



*Short Communication*

# **Dietary supplementation with walnuts and almonds attenuates cardiovascular responses to mental stress in healthy humans**

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## **ABSTRACT**

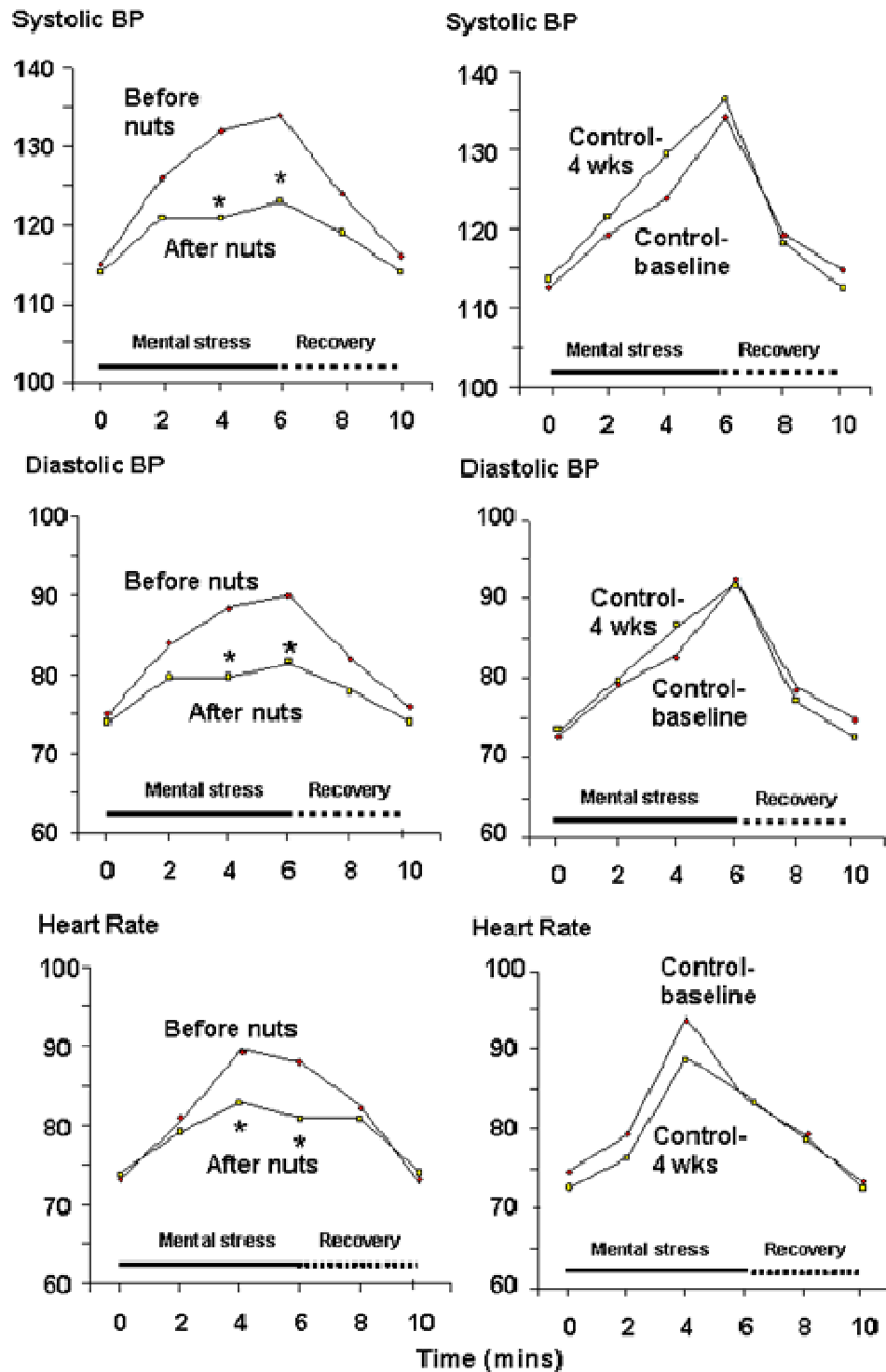
Lifestyle modifications for cardiovascular risk reduction include nutritional approaches. We hypothesized that dietary supplementation with unsalted walnuts and almonds reduce stress-induced cardiovascular responsiveness. We examined the effect of 4 weeks of nut consumption on blood pressure (BP), heart rate (HR) and responses to mental stress in 18 healthy volunteers. Following a run-in period of 2 weeks, subjects were randomized for 4 weeks to either nut consumption, walnuts (15g) and almonds (15g) daily (n=12) or control, no nut consumption (n=6). BP and HR responses during mental stress were assessed before and after dietary intervention or control. Resting systolic and diastolic BP decreased slightly by  $4\pm 2$  and  $2\pm 1$  mmHg (both  $P<0.05$ ) in the nut consumption, but not the control group. Systolic and diastolic BP, and HR increased significantly in all subjects during mental stress. Mental stress-induced increases in systolic and diastolic BP, and HR were significantly attenuated by 4 weeks of nuts, but not in controls. Body weight did not change significantly in either group. Unsalted nut consumption reduced systolic and diastolic BP, and significantly attenuated responses to mental stress in healthy humans. Nuts may reduce cardiovascular risk by blunting increases in sympathetic nervous system activity induced by mental stress.

