



YOGURT  
IN  
NUTRITION

INITIATIVE FOR A BALANCED DIET

# 2017 BEST OF YOGURT PUBLICATIONS

Selected for you  
by the YINI experts





## CONTENTS

### INTRODUCTION

Obesity and type 2 diabetes: could yogurt be protective? 5

### STUDIES

**YOGURT IS ASSOCIATED WITH LOWER T2D RISK IN OLDER ADULTS AT HIGH CARDIOVASCULAR RISK** 6

Díaz-López A, Bulló M, Martínez-González MA, 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;55:349–60.

**INCREASED YOGURT CONSUMPTION COULD POTENTIALLY HELP TO REDUCE HEALTH SERVICE COSTS ASSOCIATED WITH T2D** 8

Lenoir-Wijnkoop I, Mahon J, Claxton L, et al. An economic model for the use of yoghurt in type 2 diabetes risk reduction in the UK. *BMC Nutr* 2016;2:77.

**YOGURT CONSUMPTION IS ASSOCIATED WITH REDUCTION IN ABDOMINAL OBESITY IN THE ELDERLY** 10

Santiago S, Sayón-Orea C, Babio N, et al. Yogurt consumption and abdominal obesity reversion in the PREDIMED study. *Nutr Metab Cardiovasc Dis* 2016;26:468–75.

**YOGURT CONSUMPTION MAY BE BENEFICIAL IN OBESITY** 12

Pei R, Martin DA, DiMarco DM, Bolling BW. Evidence for the effects of yogurt on gut health and obesity. *Crit Rev Food Sci Nutr* 2017;57:1569–83.

**COMBINED INTAKE OF YOGURT AND FRUIT OFFERS POTENTIAL SYNERGISTIC BENEFITS** 14

Fernandez MA, Marette A. Potential health benefits of combining yogurt and fruits based on their probiotic and prebiotic properties. *Adv Nutr* 2017;8:155S–64S.

**REFERENCES** 16



## INTRODUCTION

### **Obesity and type 2 diabetes: could yogurt be protective?**

The prevalence of obesity is rising rapidly worldwide and has become a growing health concern since it has been identified as a major risk factor for the development of several chronic diseases. The alarming rise in the incidence of type 2 diabetes (T2D) is of particular concern, especially among older age groups, because of its detrimental impact on people's lives and the enormous healthcare costs associated with managing the condition and its related complications. Gut health is known to be impaired in obesity, and this suggests that dietary interventions may play a valuable role in weight-control programmes.

Yogurt is widely recognised as a healthy food. Epidemiological studies have shown that yogurt consumption is associated with a reduction in indicators of overweight and obesity, such as waist circumference and body mass index (BMI). In addition, there is some evidence that increased yogurt intake is associated with a reduction in the risk of developing T2D. However, until recently, such studies have largely excluded elderly individuals.

The Yogurt in Nutrition Initiative (YINI) experts have selected and summarised five recent scientific studies and reviews, including studies in elderly individuals, that provide further information on the benefits of yogurt in tackling obesity and T2D. There is evidence that increased whole-fat yogurt consumption is associated with a reduction in waist circumference, an increased probability of reversion of abdominal obesity, and a reduction in the risk of T2D in older people. Yogurt consumption appears to improve gut health in obese individuals, may improve lipid profiles, and may help to suppress appetite.

The benefits of yogurt may be further enhanced if it is eaten with fruit. A recent study suggests that increased yogurt consumption among adults may lead to substantial healthcare cost savings through reductions in the incidence of T2D.

We hope that you find these summaries interesting and useful. More information can be found on the YINI website: <http://www.yogurtinnutrition.com/>

*The YINI Board*

### **The Yogurt in Nutrition Initiative (YINI)**

The Yogurt in Nutrition Initiative (YINI) for a Balanced Diet is a collaborative project between the *Danone Institute International* and the *American Society for Nutrition* dedicated to examining the health effects of yogurt, stimulating new research and communicating available scientific information on the subject. The YINI Board comprises experts within medical and nutrition fields from all over the world.

# YOGURT IS ASSOCIATED WITH LOWER T2D RISK IN OLDER ADULTS AT HIGH CARDIOVASCULAR RISK

Díaz-López A, Bulló M, Martínez-González MA, 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;55:349–60.

## Summary

The authors followed more than 3000 older-aged people at high risk for cardiovascular disease and discovered they were less likely to develop T2D if they frequently ate yogurt and other dairy foods – particularly low-fat products. Replacing biscuits and chocolate confectionery, or whole grain biscuits and homemade pastries, typical desserts or snacks in Spain, for yogurt was associated with a significantly lower risk of T2D.

Studies examining the effects of dairy consumption on T2D prevention have been conducted in healthy young or middle-aged people and have shown mixed results. The authors of this study aimed to investigate the **association between dairy consumption and risk of T2D in an elderly**, community-dwelling Spanish population **at high cardiovascular risk**.

