Nutrition, Metabolism & Cardiovascular Diseases (2014) **24**, 983–989

Available online at www.sciencedirect.com

Nutrition, Metabolism & Cardiovascular Diseases

journal homepage: www.elsevier.com/locate/nmcd

Effect of high potassium diet on endothelial function

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Received 28 January 2014; received in revised form 9 April 2014; accepted 24 April 2014
Available online 2 May 2014

KEYWORDS
Potassium;
Endothelial function;
Diet

Abstract *Background and aims:* Increased potassium intake is related to reduced blood pressure (BP) and reduced stroke rate. The effect of increased dietary potassium on endothelial function remains unknown. The aim was to determine the effect of increased dietary potassium from fruit and vegetables on endothelial function.
Methods and results: Thirty five healthy men and women (age 32 ± 12 y) successfully completed a randomised cross-over study of 2 × 6 day diets either high or low in potassium. Flow mediated dilatation (FMD), BP, pulse wave velocity (PWV), augmentation index (AI) and a fasting blood sample for analysis of Intercellular Adhesion Molecule-1 (ICAM-1), E-selectin, asymmetric dimethylarginine (ADMA) and endothelin-1 were taken on completion of each intervention. Dietary change was achieved by including bananas and potatoes in the high potassium and apples and rice/pasta in the low potassium diet. Dietary adherence was assessed using 6 day weighed food diaries and a 24 h urine sample. The difference in potassium excretion between the two diets was 48 ± 32 mmol/d ($P = 0.000$). Fasting FMD was significantly improved by 0.6% ± 1.5% following the high compared to the low potassium diet ($P = 0.03$). There were no significant differences in BP, PWV, AI, ICAM-1, ADMA or endothelin-1 between the interventions. There was a significant reduction in E-selectin following the high (Median = 5.96 ng/ml) vs the low potassium diet (Median = 6.24 ng/ml), $z = -2.49$, $P = 0.013$.
Conclusion: Increased dietary potassium from fruit and vegetables improves FMD within 1 week in healthy men and women but the mechanisms for this effect remain unclear.
Clinical trial registry: ACTRN12612000822886.

Introduction

Endothelial dysfunction precedes the development of atherosclerosis [1], correlates with classical risk factors for and severity of coronary disease [2] and predicts cardiovascular events in those with pre-existing vascular disease [2]. Improvement in endothelial function has been associated with reduced cardiovascular disease (CVD) morbidity and mortality [3] in people with and without pre-existing vascular disease. High potassium intakes have been associated with reduced CVD risk [4]. The effects of potassium on other measures of endothelial function assessed by flow mediated dilatation (FMD) are unclear. He et al. [5] demonstrated that potassium supplementation for 4 weeks improved fasting FMD. Whereas Berry et al. [6] found no effect on FMD by increasing dietary potassium for 6 weeks. He et al. [5] reported a higher mean urinary potassium excretion (125 mmol/d) following the potassium intervention compared to the Berry study (87 mmol/d) suggesting there may be a threshold increase required.

In an acute study we have shown that a 36 mmol potassium meal attenuated the postprandial reduction in FMD [7].

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http://dx.doi.org/10.1016/j.numecd.2014.04.009

Arterial stiffness predicts CV risk in the general population [8]. Pulse wave velocity (PWV) is considered as the gold standard method for assessing aortic stiffness, and is a strong predictor of future CV events and all-cause mortality [9]. Augmentation index (AI) is also an index of arterial stiffness [10] and an independent predictor of CV events [11].

This study aimed to determine the effect of increasing dietary potassium on endothelial function after a 6 day feeding period. Our secondary aim was to investigate the effects of dietary potassium on blood pressure, measures of arterial stiffness and to elucidate potential mechanisms for any response. Our hypothesis was that increased potassium intake would improve endothelial function and measures of vascular compliance.

