MILK

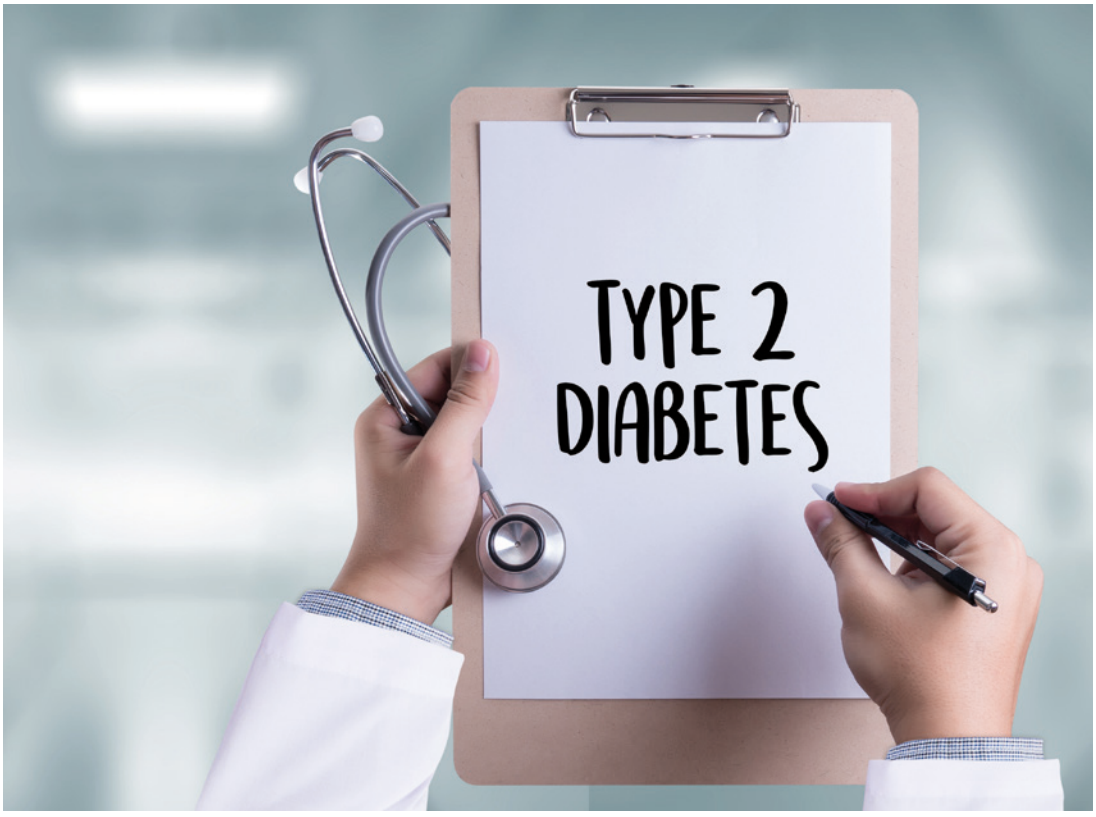
Nutritious by nature

The science behind
the health and nutritional impact
of milk and dairy foods

Type 2 diabetes

Evidence is building that dairy foods may help reduce the risk of type 2 diabetes. Protective associations have been reported for total dairy consumption as well as for both low-fat and regular-fat dairy, and are particularly pronounced for fermented products such as yogurt and cheese.

Several components of dairy foods could potentially be involved in the reduced risk including protein, calcium, magnesium and dairy fatty acids, along with mechanisms related to fermentation. These are not mutually exclusive and may well interact in the dairy matrix to produce the beneficial effects. Since the number of people with type 2 diabetes is rising in European populations, even a small protective effect of dairy as part of a healthy diet could have important public health implications.



Observational studies

A number of epidemiological studies have reported that intake of milk and dairy food is associated with a reduced risk of developing type 2 diabetes. An overview of four prospective cohort studies in 2007 showed a reduction of about 15% in the risk of diabetes in the highest dairy consumers (3 to 5 compared with less than 1.5 servings/day)[1]. Similar reductions were reported in overviews in 2010 and 2011 based on five and seven cohorts respectively[2,3]. In the latter meta-analysis, the protective effect of dairy was largely attributable to low-fat dairy foods, and a further dose-response analysis (involving three of the studies) suggested a 10% reduction in type 2 diabetes for every additional serving of low-fat dairy a day.