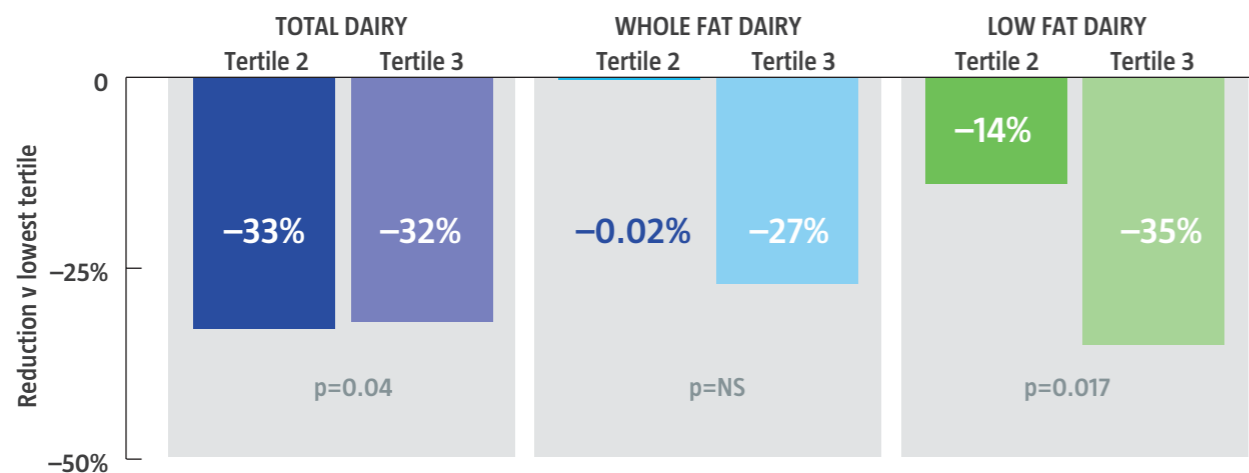
## Study methodology

- The authors followed prospectively 3454 non-diabetic participants (mean age 67 years) in the PREDIMED (PREvención con Dieta MEDiterránea) study.
- Dairy consumption was assessed at baseline and yearly using food frequency questionnaires.
- Participants were categorised into tertiles of dairy consumption (mean ± SD [g/day]: lowest 182 ± 73; intermediate 343 ± 39; highest 562 ± 119).
- Incidences of T2D during follow-up in the two upper dairy consumption tertiles were compared with the lowest tertile.
- Consumption was categorised into total, low-fat, whole-fat, and subgroups: milk, yogurt, cheeses, fermented dairy, concentrated full-fat, and processed dairy.
- Hazard regression models were adjusted for a wide range of potential confounders, including BMI, smoking status, physical activity, fasting glucose, hypertension and lipids.
- Subsequent multivariate analyses were carried out to examine the hazard ratios (HRs) for T2D of substituting one serving/day of alternative foods for one serving/day of dairy products (only those dairy products that were associated with T2D).

## Results: More dairy, lower risk

During a median follow-up of 4.1 years, 270 incident cases of T2D were documented. **Increased total dairy consumption was associated with a reduced risk of T2D** after adjustment for potential confounders (Figure 1). This association appeared to be largely attributable to low-fat dairy products.

Figure 1. Reduction in T2D risk is associated with increased dairy consumption



**High consumption of low-fat dairy products was associated with a significant reduction in T2D risk**

Low-fat milk and yogurt consumption were strongly associated with a lower T2D risk after adjustment for potential confounders (Table 1). No significant association was found for total and whole-fat milk, cheese, concentrated full-fat dairy and processed dairy products.

Table 1. T2D risk in relation to consumption of specific dairy products

	Hazard ratio (95% CI)		p for trend
	Tertile 2	Tertile 3	
Low-fat milk	0.98 (0.71–1.38)	0.67 (0.46–0.95)	0.034
Total yogurt	0.61 (0.43–0.85)	0.60 (0.42–0.86)	0.002
Low-fat yogurt	0.69 (0.49–0.97)	0.68 (0.47–0.97)	0.047
Whole-fat yogurt	0.84 (0.60–1.18)	0.66 (0.47–0.92)	0.020

Tertiles 2 and 3 (intermediate and highest dairy consumption, respectively) were compared with tertile 1 (lowest dairy consumption).



**Substituting typical desserts and snacks with yogurt was associated with a significant reduction in T2D risk**

## Conclusion: Yogurt may offer protection

High consumption of dairy products, particularly yogurt, as part of a healthy dietary pattern may help protect against T2D in older adults who are at high cardiovascular risk and highly predisposed to develop T2D.

## Discussion: Studies to unravel mechanisms

The findings of this study are consistent with several reports in the literature of a reduced risk of T2D in healthy individuals with a high intake compared with a low intake of dairy products.<sup>1–3</sup> A meta-analysis published in 2014 reported that higher yogurt consumption was associated with a reduced risk of T2D, whereas there was no appreciable association for other dairy products.<sup>4</sup> The mechanism behind the relationship between dairy or yogurt consumption and T2D risk is unclear. Studies are warranted to examine the potential mechanisms that have been suggested, including increased bioavailability of micronutrients, satiety effects and weight reduction, insulinotropic effects, beneficial metabolic effects of probiotic bacteria and fermented products, and suppression of oxidative and inflammatory stress associated with obesity.

