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Dairy consumption is associated with decreased insulin resistance among the Japanese☆

Shamima Akter[a,*], Kayo Kurotani[a], Akiko Nanri[a], Ngoc M. Pham[a], Masao Sato[b], Hitomi Hayabuchi[c], Tetsuya Mizoue[a]

[a] *Department of Epidemiology and Prevention, Clinical Research Center, National Center for Global Health and Medicine, Tokyo, Japan*
[b] *Department of Applied Biological Chemistry, Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Fukuoka, Japan*
[c] *Faculty of Human Environmental Science, Fukuoka Women's University, Fukuoka, Japan*

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ABSTRACT

Beneficial effects of dairy consumption in preventing obesity and metabolic syndrome have been suggested, but the association between dairy intake and insulin resistance (IR) is not clear. To test the hypothesis that higher dairy consumption is associated with lower insulin resistance, the authors investigated the association between dairy intake (taking fat content into consideration) and markers of IR in a Japanese working population. A cross-sectional study was conducted in 2009 among 496 subjects aged 20–68 years who participated in a health survey during a periodic checkup. Dairy consumption was assessed using a validated brief dietary history questionnaire. Multiple regression analysis was used to assess the association between fasting serum insulin, plasma glucose, and the homeostatic model assessment of IR (HOMA-IR) and dairy consumption with adjustment for potential confounding variables. The subjects in the highest quartile for total dairy intake showed the lowest mean IR markers compared to those in other categories, although the difference was not statistically significant. Intake of full-fat dairy products was inversely associated with HOMA-IR (P for trend = 0.02). The multivariable adjusted mean HOMA-IR values (with 95% confidence intervals) for the four groups, from those who consumed the fewest to those who consumed the most servings of full-fat dairy products, were 1.04 (0.96-1.12), 1.04 (0.96-1.13), 1.00 (0.91-1.08), and 0.86 (0.76-0.96), respectively. Low-fat dairy intake was not significantly associated with any IR markers. The results suggest that the consumption of full-fat dairy products may be associated with lower IR among Japanese adults.

1. Introduction

Dairy foods are widely recommended as part of a healthy diet not only because they offer a readily available source of calcium but also because they are a good source of protein, other minerals and vitamins [1]. It has been postulated that higher dairy consumption reduces the risk of many chronic diseases [2]. A recent systematic review included a meta-

Abbreviations: BMI, body mass index; CI, confidence interval; HOMA, homeostatic model assessment; IR, insulin resistance; PUFA, polyunsaturated fatty acids; SD, standard deviation; SAFA, saturated fatty acids.

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* *Corresponding author*. Department of Epidemiology and Prevention, Clinical Research Center, National Center for Global Health and Medicine, Toyama 1-21-1, Shinjuku-ku, Tokyo 162–8655, Japan. Tel.: +81 3 3202 7181; fax: +81 3 3202 7364.
E-mail address: samimarub@yahoo.com (S. Akter).

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analysis of six cohort studies and found a 14% reduction in the risk of type 2 diabetes mellitus for those with the highest intake of dairy products compared to those with the lowest intake [3]. The results of another systematic review of observational studies indicated that dairy consumption has a beneficial effect in protecting against metabolic syndrome [4]. Thus, it would be interesting to determine whether dairy consumption can protect against the development of insulin resistance (IR), an important underlying condition of these metabolic disorders.

To date, some epidemiologic studies have investigated the association between dairy consumption and markers of IR, including fasting plasma insulin [5], glucose [5–9], and homeostatic model assessment of IR (HOMA-IR) [9] but the results have been inconsistent. The few clinical trials addressing this issue have also reported mixed results [10–12]. Furthermore, the evidence about the association between dairy consumption and IR has been obtained mainly among Western populations; there is limited evidence from Asian populations [7,8], and Asians have lower body mass index and lower insulin secretion capacity than Westerners [13]. The two Asian studies [7,8] reported an association only with fasting glucose, not with fasting insulin or HOMA-IR, which are more relevant to IR. We recently reported lower IR, assessed by C-peptide, among persons with a dietary pattern that included greater amounts of bread, confectionaries, and milk and yogurt [14].

