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Does daily consumption of vitamin K1 from cruciferous vegetables reach the circulation and the knee joint?

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Cruciferous vegetables, such as broccoli, cabbage and kale, are rich dietary sources of vitamin K1 (Phylloquinone); however, 55% of Irish adults have phylloquinone intakes below the EU recommendation of $1 \mu\text{g} \cdot \text{kg body weight}^{-1} \cdot \text{day}^{-1}$. Vitamin K acts as an enzyme co-factor which carboxylates vitamin K-dependent proteins and is associated with cardio-metabolic⁽²⁾ and musculoskeletal⁽³⁾ benefit. Osteoarthritis (OA) is the most prevalent joint disorder in older adults and a major cause of disability. Emerging observational data indicate low vitamin K1 status is associated with a higher incidence of OA⁽⁴⁾.

This feasibility study investigated the response of vitamin K1 in plasma and the synovial fluid of the knee joint following a broccoli-based dietary intervention in adults with knee OA. Men and post-menopausal women awaiting total knee replacement surgery were enrolled in this feasibility study as described by Davidson et al. (2017)⁽⁵⁾. Participants ($n = 37$, men/women 17/20, aged 70 ± 8.5 years) underwent a washout period for 7-days where cruciferous vegetable consumption was restricted; prior to being randomised to either increased broccoli consumption (100 g of cooked broccoli/day (treatment $n = 17$)) or no broccoli consumption (control $n = 20$) for 14-days prior to surgery. A fasting blood sample was collected at baseline (BL) and post-intervention (PI) (on the morning of the surgery). A synovial fluid sample was collected during surgery ($n = 23$; control = 13, treatment = 10). Vitamin K1 concentrations were measured in plasma and synovial fluid using reversed phase-HPLC.

Vitamin K1 concentrations did not differ across treatments at BL ($P = 0.916$). Concentrations of vitamin K1 increased significantly in the treatment (Mean (SD): BL: 1.04 (0.9); PI: 1.82 (1.6) nmol/L) compared to the control group (BL: 1.01 (1.1); PI: 0.71 (0.5) nmol/L) ($P = 0.001$) (Fig. 1). Vitamin K1 was detected in synovial fluid and was significantly higher in the treatment (0.24 (0.2)) compared to the control group (0.11 (0.1)) ($P = 0.026$) (Fig. 2).

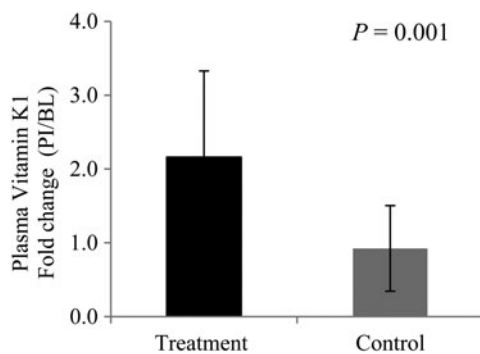


Fig. 1. Mean fold change in plasma vitamin K1 concentrations by treatment ($n = 37$) (Independent t test with Welch's correction).

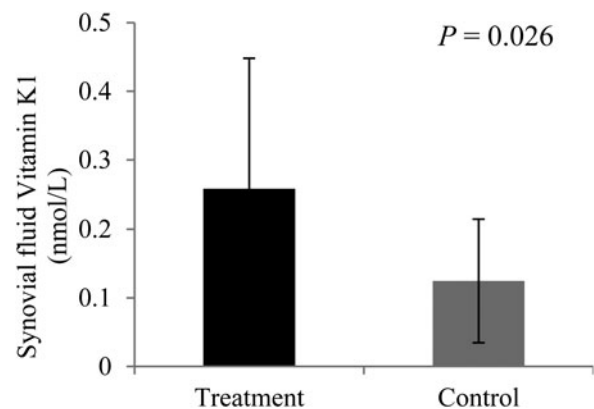


Fig. 2. Mean vitamin K1 concentrations in synovial fluid PI by treatment ($n = 23$) (Independent t test using log-transformed data).

Results suggest that a modest intake of broccoli (100 g/day) for two weeks significantly increased circulating vitamin K1 concentrations by approximately two-fold. The potential to modulate vitamin K1 in the synovial fluid of the knee joint in response to dietary intervention also warrants further investigation.

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