

Title	Does daily consumption of vitamin K1 from cruciferous vegetables reach the circulation and the knee joint?
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Publication date	2018-06-20
Original Citation	O'Sullivan, S. M., Galvin, K., Heneghan, C., Davidson, R., Clark, I. and Lucey, A. J. (2018) 'Does daily consumption of vitamin K1 from cruciferous vegetables reach the circulation and the knee joint?', Proceedings of the Nutrition Society, 77(OCE3), E68. doi: 10.1017/S0029665118000721
Type of publication	Article (peer-reviewed);Conference item
Link to publisher's version	https://www.cambridge.org/core/article/does-daily-consumption-of-vitamin-k1-from-cruciferous-vegetables-reach-the-circulation-and-the-knee-joint/CFDA22382C348C39086E978C539268F7 - 10.1017/S0029665118000721
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Download date	2023-09-29 03:38:16
Item downloaded from	https://hdl.handle.net/10468/9730



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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).

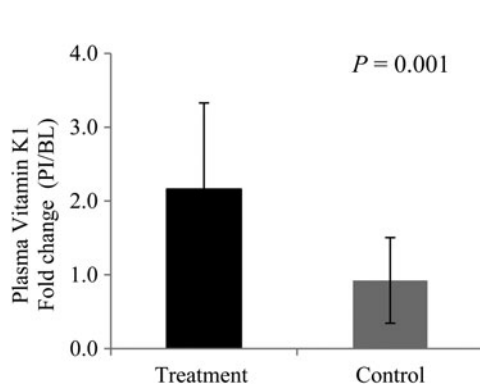


Fig. 1. Mean fold change in plasma vitamin K1 concentrations by treatment ($n = 37$) (Independent t test with Welch's correction).

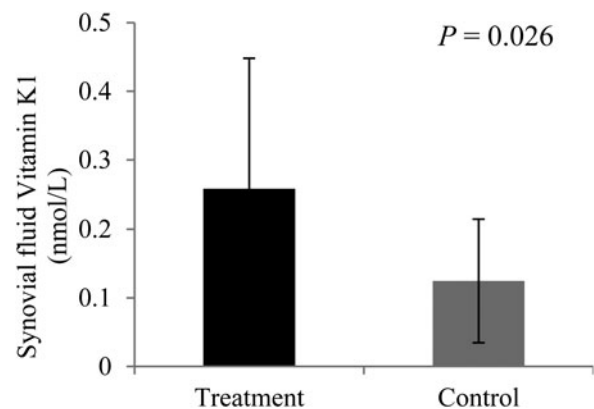


Fig. 2. Mean vitamin K1 concentrations in synovial fluid PI by treatment ($n = 23$) (Independent t test using log-transformed data).

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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