Dietary patterns are positively associated with semen quality

Michal Efrat, M.Sc.,[a,b] Anat Stein, Ph.D.,[c,d,e] Haim Pinkas, M.D.,[c,d,e] Ron Unger, Ph.D.,[b] and Ruth Birk, Ph.D.[a]

[a] Department of Nutrition, Faculty of Health Sciences, Ariel University, Ariel, West Bank; [b] Mina and Everard Goodman Faculty of Life Sciences, Bar Ilan University, Ramat Gan; [c] Department of Obstetrics and Gynecology, Beilinson Medical Center, Infertility and In Vitro Fertilization Unit, Petah Tikva; [d] Beilinson Medical Center, Petah Tikva; and [e] Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel

Objective: To study association of semen quality with a priori whole dietary pattern indexes, which reflect real-world dietary practices and the numerous combinations by which foods are consumed: Healthy Eating Index (HEI), Dietary Approaches to Stop Hypertension (DASH), alternate Mediterranean Diet score (aMED), and Alternative Healthy Eating Index (AHEI).
Design: A cross-sectional single-center study.
Setting: Hospital fertility center and university.
Patient(s): A total of 280 men attending fertility center from 2012 to 2015.
Intervention(s): Food frequency questionnaire (FFQ) and semen and sperm analysis.
Main Outcome Measure(s): Food consumption with the use of FFQ and HEI, AHEI, aMED, DASH nutritional individual scoring indexes. Semen parameters, including semen volume, sperm concentration, motility, total count, and morphology.
Result(s): Comparing the highest and lowest quartiles of the nutritional indexes, men in the highest quartiles of HEI, AHEI, aMed, and DASH indexes had significantly higher adjusted means of sperm concentration (by 10%, 45%, and 24% for HEI, AHEI, and DASH, respectively), normal sperm morphology (by 21% and 8% for AHEI and DASH, respectively), total sperm count (by 29% for AHEI), and sperm motility (by 6% and 11% for aMed and HEI, respectively).
Conclusion(s): Adherence to any of the four dietary indexes is associated with better overall sperm quality, with AHEI best associated. Following our novel findings, we recommend using AHEI as a clinical and practical tool for public whole nutritional recommendation for semen quality. (Fertil Steril® 2018;109:809–16. ©2018 by American Society for Reproductive Medicine.)
Key Words: Semen, sperm, nutrition, dietary indexes

Discuss: You can discuss this article with its authors and other readers at https://www.fertstertdialog.com/users/16110-fertility-and-sterility/posts/29128-24936

Semen quality and male fertility have been declining over the past few decades (1–5). For instance, a recent comprehensive meta-regression analysis reported significant decline (50%–60%) in sperm counts (concentration and total sperm count) from 1973 to 2011 among men from North America, Europe, Australia, and New Zealand (1). This phenomenon has been attributed mainly to environmental, nutritional, and lifestyle habits. The relative new concept of the role of nutrition in male fertility along with the complexity of nutrition gave rise to scientific research that focused mainly on the effect of specific nutrients and/or nutritional supplements on male fertility. Nutrients that were found to have a positive effect on reproduction outcome include, among others vitamin A (6), zinc (7), folate (8), vitamin D (9), vitamin C (10), and omega-3 fatty acids (11). Nutrients that were found to have a negative effect on reproduction outcome include saturated fat (12), trans fat (13), and alcohol (14). Consequently, relatively small number of studies have focused on food groups or dietary patterns in relation to fertility (15–17).

Unlike some risk factors, diet poses an opportunity for intervention, thus making it important to consider as a tool in recommendations for subfertile men. Nutrition is consumed as a whole dietary pattern. Recently, nutrition research is using whole dietary patterns that reflect real-world dietary practices and their numerous combinations (18–21) to analyze association with disease and health. In the present study we used a scientific approach to analyze a priori nutritional indexes that are based on known/acceptable dietary indexes in relation to health and disease.

The commonly used nutritional indexes representing and reflecting major nutritional patterns are: the Healthy Eating Index (HEI), the alternate Mediterranean Diet score (aMED), the Alternative Healthy Eating Index (AHEI), and the Dietary Approaches to Stop Hypertension (DASH) (22–24). These

Received August 31, 2017; revised December 28, 2017; accepted January 9, 2018.
M.E. has nothing to disclose. A.S. has nothing to disclose. H.P. has nothing to disclose. R.B. has nothing to disclose.
Reprint requests: Ruth Birk, Ph.D., Head, Nutrigenetics and Nutrigenomics Laboratory, Nutrition Department, School of Health Sciences, Ariel University, 40700, Petah Tikva, Israel (E-mail: ruthb@ariel.ac.il).