## Highlights

*'Although nutritionally yogurt is comparable to milk, processing, added ingredients, and fermentation improve the nutritional value of yogurt and provide it with unique properties that enhance the bioavailability of some nutrients (e.g., riboflavin, vitamin B12, calcium, magnesium, zinc)... yogurt consumption may help to ameliorate some of the most common nutritional deficits and related complications in older adults.'* – A. Díaz-López et al



# INCREASED YOGURT CONSUMPTION COULD POTENTIALLY HELP TO REDUCE HEALTH SERVICE COSTS ASSOCIATED WITH T2D

Lenoir-Wijnkoop I, Mahon J, Claxton L, et al. An economic model for the use of yoghurt in type 2 diabetes risk reduction in the UK. BMC Nutr 2016;2:77.

## Summary

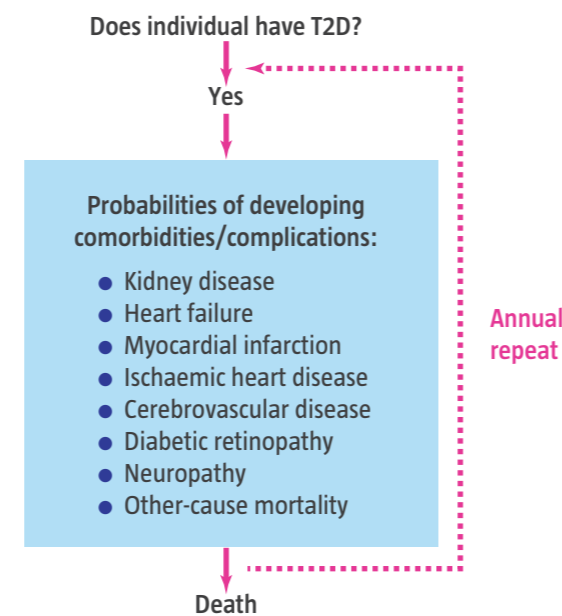
The authors developed an economic model to predict likely cost savings achieved if UK adults ate more yogurt. The predictions suggest that if British people ate on average one pot (125 g) of yogurt a day, over 388,000 cases of diabetes could be prevented over the next 25 years. This translates to potential savings to the UK National Health Service (NHS) of GBP £2377 million over the 25-year period.

Type 1 and type 2 diabetes and their complications account for about 10% of the UK NHS budget, and this is projected to rise to 17% by 2035/2036 as the prevalence of T2D continues to escalate. A meta-analysis of prospective studies published in 2014 reported that increased intake of yogurt is linked to a reduced risk of developing T2D, an association not seen for other dairy products and total dairy consumption.<sup>4</sup> The authors of this study describe an economic model used to predict the patient benefits and potential cost savings to the NHS of increased yogurt consumption in the UK adult population.

## Study methodology

- A patient simulation model was constructed for UK adults, >25 years of age, comparing incidence rates for T2D arising with current and increased yogurt consumption. The model was an annual cycle until death (Figure 1), for up to 25 years.
- Age-specific incidence and prevalence for T2D and related comorbidities and mortality rates were derived from the literature.
- Current yogurt consumption in the UK was taken to be 20.4 g/person/day<sup>10</sup> and in the base-case model it was assumed to rise to 125 g (a standard single-serving size).
- Incidence rates for developing T2D with current and increased yogurt consumption were extrapolated from the 2014 meta-analysis.<sup>4</sup>
- Costs incorporated into the model included direct diabetes management costs, hospital costs and non-inpatient costs for treating diabetes-related complications.
- At the end of each annual cycle, a level of quality of life was assigned to the individual based on their age and disease-specific health state.
- 100,000 individuals were cycled through the model.

Figure 1. Patient simulation model



## Results: More yogurt, less diabetes

The model predicted that increased yogurt consumption could result in 388,369 fewer people developing T2D, and 2187 fewer people dying, over 25 years.

Discounted mean savings to the NHS of increasing average daily yogurt consumption to 125 g would be £140 million over 5 years, and £2377 million over 25 years (Table 1).

Table 1. Total UK NHS costs and savings over 25 years as a result of increasing yogurt consumption

Time horizon	Total NHS costs (mean and 95% CI)		Savings
	Current yogurt consumption	Increased yogurt consumption	
5 years	£261,710 million (£260,941 m, £262,480 m)	£261,570 million (£260,801 m, £262,339 m)	£140 million (£116 m, £165 m)
25 years	£939,994 million (£937,509 m, £942,480 m)	£937,617 million (£935,140 m, £940,095 m)	£2377 million (£2181 m, 2573 m)

Increase consumption to **125g daily**

**£2.377 billion** potentially saved in T2D-related costs over 25 years

At a UK population level, increasing average yogurt consumption to 125 g daily would generate about 17,000 quality-adjusted life years (QALYs) over 5 years, and about 276,000 QALYs over 25 years (Table 2).

