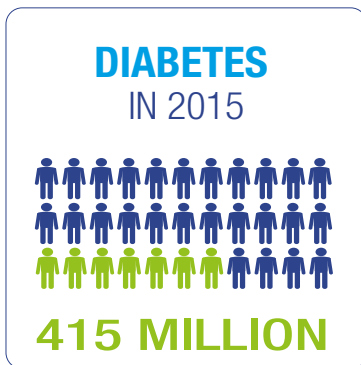


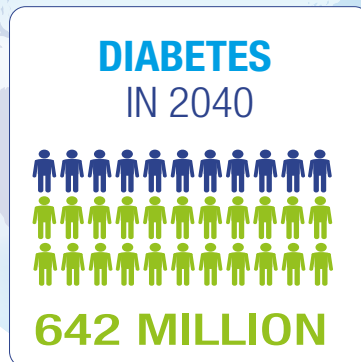
This Digest is all about #Yogurt and #Diabetes

Yogurt and type 2 diabetes: from evidence to eating

DIABETES PREVALENCE



DIABETES EVOLUTION



PREVENTIVE SOLUTIONS



Figure 1: Three main facts related to diabetes worldwide ^(1, 2)

The direct cost of diabetes globally is estimated to be more than US\$ 827 billion ⁽⁸⁾

Dietary behaviour change has been shown to impact risks of type 2 diabetes (T2D) ⁽³⁾. For example, higher relative risks have been associated with processed red meat and sugar-sweetened beverages, whilst lower risks have been linked to intakes of dairy products and whole grains. Four meta-analyses of prospective studies have shown a decreased risk of diabetes in those individuals who had a higher consumption of dairy products ⁽⁴⁻⁷⁾.

This Digest will summarise some of the key research and pose questions on the value of all yogurt, regardless of fat and sugar content, in promoting positive dietary strategies for the prevention of T2D.

First things first – how do we define & diagnose diabetes?

Key Definitions

High blood glucose

A fasting plasma glucose level that is higher than the level that would minimise risks to health.

Type 1 diabetes

A condition where the body does not produce enough insulin.

Type 2 diabetes

A condition where the body's insulin is not working effectively. This is the most common type of diabetes.

Gestational diabetes

A temporary condition that occurs in pregnancy and carries long-term risk of type 2 diabetes. Women with gestational diabetes are at increased risk of some complications during pregnancy and delivery, as are their infants.

Impaired fasting tolerance and impaired fasting glycaemia

The stage between normal blood glucose levels and potential development of diabetes.

The optimal functioning of the body requires that some variables be precisely regulated. This means that for some biological markers like body temperature, the level must remain within a narrow range to keep the body working optimally. This is also the case for glycaemia, which represents the concentration of sugar in our blood. If blood sugar chronically exceeds a threshold of normality, there will be a significant increase in the risk to develop severe long-term body damage and dysfunction, particularly targeting organs like the eyes, kidneys, nerves, heart and blood vessels. Taken together, these abnormalities are the common symptoms characterizing a disease that we call “diabetes”.

The need for criteria

The establishment of optimal criteria has been a challenge for public health agencies and medical associations over the last decades. Today, there is a relatively good consensus. As shown in Figure 2, international agencies use fasting plasma blood glucose concentration (FBGC) as well as the value at 2-hours post-ingestion (2-Hr OGTT), to make a diagnosis of diabetes and pre-diabetes⁽⁹⁾.

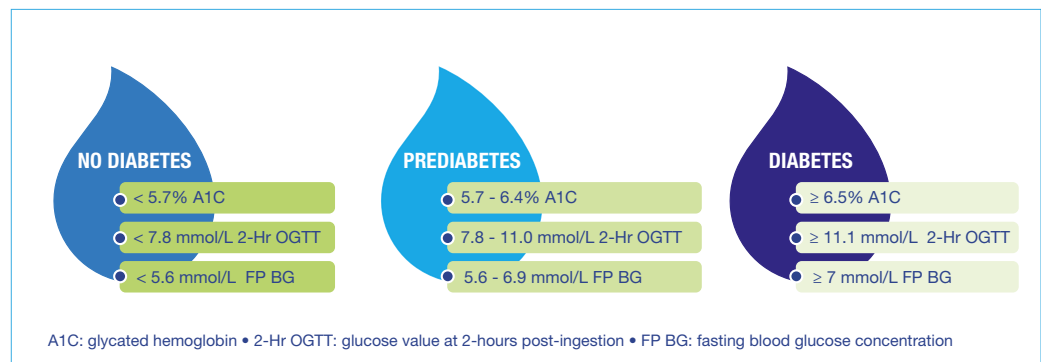


Figure 2: Summary of diagnosis criteria (American Diabetes Association, 2012)

