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Nutrients from dairy foods are difficult to replace in diets of Americans: food pattern modeling and an analyses of the National Health and Nutrition Examination Survey 2003-2006☆

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Abstract

Because dairy products provide shortfall nutrients (eg, calcium, potassium, and vitamin D) and other important nutrients, this study hypothesized that it would be difficult for Americans to meet nutritional requirements for these nutrients in the absence of dairy product consumption or when recommended nondairy calcium sources are consumed. To test this hypothesis, MyPyramid dietary pattern modeling exercises and an analyses of data from the National Health and Nutrition Examination Survey 2003-2006 were conducted in those aged at least 2 years (n = 16 822). Impact of adding or removing 1 serving of dairy, removing all dairy, and replacing dairy with nondairy calcium sources was evaluated. Dietary pattern modeling indicated that at least 3 servings of dairy foods are needed to help individuals meet recommendations for nutrients, such as calcium and magnesium, and 4 servings may be needed to help some groups meet potassium recommendations. A calcium-equivalent serving of dairy requires 1.1 servings of fortified soy beverage, 0.6 serving of fortified orange juice, 1.2 servings of bony fish, or 2.2 servings of leafy greens. The replacement of dairy with calcium-equivalent foods alters the overall nutritional profile of the diet and affects nutrients including protein, potassium, magnesium, phosphorus, riboflavin, vitamins A, D and B_{12}. Similar modeling exercises using consumption data from the National Health and Nutrition Examination Survey also demonstrated that nondairy calcium replacement foods are not a nutritionally equivalent substitute for dairy products. In conclusion, although it is possible to meet calcium intake recommendations without consuming dairy foods, calcium replacement foods are not a nutritionally equivalent substitute for dairy foods and consumption of a calcium-equivalent amount of some nondairy foods is unrealistic.

Keywords: NHANES; Dairy; Milk; Nutrient intake; Calcium; Vitamin D; Potassium
Abbreviations: DGAC, Dietary Guidelines Advisory Committee; NDB, USDA National Nutrient Database; NHANES, National Health and Nutrition Examination Survey; RAE, retinol activity equivalent.

1. Introduction

The 2010 US Dietary Guidelines for Americans recommended that Americans 9 years and older consume 3 cups of low-fat or fat-free milk or milk products each day and children aged 4 to 8 years consume 2.5 cups to help meet nutrient needs including calcium [1]. Despite current

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recommendations, Americans only consume an average of 1.8 cups of milk or milk products daily [2]; and few Americans (<85%) consume the recommended 3 daily servings [2-4]. Many Americans consequently fall short on achieving the recommended nutrient intakes for many nutrients provided by dairy products including calcium, vitamin D, and potassium [3,5,6]. Consumption of milk and milk products has been linked to improved health outcomes including bone health [1,3].

The dairy food group (milk, cheese, and yogurt) contributes substantial amounts of many essential nutrients to the diet, including protein; vitamins A, D, and B12; riboflavin; and minerals calcium, potassium, phosphorus, magnesium, and zinc. In addition to contributing about 70% of the calcium in the diet, dairy foods also supply 16% of the potassium, 30% of the phosphorus, 14% of the magnesium, 15% of the zinc, 18% of the protein, 16% of the vitamin A, 18% of the vitamin B12, and 25% of the riboflavin in the food supply [7]. Fluid milk is the number one single dietary source of calcium, potassium, vitamin D, and phosphorus for Americans older than 2 years [8].

The 2010 Dietary Guidelines Advisory Committee (DGAC) examined a wide range of dietary patterns and found that, across the diverse cultures in the United States, there are many healthy dietary patterns that can meet individual tastes and preferences [3]. Among others, the Committee examined vegetarian and "plant-based" diets as well as diets where milk was eliminated entirely for other reasons. A US Department of Agriculture base pattern for MyPyramid (now called *MyPlate*) based on calorie levels served as a "standard dietary pattern" for comparative purposes [3].