Table 2. Total UK QALYs and gains over 25 years as a result of increasing yogurt consumption

Time horizon	UK population QALYs (mean and 95% CI)		QALYs gained
	Current yogurt consumption	Increased yogurt consumption	
5 years	191 million (191 m, 192 m)	191 million (191 m, 192 m)	0.017 million (0.015 m, 0.020 m)
25 years	689 million (687 m, 691 m)	689 million (688 m, 691 m)	0.276 million (0.246 m, 0.307 m)

*The major driver of both cost savings and QALY gains was the reduction in T2D cases rather than a reduction in complications*

## Conclusion: Cost savings reflect patient benefits

Increasing yogurt consumption in the UK adult population by 100 g per day – so that the average adult ate one 125 g serving per day – could save the NHS billions of pounds, as well as achieving major patient benefits through a reduced incidence of T2D.

## Discussion: Increasing yogurt consumption to relieve the burden of diabetes

If the relationship between yogurt consumption and T2D risk reported in the literature is causative, increasing yogurt intake could be an effective policy for reducing the incidence of T2D. This aligns well with the UK government's National Institute for Health and Care Excellence (NICE) 2015 Clinical Guidelines to integrate dietary advice into prevention and treatment of T2D. Given the rapidly increasing prevalence of T2D and the high healthcare costs associated with the condition and its complications, increasing yogurt consumption potentially offers a cost-saving measure that could help alleviate the economic burden of T2D on the NHS.

## Highlights

'...if the average consumption of yoghurt...increased to 125 g per day...this would generate approximately 276,352 (246,172, 306,532) total additional discounted QALYs over 25 years. If these QALYs were valued at £20,000/QALY as is usually applied by NICE in the UK for approval of therapies, then the NHS should be prepared to pay £5,500m over 25 years for an intervention that would generate the same number of QALYs.' – I. Lenoir-Wijnkoop et al

# YOGURT CONSUMPTION IS ASSOCIATED WITH REDUCTION IN ABDOMINAL OBESITY IN THE ELDERLY

Santiago S, Sayón-Orea C, Babio N, et al. Yogurt consumption and abdominal obesity reversion in the PREDIMED study. *Nutr Metab Cardiovasc Dis* 2016;26:468–75.

## Summary

The authors examined prospectively the association between yogurt consumption and waist circumference in more than 4500 people aged ≥65 years. They found that those who ate yogurt most frequently had a higher probability for reversion of abdominal obesity than those who rarely ate yogurt. The benefit was seen with whole-fat, rather than low-fat yogurt.

The global prevalence of obesity has more than doubled since 1980,<sup>5</sup> and studies in Spanish populations have reported prevalence rates for abdominal obesity of 56–62% in adults aged ≥65 years.<sup>6,7</sup> A recent systematic review of epidemiological studies concluded that yogurt consumption was associated with lower BMI, lower body weight and/or weight gain, smaller waist circumference and lower body fat.<sup>8</sup>

The authors of this study aimed to evaluate the association between yogurt consumption and abdominal obesity and waist circumference in an older Spanish population at high cardiovascular risk.

## Study methodology

- The authors followed prospectively 4545 participants (mean age 67 years) in the PREDIMED study who had abdominal obesity at baseline (defined as a waist circumference ≥102 cm in men and ≥88 cm in women).
- Yogurt consumption was assessed at baseline and yearly using food frequency questionnaires, and classified into quintiles of energy-adjusted consumption of total, whole-fat and low-fat yogurt.
- Participants' waist circumference was recorded yearly during follow-up.
- The outcomes for each of the four upper quintiles of yogurt consumption (2–5) were compared with the outcomes for the lowest quintile (1; reference).
- Logistic regression models were used to calculate odds ratios (ORs) and 95% confidence intervals (CIs) for reversion of abdominal obesity.
- Regression models were adjusted for a wide range of potential confounders, including BMI, smoking status, physical activity and total energy intake.

## Results: More yogurt linked to slimmer waist

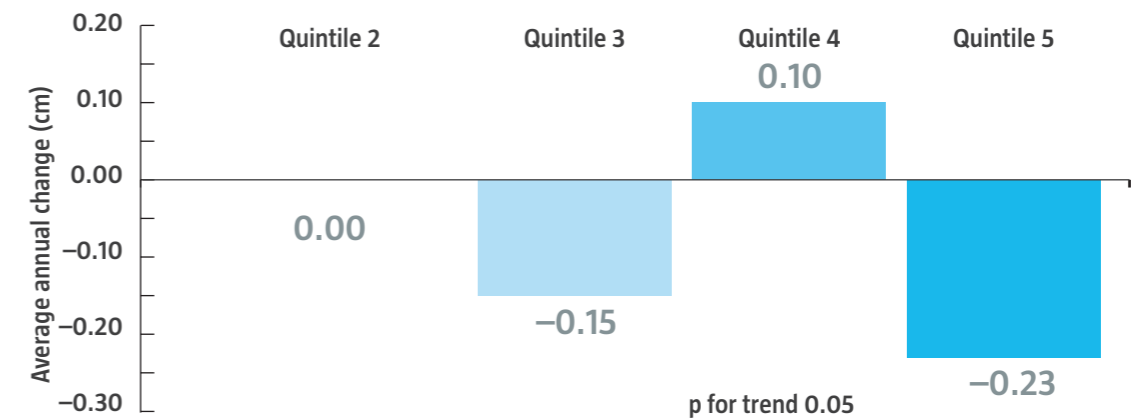
After adjustment for potential confounders, participants in the highest quintile of total (mean ± SE: 213.5 ± 113.5 g/day), whole-fat (52.5 ± 104.1 g/day) or low-fat (161.1 ± 122.2 g/day) yogurt consumption had a reduced waist circumference compared with participants in the lowest quintile (3.4 ± 6.4, 1.7 ± 4.7, and 1.7 ± 4.7 g/day, respectively) (Table 1). This relative reduction in waist circumference was only statistically significant for whole-fat yogurt (Table 1 and Figure 1).

