Supplementary Data

The impact of dairy products in the development of type 2 diabetes: where does the evidence stand in 2019?

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Supplemental Table 1. Cohort studies that assessed the association between dairy consumption and type 2 diabetes risk (in alphabetical order).

Reference/ country	was used in Gijsbers et al. (1)	was used in Gao et al. (2)	was used in Aune et al. (3)	Study design	Study participants (number, gender, age, BMI)	Dairy types	Definition	Calculation method	Outcome measures and effect
Brouwer-Brolsma et al. 2016 (4)/ Netherlands	N	N	N	Longitudinal, 9.5 years	2974 men and women, aged 65 years, BMI 26.0 kg/m^2	Total dairy	All dairy products, except butter.	Semi-quantitative FFQ	No association with T2D
						Skimmed dairy	All milk and milk products with a fat content <0.5%, cheeses with a fat content <10%, and curd cheese/quark and cream cheese with a fat content <10%.		No association with T2D
						Semi-skimmed dairy	All milk and milk products with a fat content ≥1.50%-≤1.80%, cheeses with a fat content >10% <50%, and curd cheese/quark and cream cheese with a fat content ≥10%-≤ 34%.		No association with T2D
						Full-fat dairy	All milk and milk products with a fat content >1.80%, cheeses with a fat content ≥50%, and curd cheese/quark and cream cheese with a fat content ≥35%.		No association with T2D
						Fermented dairy	All types of yogurt, curd cheese/quark, buttermilk, and cheese.		No association with T2D
Chen et al. 2014 (5)/ United States	Y	Y	Y	Longitudinal, 18-30 years	194458 women, aged 43 years, BMI 24.4 kg/m^2	Total dairy	NA	Updated validated FFQ	No association with T2D
						Low-fat dairy	NA		No association with T2D
						High-fat dairy	NA		No association with T2D
						Low-fat milk	NA		No association with T2D
						High-fat milk	NA		No association with T2D
						Cheese	NA		No association with T2D
						Yogurt	NA		T2D↓ in higher consumers compared to lower consumers
						Cream	NA		No association with T2D
						Ice cream	NA		No association with T2D
Diaz-Lopez et al. 2016 (6)/ Spain	Y	N	N	Longitudinal, 4.1 years	3454 men and women, aged 67 years, BMI 30 kg/m^2	Total dairy	All types of milk, yogurt and cheeses, custard, whipped cream, butter, and ice cream	FFQ	T2D↓ in higher consumers compared to lower consumers
						Low-fat dairy	Semi-skim/skim milk and skim yogurt		T2D↓ in higher consumers compared to lower consumers
						High-fat dairy	Whole-fat milk and whole-fat yogurt		No association with T2D

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						Total milk	Total, low-fat, and whole-fat milk		No association with T2D
						Low-fat milk	NA		No association with T2D
						High-fat milk	NA		T2D↓ in higher consumers compared to lower consumers
						Fermented dairy	All types of yogurt and cheeses		T2D↓ in higher consumers compared to lower consumers
						Cheese	Petit Suisse, ricotta, cottage, spreadable, and semi-cured/cured cheeses		No association with T2D
						Yogurt	Total, low-fat and whole-fat yogurt		T2D↓ in higher consumers compared to lower consumers
Elwood et al. 2007 (7)/ United Kingdom	Y	Y	Y	Longitudinal, 20 years	2375 men, aged 52 years, BMI 26 kg/m^2	Total dairy	Milk, butter, cheese, cream and yogurt	7-day weighed dietary intake records	No association with T2D
						Total milk	All milk drunk and added to drinks, milk added to cereals, milk used in puddings and other recipes, together with dried milk converted to the equivalent weight of whole milk		No association with T2D
Ericson et al. 2015 (8)/ Sweden	Y	Y	N	Longitudinal, 14 years	26930 men and women, aged 58 years, BMI 25.8 kg/m^2	Total dairy	Milk, yoghurt, sour milk, cream, cheese, ice cream and butter	7-day menu book and 168-item questionnaire	No association with T2D
						Low-fat dairy	Low-fat alternatives of milk (<2.5% fat), yoghurt (<2.5% fat), sour milk(<2.5% fat), cream (≤12% fat) and cheese (≤20% fat)		No association with T2D
						Low-fat fermented dairy	Low-fat alternatives of yoghurt, sour milk and cheese		No association with T2D
						High-fat dairy	Butter and high-fat (=regular fat) alternatives of milk (≥2.5% fat), yoghurt (≥2.5% fat), sour milk (≥2.5% fat), cream (>12% fat) and cheese (>20% fat)		T2D↓ in higher consumers compared to lower consumers
						High-fat fermented dairy	High-fat alternatives of yoghurt, sour milk and cheese		T2D↓ in higher consumers compared to lower consumers
						Milk	Non-fermented milk, yoghurt and sour milk		T2D↑ in higher consumers compared to lower consumers
						Low-fat milk	Low-fat alternatives of milk		No association with T2D
						High-fat milk	High-fat alternatives of milk, yoghurt and sour milk		No association with T2D
						Cheese	All types		No association with T2D
						Cream	All types		T2D↓ in higher consumers compared to lower consumers

