Dairy intake and semen quality among men attending a fertility clinic

Myriam C. Afeiche, Ph.D.,[a] Naima D. Bridges, M.D.,[b,c] Paige L. Williams, Sc.D.,[d] Audrey J. Gaskins, B.S.E.,[a,e] Cigdem Tanrikut, M.D.,[f] John C. Petrozza, M.D.,[g] Russ Hauser, Sc.D.,[e,g,h] and Jorge E. Chavarro, M.D., Sc.D.[a,e,i]

[a] Department of Nutrition, Harvard School of Public Health; [b] Department of Global Health and Population Global Health MPH Program, Harvard School of Public Health, Boston, Massachusetts; [c] Department of Obstetrics and Gynecology, University of Illinois, Chicago, Illinois; [d] Department of Biostatistics, Harvard School of Public Health; [e] Department of Epidemiology, Harvard School of Public Health; [f] Department of Urology, Massachusetts General Hospital and Harvard Medical School; [g] Vincent Obstetrics and Gynecology, Massachusetts General Hospital and Harvard Medical School; [h] Department of Environmental Health, Harvard School of Public Health; and [i] Channing Laboratory, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, Massachusetts

Objective: To examine the relationship between dairy food intake and semen parameters.
Design: Longitudinal study.
Setting: Academic medical center fertility clinic.
Patient(s): One hundred fifty-five men.
Intervention(s): None.
Main Outcome Measure(s): Total sperm count, sperm concentration, progressive motility, morphology, and semen volume.
Result(s): Low-fat dairy intake was positively related to sperm concentration and progressive motility. On average, men in the highest quartile of intake (1.22–3.54 servings/d) had 33% (95% confidence interval [CI] 1, 55) higher sperm concentration and 9.3 percentage units (95% CI 1.4, 17.2) higher sperm motility than men in the lowest quartile of intake (≤0.28 servings/d). These associations were primarily explained by intake of low-fat milk. The corresponding results for low-fat milk were 30% (95% CI 1, 51) higher sperm concentration and 8.7 percentage units (95% CI 3.0, 14.4) higher sperm motility. Cheese intake was associated with lower sperm concentration among ever-smokers. In this group, men in the highest tertile of intake (0.82–2.43 servings/d) had 53.2% (95% CI 9.7, 75.7) lower sperm concentration than men in the lowest tertile of cheese intake (<0.43 servings/d).
Conclusion(s): Our findings suggest that low-fat dairy intake, particularly low-fat milk, is related to higher sperm concentration and progressive motility, whereas cheese intake is related to lower sperm concentration among past or current smokers. (Fertil Steril® 2014;101:1280–7. ©2014 by American Society for Reproductive Medicine.)
Key Words: Infertility, sperm quality, dairy, diet

Discuss: You can discuss this article with its authors and with other ASRM members at http://fertstertforum.com/afeichem-dairy-diet-semen-infertility-sperm/

Use your smartphone to scan this QR code and connect to the discussion forum for this article now.*

* Download a free QR code scanner by searching for "QR scanner" in your smartphone's app store or app marketplace.

Infertility affects 10%–15% of reproductive-aged couples (1, 2). Although reproductive abnormalities in the male partner are identified in as many as 58% of the couples evaluated for infertility (3), few risk factors for abnormal semen quality have been identified. Emerging evidence suggests that environmental estrogens (E) may be related to lower semen quality (4). A particularly prevalent exposure route to environmental E is by consumption of dairy foods (5). Because commercial milk is a mixture of milk from cows at different stages of pregnancy (6), dairy products contain detectable amounts of E and other hormones that increase during pregnancy (7, 8) and account for 60%–80% of intake of E from foods in Western countries (9). Intake of milk and other dairy products has been related to lower semen quality in some studies (10–12), but not others (13). We have previously reported that intake of full-fat dairy foods is associated with a lower sperm morphology and progressive motility among healthy young men (12). Other researchers have reported higher intake of full-fat dairy products among oligoasthenoteratospermic men (11) and of dairy products in general among asthenospermic (10) men. In addition, full-fat dairy foods are an important

Received October 15, 2013; revised and accepted February 4, 2014; published online March 14, 2014.
M.C.A. has nothing to disclose. N.D.B. has nothing to disclose. P.L.W. has nothing to disclose. A.J.G. has nothing to disclose. C.T. has nothing to disclose. J.C.P. has nothing to disclose. R.H. has nothing to disclose. J.E.C. has nothing to disclose.
M.C.A. and N.D.B. should be considered similar in author order.
Supported by National Institutes of Health grants R01-ES009718 from National Institutes of Environmental Health Sciences, P30 DK046200 from National Institute of Diabetes and Digestive and Kidney Diseases. M.C.A. and A.J.G. were supported by a Ruth L. Kirschstein National Research Service Award T32 DK 007703-16 from National Institute of Diabetes and Digestive and Kidney Diseases.
Reprint requests: Myriam C. Afeiche, Ph.D., Department of Nutrition, Harvard School of Public Health, 665 Huntington Avenue, Boston, Massachusetts 02115 (E-mail: mafeiche@hsph.harvard.edu).

