

# The effect of supplementary calcium on blood pressure in healthy adult women aged 18-30 years in Tehran, Iran

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## ABSTRACT

**Introduction:** Cardiovascular disease is the major cause of mortality in developed countries and has an increasing trend in developing countries. There are some evidences that calcium supplementation may decrease blood pressure and consequently cardiovascular disease, but they are not conclusive and there is no agreement in this respect. The aim of the present study was to assess the effect of supplementary calcium on systolic and diastolic blood pressure in healthy adult women aged 18–30 years. **Materials and Methods:** Seventy-five normotensive volunteers were randomly divided into two groups, the treatment group received 1000 mg/day calcium (four doses of 625 mg calcium carbonate) for 1 month and the control group received placebo (dextrose). Systolic and diastolic blood pressure was determined before and after intervention in supine position after 10 min of rest. **Results:** The mean daily calcium intake from food was 773.9 mg in treatment and 721 mg in control group (no significant difference) but in both the groups dietary calcium intake was less than the recommended dietary allowance: After calcium supplementation, the mean change of systolic blood pressure was not significant in the two groups, but diastolic blood pressure reduced in treatment group and increased in control group (−4.9 vs 2.6 mmHg) ( $P < 0.05$ ). **Conclusions:** These results suggest that, calcium supplementation does not have any effect on systolic blood pressure of our volunteers but can decrease diastolic blood pressure significantly and therefore it seems that calcium supplementation may be useful for people with increased diastolic blood pressure, especially for those who receive less calcium than recommended dietary allowance.

**Key words:** Blood pressure, calcium, Tehran, women

## INTRODUCTION

Cardiovascular diseases are the major causes of morbidity and mortality in the world. Undesirable change in blood

pressure is also a powerful risk factor for cardiovascular diseases in developed and developing countries such as Iran.<sup>[1]</sup> The prevalence of hypertension in Iranian adults is more than 20% and it is the main cause of cardiovascular accidents in Iran.<sup>[2]</sup> It seems that Iranian women are more vulnerable than men.<sup>[3]</sup> In the past decades there has been a specific attention to dietary habits and hypertension, in this respect many epidemiological studies and clinical trials have been shown the beneficial effects of calcium intake on blood pressure,<sup>[4-6]</sup> but they are not conclusive and there is no agreement in this respect. Wang reported a higher level of blood pressure among women consuming low dietary calcium (<558 mg/day) compared with women with high calcium intake (1,679 mg/day).<sup>[7]</sup>

However, there are also a lot of findings that indicate no correlation between calcium intake and blood pressure,<sup>[8-16]</sup> even some meta-analyses data indicate about adverse

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effects,<sup>[17,18]</sup> on the other hand there are some evidences from observational studies that calcium intake in pregnant women may reduce their offspring blood pressure in future.<sup>[19,20]</sup> However, later studies did not confirm them.<sup>[21]</sup> In Iran also some studies have evaluated the effect of calcium on systolic and diastolic blood pressure but the results were not identical.<sup>[22-24]</sup> Insufficient calcium may destabilize cell membranes and consequently more calcium enters in cytosol of muscle cells of arteries and increase contractibility of them which results in hypertension.<sup>[25]</sup> The effect of calcium on blood pressure is more obvious on population whose calcium intake is low, but in dosages more than 1000 mg per day there was no correlation.<sup>[26]</sup>

Recent studies showed that calcium sensing receptors affect blood pressure and PTH secretion.<sup>[27-29]</sup> There are evidences that insufficient calcium intake will also increase  $1,25(\text{OH})_2\text{D}_3$  and consequently more calcium will enter the smooth muscle cells resulting in increment of blood pressure.<sup>[30]</sup>

In salt-sensitive people (blood pressure increases with increment of salt intake), there is a close relationship between calcium and sodium excretion and any increase in sodium intake will increase renal calcium excretion, which results in calcium deficiency and subsequently increment in calcitrophic hormones, which ultimately will increase blood pressure. Increasing dietary calcium will attenuate these effects.<sup>[31-33]</sup>

The aim of present study was to assess the effect of supplementary calcium on blood pressure in young healthy adult women.