It remains unclear whether the association between dairy consumption and IR differs by the fat content of the dairy products. Dairy fat is a saturated fat, which may increase IR, but it contains a large number of medium-chain saturated fatty acids, which decrease IR [15]. In addition, dairy fat contains bioactive lipids, including trans-palmitoleic acid and conjugated linoleic acid that have the potential to improve IR [1]. Given these beneficial effects of the fatty acids in dairy products, the impact of full-fat dairy product intake on IR may be greater than that of low-fat dairy product intake. However, only a few studies among Western populations have compared low-fat dairy products to high-fat dairy products in terms of their association with IR [5,6], and no studies have addressed this issue among Asians, including the Japanese, whose dairy consumption is much lower than Westerners' consumption [16]. Therefore, we investigated the association between dairy consumption and markers of IR, including fasting insulin, glucose, and HOMA-IR in a Japanese working population, with consideration of the fat content of the dairy products. We hypothesized that greater consumption of full-fat dairy products is associated with lower IR.

2. Methods and materials

2.1. Study procedure

The data were obtained from a cross-sectional survey carried out in July and November 2009 among employees of two municipal offices in northeastern Kyushu, Japan, as described elsewhere [17,18]. In short, at the time of the periodic health examination, all full-time workers (n = 605) except those on an extended sick leave or maternity leave were invited to participate in this study. The participants were asked to fill out the survey questionnaires before the examination. The questionnaires were checked by the research staff for completeness; if necessary, the subjects were asked to clarify answers during the examination. Data were also obtained from routine health checkup, including anthropometric measurements, biochemical data, and information about medical history, smoking, and alcohol drinking. Blood and urine specimens were also collected. The study was approved by the Ethics Committee of the National Center for Global Health and Medicine in Japan, and written informed consent was obtained from all subjects before the survey.

2.2. Study subjects

Of 605 eligible employees, 567 subjects (325 men and 242 women) aged 20 to 68 years participated in the survey (response rate 94%). We excluded 32 subjects with a history of diabetes, cardiovascular disease or cancer and 1 subject who had missing information for the covariates used in the main analysis. We also excluded 16 subjects who had missing values for the insulin measurement and 25 subjects with non-fasting status. Some of the subjects met more than one of the exclusion criteria. Ultimately, 496 subjects (286 men and 210 women) remained in the study.

2.3. Blood measurements

Venous blood (7 mL) was drawn into a tube and taken to the laboratory in a cooler box. The blood was centrifuged for 10 minutes and divided into a maximum of six tubes (0.5 mL each) held at −80°C or −20°C until the analysis was conducted. Serum insulin was measured at an external laboratory (Mitsubishi Chemical Medience Corporation, Tokyo, Japan) using a chemiluminescence immunoassay. Plasma glucose concentration was measured as a part of the regular health checkup using the mutarotase-GOD method (Glucose CII-test Wako, Wako Pure Chemical Industries, Osaka, Japan). We computed HOMA-IR as surrogate indicator of IR by using the following formula: fasting glucose (mg/dL) × fasting insulin (μg/mL)/405.

2.4. Other variables

Body height was measured to the nearest 0.1 cm while the subjects stood without shoes. Body weight was measured to the nearest 0.1 kg while the subjects wore light clothing. Body mass index (BMI) was calculated by dividing body weight (kg) by the square of body height (m^2). Smoking status, alcohol consumption, marital status, job title, job position, and non-occupational physical activity were self-reported in the lifestyle questionnaire. Job titles were used to create categories for occupational physical activity: sedentary work included managerial and clerical jobs, whereas physically active work included childcare, cooking school lunches, and technical jobs. Non-occupational physical activity was expressed as the number of daily minutes spent walking or cycling to or from work and the number of weekly hours engaged in 5