Table 1. Effect of yogurt consumption on waist circumference

	Difference in average annual waist change (highest quintile vs lowest quintile)	p for trend
Total yogurt	−0.21 cm (95% CI −0.46, 0.05)	0.25
Whole-fat yogurt	−0.23 cm (95% CI −0.46, 0.00)	0.05
Low-fat yogurt	−0.15 cm (95% CI −0.47, 0.17)	0.43

High consumption of whole-fat yogurt was associated with a decrease in waist circumference in the elderly

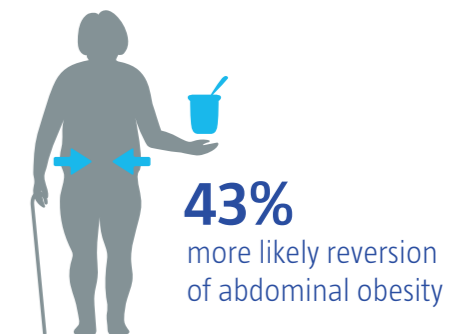
Figure 1. Whole-fat yogurt consumption is significantly associated with reduced waist circumference



## High consumption of whole-fat yogurt increased the probability of reversion of abdominal obesity by 43%

During a median follow-up of 4.9 years, 867 individuals no longer had abdominal obesity (abdominal obesity reversion).

Compared with the lowest quintile of whole-fat yogurt consumption, the probabilities of reversion of abdominal obesity across the ascending quintiles were higher by 40% (quintile 2), 33% (quintile 3), 21% (quintile 4) and 43% (quintile 5), respectively (p for trend 0.26).



## Conclusion: Whole-fat yogurt shows benefit

Higher consumption of whole-fat yogurt was associated with reduced waist circumference and an increased probability of reversion of abdominal obesity. Low-fat yogurt showed no beneficial effects in the management of abdominal obesity.

## Discussion: Yogurt represents a healthy diet

Although high consumption of whole-fat yogurt was associated with a reduction in waist circumference, the reduction was very small and no dose response was demonstrated. Consequently, yogurt consumption alone should not be regarded as a panacea for abdominal obesity in older people. Nevertheless, the findings of this study are consistent with published studies that have shown an association between the consumption of yogurt, notably whole-fat yogurt, and waist circumference and abdominal obesity. The underlying mechanism behind this association remains poorly understood. Yogurt intake is considered a good marker of a healthy diet,<sup>9</sup> and yogurt has been reported to satiate appetite more readily than other dairy products or high-fat snacks. Furthermore, yogurt supplies calcium, which can reduce lipogenesis and promote lipolysis and lipid oxidation, may increase faecal fat excretion, and has been implicated in appetite control mechanisms. Probiotics in yogurt may also improve gut health and reduce the inflammation that is often seen with obesity.

## Highlights

'To the best of our knowledge, this is the first epidemiologic study that specifically assessed the association between types of yogurt (total, whole-fat and low-fat) and abdominal obesity and waist circumference in elderly.'

'Our results are in line with previous studies suggesting that whole-fat yogurt consumption is associated with a reduced risk of general obesity and also abdominal obesity.' – S. Santiago et al

# YOGURT CONSUMPTION MAY BE BENEFICIAL IN OBESITY

Pei R, Martin DA, DiMarco DM, Bolling BW. Evidence for the effects of yogurt on gut health and obesity. Crit Rev Food Sci Nutr 2017;57:1569–83.

