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This review describes current evidence regarding the role of dairy intake in reducing the risk of type 2 diabetes mellitus and summarises possible mechanisms of action.

A publication for health professionals

The role of dairy consumption in preventing type 2 diabetes mellitus

Diabetes mellitus (DM), diagnosed as glycated haemoglobin (HbA1c) levels >6.5%, is considered one of the most common chronic diseases worldwide. The prevalence of DM in South Africa is reported to be 9.6%, while 19% of the population has impaired glucose homeostasis (6.1% < HbA1c < 6.5%).[1] The most recent South African mortality profile ranks DM as the ninth highest cause of death among South Africans (tenth position among men; fifth position among women).[2] In addition, the recent (2016) South African Demographic and Health Survey indicates that 46% of adult women and 44% of adult men suffer from hypertension, together with a high prevalence of overweight and obesity among South Africans (68% in women and 31% in men).[3]

Poor diet and lifestyle factors (lack of exercise and obesity) seem to be major contributing factors in the development of type 2 DM (T2DM). Medical nutrition guidelines for the management of DM recommend a healthy, balanced eating plan, which includes optimal, individualised combination of carbohydrates and fat.[4,5] It is advised that a variety of protein sources should be consumed, with a reduced intake of red meat and an increased intake of nuts and low-fat dairy products.[4,5]

Association between the intake of dairy products and the risk for type 2 diabetes mellitus

The role of dairy consumption in T2DM has received considerable attention lately, with conflicting results reported in literature: from a significant inverse association between dairy consumption and the risk of T2DM[6,7] to no significant associations.[8] The inconsistencies may be related to dairy being considered as a whole food matrix, rather than individual components being investigated separately.

A recent meta-analysis of 22 observational studies reported that intake of total dairy, low-fat dairy and yoghurt correlated inversely with the risk of T2DM. Intake of other dairy products was not significantly associated with a risk of T2DM.[9] Similarly, a meta-analysis by Tian et al.[10] showed significant inverse correlations between T2DM and the intake of total dairy, whole milk and yoghurt.[2]

High intake of dairy products as a whole has been associated with a significant reduction in the risk of T2DM (3–11%).[10,11] The consumption of low-fat dairy has further also been shown to be associated with a 4–19% lower risk of T2DM.[9,12] Similarly, a significant inverse association was reported between the consumption of low-fat milk, cheese, yoghurt[6,8,9] and fermented dairy products and the risk of T2DM. No significant association was found between the intake of full-fat dairy, total milk and full-fat milk[9,13] and the risk of T2DM, whereas some studies found a positive association[9] or a reduced risk with total milk intake.[10,11]

Dose–response association between dairy consumption and risk of type 2 diabetes mellitus

Dose-dependent effects of dairy need to be considered when interpreting data. With regard to **total dairy intake**, reduction was more pronounced at lower intakes, with a threshold of 200 g per day associated with the best risk reduction.[12,14] Although the association was still significant at higher intakes, risk reduction was more modest. No additional benefit has been reported at intakes exceeding 300–400 g per day[14] or 400–600 g per day.[15] For **low-fat dairy**, an intake of 300 g per day was reported to be associated with the best risk reduction.[12] No additional benefit was found at intakes exceeding 400 g per day.[12] In the case of **yoghurt**, a 14% reduction was reported at intakes of 80 g per day compared with no intake. No further risk reduction was found at higher intakes.[9] Another group reported risk reduction to stabilise beyond intakes of 120–140 g per day.[14]

Possible mechanisms of action

For an intervention to be effective, it needs to change the risk factors implicated in the development of a condition. In the case of T2DM, manipulation of insulin receptor sensitivity, insulin secretion or reducing insulin resistance could be effective in targeting primary causes of DM. Changes in lifestyle-associated risk factors (e.g. promoting weight loss or preventing weight gain and efforts to reduce blood pressure or stimulate increase satiety) could be equally effective.[5] Various mechanisms could therefore explain the inverse association between intake of dairy products and reduced risk of T2DM, of which anti-inflammatory effects may be one.[7,11]