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						Butter	Butter and butter/oil-blends	T2D↓ in higher consumers compared to lower consumers
						Ice cream	All types	No association with T2D
Fuhrman et al. 2009 (9)/ Puerto Rico	Y	N	N	Longitudinal, 2.6 years	4685 men, aged 58 years, BMI 25.8 kg/m^2	Milk	Amounts consumed with coffee and separately	24-h dietary recall	T2D↓ in higher consumers compared to lower consumers
Grantham et al. 2013 (10)/ Australia	Y	Y	Y	Longitudinal, 5 years	5582 men and women, aged 51 years, BMI NA	Total dairy	Milk, cheese and yogurt together	FFQ	No association with T2D
						Low-fat milk	NA		T2D↓ in higher consumers compared to lower consumers
						High-fat milk	NA		No association with T2D
						Cheese	NA		No association with T2D
						Yogurt	D		No association with T2D
Hruby et al. 2017 (11)/ United States	N	N	N	Longitudinal, 12 years	2809 men and women, aged 54 years, BMI 27.1 kg/m^2	Total dairy	Milk, sherbet and ice milk, ice cream, yogurt, cottage and ricotta cheese, and other cheese	FFQ	Prediabetes↓ in higher consumers compared to lower consumers
						High-fat dairy	Whole milk, ice cream, cottage and ricotta cheese, and other cheese		Prediabetes↓ and T2D↓ in higher consumers compared to lower consumers
						Low-fat dairy	Skim milk, sherbet and ice milk, and yogurt		Prediabetes↓ in higher consumers compared to lower consumers
						Total milk	Full-fat and skim and low-fat milk		No association with prediabetes
						Skim milk	NA		No association with prediabetes
						Whole milk	NA		Prediabetes↓ in higher consumers compared to lower consumers
						Cheese	Cottage and ricotta cheese and other cheese		No association with prediabetes; T2D↓ in higher consumers compared to lower consumers
						Cream and butter	NA		No association with prediabetes
						Yogurt	NA		No association with prediabetes
	Y	Y	Y	Longitudinal, 5 years	59796 men and women, aged 57 years, BMI 23.6 kg/m^2	Total dairy	NA	FFQ	Women: T2D↓ in higher consumers compared to

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Kirii et al. 2009 (12)/ Japan									lower consumers; Men: no association with T2D
						Total milk	NA		No association with T2D
						Cheese	NA		No association with T2D
						Yogurt	NA		No association with T2D
Liu et al. 2006 (13)/ United States	Y	Y	Y	Longitudinal, 10 years	37183 women, aged 55 years, BMI 25.9 kg/m^2	Total dairy	Skim or low-fat milk, sherbet, yogurt, and cottage/ricotta cheese, whole milk, cream, sour cream, ice cream, cream cheese, and other cheese	FFQ	T2D↓ in higher consumers compared to lower consumers
						Low-fat dairy	Skim or low-fat milk, sherbet, yogurt, and cottage/ricotta cheese		T2D↓ in higher consumers compared to lower consumers
						High-fat dairy	Whole milk, cream, sour cream, ice cream, cream cheese, and other cheese		No association with T2D
						Low-fat milk	NA		No association with T2D
						High-fat milk	NA		No association with T2D
						Cheese	NA		No association with T2D
						Yogurt	NA		T2D↓ in higher consumers compared to lower consumers
						Cream	NA		No association with T2D
						Ice cream	NA		No association with T2D
Louie et al. 2013 (14)/ Australia	Y	Y	Y	Longitudinal, 10 years	1824 men and women, aged 64 years, BMI 26.2 kg/m^2	Total dairy	Regular milk, reduced fat/skim milk, low-fat cheese, regular cheese, reduced fat dairy dessert (e.g. low fat yogurt), and medium fat dairy dessert (e.g. custard and regular yogurt)	FFQ	No association with T2D
						Low-fat dairy	Reduced fat/skim milk, reduced fat dairy dessert and low- fat cheese		No association with T2D
						High-fat dairy	Regular milk, regular cheese and medium-fat dairy dessert		No association with T2D
Margolis et al. 2011 (15)/ United States	Y	Y	Y	Longitudinal, 8 years	82076 women, aged 63 years, BMI 27 kg/m^2	Total dairy	Intake of milk as a beverage, on cereal, or in coffee or tea, cheese (including cheese in entrees and mixed dishes and cottage cheese and ricotta cheese), cream soups, yogurt, ice cream, pudding, custard, and flan	FFQ	No association with T2D
						Low-fat dairy	Low-fat milk (non-fat milk, skim milk, or 1% milk), low-fat cottage cheese, part-skim or reduced-fat cheese, non-fat yogurt, and low-fat or non-fat frozen desserts		T2D↓ in higher consumers compared to lower consumers