Since these overviews, several more prospective studies looking at the relationship between dairy consumption and type 2 diabetes have been published, including for European populations. The EPIC-InterAct Study (an investigation in eight European countries to identify the genes and lifestyle factors that influence risk of type 2 diabetes) found that both cheese consumption and fermented dairy product intake (cheese, yogurt, and thick fermented milk combined) were associated with a reduced risk of diabetes[4]. Similarly, in another EPIC cohort, this time in the UK and using 7-day food diaries, low-fat fermented dairy intake, largely driven by yogurt, was associated with a decreased risk of type 2 diabetes: 24% less between the highest and lowest consumers[5]. The PREDIMED study in an elderly Mediterranean population at high cardiovascular risk also reports that a healthy dietary pattern incorporating dairy products and, again, particularly yogurt, was protective against type 2 diabetes[6]. In the French DESIR cohort (Data from the Epidemiological Study on the Insulin Resistance Syndrome), those who consumed more than three servings of milk or yogurt a day had a lower risk of type 2 diabetes compared with those who consumed less than one serving a day[7]. Two other recent studies, in Danish and British cohorts, found no relationship between dairy intake and diabetes[8,9]. The Danish data did suggest a beneficial effect of cheese and fermented dairy on glucose regulation measures but these did not translate into a significant association with type 2 diabetes[8]. Another Danish study looking specifically at milk intake found no relationship with diabetes risk[10]. In the Dutch Maastricht Study, a high intake of full-fat products was positively related to diabetes risk[11]. However, individuals with a high total dairy consumption had lower risk of type 2 diabetes, and those with a high consumption of skimmed and fermented products had lower risk of impaired glucose metabolism[11].

A systematic review and dose-response meta-analyses published in 2013 utilised the available data to investigate in more detail the relation between the intake of individual dairy foods and diabetes risk, as well as between regular- and low-fat dairy[12]. Seventeen cohort studies were included in the overall meta-analysis and a significant reduction in the risk of type 2 diabetes was reported with increasing intakes of total dairy products and low-fat dairy products (up to 300g - 400g per day) and with increasing intake of cheese (up to around 50g per day). Another meta-analysis published in 2013 also found that total dairy product consumption, low-fat dairy products and cheese were associated with a reduced risk of diabetes, and additionally in this overview, so was yogurt[13]. In this case, total dairy and low-fat dairy intake were associated with 6% and 12% respectively, lower risk of type 2 diabetes per 200g a day consumption, with most of the risk reduction occurring with intakes up to about 200g per day for total dairy, and 300g per day for low-fat dairy.

A more recent analysis of cohort studies to inform the 2015 Dutch Dietary Guidelines concluded that there is convincing evidence that yogurt consumption is associated with a lower risk of type 2 diabetes; yogurt intake of more than 60g a day was associated with a 15% reduction in diabetes risk, compared

with intakes less than 10g per day[14]. Similarly, a meta-analysis in 2016 which summarised the evidence from 22 prospective cohort studies found yogurt consumption was associated with a reduced risk of type 2 diabetes at 80g/day, but not with higher intakes[15]. In this analysis, total dairy food consumption was also associated with a lower risk, mainly attributable to low-fat dairy foods; there were no associations with either milk or cheese intake. The same conclusion was reached from a systematic review published in 2016; namely, that there is high-quality evidence to support favourable associations between yogurt and low-fat dairy intake and reduced risk of type 2 diabetes[16].

Intervention studies

Randomised control trials are needed to further confirm the results of the cohort studies. One recent small-scale trial found that consumption of four servings of low-fat milk and yogurt a day for six months improved plasma insulin and insulin resistance without negatively impacting on body weight or blood lipids[17]. Similarly, a six-week trial of three servings of low-fat dairy a day resulted in improvements in fasting glucose in men[18].