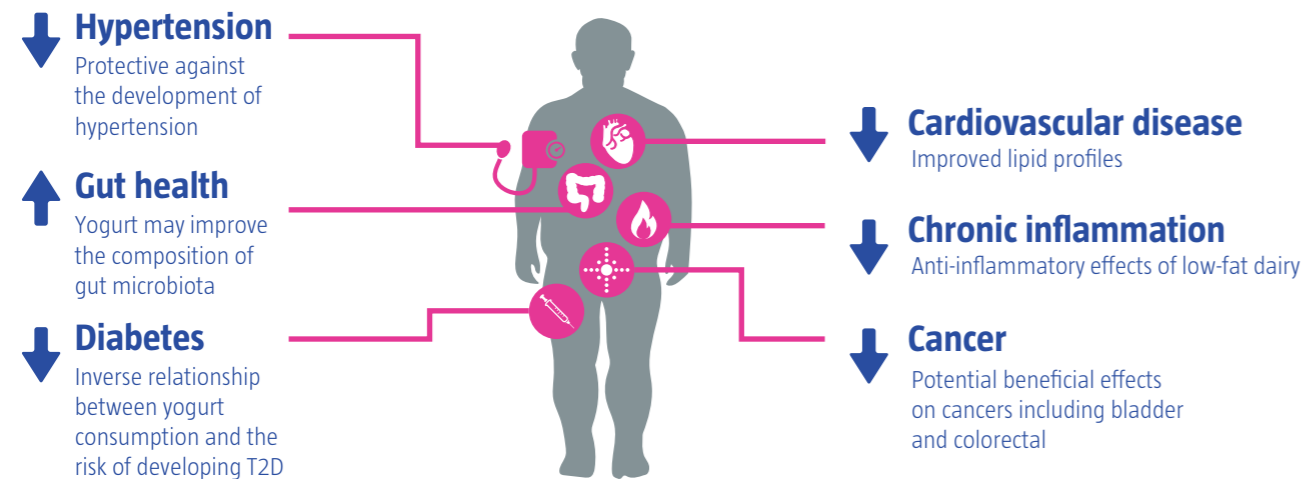
## Summary

In this review, the authors examined the potential benefits of consuming yogurt on gut health and obesity. There are several possible ways in which yogurt may exert its beneficial effects for people who are obese, and these potential mechanisms require further investigation.

Evidence suggests that yogurt benefits people with lactose intolerance, constipation, diarrhoea, allergies, inflammatory bowel diseases, hypertension, cardiovascular disease, T2D and some cancers. Recent data indicate that yogurt consumption may also be advantageous in obese individuals. The authors of this review examined the potential health benefits of yogurt consumption in obese people.

## Obesity and potential health benefits of yogurt

Obesity is a major risk factor for cardiovascular disease, hypertension, cancer, T2D, chronic inflammation, and compromised gut health.



### Cardiovascular disease

Studies have suggested that conventional yogurt consumption may improve lipid profiles in healthy adults and those with raised cholesterol.<sup>25,26</sup> Probiotic- or prebiotic-containing yogurt may provide further improvement in lipid profiles.

**Yogurt consumption may improve lipid profiles**

### Hypertension

Low-fat dairy consumption appears to be protective against the development of hypertension,<sup>27</sup> but further studies are needed to evaluate whether yogurt also has blood pressure-lowering effects.

### Cancer

Accumulating evidence suggests potential beneficial effects of conventional yogurt consumption on cancers, including bladder cancer and colorectal cancer.<sup>28,29</sup>

### Type 2 diabetes

Epidemiological studies have shown an inverse relationship between conventional yogurt consumption and the risk of developing T2D.<sup>30</sup>

### Chronic inflammation

Obesity is accompanied by chronic, low-grade inflammation in various tissues. The anti-inflammatory effects of low-fat dairy products are well documented. There is some evidence that dairy or conventional yogurt consumption may mitigate the chronic inflammation associated with obesity by modulating the immune system.<sup>31</sup>

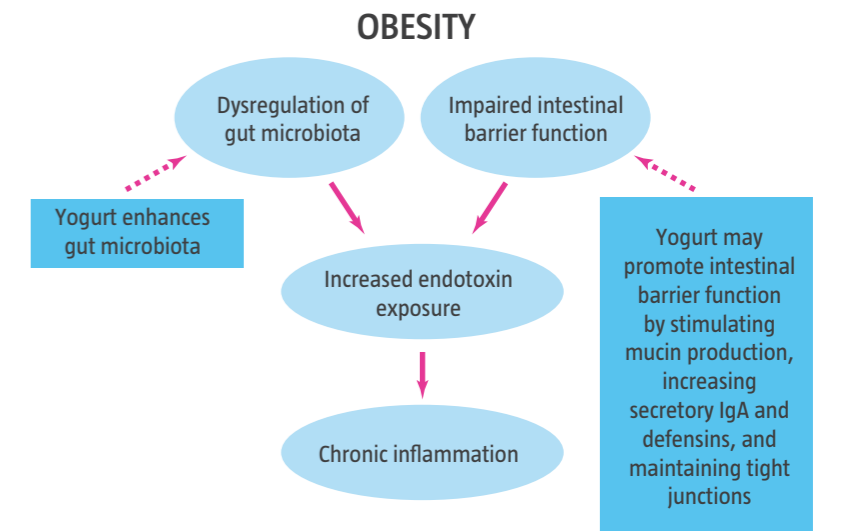
## Gut health

The composition of gut microbiota appears to affect the development of obesity. Although conventional yogurt cultures have limited viability in the gut and a limited ability to influence the composition of the gut microbiota, certain additional bacterial yogurt cultures have greater viability in the gut and may have an improved ability to enhance the composition of the gut microbiota.

Obesity is associated with impaired intestinal barrier function (Figure 1).