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						Yogurt	NA		T2D↓ in higher consumers compared to lower consumers
Montonen et al. 2005 (16)/ Finland	Y	Y	Y	Longitudinal, 23 years	4304 men and women, aged 52 yeas, BMI 26.5 kg/m^2	High-fat dairy	Cheese, cream, ice cream and yogurt	Dietary history interview with the use of a 100-item questionnaire	No association with T2D
						Reduced-fat dairy	Skimmed and low-fat milk, low-fat cheese		No association with T2D
						Milk	Whole milk		No association with T2D
						Butter	NA		No association with T2D
Nettleton et al. 2008 (17)/ United States	Y	N	N	Longitudinal, 11 years	4127 men and women, aged 61 years, BMI 27.9 kg/m^2	Low-fat dairy	NA	Validated 120-item FFQ	No association with T2D
						High-fat dairy	Whole milk and high-fat cheese/cream sauces		No association with T2D
O'Connor et al. 2014 (18)/ United Kindom	Y	N	N	Longitudinal, 11 years	3502 adults, men and women, aged 59 years, BMI 26.3 kg/m^2	Total dairy	Butter, cheese, cream, crème fraîche, dried/powdered milk (made up weight), evaporated milk, milk, sour cream, yoghurt, baby milk	7-day diet diary	No association with T2D
						High-fat dairy	Butter, full fat unripened cheese, all hard, processed and soft cheese, cream, sour cream, crème fraîche, whole milk, whole dried/powdered milk (made up weight), all evaporated milk, baby milk		No association with T2D
						Low-fat dairy	Low-fat unripened cheese, semi-skimmed milk, skimmed milk, dried semi-skimmed/skimmed milk, all yoghurt		No association with T2D
						Milk	Liquid and powdered/dried milk (made up weight); cow, sheep and goat sources		No association with T2D
						Yogurt	Full-, low-, reduced-, 0%- fat varieties		T2D↓ in higher consumers compared to lower consumers
						Cheese	Hard, processed, soft (e.g. brie) and unripened (e.g. mozzarella, fromage frais, ricotta)		No association with T2D
						Total fermented dairy	All yoghurt, all cheese, sour cream and crème fraîche		No association with T2D
						High-fat fermented dairy	Hard cheese, soft cheese, high-fat unripened cheese, sour cream, crème fraîche		No association with T2D

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						Low-fat fermented dairy	All yoghurt, low-fat unripened cheeses (e.g. fromage frais, low-fat cottage cheese)	T2D↓ in higher consumers compared to lower consumers
Sluijs et al. 2012 (19)/ 8 countries in Europe	Y	Y	Y	Longitudinal, 12 years	340234 men and women, aged 52 years, BMI 26.1 kg/m^2	Total dairy	Milk (both nonfermented milk and fermented milk such as buttermilk), milk beverages (eg, chocolate milk), yogurt and thick fermented milk (eg, sour milk), curd (eg, quark), cream desserts (eg, custard), dairy creams (eg, whipped cream), milk for coffee and creamers, and cheese, excluding butter	Semi quantitative FFQ	No association with T2D
						Total milk	NA	No association with T2D
						Fermented dairy	Cheese, yogurt, and thick fermented milk	T2D↓ in higher consumers compared to lower consumers
						Cheese	NA	T2D↓ in higher consumers compared to lower consumers
						Yogurt	Yogurt and thick fermented milk	No association with T2D
Soedamah-Muthu et al. 2013 (20)/ United Kingdom	Y	Y	Y	Longitudinal, 10 years	4186 men and women, aged 56 years, BMI 25.9 kg/m^2	Total dairy	All dairy products, except butter and ice cream	FFQ	No association with T2D
						High-fat dairy	Full-fat cheese, yogurt, milk puddings, whole and Channel Islands milk	No association with T2D
						Low-fat dairy	Cottage cheese, semi-skimmed, skimmed milk and milk-based hot drinks	No association with T2D
						Total milk	Whole and low-fat milk	No association with T2D
						Fermented dairy	Yogurt and total cheese	No association with T2D
						Cheese	Full-fat cheese and cottage	No association with T2D
						Yogurt	NA	No association with T2D
Struijk et al. 2013 (21)/ Denmark	Y	Y	Y	Longitudinal, 5 years	5953 men and women, aged 46 years, BMI 26.1 kg/m^2	Total dairy	All dairy food products except for butter and ice cream	FFQ	No association with T2D
						Low-fat dairy	Skimmed and semi-skimmed milk and milk products with a total fat content of <2 g/100 g and cheese with a total fat content of <20 g/100g		No association with T2D
						High-fat dairy	Whole milk and milk products with a total fat content of ≥2 g/100 g and cheese with a total fat content of ≥20 g/100 g		No association with T2D
						Total milk	Milk and milk products included all dairy products except cheese		No association with T2D
						Fermented dairy	Buttermilk, yogurt and cheese		No association with T2D
						Cheese	All types of cheese except curd		No association with T2D