Potential dairy matrix mechanisms

Several components of the dairy matrix could potentially be involved in the protective relationship between dairy and type 2 diabetes. These are not mutually exclusive and a combination of mechanisms may well produce beneficial effects on glycaemic control and other risk factors. These include dairy minerals such as **calcium and magnesium**: both have a role in regulating insulin-mediated intracellular processes[1,19,20]. **Protein** in dairy has also been shown to have beneficial effects on insulin secretion and blood glucose control[21-24]. The **bioactive peptides** that may be involved result from digestion of milk protein in the gut and from the fermentation process in foods such as cheese, yogurt and fermented milk. Similarly, a form of **vitamin K** (vitamin K2; part of the menaquinone family) which is associated with fermented dairy foods has been linked to reduced risk of type 2 diabetes[25].

In addition, dairy fatty acids may play a role. Certainly, evidence from cohort studies suggests that the positive effect of dairy on diabetes risk is not restricted to low-fat dairy foods but also includes higher fat ones such as cheese. Data from the Malmö Diet and Cancer cohort, for example, indicated a decreased risk of type 2 diabetes with high intakes of regular-fat dairy foods but not with low-fat dairy[26]. A number of recent studies have found that the dairy-derived fatty acid trans-palmitoleate is associated with a substantially lower incidence of diabetes (60% less in one study)[27-29]. Other fatty acids in dairy have also been associated with reduce diabetes risk including odd-chain saturated fatty acids pentadecanoic acid (C15:0) and heptadecanoic acid (C17:0) and short-chain fatty acids (SCFA) including buyrate (C4:0); the branched-chain dairy fatty acid phytanic acid has been reported to have anti-diabetic effects including increasing insulin sensitivity[30-32].

Dairy may indirectly modify diabetes risk through beneficial effects on weight, body fat and central adiposity, and on muscle mass and function. Additional research will help to differentiate the effects of individual dairy foods and components of the dairy matrix for diabetes risk particularly the relevance of fermented dairy products such as yogurt. Randomised control trials to confirm the results of cohort studies would also be useful. However, the protective effect of dairy suggested by evidence to date, has important public health implications given that there are already around 60 million people with diabetes in the European Region, and these numbers are increasing[33].

Milk nutritious by nature - nutrient richness **- an important part of European dietary guidelines**

Type 2 diabetes

1. Pittas AG et al. Review: the role of vitamin D and calcium in type 2 diabetes. A systematic review and meta-analysis. J Clin Endocrinol Metab. 2007; 92: 2017-2029.

2. Elwood PC et al. The consumption of milk and dairy foods and the incidence of vascular disease and diabetes: an overview of the evidence. Lipids. 2010; 45: 925-939.

3. Tong X et al. Dairy consumption and risk of type 2 diabetes mellitus: a meta-analysis of cohort studies. Eur J Clin Nutr. 2011; 65: 1027-1031.

4. Sluijs I et al. The amount and type of dairy product intake and incident type 2 diabetes: results from the EPIC-InterAct Study. Am J Clin Nutr. 2012; 96: 382–390.

5. O'Connor LM et al. Dietary dairy product intake and incident type 2 diabetes: a prospective study using dietary data from a 7-day food diary. Diabetologia. Epub ahead of print 8 February 2014. DOI: 10.1007/s00125-014-3176-1.

6. Diaz-Lopez A et al. Dairy product consumption and risk of type 2 diabetes in an elderly Spanish Mediterranean population at high cardiovascular risk. Eur J Nutr. 2015 Feb 7. [Epub ahead of print]

7. Fumeron F et al. Dairy products and the metabolic syndrome in a prospective study, DESIR. J Am Coll Nutr. 2011; 30(5 Suppl 1): 454S-463S

8. Struijk EA et al. Dairy product intake in relation to glucose regulation indices and risk of type 2 diabetes. Nutr Metab Cardiovasc Dis. 2013; 23: 822-828.

9. Soedamah-Muthu SS et al. Consumption of dairy products and associations with incident diabetes CHD and mortality in the Whitehall II study. Br J Nutr. 2013; 109: 718-726.

10. Bergholdt HK et al. Milk intake is not associated with low risk of diabetes or overweight obesity: a Mendelian randomization study in 97,811 Danish individuals. Am J Clin Nutr. 2015; 102(2): 487-496.