**Keywords:** Nuts, blood pressure, mental stress, almonds, walnuts.

## **INTRODUCTION**

Lifestyle modifications for cardiovascular risk reduction include nutritional approaches (Zellner and Sudhir, 1992), such as salt restriction and foods high in potassium (Sudhir et al., 1997). Nuts have a high content of poly- and monounsaturated fatty acids and the amino acid L-arginine, and consumption improves lipid profiles and reduces coronary risk (Ros, 2009). Data from the 1999-2004 National Health and Nutrition Examination Survey showed that nut consumers had decreased body mass and systolic blood pressure, as well as lower rates of

hypertension, abdominal obesity, low HDL-C and hyperglycemia compared with non-consumers (O'Neil et al., 2011). Short term supplementation with flaxseed and walnuts demonstrated a lower prevalence of metabolic syndrome (Wu et al., 2010). The mechanisms underlying the beneficial effects of nut consumption on blood pressure are not well established. We hypothesized that dietary supplementation with unsalted walnuts and almonds would attenuate stress-induced cardiovascular responsiveness.



**Figure 1.** Systolic and Diastolic BP and Heart Rate responses to Mental Stress, before and after 4 weeks of unsalted nut supplementation (left) or no nuts (right, control); \* indicates significant difference at  $p < 0.05$ .

## METHODS

We examined the effect of 4 weeks of nut consumption on blood pressure (BP), heart rate (HR) and mental stress responses in a community-based trial in 18 healthy volunteers. The study received scientific review and ethical approval from the Synopsys Silicon Valley Institutional Review Board; all subjects gave full written informed consent. Following a run-in period of 2 weeks, subjects were randomized in a 2:1 ratio for a period of 4 weeks to one of 2 arms, (i) nut consumption, 15g of walnuts and 15g of almonds daily (n=12, 8 males, 4 females) or (ii) controls, no nut consumption (n=6, 3 males, 3 females). Resting systolic BP, diastolic BP and HR were obtained using an automated sphygmomanometer. Mental stress was induced by asking subjects to subtract in serial 7's from 1000 (Sudhir et al., 1997), with ambient noise introduced to increase stress. BP and HR responses during mental stress were measured at baseline, 2, 4 and 6 minutes. Subjects then relaxed, with additional recordings at 8 and 10 minutes during recovery. Comparisons before and after nuts were made by a Student paired t-test. BP and HR responses to mental stress were assessed by two-way repeated measures ANOVA followed by a post hoc Student-Neuman-Keuls multiple comparison test.

## RESULTS AND DISCUSSION

Mean age was 22+3 years in the nut consumption group, and 26+4 years in controls. Baseline body weight was 81+4kg in the nut consumption group, and 84+5kg in controls. None of the subjects had any risk factor for cardiovascular disease, with the exception of a family history of heart disease in 7/12 subjects in the nut consumption group, and 4/6 in the controls. Resting systolic and diastolic BP decreased slightly by 4±2 and 2±1 mmHg respectively (both P<0.05) in the nut consumption group over 4 weeks, but not in the control group; resting HR remained unchanged in both groups. Systolic BP, diastolic BP and HR increased significantly in all subjects during the 6 minutes of mental stress, and returned to baseline during the 4 minute recovery phase. Mental stress-induced increases in systolic BP, diastolic BP and HR were significantly attenuated by 4 weeks of nuts, but not in controls (Figure 1). Body weight did not change significantly in either group.

A Mediterranean diet supplemented with nuts has recently been shown to reduce the incidence of major cardiovascular events (Estruch et al., 2013). While the beneficial effects of nut consumption on lipid profiles and

dyslipidemia are well described (Ascari et al., 2013; Damasceno et al, 2011), those on vasopressor function have been less well studied. Prior studies have shown that increasing intake of alpha-linolenic acid from walnuts and flax reduced diastolic BP and peripheral resistance during acute stress, and improved endothelial function in hypercholesterolemic subjects (West et al., 2010). Responses to laboratory stress predict those in the extra laboratory environment (Dimsdale et al., 1992). The sympathetic nervous system is activated during cognitive challenge (Esler et al, 1989), and heightened systemic vascular resistance during stress may reflect endothelial dysfunction (Sherwood et al., 1999). Our study demonstrated that unsalted nut consumption reduced BP, and significantly attenuated responses to mental stress. Nuts may thus reduce cardiovascular risk by blunting stress-induced increases in sympathetic nervous system activity. Their high content of L-arginine, a nitric oxide precursor (Ros 2009), may also mediate these cardiovascular actions through favorable effects on endothelial function. Confirmation of these findings in a larger group of subjects is needed.

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How to cite this article: Arhant-Sudhir K, Arhant-Sudhir R, Ahir R, Sudhir K (2013). Dietary supplementation with walnuts and almonds attenuates cardiovascular responses to mental stress in healthy humans. *J. Med. Med. Sci.* 4(10):390-393