Reducing risks of diabetes and long term complications

Controlling blood glucose levels, through a combination of diet, physical activity, and, if necessary, medication, is imperative to help improve outcomes associated with diabetes. The World Health Organisation, in its Global Report on Diabetes 2016⁽¹⁾ states: “Promoting healthy diets and increasing physical activity in the population will help reduce the occurrence of obesity and type 2 diabetes, and will accrue additional benefits by reducing complications among people with all types of diabetes and glucose intolerance.”

80g of yogurt daily has been associated with 14% reduction in risk of T2D⁽¹⁰⁾

The value of yogurt – research findings

Three meta-analyses show a consistent association between yogurt consumption and reduced type 2 diabetes risk^(7, 10, 11). Gijsbers et al.⁽¹⁰⁾ conducted a meta-analysis of 22 longitudinal studies, comprising over half a million people and 43,000 cases of type 2 diabetes. They reported that yogurt consumption was associated with a 14% reduction in type 2 diabetes risk. This effect was observed at 80 g/d of yogurt intake.

T2D risk reduction has been shown to be 22% with daily intakes of 200 g yogurt⁽⁷⁾

«Higher intake of yogurt is associated with reduced risk of T2D»⁽¹¹⁾

» Hot news! Flavoured yogurt is also associated with lower risks of T2D

» Hotter news! Full-fat yogurt is also associated with lower risks of T2D

Aune and colleagues⁽⁷⁾ reported that yogurt intake was associated with a 14% reduction in type 2 diabetes risk among seven cohort studies with a total close to 20,000 cases among more than 250,000 participants. Further, they reported a 22% reduction when they examined the specific quantity of yogurt (200 g/d).

Chen et al. reported that frequent yogurt intake was consistently and inversely associated with type 2 diabetes risk in young, middle-aged as well as elderly individuals and this association was independent of the fat content of the diet. For example, an 18% reduction in diabetes incidence was observed in those consuming 1 serving of yogurt per day⁽¹¹⁾.

Importantly, higher consumption of either plain or flavoured yogurt was associated with a non-significant lower risk of type 2 diabetes. The authors conclude "This dose-response meta-analysis of observational studies suggests a possible role of yogurt, in the prevention of T2D".

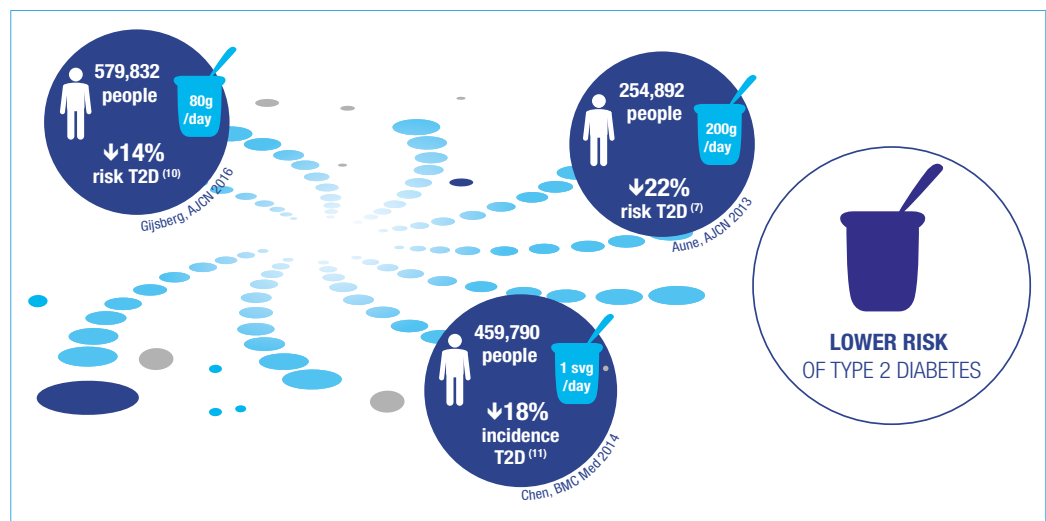


Figure 3: Several meta-analyses show consistent association between yogurt consumption and reduced type 2 diabetes risk

