaches to prevent and treat hypertension: a scientific statement from the American Heart Association. Hypertension. 2006;47(2):296-308.

33. Salehi-Abargouei A, Maghsoudi Z, Shirani F, Azadbakht L. Effects of dietary approaches to stop hypertension (DASH)-style diet on fatal or nonfatal cardiovascular diseases--incidence: a systematic review and meta-analysis on observational prospective studies. Nutrition. 2013;29(4):611-8.

34. He FJ, Li J, Macgregor GA. Effect of longer term modest salt reduction on blood pressure: Cochrane systematic review and meta-analysis of randomised trials. BMJ. 2013;346:f1325.

35. van Mierlo LA, Arends LR, Streppel MT, Zeegers MP, Kok FJ, Grobbee DE, et al. Blood pressure response to calcium supplementation: a meta-analysis of randomized controlled trials. J Hum Hypertens. 2006;20(8):571-80.

36. Altorf-van der Kuil W, Engberink MF, Brink EJ, van Baak MA, Bakker SJ, Navis G, et al. Dietary protein and blood pressure: a systematic review. PloS One. 2010;5(8):e12102.

37. Cezaretto A, Siqueira-Catania A, de Barros CR, Salvador EP, Ferreira SR. Benefits on quality of life concomitant to metabolic improvement in intervention program for prevention of diabetes mellitus. Qual Life Res. 2012;21(1):105-13.