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## Lower intake of plant-derived nitrate is associated with higher odds of frailty: a cross-sectional study in community-dwelling older women

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Frailty is a distinctive health state related to the ageing process in which multiple body systems gradually lose their in-built reserves, and is associated with declines across sensory, neurological, cardiovascular, and musculoskeletal systems<sup>(1)</sup>. Previously, relationships have been identified between high dietary nitrate intake and several components of frailty including muscle strength and cognitive function, as well as vascular disease<sup>(2)</sup>. However, little is known about the relationship between dietary nitrate intake and frailty in older adults. We investigated if higher habitual nitrate intake, derived from plant (e.g., vegetables, grains, beans, and fruits) and animal foods (e.g., meats, cheese, yoghurt) was associated with frailty in older women.

1390 community-dwelling older women (mean age  $75.1 \pm 2.7$  years) from the Perth Longitudinal Study of Ageing Women completed a validated semi-quantitative food frequency questionnaire (FFQ) at baseline (1998). Nitrate concentrations in food were obtained from our recently published international plant and animal nitrate databases and applied to each of the plant and animal foods within the FFQ (described in<sup>3</sup>). Frailty was operationalised using a standardised frailty index (FI) of cumulative deficits from 33 variables across multiple health domains (physical, mental, comorbidities), with a score  $\geq 0.25$  indicating frailty. Cross-sectional associations between dietary nitrate derived from plant and animal foods (separately) with frailty were analysed using multivariable-adjusted logistic regression models as part of restricted cubic splines. Models were adjusted for lifestyle and dietary factors (not used in the FI) that included age, smoking history, protein, alcohol, and energy intake.

Frailty was observed in 276 (19.9 %) women. Median (IQR) daily plant and animal nitrate were 72.1 (55.6-90.0) mg/day and 3.5 (2.2-5.1) mg/day, respectively. A significant non-linear relationship was observed between higher plant nitrate intake and frailty, with a nadir recorded once intakes of ~64 mg/day were achieved (median of quartile [Q]2). Specifically, compared to women with the lowest intake of plant-derived nitrate (Q1, median 45 mg/day), women in Q2 (OR 0.69 95%CI 0.56-0.84), Q3 (OR 0.67 95%CI 0.50-0.90) and Q4 (OR 0.66 95%CI 0.45-0.98) had lower odds for frailty (all  $p < 0.05$ ). Additional adjustment for diet quality (Nutrient Rich Food Index per 1000 kJ) or total plasma 25-hydroxyvitamin D did not alter the findings. Nitrate derived specifically from vegetables and grains were found to drive these results. No relationship was observed between animal-derived nitrate and frailty.

Community-dwelling older women consuming higher amounts of nitrate derived primarily from plants were less likely to present with frailty. Consuming 1-2 servings (75-150 g) per day of nitrate-rich green leafy vegetables, as part of total vegetable intake, will provide adequate nitrate levels ( $>70$  mg/day) that could serve as a novel intervention to limit frailty.

### References

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2. Bondonno CP (2023) *Trends Food Sci Technol* **135**, 57–73.
3. Searle SD, Mitnitski A, Gahbauer EA et al. (2008) *BMC Geriatrics* **8**(1), 1–10.