Methods

Study population

Forty men and women 18–70 y were recruited through personal contact and public advertisement. Inclusion criteria were body mass index (BMI) $\geq$18 and $\leq$30 kg/m^2, systolic BP (SBP) $<$ 130 mmHg, diastolic BP (DBP) $<$ 90 mmHg, weight stability in the preceding 6 months, and no use of antihypertensive, cholesterol lowering, systemic steroids, non-steroidal anti-inflammatory medications or folate supplementation. Participants were included if taking other vitamin supplements, provided the dose was kept constant for the duration of the study. Exclusion criteria were known metabolic disease such as liver or kidney disease, treated hypertension, known high cholesterol, clinical CV disease and inability to comprehend study protocol. Of the 48 screened participants, one was excluded due to high BMI, one due to medications, four due to potential difficulties with the diet, two failed to attend first appointments. Forty were enrolled to commence the study (Fig. 1).

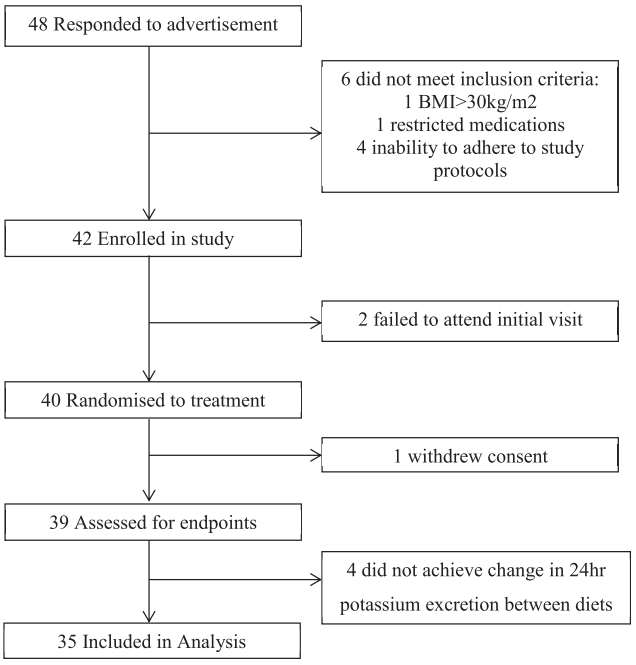

Figure 1 Diagram of participant recruitment and withdrawal. BMI, body mass index.

Ethics

This study was approved by University of South Australia's Human Research Ethics Committee (HREC). All participants gave written informed consent.

Ethics approval number: 0000029701.

ANZCTR number: ACTRN12612000822886.

Study methods

Participants completed a randomised single-blinded cross-over design study, over a two week period with a 24 h washout period between the 2 $\times$ 6 day diets. Participants met with a dietitian to ensure eligibility and to assess participants' ability to comply with the dietary protocol. Participants were assigned a diet order by an online generated balanced random number allocation sequence (randomization.com) by a person independent of the study. They received dietary advice from a dietitian for the first diet and then crossed over to the other diet for the second week of the study. Participants completed an online dietary survey (Dietary Questionnaire for Epidemiological Studies, Cancer Council Victoria) prior to commencing the interventions. At the end of each intervention, participants returned fasting for outcome measurements by a person blinded to the interventions.

Study diets

The diets were high potassium (5690 mg/150 mmol/d) and usual potassium (3110 mg/80 mmol/d), achieved by including 300 g banana and 300 g potato (unpeeled) per day in the high potassium diet and rice/pasta (equal portions to replace potatoes) and apples in the low potassium diet. Both diets were designed to ensure weight stability and were ~7000 kJ for women and ~8000 kJ for men. No other diet changes were made. Participants were asked to keep alcohol intake and physical activity consistent, and to refrain from eating out during the study. Participants were given personalised advice by a dietitian on how to achieve diet targets and complete weighed food records for the 2 $\times$ 6 days of the trial. They were given written dietary advice, scales, weighed food diary and key diet foods (e.g. bananas, potatoes or rice/pasta and apples), to aid compliance. Participants prepared all meals at home after the advice was provided. On completion of each intervention the food records were reviewed by the dietitian while the participants were present to ensure accuracy. The food records were analysed using a computerised database of Australian foods (version 7, 2012, Foodworks Professional Edition; Xyris Software, Highgate Hill, Australia).