Trans-palmitoleate is a component of dairy fat and, thus, represents a biomarker for dairy fat intakes. Two prospective studies by Mozaffarian showed that higher levels of trans-palmitoleate were associated with lower incidence of type 2 diabetes than those with the lowest plasma concentrations (62% lower incidence⁽¹²⁾ and 48% lower incidence⁽¹³⁾).

A study of about 6,000 Danish men and women showed that fermented dairy intake, which included all varieties of yogurt, was inversely associated with fasting plasma glucose and glycosylated haemoglobin. Together, these studies suggest that full-fat varieties of yogurt are beneficially associated with type 2 diabetes risk⁽¹⁴⁾. Trans-palmitoleate is associated with lower insulin resistance. Some of the above findings could be affected by confounding factors, and there is a need for more research to investigate further the benefits of dairy and particularly full-fat dairy products.

Possible Mechanisms

Why is yogurt associated with a lower risk of type 2 diabetes? While the answer is not perfectly clear, there are several potential mechanisms that could explain the beneficial relationship:

- Yogurt intake is related to lower obesity, which is a risk factor for type 2 diabetes⁽¹⁵⁾.
- Yogurt contains vitamin K-2 that has been shown to be related to reduced risk for type 2 diabetes⁽¹⁶⁾.

Guidelines

US Dietary Guidelines 2015 ⁽²⁰⁾

Increased intake of dairy products, especially fat-free or low-fat milk and yogurt. Some sweetened yogurt so long as daily sugars don't exceed added sugars limit.

American Diabetes Association ⁽²¹⁾

Milk has a low glycemic index so choose lower-fat dairy products to fit into your meals. The best choices of dairy products include plain non-fat yogurt and non-fat light yogurt (regular or Greek yogurt).

Canadian Diabetes Association ⁽²²⁾

Have at least three out of the four key food groups at each meal from Eating Well with Canada's Food Guide: vegetables and fruit; grains; milk & alternatives; meat & alternatives. Suggested meal plans refer to low-fat plain yogurt.

UK, The Eatwell Guide ⁽²⁴⁾

Have some dairy or dairy alternative daily; choosing lower fat and lower sugar options.

Diabetes UK ⁽²³⁾

Aim for three portions of dairy foods each day. Choose low-fat yogurt and check labels to choose varieties that are lower in added sugar.

Greece, Dietary Guidelines ⁽²⁶⁾

Consume an average of 2 daily servings of dairy products.

Spain, Food-Based Guidelines ⁽²⁷⁾

Eat milk and dairy products every day.

Mediterranean Diet Foundation ⁽²⁸⁾

Dairy products are excellent sources of proteins, minerals (calcium, phosphorus, etc.) and vitamins.

Australia, Food for Health ⁽²⁹⁾

Milk, yogurt, cheese and/or their alternatives, mostly reduced fat, daily.

China, Food Guide Pagoda ⁽³⁰⁾

Consume milk or soya-bean products every day (300g of milk and milk products).

- Probiotics found in some yogurts can help improve antioxidant status in those with type 2 diabetes ⁽¹⁷⁾.
- The proteins in yogurt can stimulate insulin secretion, thus helping with glycemic control ⁽¹⁸⁾.
- Yogurt is a low glycemic food suggesting that it will not spike glucose levels after a meal ⁽¹⁹⁾.

Dietary recommendations around the globe

The US 2015 Dietary Guidelines Advisory Committee concluded that “consumption of dairy foods provides numerous health benefits, including lower risk of diabetes, metabolic syndrome, cardiovascular disease and obesity” ⁽²⁰⁾. Indeed, dietary guidelines around the world recommend yogurt and dairy foods as an integral food group. Several diabetes associations around the world (shown in pink in sidebar) also recommend consumption of yogurt and low fat dairy foods each day.