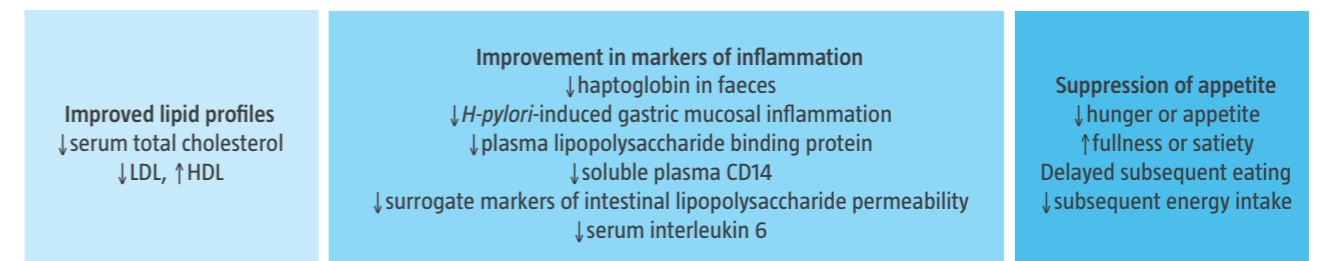
- Impaired intestinal barrier function may contribute to chronic inflammation in obesity by initiating inflammation through endotoxin exposure<sup>32</sup> (Figure 1).
- Endotoxins are lipopolysaccharides found in the outer membrane of Gram-negative bacteria that elicit a strong immune response. Increased endotoxin exposure is seen in overweight and obese individuals,<sup>33</sup> and yogurt consumption may reduce endotoxin exposure by improving barrier function.<sup>34</sup>
- Live bacteria in yogurt may stimulate the production of mucins in the intestine and improve innate host defence.<sup>35</sup>
- Yogurt consumption may increase production of proteins in the intestine that prevent bacterial penetration of the lumen (secretory immunoglobulin A [IgA]) and have bactericidal activity (defensins).<sup>36,37</sup>
- Tight junctions that hold together epithelial cells in the intestinal wall may be compromised in obese individuals, and dairy calcium and probiotic yogurt may help to maintain these junctions and reduce permeability.<sup>38,39</sup>

Figure 1. Proposed mechanisms behind chronic inflammation in obesity and the potential impact of yogurt



In addition to improving lipid and inflammatory biomarkers relevant to obesity and chronic disease risk, yogurt consumption may also help to increase satiety and suppress appetite (Figure 2).

Figure 2. Effects of yogurt on biomarkers relevant to obesity and chronic disease risk



## Conclusion: Yogurt may offer multiple routes to health

In obese individuals, yogurt consumption may improve gut health and reduce chronic inflammation by enhancing innate and adaptive immune responses, intestinal barrier function, lipid profiles, and by regulating appetite.

## Highlights

*'While this evidence suggests that yogurt consumption is beneficial for obese individuals, randomised-controlled trials are needed to further support this hypothesis.'* – R. Pei et al



# COMBINED INTAKE OF YOGURT AND FRUIT OFFERS POTENTIAL SYNERGISTIC BENEFITS

Fernandez MA, Marette A. Potential health benefits of combining yogurt and fruits based on their probiotic and prebiotic properties. Adv Nutr 2017;8:1555–64S.

## Summary

In this review article, the authors examined the potential health benefits of yogurt and fruits as probiotics and prebiotics, respectively. They concluded that, when eaten at the same time, yogurt and fruit may work together to offer significant protection against several conditions, including obesity, diabetes, and cardiovascular diseases. The authors conclude that the potential additive effects of these two food types warrants further investigation.

Yogurt and fruit have individually been identified as protective against specific diseases. The diet and its association with health outcomes is complex, and there may be synergistic benefits from combining probiotic and prebiotic effects of eating different foods together. This review examines the potential health benefits of combining yogurt with whole or minimally processed fruits.

## Yogurt is a nutrient-dense food

Yogurt is a good source of dairy protein, calcium, magnesium, vitamin B<sub>12</sub>, and key fatty acids (Table 1). It also contains beneficial bacterial cultures, making it a potential source of probiotics.

- The bacterial fermentation of milk to yogurt increases its viscosity and energy density and reduces the pH. This alteration delays movement of yogurt through the gastrointestinal (GI) tract when compared with milk, thereby enhancing the absorption of nutrients such as vitamin B<sub>12</sub>, calcium and magnesium, and reducing GI disturbance.<sup>11</sup>

## Yogurt's unique fermented food matrix enhances nutrient absorption and digestion

## Fruit contains fibre and antioxidants

Fruit is an excellent source of dietary fibre, potassium, antioxidants, phenolic compounds and carotenoids (Table 1).

- Fruit is a good source of oligosaccharides, a dietary prebiotic fibre that promotes colonisation of lactobacilli and bifidobacteria in the colon.
- Polyphenols appear to have prebiotic properties as they have been shown to stimulate the proliferation of beneficial microflora in the gut in animal studies.<sup>12</sup>

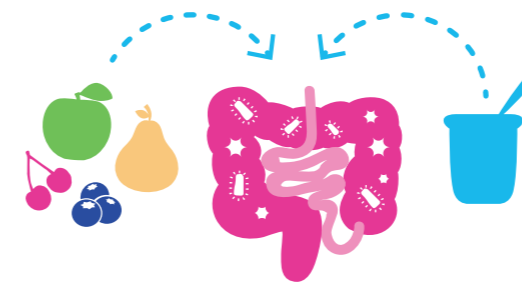
Table 1. Nutritional components of yogurt and fruit that may prevent diet-related diseases