Fertility and Sterility® Vol. 101, No. 5, May 2014 0015-0282/$36.00

http://dx.doi.org/10.1016/j.fertnstert.2014.02.003

source of saturated fat, which has been previously related to low sperm counts (14, 15). Thus we hypothesized that full-fat dairy products would be related to lower semen quality. We examined this hypothesis among men attending a fertility clinic in Boston, Massachusetts.

MATERIALS AND METHODS

Study Population

Men in subfertile couples presenting for evaluation at the Massachusetts General Hospital Fertility Center were invited to participate in an ongoing study of environmental factors and fertility (16). Men from couples using their own gametes for IUI or assisted reproductive technologies (ART), aged 18–55 years, and without a history of vasectomy were eligible. A food frequency questionnaire (FFQ) was introduced in April 2007, and was completed by 188 of the 246 men (76%) recruited through March 2012. Of these, 161 men produced one or more semen samples after the completion of the FFQ. We excluded men with incomplete semen analysis data (n = 5) and azoospermic men (n = 1). Because diet was assessed once, we also excluded all semen samples (47 samples from 8 men) that were collected >18 months after FFQ completion to minimize any influence that misclassification of dairy intake due to true intake changes over time might have on the associations. After exclusions, 155 men with a total of 338 semen samples were included in the analysis; 57 men provided only 1 sample, 51 men provided 2 samples, and 47 men provided 3 or more samples. At enrollment, trained personnel administered a general health questionnaire (asking about demographics, lifestyle, and reproductive disorders such as varicocele and surgical scars) and men completed an anthropometric assessment at the clinic. The study was approved by the Human Subject Committees of the Harvard School of Public Health and the Massachusetts General Hospital, and informed consent was obtained from all participants.

Semen Analysis

Semen samples were obtained on site by masturbation and collected into a sterile plastic container. Men were instructed to abstain from ejaculation for 48 hours before producing the sample and to report the specific time of abstinence; 18 men (19 semen samples) did not report their last ejaculation date and were assigned to the most common abstinence time category (2–3 days). Semen samples were liquefied at 37°C for 20 minutes before analysis. Sperm morphology was determined using Kruger's strict criteria and results were expressed as percent normal spermatozoa (17). Ejaculate volume was estimated by sample weight assuming a density of 1 g/mL. Sperm concentration and motility were assessed with computer-aided semen analysis (Hamilton-Thorne, Biosciences, Ceros, version 14). The percentage of motile sperm was classified according to World Health Organization guidelines as progressive and total (progressive + nonprogressive) (18). Total sperm count was calculated as sperm concentration × ejaculate volume. Similarly, total motile count was calculated as sperm concentration × ejaculate volume × total motility.

Dietary Assessment

Participants completed a previously validated 131-item FFQ at home (19). They were asked to report how often, on average, they consumed specific foods during the previous year. The FFQ had nine categories for intake frequency options that ranged from never to six or more times per day. Fifteen questions in the FFQ addressed dairy intake. The nutrient content of each food and the specific portion size was calculated by the nutrient database from the US Department of Agriculture (20) with additional information from manufacturers when necessary. Assessment of dairy food intake using this questionnaire has been validated against prospectively collected diet records representing 1 year of a diet (21). The deattenuated correlation of dairy food intakes assessed with the FFQ and the 1-year average of prospectively collected diet records ranged from 0.52 for cottage cheese to 0.88 for skim milk (21). Low-fat milk was defined as the sum of skim milk and low-fat (1% and 2%) milk. Full-fat dairy intake was defined as the sum of whole milk, cream, ice cream, and cheese. Low-fat dairy was defined as the sum of low-fat milk, yogurt, and cottage cheese. Total dairy food intake was defined as the sum of full-fat and low-fat dairy. We used two data-derived dietary patterns to describe general patterns of food consumption (22): the Prudent Pattern, characterized by intakes of fish, low-fat dairy, fruits, vegetables, whole grains; and the Western Pattern, characterized by processed and red meats, fried fish and seafood, butter, margarine, full-fat dairy, French fries, refined grains, pizza, snacks, high energy drinks, mayonnaise, and sweets. We then calculated a summary score, ranging from −1.7 to 3.7 for the Prudent Pattern and −2.1 to 5.0 for the Western Pattern, reflecting how closely each man followed each of these dietary patterns (where higher scores reflect closer adherence).

Statistical Analysis

We first summarized participant characteristics and compared them across quantiles of dairy food intake. We used the Kruskal-Wallis test to compare differences in continuous measures across categories of dairy intake and an extended Fisher's exact test for categorical variables. Linear mixed models with random intercepts were used to examine the relation between dairy food intake and semen parameters while adjusting for potential confounders and accounting for the correlation between multiple semen samples provided by the same man. Specifically, in these regression models, we compared semen quality parameters (total sperm count, sperm concentration, progressive motility, morphology, and semen volume) for men in increasing quantiles of dairy food intake in relation to those of men in the lowest quantile (reference). Robust estimators of the variance (23) were used in the computation of 95% confidence intervals (CI). Population marginal means (24) were used to present marginal population averages adjusted for the covariates in the model. Total sperm count and sperm concentration were log-transformed to more closely approximate a normal distribution. Results for these parameters were back-transformed to allow presentation of results in the original scale. Tests for