The role of the food matrix (the combination of nutrients within the specific food structure) should also be considered in understanding the mechanism of action. The food matrix affects the digestibility and absorption of nutrients and the health effects of nutrient combinations may be different from those of the individual nutrients.[16,17] The collective effect of nutrients seem to be stronger than that of individual nutrients, which is why the nutritional value of a food item is not equal to that of the individual nutrients.[17,18]

The dairy matrix is complex and therefore the contribution of a number of components should be considered when investigating the association between dairy consumption and the reduced risk of DM.[7,13] Factors related to both the macronutrient composition, such as protein and amino acid content and the specific fat distribution, and the micronutrient content of dairy should be considered.

Milk contains up to 400 different **fatty acids**, with butyric acid as the primary component. Saturated fatty acids can stimulate a low-grade inflammatory response and contribute to insulin resistance,[7] and it is recommended that saturated fats should not contribute more than 15% of total energy in the diet.[13] Genetic, environmental and seasonal factors appear to determine the specific fatty acid composition of dairy,[7] which may explain some of the inconsistencies seen in the effect of dairy products on T2DM risk.[13]

Milk and dairy products are good sources of **calcium, magnesium** and **vitamin D**. The positive effects of these nutrients include their role in increasing insulin receptor expression and sensitivity and improving beta-cell function,[11] decreasing fat absorption,[19] improving dyslipidemia (by increasing high-density lipoprotein cholesterol and decreasing total and low-density lipoprotein cholesterol),[19] and reducing blood pressure.[19] These nutrients also contribute to weight loss by increasing the thermic effect of a meal and fat oxidation.[20] Calcium from non-dairy sources did not result in a reduced T2DM risk, suggesting that the other components found in the food matrix of dairy products contribute to the positive effects of dairy-based calcium.[11]

Dairy protein, and specifically **whey protein**, is known to increase satiety,[10] lower blood pressure pressure[7,19] and lower blood glucose through insulinotropic[4] effects.[7,13,21] The latter enhances lipoprotein lipase activity, which assists with triglyceride clearance.[7] Whey protein is also higher in branched-chain amino acids (leucine, isoleucine and valine), which are known to stimulate the insulin response.[7,21] Consumption of whey protein before a meal or together with a carbohydrate-containing meal increases the insulin response and releases other incretin hormones, with a subsequent lowering effect on blood glucose levels.[21] However, the insulinotropic response is greater when whey protein is consumed 30 minutes before the meal than as part of the meal.[7]

Conclusion

The prevalence of DM in South Africa is alarmingly high, with nearly 10% of the population affected by the condition. Every effort should be made to curb a further climb. Medical nutrition guidelines recommend being physically active and following a balanced diet that includes a wide variety of foods. The daily intake of dairy products, especially low-fat options, significantly reduces the risk of developing DM and should therefore be encouraged.