11. Eussen SJ 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: 1453-1461.

12. Aune D et al. 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: 1066-1083.

13. Gao D et al. Dairy Products Consumption and Risk of Type 2 Diabetes: Systematic Review and Dose-Response Meta-Analysis. PLOS ONE. 2013; 8: e73965.

14. Health Council of the Netherlands. Dutch Dietary Guidelines 2015. The Hague: Health Council of the Netherlands, 2015; publication no. 2015/24E.

15. Gijsbers L et al. Consumption of dairy foods and diabetes incidence: a dose-response meta-analysis of observational studies. Am J Clin Nutr 2016; 103: 1111–1124.

16. Drouin-Chartier J-P et al. Systematic review of the association between dairy product consumption and risk of cardiovascular-related clinical outcomes. Adv Nutr. 2016; 7: 1026–1040.

17. Rideout TC et al. Consumption of low-fat dairy foods for 6 months improves insulin resistance without adversely affecting lipids or bodyweight in healthy adults: a randomized free-living cross-over study. Nutr J. 2013; 12: 56-64.

18. Dugan CE et al. Increased dairy consumption differentially improves metabolic syndrome markers in male and female adults. Metab Syndr Relat Disord. 2014; 12: 62-69.

19. Belin RJ & He K. Magnesium physiology and pathogenic mechanisms that contribute to the development of the metabolic syndrome. Magnes Res. 2007; 20:107-129.

20. Dong JY et al. Magnesium intake and risk of type 2 diabetes: meta-analysis of prospective cohort studies. Diabetes Care. 2011; 34(9): 2116-2122.

21. McGregor RA & Poppitt SD. Milk protein for improved metabolic health: a review of the evidence. Nutr Metab. 2013; 10: 46.

22. Jakubowicz D & Froy O. Biochemical and metabolic mechanisms by which dietary whey protein may combat obesity and Type 2 diabetes. J Nutr Biochem. 2013; 24: 1-5.

23. Ricci-Cabello et al. Possible role of milk-derived bioactive peptides in the treatment and prevention of metabolic syndrome. Nutr Rev. 2012; 70: 241-255.

24. Comerford KB et al. Emerging evidence for the importance of dietary protein source on glucoregulatory markers and type 2 diabetes: different effects of dairy, meat, fish, egg, and plant protein foods. Nutrients. 2016; 8: 446.

25. Beulens JW et al. Dietary phylloquinone and menaquinones intakes and risk of type 2 diabetes. Diabetes Care. 2010; 33: 1699–1705.

26. Ericson U et al. Food sources of fat may clarify the inconsistent role of dietary fat intake for incidence of type 2 diabetes. Am J Clin Nutr. 2015; 101: 1065-1080.

27. Mozaffarian D et al. Trans-palmitoleic acid, metabolic risk factors, and new-onset diabetes in US adults: a cohort study. Ann Intern Med. 2010; 153: 790-799.

28. Mozaffarian D et al. trans-Palmitoleic acid, other dairy fat biomarkers, and incident diabetes: the Multi-Ethnic Study of Atherosclerosis (MESA). Am J Clin Nutr. 2013; 97: 854–861.

29. de Souza RJ et al. Intake of saturated and trans unsaturated fatty acids and risk of all cause mortality, cardiovascular disease, and type 2 diabetes: systematic review and meta-analysis of observational studies.BMJ. 2015; 11; 351:h3978.

30. Forouhi NG et al. Differences in the prospective association between individual plasma phospholipid saturated fatty acids and incident type 2 diabetes: the EPIC-InterAct case-cohort study. Lancet. Diabetes Endocrinol. 2014; 2: 810–818.

31. Hellgren LI. Phytanic acid - an overlooked bioactive fatty acid in dairy fat? Ann N Y Acad Sci. 2010; 1190: 42-49.

32. Nestel PJ et al. Specific plasma lipid classes and phospholipid fatty acids indicative of dairy food consumption associate with insulin sensitivity. Am J Clin Nutr. 2014; 99: 46-53.

33. WHO, Regional Office for Europe, Diabetes, Data and statistics. http://www.euro.who.int/en/health-topics/noncommunicable-diseases/diabetes/data-and-statistics (accessed 11/12/15).

by

European
Milk
Forum

www.milknutritiousbynature.eu

September 2017 ref 2383