Other dietary patterns have been associated with improved T2D risk ^(31, 32). For example, the DASH (Dietary Approaches to Stop Hypertension) diet emphasises fruits, vegetables, and low-fat dairy products, as well as whole grains, poultry, fish, and nuts. And the Mediterranean style eating pattern, which has been associated with reduced incidence of T2D, includes fruits, vegetables, beans, nuts and seeds, minimally processed foods, olive oil, and dairy products (mainly cheese and yogurt).

Yogurt and diabetes in practice – the swaps approach

Dietitians are skilled in translating evidence-based approaches to practical and simple guidelines. Advice is more likely to be acceptable if the recommended diet is as close to current eating habits as possible. One relatively simple method for encouraging better eating habits is via swaps. Swapping out less healthy foods or snacks for more nutrient-dense ones can help meet nutrient needs and may improve overall health. For example, a study in a Mediterranean population showed that substituting one serving per day of snacks such



Figure 4: Replacing less healthy snacks with a yogurt reduced the risk of T2D, in Spanish and British cohorts ⁽³³⁻³⁵⁾.

as biscuits and chocolate or whole grain biscuits and pastries for yogurt resulted in a >40% reduction in type 2 diabetes risk ⁽³⁴⁾. Similarly, a study in a British population showed that eating one portion of yogurt in place of an alternative snack was related to a 47% lower hazard for type 2 diabetes ⁽³⁵⁾.

The swaps approach is an example of how people can incorporate yogurt into their diet by replacing a regular food or ingredient, thereby reducing calorie intake or improving nutrient profile. An added benefit can often be a greater portion size at the same, or lower, calorie content.

**Yogurt swaps
can help reduce
calories**

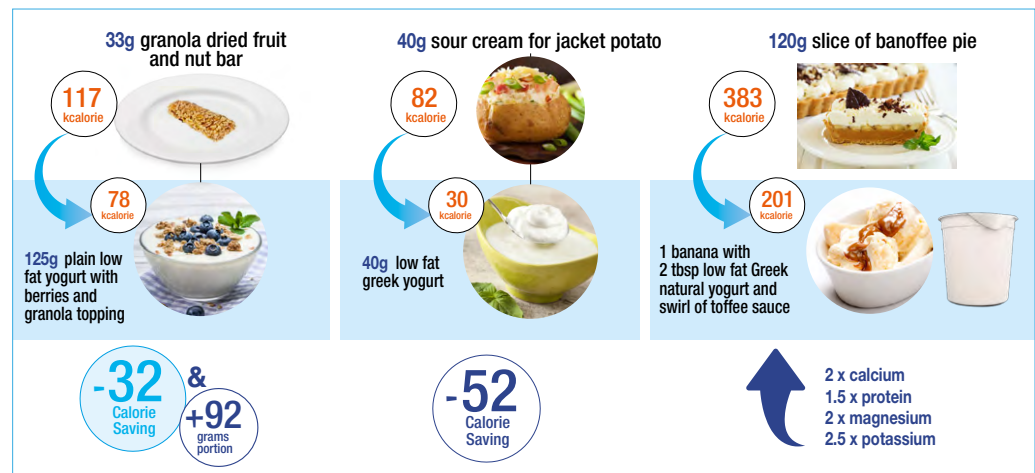


Figure 5: Incorporating yogurt into a daily menu.

(See more swaps in slideshow available at <http://www.yogurtinnutrition.com/yogurt-diabetes-put-practice/>)

Three dietetic questions to ponder over...

1 - Balanced eating is as much about what you eat as what you don't eat...

...yet media headlines typically highlight what we shouldn't eat – eat less sugar, less fat, for example. One might argue that a more positive approach, embracing the nutrient and energy density benefits of foods such as yogurt, could be around an “eat” philosophy, so long as this is attached to healthful foods like whole grains, fruit, vegetables, pulses, yogurt, and so on, in appropriate amounts. By the time people have eaten three or more servings of whole grains, at least five portions of fruit and vegetables, 2-3 servings of dairy foods, 8-10 cups of fluid, a handful of nuts, a tablespoon of seeds, and so on, there would be less room for unhealthy foods. Could this be an alternative approach to the “eat less” tone of dietary advice?