## MATERIALS AND METHODS

### Participants

This double-blinded placebo-controlled clinical trial was carried out in normotensive females of Shahid Beheshti University of Medical Sciences in Tehran, Iran. We chose women because they are more vulnerable to hypertension than men,<sup>[3]</sup> and also were more cooperative, we also chose normotensives because hypertensive individuals were consuming drugs and ethical committee did not allow us to work with them.

The inclusion criteria were body mass index (BMI) <27, age 18–30 years, no known disease, and normal blood pressure. The exclusion criteria were irregular consumption of supplements, no desire for continuation in the project. Participants were not undergoing dietary changes in the last 3 months. Sample size for this study was calculated based on suggested formula for clinical trials:

$$N = [2\sigma^2(z_{1-\alpha/2} + z_{1-\beta})^2] / (\mu_1 - \mu_2)^2 = [2(0.14)^2(1.645 + 0.842)^2] / (0.1)^2 \approx 24$$

According to this equation, we reached the sample size of 24 participants for the whole intervention. Because there are

high dropouts in clinical trials, we recruited 75 women in this study.

### Ethical considerations

The study was approved by Ethical Committee of Shahid Beheshti University of Medical Sciences, Tehran, Iran. All volunteers attended an explanation class and were briefed about the projects and all of them signed the written consent.

Eligible cases were randomly divided into two groups (treatment and control), treatment group received four capsules of supplementary calcium daily, each capsule contained 625 mg calcium carbonate, which is equal to 250 mg of calcium element, placebo group received 1000 mg dextrose capsules instead of calcium carbonate. We advised the volunteers to consume capsules with meals (breakfast, lunch, dinner, and before bed).

We got them capsules weekly and asked them about any inconvenience, any doubt about consumption of capsules made the volunteer to be withdrawn, in this respect more than 15 cases withdrew.

The duration of project was 30 days. Dietary calcium intake was calculated from three days dietary recalls (two working and one off days), dietary recalls was done prior, during, and after intervention. The food analyzing software (N4) of Shahid Beheshti University in Iran was employed for analyzing dietary ingredients. Systolic and diastolic blood pressure was determined before and after intervention in supine position after 10 min of rest.

### Statistical methods

Data analysis was performed using SPSS version 18 software (SPSS Inc, Chicago, IL, USA). All subjects who completed the project successfully were included in the final analysis. A paired *t*-test was used to examine the differences of variables in each group at the beginning and end of the study. Results are described as mean  $\pm$  standard deviation (mean  $\pm$  SD).  $P < 0.05$  were considered statistically significant. Dietary records were assessed using nutritionist IV software.

## RESULTS

Fifty-three volunteers completed the project successfully; 27 in treatment and 26 in control group. The basal characteristic of participants was as shown in Table 1. There were no significant differences between them with respect to hypertension and other confounding variables such as physical activity, age, weight, and BMI (body mass index).

We compared the mean of blood pressure before and after intervention in each group. The results are shown in Tables 2 and 3. No difference was seen.

For more precision, we compared the mean changes in blood pressure in two groups after intervention, now the diastolic

**Table 1: Basal characteristics of participants**

Group variable	Mean±SD		Difference	P value
	Treatment	Control		
Age (year)	22.6±1.14	23.4±2.7	-0.8	NS
Weight (kg)	57.1±0.9	56.8±7.7	0.30	NS
Height (cm)	162.2±4.9	160.3±5.5	1.9	NS
Body mass index	21.7±3.12	22.1±2.46	-0.4	NS
Dietary calcium (mg)	773.9±248.5	721±188	52	NS
Systolic blood pressure	116.5±10.3	114±11.8	2.5	NS
Diastolic blood pressure	77.1±9.5	73.1±10.7	4.0	NS

NS=Nonsignificant, SD=Standard deviation

blood pressure change in intervention group was different than control group [Table 4].

## DISCUSSION

The present double-blinded placebo-controlled clinical trial was carried out in women aged 18–30 years. This study was conducted to investigate the effect of supplementary calcium on blood pressure. The results of the present study indicated that. However our volunteers were educated and they were aware about nutritional needs, but their dietary calcium intake was less than their needs in both the groups [recommended dietary allowance (RDA) for calcium in this age group is equal to 1000 mg calcium per day]. It means that calcium deficiency is a problem in our country. The report of Iran Ministry of Health and Medical Education also confirm our results about calcium deficiency.<sup>[34]</sup>

In respect to other variables such as BMI, weight, and height our participants were in normal situations.