References

1. Shisana O, Labadarios D, Rehle T, et al. The South African National Health and Nutrition Examination Survey, 2012: SANHANES-1: The health and nutritional status of the nation. Cape Town: HSRC Press, 2013.
2. Msemburi W, Pillay-Van Wyk V, Dorrington RE, et al. Second National Burden of Disease Study for South Africa: Cause of death profile for South Africa, 1997-2010. 2014.
3. National Department of Health (NDoH), Statistics South Africa (Stats SA), South African Medical Research Council (SAMRC), and ICF. South African Demographic and Health Survey 2016: Key indicators. Pretoria, South Africa and Rockville, Maryland: NDoH, Stats SA, SAMRC and ICF, 2017.
4. Society for Endocrinology, Metabolism and Diabetes of South Africa Type 2 Diabetes Guidelines Expert Committee. SEMDSA 2017 Guidelines for the Management of Type 2 diabetes mellitus. JEMDSA. 2017; 22(1 Suppl 1):S1-S196.
5. American Diabetes Association. Standards of Medical Care in Diabetes – 2017: Abridged for primary care providers. Diabetes Care. 2017; 40(Suppl 1):S1-35.
6. Eussen SJPM, Van Dongen MCJM, Wijckmans N, et al. Consumption of dairy foods in relation to impaired glucose metabolism and type 2 diabetes mellitus: The Maastricht Study. Br J Nutr. 2016; 115(8):1453-1461.
7. Bjørnshave A, Hermansen K. Effects of dairy protein and fat on the metabolic syndrome and type 2 diabetes. Rev Diabet Stud. 2014; 11(2):153-166.
8. Brouwer-Brolsma EM, Van Woudenbergh GJ, Oude Elferink SJWH, et al. Intake of different types of dairy and its prospective association with risk of type 2 diabetes: The Rotterdam Study. Nutr Metab Cardiovasc Dis. 2016; 26(11):987-995. http://dx.doi.org/10.1016/j.numecd.2016.08.003
9. Gijsbers L, Ding EL, Malik VS, De Goede J, Geleijnse JM, Soedamah-Muthu SS. Consumption of dairy foods and diabetes incidence: A dose-response meta-analysis of observational studies. Am J Clin Nutr. 2016; 103(4): 1111-1124.
10. Tian S, Xu Q, Jiang R, Han T, Sun C, Na L. Dietary protein consumption and the risk of type 2 diabetes : A systematic review and meta-analysis of cohort studies. Nutrients. 2017; 9(9):982.
11. Talaei M, Pan A, Yuan JM, Koh WP. Dairy intake and risk of type 2 diabetes. Clin Nutr. 2018; 37(2):712-718. https://doi.org/10.1016/j.clnu.2017.02.022

12. Gao D, Ning N, Wang C, et al. Dairy products consumption and risk of type 2 diabetes: Systematic review and dose-response meta-analysis. PLoS One. 2013; 8(9):e73965.

13. Morio B, Fardet A, Legrand P, Lecerf JM. Involvement of dietary saturated fats, from all sources or of dairy origin only, in insulin resistance and type 2 diabetes. Nutr Rev. 2015; 74(1):33-47.

14. Aune D, Norat T. Dairy products and the risk of type 2 diabetes: A systematic review and dose-response meta-analysis of cohort studies. Am J Clin Nutr. 2013; 98(4):1066-1083.

15. Schwingshackl L, Schwedhelm C, Hoffmann G, et al. Food groups and risk of all-cause mortality: A systematic review and meta-analysis of prospective studies. Am J Clin Nutr. 2018; 105(6):1462-1473.

16. Fekete ÁA, Givens DI, Lovegrove JA. The impact of milk proteins and peptides on blood pressure and vascular function: A review of evidence from human intervention studies. Nutr Res Rev. 2013; 26(2):177-190. http://www.ncbi.nlm.nih.gov/pubmed/24135454 6

17. Kongerslev Thorning T, Bertram HC, Bonjour JP, et al. Whole dairy matrix or single nutrients in assessment of health effects: Current evidence and knowledge gaps. Am J Clin Nutr. 2017; 105(5):1033-1045.

18. Gholami F, Khoramdad M, Esmailnasab N, et al. The effect of dairy consumption on the prevention of cardiovascular diseases: A meta-analysis of prospective studies. J Cardiovasc Thorac Res. 2017; 9(1):1-11.

19. Abedini M, Falahi E, Roosta S. Dairy product consumption and the metabolic syndrome. Diabetes Metab Syndr. 2015; 9(1):34-37. http://dx.doi.org/10.1016/j.dsx.2014.04.027

20. Struijk EA, Heraclides A, Witte DR, et al. Dairy product intake in relation to glucose regulation indices and risk of type 2 diabetes. Nutr Metab Cardiovasc Dis. 2013; 23(9):822-828. http://dx.doi.org/10.1016/j.numecd.2012.05.011

21. Turner KM, Keogh JB, Clifton PM. Dairy consumption and insulin sensitivity: A systematic review of short- and long-term intervention studies. Nutr Metab Cardiovasc Dis. 2015; 25(1):3-8. http://dx.doi.org/10.1016/j.numecd.2014.07.013

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