2 - Is it time we stopped demonising sugar and fat?

Yogurt is a nutritious food in any form and there is evidence to suggest that sugared yogurt and full-fat varieties are still associated with health benefits. However, dietary advice typically suggests we choose plain yogurt. Is it time we stopped demonising sugar and fat, and looked at the nutritional value of yogurt as a key component of an essential food group within a balanced diet, regardless of whether it has added sugar or inherent fat?

3 - Yogurt offers more than just nutrients

There is a growing body of research on the role of yogurt in reducing risks of T2D. Indeed, yogurt eaters tend to have other healthy lifestyle behaviours, and evidence suggests that we could consider yogurt as a marker of healthy eating habits⁽³⁶⁾. Is it time we incorporated yogurt into dietary advice for reasons over and above its nutritional composition?

**Yogurt is
a nutritious
food in
any form**

Yogurt and diabetes: What's next?

The research summarised in this Digest provides a relatively convincing demonstration of a favorable link between yogurt consumption and the risk of developing type 2 diabetes. As discussed in previous Digests, the beneficial effects of yogurt are not limited to nutrition content or bacteria; simply eating yogurt appears to have an effect on the rest of the diet. However, as is generally the case in the field of nutrition, a lot of investigative work remains to be done to better understand and hence ultimately “better intervene”. Evidence to date certainly points towards the hope that yogurt might successfully contribute to preventive medicine strategies.

- Digest 1: [What added value does yogurt bring to dairy protein?](http://www.yogurtinnutrition.com/added-value-yogurt-bring-dairy-protein/)
<http://www.yogurtinnutrition.com/added-value-yogurt-bring-dairy-protein/>
- Digest 2: [Role of protein and yogurt in appetite control](http://www.yogurtinnutrition.com/role-of-protein-and-protein-rich-yogurt-in-appetite-control/)
<http://www.yogurtinnutrition.com/role-of-protein-and-protein-rich-yogurt-in-appetite-control/>
- Digest 3: [How yogurt can be a satisfying snack](http://www.yogurtinnutrition.com/how-yogurt-can-be-a-satisfying-snack/)
<http://www.yogurtinnutrition.com/how-yogurt-can-be-a-satisfying-snack/>
- Digest 4: [What is a healthy snack?](http://www.yogurtinnutrition.com/what-is-a-healthy-snack/)
<http://www.yogurtinnutrition.com/what-is-a-healthy-snack/>
- Digest 5: [Yogurt, weight and curves](http://www.yogurtinnutrition.com/yogurt-weight-and-curves/)
<http://www.yogurtinnutrition.com/yogurt-weight-and-curves/>
- Digest 6: [Yogurt – why it could be the signature of a healthy diet](http://www.yogurtinnutrition.com/yogurt-why-it-could-be-the-signature-of-a-healthy-diet/)
<http://www.yogurtinnutrition.com/yogurt-why-it-could-be-the-signature-of-a-healthy-diet/>
- Digest 7: [All you wanted to know about yogurt](http://www.yogurtinnutrition.com/everything-you-wanted-to-know-about-yogurt/)
<http://www.yogurtinnutrition.com/everything-you-wanted-to-know-about-yogurt/>

EDITORIAL BOARD

Angelo Tremblay,
Professor, Department of Kinesiology,
Laval University, Canada

Chris Cifelli,
Vice President of Nutrition Research
at the National Dairy Council, USA

Azmina Govindji,
Registered Dietitian and best-selling
author, AzminaNutrition.com, UK



<http://www.yogurtinnutrition.com>

Look out for your next issue of *Yogurt Nutrition Digest: Yogurt and You*

What did you think of Yogurt Nutrition Digest 8? Tweet us your feedback @YogurtNutrition - #Yogurt4Health

