


## Abstract

# Association between Dietary Choline and the Incidence of Type 2 Diabetes: Results from a Large Swedish Cohort <sup>†</sup>

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<sup>†</sup> Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

**Abstract:** Background and Objectives: Type 2 diabetes (T2D) has become a major global issue in the past several decades with a rapidly increasing incidence largely attributable to sedentary lifestyles and westernized diets. Previous research has shown conflicting evidence between dietary choline and the risk of T2D. The present study aimed to investigate associations between dietary choline and its individual forms with the development of T2D. Methods: In total, 41,802 females and 37,952 males attending the Västerbotten Intervention Programme (VIP) between 1990 and 2016 were included. The intake of total choline and its individual forms phosphatidylcholine, glycerophosphocholine, phosphocholine, sphingomyelin and free choline were estimated from a food frequency questionnaire. The associations between dietary choline and T2D were estimated using the Cox proportional hazards regressions to determine hazard ratios (HR) and 95% confidence intervals (CI) for T2D according to total choline, phosphatidylcholine, glycerophosphocholine, phosphocholine, sphingomyelin and free choline intake (quartiles). Models were adjusted for reported energy intake, age, body mass index, education and smoking status. All analyses were performed in females and males separately. Results: During a median follow-up of 16 years, 1195 (2.9%) and 1664 (4.4%) incident T2D cases were registered in females and males, respectively. A higher total choline intake was associated with an increased risk of T2D in both females (HR Q4 vs. Q1: 1.44; 95% CI: 1.11, 1.85; P-trend 0.03) and males (HR Q4 vs. Q1: 1.53; 95% CI: 1.24, 1.90; P-trend < 0.01). Choline intake from phosphatidylcholine and sphingomyelin were positively significantly associated with the risk of T2D in both females and males. No associations were found between choline intake from free choline, phosphocholine or glycerophosphocholine and incidence T2D. Discussion: This study demonstrates an association between the higher intake of total choline and an increased risk of T2DM in females and males in Sweden. The positive association seems to be driven mainly by the intake of choline from phosphatidylcholine and sphingomyelin. This highlights the role of dietary choline intake in relation to T2D and the importance of exploring the impact of the different forms of dietary choline.

**Keywords:** choline; betaine; type 2 diabetes; prospective cohort; Västerbotten Intervention Program



**Citation:** Karlsson, T.; Ryan, Á.; Tobin, B.; Johansson, I.; Winkvist, A.

Association between Dietary Choline and the Incidence of Type 2 Diabetes: Results from a Large Swedish Cohort.

*Proceedings* **2023**, *91*, 307. <https://doi.org/10.3390/proceedings2023091307>

Academic Editors: Sladjana Sobajic and Philip Calder

Published: 8 February 2024



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**Author Contributions:** Conceptualization, T.K. and A.W.; formal analysis, T.K., Á.R. and B.T.; resources, I.J.; writing—original draft preparation, Á.R. and T.K.; writing—review and editing, T.K., Á.R., B.T., I.J. and A.W. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded by the Wilhelm and Martina Lundgren Research foundation. The Northern Sweden Diet Database was supported by the Swedish Research Council for Health, Working Life and Welfare and the Swedish Research Council.

**Institutional Review Board Statement:** The study was conducted in accordance with the Declaration of Helsinki. The VIP study was approved by the Regional Ethical review Board of Northern Sweden (Dnr 07—165M) and the current study by the Swedish Ethical Review Authority (2019-06216).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** Data cannot be made freely available as they are subject to secrecy in accordance with the Swedish Public Access to Information and Secrecy Act [Offentlighets- och sekretesslagen, OSL, 2009:400], but can be made available to researchers upon request (subject to a review of secrecy). Requests for data should be made to Anna Winkvist, [anna.winkvist@umu.se](mailto:anna.winkvist@umu.se).

**Conflicts of Interest:** The authors declare no conflict of interest.

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