Yogurt (probiotic)		Fruit (prebiotic)	
<ul style="list-style-type: none"> <li>Calcium</li> <li>Conjugated linoleic acid</li> <li>Iodine</li> <li>Lactic acid bacteria</li> <li>Magnesium</li> <li>Phosphorus</li> </ul>	<ul style="list-style-type: none"> <li>Potassium</li> <li>Protein</li> <li>Riboflavin</li> <li>Vitamins D and B<sub>12</sub></li> <li>Zinc</li> </ul>	<ul style="list-style-type: none"> <li>Antioxidants</li> <li>Carotenoids</li> <li>Fibre</li> <li>Magnesium</li> </ul>	<ul style="list-style-type: none"> <li>Polyphenols</li> <li>Potassium</li> <li>Vitamin C</li> </ul>
<p><b>Symbiotic properties:</b></p> <ul style="list-style-type: none"> <li>Improved survival of probiotics through GI tract;</li> <li>Provide additional substrate to encourage probiotic proliferation in the colon;</li> <li>Beneficial modulation of gut microbiota</li> </ul>			

## Combined effects of probiotics and prebiotics help to modulate the gut microbiota

*Lactobacillus* species, including *L. delbrueckii* subspecies *bulgaricus* that is found in traditional yogurt, inhibit the growth of pathogenic bacteria, stimulate immune function and enhance the bioavailability of food components and minerals.<sup>13,14</sup> Some species of *Streptococcus*, including *S. thermophilus* found in traditional yogurt, may act as probiotic.

Fruits rich in fructo-oligosaccharides (e.g. bananas, nectarines and raspberries) and polyphenol-rich fruits (e.g. grapes and berries) exert prebiotic effects.<sup>15,16</sup>



The rationale for consuming yogurt with fruit lies in their symbiotic properties. Prebiotics in the fruit help maintain the viability of probiotic bacteria in the yogurt during passage through the GI tract, as well as providing an additional substrate to encourage their proliferation in the colon.<sup>17</sup> Both probiotics and prebiotics modulate the composition of the gut microbiota beneficially.<sup>18</sup>

## The prebiotic properties of fruit and probiotic bacteria in yogurt help to improve the composition of the gut microbiota

## Yogurt and fruit may help to prevent disease

### Weight gain and obesity

- Multiple studies have shown that yogurt consumption is associated with lower BMI, body weight, body weight gain and body fat, and smaller waist circumference.<sup>8</sup>
- Yogurt consumption may increase the proportion of beneficial gut microbiota believed to be involved in weight maintenance.<sup>19</sup>
- The high fibre and water content and low energy density of fruit contribute to satiety and help with weight control.<sup>20</sup>

### Type 2 diabetes

- Several studies have linked yogurt consumption to a lower incidence of T2D.<sup>4,14</sup>
- Meta-analyses suggest that fruit intake is associated with a reduced risk of T2D.<sup>21,22</sup>

## There is increasing evidence that yogurt consumption helps protect against specific diet-related diseases, such as T2D and obesity

### Cardiovascular disease

- There are insufficient data examining the relationship between yogurt and cardiovascular disease to draw any conclusions. The protective effects of fruit and vegetables on cardiovascular health are well established, but the evidence for fruit alone is less strong.
- Nutrient and phytochemical content (e.g. fibre, potassium and folate), low glycaemic load and low energy density of fruit offer heart protection.<sup>23</sup>
- Fruits with a high polyphenol content protect the heart further via mechanisms that have the potential to reduce blood pressure, platelet activation, inflammation, oxidative stress and low-density lipoprotein (LDL) oxidation, while increasing endothelial function and the high-density lipoprotein (HDL):LDL ratio.<sup>24</sup>

## High-fibre diets have been linked to lower incidences of GI disease, cardiovascular disease and some cancers

## Conclusion: Combined effects warrant study

The potential synergistic effects of combining yogurt and fruit have never been examined, although both foods separately have demonstrated protective associations against diet-related diseases in epidemiological studies. Further study is warranted of the probiotic and prebiotic properties of yogurt and fruit, respectively, when they are eaten together.

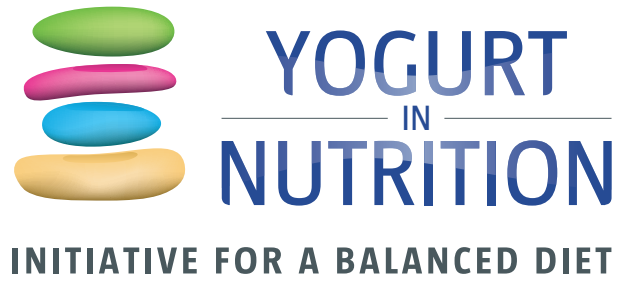
## Highlights

'Combining the intake of yogurt and fruit could provide probiotics, prebiotics, high-quality protein, important fatty acids, and a mixture of vitamins and minerals that have the potential to exert synergistic effects on health.' – M.A. Fernandez et al









Follow us



Subscribe to our newsletter on the YINI website:  
[www.yogurtinnutrition.com](http://www.yogurtinnutrition.com)