Fertility and Sterility® Vol. 109, No. 5, May 2018 0015-0282/$36.00

https://doi.org/10.1016/j.fertnstert.2018.01.010

indexes were studied previously in relation to various morbidities (25–29) and use different approaches to assess and score diet quality; the HEI uses a global approach to assess diet quality and includes nearly all foods in the calculation of the total score (30–32). AHEI and the aMED (33, 34) assess foods and chronic disease outcomes (35), and the DASH index (36, 37) reflects adherence to a particular dietary pattern (38–40).

The aim of the present study was to study, for the first time, the association between four established dietary indexes reflecting real-life healthy nutritional recommendations and male fertility as indicated by semen parameters.

MATERIALS AND METHODS

Men attending the Rabin Medical Center fertility clinic (Petah Tikva, Israel) from 2012 to 2015 were recruited. Informed consent was obtained from each participant before enrollment. The initial recruited study population included 593 men (with poor semen or normospermic) aged 18–55 years. Each recruit was requested to fill medical history, food frequency (FFQ), and lifestyle questionnaires. Exclusion criteria were in accordance with standard nutritional methodologies. Exclusion criteria included technical and nutritional issues such as inadequate filling of FFQ (n = 169), including unreasonable caloric consumption, empty questionnaire pages, questionnaires that were not completed, lack of information about physiologic or medical state, not returning questionnaire, and analysis demonstrating unreasonable values. Excluded subjects were not significantly different from the final cohort (e.g., age, body mass index [BMI], percentage with BMI >25 kg/m^2, smoking). In addition, we excluded men with medical conditions or treatments that might jeopardize testis function and sperm quality (n = 172), including genetic disorders, cryptorchidism, azoospermia, varicocele, microorchidism, vasectomy, hormonal disorders and hormonal treatment, medical conditions treated with drugs that may have an effect on semen quality (such as immunosuppressive drugs, steroids, finasteride against baldness, etc.), or any other medical condition that might have a systemic effect (such as medical history of gonadotoxic treatment, diseases accompanied by fever for long period, hormonal impairment due to pituitary gland surgery, and diabetes [41]). After applying all exclusion criteria, the final study population included 280 men.

Ethical Approval

The study protocol was approved by the Helsinki Committee at Rabin Medical Center (research code 6580).

Food Frequency Questionnaire

The FFQ is a commonly used tool to obtain frequency and portion size information about food consumption over a specified period of time (15–17). All participants filled out a 111-food-item FFQ validated for the Israeli population (42, 43). The nutrient components of each food item were taken from the Israeli National Nutrient Database ("Tzameret"). Statistical analysis of adherence to four different dietary indexes was conducted for each participant. Dietary quality scoring methods for all indexes are presented in Table 1.

The use of the FFQ in relation to sperm parameters has an additional benefit; spermatozoa mature within 3 months, so using the FFQ based on nutrient intake over the past 6 months is an effective tool in studying the association between semen quality and nutrition.

Semen Analysis

After the required 3-day sexual intercourse abstinence period, semen samples were generated via masturbation into polypropylene containers. Within an hour, the samples were liquefied and the semen parameters of volume, semen concentration, total sperm count, percentage total motility, and percentage normal morphology assessed according to World Health Organization (WHO) guidelines published in 2010 (44). The WHO reference values for normal semen are: semen volume >1.5 mL; semen concentration >15 × 10^6 cells/mL; total sperm >39x10^6; motility >40%; and normal semen morphology >4%. The percentage of normal sperm forms was determined with the use of WHO criteria. Semen morphology was assessed with the use of automated sperm quality analyzers (SQA-V gold; Medical Electronic Systems). This technology is based on the principle of electro-optical signal processing in combination with built-in computer algorithms (45–48) and is approved for use in routine semen analysis (46).

To assess subjects' sperm concentration and motility, a 10-μL aliquot was added to a Makler chamber (Sefi-Medical Instruments) (49, 50) and semen visualized with the use of a phase-contrast microscope (Olympus CX21) at ×200 magnification. In addition, total sperm counts were calculated with the use of a volume × concentration equation.

Statistical Analysis

The normality of the data was assessed graphically with the use of histograms and Q-Q plots as well as the Shapiro-Wilk test. For each participant, his adherence to each dietary index was calculated from his FFQ according to the index's criteria (22). Then the participants were ranked and for each diet index assigned to quartiles. To characterize our data, correlations between different parameters, such as anthropometric parameters and semen analysis parameters, as well as the level of adherence to the different dietary indexes were calculated with the use of either Spearman or Pearson correlations (depending on the normality of parameters). All seminal parameterss except for motility showed nonnormal distribution.

There are several relevant lifestyle confounders that may have an effect on semen quality, including: age, BMI, smoking, physical activity, total energy intake, socioeconomic level, ethnicity, and abstinence time (17). For these possible confounders, Kruskal-Wallis or analysis of variance tests were used to compare differences in continuous measures across quartiles whenever appropriate, and chi-square test was used for categoric variables. All covariates were included in the final model whether or not statistical difference between quartiles was observed. After the