



Review Article

Dairy product consumption and the metabolic syndrome

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ABSTRACT

Aims: To briefly summarize findings from epidemiological studies on the relationship between dairy product consumption and the metabolic syndrome (MetS).

Materials and methods: A search for relevant literature was undertaken on Web of Science, Google scholar, Pubmed (2000 to July 2013), to identify observational studies which examined the association between dairy intake and MetS (prevalence or incidence), and for any randomized controlled trials investigating the effect of dairy intake on MetS.

Results: Here we review the physiological effects and possible mechanisms involved of three main dairy constituents (calcium (Ca), protein, fat) on important components of the MetS. Effects of Ca may be related to intestinal binding to fatty acids or bile acids, or to changes in intracellular Ca metabolism by suppressing calciotropic hormones. Dietary proteins may increase satiety in both the short and longer term, which may result in a reduced energy intake. Dairy proteins are precursors of angiotensin-I converting enzyme-inhibitory peptides, which may lower blood pressure. To reduce the intake of saturated fatty acids (SFA), the consumption of low-fat instead of high-fat dairy products is recommended.

Conclusion: More research is warranted to better understand the physiological effects and the mechanisms involved of dairy products in the prevention and treatment of the MetS.

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1. Introduction

Cardiovascular diseases (CVDs) are one of the main causes of mortality in Iran [1], and the prevalence of these disorders continues to rise [2]. Persons with the metabolic syndrome (MetS) are at greater risk of CVD [3]. The prevalence of metabolic syndrome has been increasing throughout the world. According to the National Health and Nutritional Examination Survey (NHANES) [4], the prevalence of metabolic syndrome among adults in the United States was approximately 23% from 1988 to 1994, but increased to almost 34% from 2003 to 2006 even though the criterion for fasting blood glucose was updated to 100 mg/dl [5]. Metabolic syndrome was defined as the presence of 3 of the following 5 components as recommended by the Adult Treatment Panel III [6]: (1) enlarged waist circumference (waist circumference more than 102 cm in men and 88 cm in women); (2) low serum HDL cholesterol (less than 40 mg/dl in men and 50 mg/dl in women); (3) high serum triacylglycerol concentrations (more

than 150 mg/dl); (4) elevated blood pressure (more than 130/85 mmHg); and (5) abnormal glucose homeostasis (fasting plasma glucose concentration more than 110 mg/dl). However, it is well established that both energy restriction and dietary composition play an important role in this respect. More specifically, several studies have suggested that dairy food products have a positive impact on the prevention of the metabolic syndrome. The aim of the present review is now to briefly summarize findings from epidemiological studies on the relationship between dairy product consumption and the metabolic syndrome and to discuss the results from intervention studies on the effects of dairy products and dairy constituents on features of this syndrome. We focused on studies carried out during the last decade.

2. Methods

A search for relevant literature was undertaken on Web of Science, Google scholar, Pubmed (2000 to July 2013), to identify observational studies which examined the association between dairy intake and metabolic syndrome (prevalence or incidence), and for any randomized controlled trials investigating the effect of dairy intake on MetS.

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Table 1
Relationship between the MetS and dairy products based on previous publications.

Title	Authors	Sort of study	Method	Result
Possible protective effect of bread and dairy products on the risk of the metabolic syndrome	Mennen et al. [17]	Cross-sectional	Weight (wt), height (Ht), body mass index (BMI), waist–hip ratio (WHR), blood pressure (BP), triglyceride (TG), HDL-C were measured in 2537 women, 2439 men (aged 30–64) Every participant completed a food frequency questionnaire containing 18 questions on habitual diet	Dairy consumption was inversely related with the prevalence of MetS in men but not in women
Dairy consumption is inversely associated with the prevalence of the metabolic syndrome in Tehranian adults	Azadbakht et al. [8]	Cross-sectional	Usual dietary intake was assessed with the use of a 168-item semi-quantitative food frequency questionnaire (FFQ) in 827 subjects (357 men and 470 women) aged 18–74 Wt, Ht, BMI, WHR, BP, TG, HDL-c, LDL-c were assayed	Dairy consumption is inversely associated with the risk of having MetS. It seems that this relation is somewhat attributed to calcium
Milk and dairy consumption, diabetes and the metabolic syndrome	Elwood et al. [9]	Prospective	Food consumption – in 2512 men aged 45–59 years – was assessed with a semi-quantitative food frequency questionnaire. This included the quantity of milk usually drunk each day	The consumption of milk and dairy products is associated with a markedly reduced prevalence of the metabolic syndrome
A fruit and dairy dietary pattern is associated with a reduced risk of metabolic syndrome	Hong et al. [13]	Cross-sectional	477 people participate in this study Combination of methods: one 24-h recall and 3 days of food records assess actual individual intakes Wt, Ht, BMI, WHR, BP, TG, HDL-c, FBG were estimated	The fruit and dairy pattern was significantly associated with decreased odds of impaired blood glucose, hypertriglyceridemia, and metabolic syndrome
Ethnic differences in dairy and related nutrient consumption among US adults and their association with obesity, central obesity, and the metabolic syndrome	Beydoun et al. [14]	Cross-sectional	4519 US adults aged 18 years and over participate in this study Associations between diet (assessed 24-h recall) and metabolic and other outcomes were tested using multivariate linear and logistic models and structural equation models	The various dairy products may have different associations with the metabolic syndrome. While cheese consumption showed a positive relationship with the prevalence of the metabolic syndrome, the intake of yogurt resulted in a negative relationship
Dairy attenuates oxidative and inflammatory stress in metabolic syndrome	Stancliffe et al. [15]	Trial	Two weight-maintenance diets were presented to the subject groups in a randomized parallel-group design. A low-dairy diet (0.5 serving/d) was studied against an adequate-dairy diet (3.5 servings daily). Each diet was presented for 84 day, with measurements taken at baseline and on day 7, day 14, day 28, and day 84 Plasma samples were collected at baseline and on day 7, day 28, and day 84. Interleukin-6, monocyte chemoattractant protein 1, adiponectin, TNF- α , and CRP concentrations in plasma were determined by enzyme-linked immunosorbent assay Body composition, anthropometric measures and blood pressure were measured	Increase in dairy intake attenuates oxidative and inflammatory stress in metabolic syndrome
A prospective study of dairy consumption in relation to changes in metabolic risk factors	Snijder et al. [11]	Prospective	A 92-item semi-quantitative food-frequency questionnaire was used to assess average food intake, which also included the consumption of dairy products. Nutrient intake was calculated using a computerized version of the Dutch food composition table Total dairy consumption was categorized as low-fat dairy ($\leq 2\%$ fat) or high-fat dairy ($> 2\%$ fat) High-density lipoprotein-cholesterol, low-density lipoprotein-cholesterol, and triglycerides were determined and blood pressure, weight, height, waist and hip circumferences were measured (17,18), and the change in these variables over time was calculated	Results do not support the hypothesis that a higher dairy consumption protects against weight gain and development of metabolic disturbances in a Dutch elderly population

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