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Talaei et al.2017 (22)/ Singapore	N	N	N	Longitudinal, 12 years	45411 men and women, aged 55 years, BMI 23.1 kg/m^2	Dairy products	Milk (powdered, whole, low-fat and chocolate but excluding addition to coffee or tea), Milo, Ovaltine, or Horlicks, and Yakult or Vitagen (probiotic clutured milk drinks)	semi-quantitative food frequency questionnaire	T2D↓ in higher consumers compared to lower consumers
						Milk	Powdered, whole, low-fat and chocolate but excluding addition to coffee or tea		T2D↓ in higher consumers compared to non-consumers
van Dam et al. 2006 (23)/ United States	Y	Y	Y	Longitudinal, 8 years	41186 women, aged 39 years, BMI 27.6 kg/m^2	Total dairy	Whole milk, 2% milk, skim milk, 1% milk or buttermilk, milk or cream in coffee or tea, yogurt, frozen yogurt, ice cream, butter on bread or rolls, and cheeses and cheese spreads not including cottage cheese	FFQ	No association with T2D
						Low-fat dairy	Reduced-fat milk (≤2% fat), reduced-fat yogurt, and reduced-fat frozen yogurt		T2D↓ in higher consumers compared to lower consumers
						High-fat dairy	Dairy items not included in low-fat dairy group		No association with T2D
von Ruesten. 2013 (24)/ Germany	N	N	Y	Longitudinal, 8 years	23531 men and women, aged 35-65 years, BMI NA	High-fat dairy	Normal- or high-fat variants of: mlk/milkshake, yoghurt, fruit yoghurt, soured milk/kefir, curd/curd with herbs	FFQ	No association with T2D
						Low-fat dairy	Fat-reduced variants of: milk/milkshake (1.5% fat or less), yoghurt, fruit yoghurt (1.5% fat or less), soured milk/kefir, curd/curd with herbs		No association with T2D
						High-fat cheese	Normal- or high-fat variants of: Cream cheese, processed cheese, hard cheese (for example, gouda, Emmental cheese, Tilsiter cheese), soft cheese (for example, camembert, brie, gorgonzola), whipped cream		No association with T2D
						Low-fat cheese	Fat-reduced variants of: Cream cheese, hard cheese (for example, gouda, Emmental cheese, Tilsiter cheese), soft cheese (for example, camembert, brie, gorgonzola)		No association with T2D
Villegas et al. 2009 (25)/ China	Y	Y	Y	Longitudinal, 6.9 years	64169 women, aged 50 years, BMI 23.8 kg/m^2	High-fat milk	Fresh milk	In-person interviews using FFQ	T2D↓ in higher consumers compared to lower consumers
Virtanen et al. 2017 (26)/ Finland	N	N	N	Longitudinal, 19.3 years	2332 men, aged 53 years, BMI 26.2 kg/m^2	Total dairy	Non-fermented dairy products (mainly milk, cream and ice cream) and fermented dairy products (mainly sour milk, curdled milk, yogurt and cheese)	4-d dietary records	No association with T2D
						Milk	NA		No association with T2D

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						Fermented dairy products	Sour milk, curdled milk, yogurt and cheese		No association with T2D
						Cheese	NA		No association with T2D
Vang et al. 2008 (27)/ United States	Y	N	Y	Longitudinal, 17 years	8401 men and women, aged 65 years, BMI 24.5 kg/m^2	Total milk	NA	Self-report	No association with T2D
						Cheese	NA		No association with T2D
Zong et al. 2014 (28)/ China	Y	N	N	Longitudinal, 6 years	2091 men and women, aged 59 years, BMI 24.3 kg/m^2	Total dairy	Milk, yogurt, ice cream, milk powder, and other products (milk flake, cheese, cream, cream cake, evaporated milk)	FFQ	T2D↓ in higher consumers compared to lower consumers
						Total milk	NA		T2D↓ in higher consumers compared to lower consumers

Body mass index (BMI); Food frequency questionnaire (FFQ); Fasting Glucose (FG); Glycated haemoglobin (HbA1c); Not Available (NA); No (N); 2-h Postload Glucose (PG); Type 2 diabetes (T2D); Yes (Y).

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