We add 1000 mg supplementary calcium to normal diet and expected to reduce blood pressure in treatment group, but only diastolic blood pressure was reduced significantly, therefore our results suggest that, calcium supplementation does not have any significant effect on systolic blood pressure of our volunteers but can decrease diastolic blood pressure significantly and therefore it seems that calcium supplementation may be useful for people with increased diastolic pressure, especially those who receive less calcium than the RDA.

Our results [Table 4] showed a mild but nonsignificant reduction in systolic blood pressure in both the groups. This may be attributable to confounding factors. But it was not important in practice.

Ackley and colleagues<sup>[35]</sup> reported an inverse correlation between calcium intake from dairy products and blood pressure; however, this is partially in accordance to our results, but we should remember that dairy products also contain other bioactive nutrients that may affect blood pressure.

Salem and colleagues<sup>[23]</sup> reported beneficial effect of supplementary calcium on diastolic and systolic blood

**Table 2: Mean and difference of blood pressure in treatment group before and after intervention**

Variable	Mean±SD		P value
	Before intervention	After intervention	
Systolic blood pressure	116.5±10.3	115.0±9.0	NS
Diastolic blood pressure	77.1±9.5	72.2±6.6	NS

NS=Nonsignificant, SD=Standard deviation

**Table 3: Mean and difference of blood pressure in control group before and after intervention**

Variable	Mean±SD		P value
	Before intervention	After intervention	
Systolic blood pressure	114±11.8	113.1±9.6	NS
Diastolic blood pressure	73.1±10.7	75.7±7.4	NS

NS=Nonsignificant, SD=Standard deviation

**Table 4: Compare the differences of blood pressure in two groups after intervention**

Group variable	Mean±SD		P value
	Treatment	Control	
Δ Systolic blood pressure	-1.46±14.5	-0.96±10.0	Nonsignificant
Δ Diastolic blood pressure	-4.9±9.0	2.6±10.9	0.008

Δ=Each variable after intervention minus the same variable before intervention. SD=Standard deviation

pressure. Their results were very similar to ours, but the studied population was different and they studied pregnant women, whereas we investigated normal nonpregnant women.

Park and colleagues<sup>[36]</sup> also reported an inverse relationship between calcium intake and blood pressure; in their study both systolic and diastolic blood pressure was negatively related to calcium intake. Their population was similar to ours, but the results were not completely similar to our results.

In a recent study in Tehran (Iran), Shidfar *et al.*<sup>[22]</sup> reported that supplementary calcium reduced systolic blood pressure but no effect on diastolic blood pressure. Although the amount and form of supplement in this study was very similar to our projects, there was a difference with regard to gender

and BMI was completely different, therefore it is not surprising that two studies did not have identical results.

Khatake *et al.*,<sup>[37]</sup> has assessed the relationship between serum calcium level, bone mineral density, and blood pressure in postmenopausal women. They did not find any relationship between serum calcium and blood pressure levels. This finding was not similar to ours, but it is not so unexpected because serum calcium level is not an indicative of calcium intake.

## CONCLUSIONS

Results of this project showed that calcium intake of almost all of our volunteers was less than the RDA. Although our results showed that calcium supplementation does not have any effect on systolic blood pressure but can decrease diastolic blood pressure significantly and therefore it seems that calcium supplementation may be useful for people with increased diastolic blood pressure, especially those who received less calcium than the RDA. We suggest more studies to be done before using calcium supplements as a treatment for hypertension.

### Strengths of the study

This study was done in a population who were calcium deficient, and therefore the effect of calcium supplement should be shown more prominently. Another strength of this study was its double blind nature and homogeneity of intervention and control groups.

### Limitations of the study

This study has also some limitations. The study was done on female gender, and a small sample size was recruited. Another limitation was the self-reporting of dietary recalls and no biochemical marker was used. Because of financial limitations and compliance the duration of study was limited to 30 days.

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