Low intake of dairy foods or complete dietary elimination of dairy foods may occur because of perceived lactose intolerance as well as cultural or familial practices. A recent study assessing self-reported lactose intolerance and dairy food intake habits of African Americans found that, whereas 24% of African Americans surveyed self-reported lactose intolerance, an additional 26% of African Americans reported consuming less than 1 serving of dairy per day yet did not identify themselves as lactose intolerant [9], implying that other factors besides lactose intolerance may contribute to dairy avoidance. Inadequate dairy food intake may have adverse effects on health. The recent Institute of Medicine consensus report on Dietary Reference Intakes for vitamin D and calcium noted that exclusion or avoidance of dairy foods can lead to inadequate intakes of these vital nutrients [10]. Similarly, lower milk intake has been associated with lower bone mineral in girls [11]; and the 2010 DGAC report links milk and milk product under-consumption to an increased risk for cardiovascular disease, type 2 diabetes, and poor bone health [3].

Although health authorities recommend adequate daily dairy food intake and acknowledge that a decrease in or elimination of milk and milk products may adversely impact nutrient intake and overall health, some also highlight nondairy calcium replacements as suitable alternatives [12]. The 2010 DGAC evaluated the impact on nutrient adequacy if no dairy foods were consumed, and examined whether nutritional adequacy could be maintained by exchanging dairy foods for nondairy alternatives, such as fortified soy or rice drink, fortified orange juice, calcium-set tofu, leafy greens, or bony fish. The committee found that to provide sufficient calcium, it would take a large amount of alternative foods, consumption of which may be unachievable by many, and many of the alternative foods would provide too many calories. The committee concluded that alternate calcium sources would need to be chosen carefully, considering both the content and bioavailability of the nutrients, and a composite of alternate foods would be needed to supply the nutrients provided by dairy foods [3].

The objective of this study was to further examine the effect of removing or adding dairy food servings on nutrient intakes and to determine the nutritional impact of using nondairy calcium-containing foods instead of cow's milk and milk products to meet nutrient needs. In particular, this study took 2 modeling approaches to examine the nutritional significance of dairy foods in the US diet. One approach was based on MyPyramid food patterns, and the other was based on actual food and nutrient intakes using National Health and Nutrition Examination Survey (NHANES). The hypothesis of this study was that adding dairy servings to the diet would have a positive impact on nutrient intake, whereas removing dairy servings would have a negative impact on nutrient intake, and that replacing nutrients provided by dairy foods is not easily accomplished with nondairy calcium sources.

2. Methods and materials

2.1. MyPyramid modeling

Twelve MyPyramid [13] dietary patterns based on total energy content were evaluated to determine the nutritional impact of (1) removing a serving of dairy (one 8-oz cup of fat-free milk represents a dairy serving in the MyPyramid food patterns); (2) adding a serving of dairy; (3) completely removing dairy; and (4) using individual nondairy sources of calcium as dairy replacement foods. The replacement foods included the following choices with nutrient composition taken from the USDA National Nutrient Database (NDB) for Standard Reference [14]: calcium, vitamin D, and vitamin A fortified soy beverage (NDB code 16230); calcium and vitamin D fortified orange juice (NDB code 09210); leafy greens (average of kale, spinach, collards, and turnip greens; NDB codes 11236, 11464, 11164, and 11575, respectively); and bony fish (average of canned sardines with bones and canned pink salmon with bones; NDB codes 15088 and 15084, respectively). The 12 dietary patterns were based on total daily energy content and ranged from 4184 kJ to 13389 kJ (1000 kcal to 3200 kcal) patterns. The nutritional impact of altering dairy food intake and using replacement foods on these 12 patterns was assessed by determining total energy, fat, saturated fat, protein, calcium, magnesium, phosphorus, sodium, and potassium dietary content for each of the 4 scenarios.