References: 1. World Health Organization. Global Report on Diabetes. 2016. (http://apps.who.int/iris/bitstream/10665/204871/1/9789241565257_eng.pdf) 2. International Diabetes Federation (IDF). Diabetes Atlas, Seventh Edition 2015. <http://www.idf.org/about-diabetes/facts-figures> or <https://www.idf.org/sites/default/files/Atlas7e-poster.pdf> 3. Ley SH, Hamdy O, Mohan V, Hu FB. Prevention and management of type 2 diabetes: dietary components and nutritional strategies. *Lancet* 2014; 383 (9933):1999-2007. 4. Elwood C, Pickering JE, Givens DI, Gallacher JE. 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. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2950929/> 5. Tong X, Dong JY, Wu ZW, Li W, Qin LQ. Dairy consumption and risk of type 2 diabetes mellitus: a meta-analysis of cohort studies. *Eur J Clin Nutr* 2011; 65(9):1027-31. <http://www.ncbi.nlm.nih.gov/pubmed/21559046> 6. Gao D, Ning N, Wang C, Wang Y, Li Q, Meng Z, Liu Y, Li Q. Dairy products consumption and risk of type 2 diabetes: systematic review and dose-response meta-analysis. *PLoS One* 2013; 8(9):e73965. <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0073965> 7. Aune D, Norat T, Romundstad P, Vatten LJ. 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):1066-83. <http://www.ncbi.nlm.nih.gov/pubmed/23945722> 8. NCD Risk Factor Collaboration. www.ncdrisc.org/index.html 9. Standards of Medical Care in Diabetes—2015. *Diabetes Care* 2015 ; VOLUME 38(S1). http://care.diabetesjournals.org/content/suppl/2014/12/23/38.Supplement_1.DC1/January_Supplement_Combined_Final.6-99.pdf 10. Gijbbers 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 Apr;103(4):1111-24. doi: 10.3945/ajcn.115.123216. Epub 2016 Feb 24. <https://www.ncbi.nlm.nih.gov/pubmed/26912494> 11. Chen M, Sun Q, Giovannucci E, Mozaffarian D, Manson JE, Willett WC, Hu FB. Dairy consumption and risk of type 2 diabetes: 3 cohorts of US adults and an updated meta-analysis. *BMC Med*. 2014 Nov 25;12:215. doi: 10.1186/s12916-014-0215-1. <https://www.ncbi.nlm.nih.gov/pubmed/25420418> 12. Mozaffarian D, Cao H, King IB, Lemaitre RN, Song X, Siscovick DS, Hotamisligil GS. trans-palmitoleic acid, metabolic risk factors, and new-onset diabetes in U.S. adults: a cohort study. *Ann Intern Med* 2010; 153(12):790-9. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3056495/> 13. Mozaffarian D, de Oliveira Otto MC, Lemaitre RN, Fretts AM, Hotamisligil G, Tsai MY, Siscovick DS, Nettleton JA. trans-Palmitoleic acid, other dairy fat biomarkers, and incident diabetes: the Multi-Ethnic Study of Atherosclerosis (MESA). *Am J Clin Nutr* 2013; 97(4):854-61. <http://ajcn.nutrition.org/content/97/4/854.long> 14. Struijck EA, Heraclides A, Witte DR, Soedamah-Muthu SS, Geleijnse JM, Toft U, Lau CJ. Dairy product intake in relation to glucose regulation indices and risk of type 2 diabetes. *Nutr Metab Cardiovasc Dis*. 2013 Sep;23(9):822-8. <http://www.ncbi.nlm.nih.gov/pubmed/22831954> 15. Mozaffarian D1, Hao T, Rimm EB, Willett WC, Hu FB. Changes in diet and lifestyle and long-term weight gain in women and men. *N Engl J Med*. 2011; 364(25):2392-404. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3151731/> 16. Beulens JW1, van der A DL, Grobbee DE, Suijls I, Spijkerman AM, van der Schouw YT. Dietary phytyloquinone and menaquinones intakes and risk of type 2 diabetes. *Diabetes Care*. 2010; 33(8):1699-705. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2909045/> 17. Ejtahed HS, Mohtadi-Nia J, Homayouni-Rad A, Niafar M, Asghari-Jafarabadi M, Mofid V, Akbarian-Moghari A. Effect of probiotic yogurt containing *Lactobacillus acidophilus* and *Bifidobacterium lactis* on lipid profile in individuals with type 2 diabetes mellitus. *J Dairy Sci*. 2011; 94(7):3288-94. <http://www.ncbi.nlm.nih.gov/pubmed/21700013> 18. Pasin G, Comerford KB. Dairy foods and dairy proteins in the management of type 2 diabetes: a systematic review of the clinical evidence. *Adv Nutr* 2015;6:245-59. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4424779/> 19. Yogurt intake in relation to glycemia and insulinemia. *Experimental Biology EB-2016, 4th Global Summit on the Health Effects of Yogurt*. Yogurt in Nutrition website <http://www.yogurtinnutrition.com/yogurt-intake-relation-glycemia-insulinemia/> 20. U.S. Department of Health and Human Services and U.S. Department of Agriculture. Scientific report of the 2015 dietary guidelines advisory Committee. February 2015. <https://health.gov/dietaryguidelines/2015-scientific-report/pdfs/scientific-report-of-the-2015-dietary-guidelines-advisory-committee.pdf> 21. U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015 – 2020 Dietary Guidelines for Americans. 8th Edition. December 2015. <http://health.gov/dietaryguidelines/2015/guidelines/> 22. American Diabetes Association (website). What can I eat? <http://www.diabetes.org/food-and-fitness/food/what-can-i-eat/> Accessed online 21 July 2016 23. Canadian Diabetes Association (website) <http://www.diabetes.ca/diabetes-and-you/healthy-living-resources/diet-nutrition/basic-meal-planning#sthash.WJUHPh.dpuf> Accessed online 21 July 2016 24. Public Health England in association with the Welsh Government, Food Standards Scotland and the Food Standards Agency in Northern Ireland. The Eatwell Guide 2016. Helping you eat a healthy, balanced diet. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/528200/Eatwell_guide_booklet.pdf 25. Diabetes UK (website). Eating with diabetes <https://www.diabetes.org.uk/Guide-to-diabetes/Enjoy-food/Eating-with-diabetes/> Accessed online 21 July 2016 26. Dietary guidelines for adults in Greece (1999). <http://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/greece/en/> 27. Spanish Agency for Consumer Affairs, Food Safety and Nutrition of the Spanish Ministry of Health, Social Services and Equality. Eat healthy and move: 12 healthy decisions (2008). <http://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/spain/en/> 28. Fundación Dieta Mediterránea. What's the Mediterranean diet? <http://dietamediterranea.com/en/nutrition/> 29. National Health and Medical Research Council (2013) Australian Dietary Guidelines. Canberra: National Health and Medical Research Council. <https://www.eatforhealth.gov.au/guidelines/australian-dietary-guidelines-1-5> 30. Chinese Nutrition Society. Chinese Dietary Guidelines & Food Guide Pagoda. <http://debategraph.org/Stream.aspx?nid=154620&vt=bubble&dc=focus> 31. Cespedes EM, Hu FB, Tinker L, Rosner B, Redline S, Garcia L, Hingle M, Van Horn L, Howard BV, Levitan EB, Li W, Manson JE, Phillips LS, Rhee JJ, Waring ME, Neuhouser ML. Multiple Healthful Dietary Patterns and Type 2 Diabetes in the Women's Health Initiative. *Am J Epidemiol*. 2016; 183(7):622-33. <http://www.ncbi.nlm.nih.gov/pubmed/26940115> 32. Evert AB et al. Nutrition Therapy Recommendations for the Management of Adults With Diabetes. *Diabetes Care* 2014 Jan; 37(Supplement 1): S120-S143. <http://dx.doi.org/10.2337/dc14-S120> 33. Snack swap to yogurt & reduce T2 Diabetes risk. *Experimental Biology EB-2016, 4th Global Summit on the Health Effects of Yogurt*. Yogurt in Nutrition website http://www.yogurtinnutrition.com/help-reduce-type-2-diabetes-risk-healthy-snack-swaps/?utm_content=buffer87002&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer 34. 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*. 2016; 55(1):349-60. <http://www.ncbi.nlm.nih.gov/pubmed/25663611> 35. O'Connor LM, Lentjes MA, Luben RN, Khaw KT, Wareham NJ, Forouhi NG. Diabetologia. 2014; 57(5):909-17. Dietary dairy product intake and incident type 2 diabetes: a prospective study using dietary data from a 7-day food diary. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3980034/> 36. Why yogurt could be the signature of a healthy diet. *Yogurt Nutrition Digest n°6, June 2016*. <http://www.yogurtinnutrition.com/yogurt-why-it-could-be-the-signature-of-a-healthy-diet/>