Reproductive parameters in young men living in Rochester, New York

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Objective: To describe semen quality and reproductive hormone concentrations of young men living in Rochester, New York, and to compare these with published data from similar European and Japanese populations.
Design: Cross-sectional study.
Setting: University and college campuses in the Rochester, New York, area.
Patient(s): Unselected young college students (n = 222).
Intervention(s): A physical examination, blood and semen samples, and completion of a brief questionnaire.
Main Outcome Measure(s): Semen parameters and serum reproductive hormone levels.
Result(s): Subjects were aged 18–22 years (median age, 19.5 years), predominantly Caucasian (81%), and nonsmokers (79%), with a mean (SD) body mass index of 25.5 (4.2) kg/m^2. Overall, median sperm concentration was 52 × 10^6/mL (5th–95th percentiles: 7–181 × 10^6/mL), median total sperm count was 158 × 10^6 (14–587 × 10^6), and 23.1% and 15.8% of men had a sperm concentration below 20 × 10^6/mL and 15 × 10^6/mL, respectively. Few men had serum hormones falling outside clinically normal ranges. Median sperm concentrations and reproductive hormone levels were comparable to those seen in young men in Denmark, Finland, and Japan.
Conclusion(s): Our study provides the first data in 70 years on semen quality and reproductive hormones in young men in the United States with unknown fertility. These data suggest that, overall, reproductive parameters in our study population of young college students from the northeastern United States are similar to those of young European and Japanese men. (Fertil Steril® 2014;101:1064–71. ©2014 by American Society for Reproductive Medicine.)
Key Words: Andrology, male factor, reproductive hormones, semen quality, United States

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Although controversial, some recent data suggest decreasing fecundity over the past 20 years (1, 2), and in many developed countries fertility rates are below replacement level (2.1 children per couple) (2). Causes of this decline are varied and only partially known, but contributing factors include changes in lifestyle, social habits, and increased contraception (3) and environmental factors (4–7).

In parallel, sperm concentration and serum T levels seem to have declined in several Western countries over the last decades (8–12), with the decline in sperm concentration varying by geographic region (13–15). Semen quality has been linked to numerous factors, including diet (16–18) and stress (19), as well as environmental and work-related toxic exposures (6, 7, 20), all of which may have changed over time and may have contributed to a decline. However, it has recently been shown that other lifestyle factors—and perhaps not all the previous ones—might be affecting semen quality (21), and this topic is still controversial.

Recently several Nordic studies have evaluated trends in semen quality among young men from the general population. In Denmark, small increases in total sperm counts and sperm concentration, but not in morphology or motility, have been shown between 1996 and 2010 (22), whereas no

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changes were observed between 2000 and 2010 for Swedish men (23), and a decrease was observed for Finnish men between 1998 and 2006 (24). Recently adverse trends of sperm concentration and morphology between 1989 and 2005 have been observed in men representative of the general population in France (25). Similarly, it has been suggested that total sperm count and sperm concentration may have declined in young Spanish men over the last decade (2001–2011) (26). Despite differences, all these studies reported relatively poor semen quality in their study populations (27–29).

To our knowledge there is only one published article on semen quality in young men from the United States (30). That investigation was based on 100 medical students, of whom more than 65 had a sperm count that exceeded 100×10^6/mL. Since then no studies of semen quality in US men have been published, and reproductive hormones in young men in the US have not been described previously. Although this is the first article to describe the semen quality and serum reproductive hormone levels in the Rochester Young Men's Study (RYMS) population, several recent publications investigated specific associations between lifestyle factors and reproductive parameters (e.g., diet and exercise) on the RYMS population (16, 31, 32), and one article examined anogenital distance in relation to semen parameters in a subset of these men (33).

The aim of the present study is to describe reproductive parameters of young college students living in Rochester, New York, and to compare these with published data from populations in Europe and Japan.

MATERIALS AND METHODS

Study Population

Subjects were participants in RYMS, a cross-sectional study of young men conducted in 2009–2010 at the University of Rochester, Rochester, New York. Men were recruited at college and university campuses in the Rochester area. Subjects were eligible if they were born in the United States after December 31, 1987, were able to read and speak English, and were able to contact their mother and ask her to complete a questionnaire. A total of 389 potential participants responded to study flyers and newspaper advertisements between the winter of 2009 and the spring of 2010. Of these, 305 met all eligibility criteria. Among eligible men, 83 did not participate because they were unable to arrange a study visit owing to scheduling or transportation difficulties, were no longer interested after learning about the details of the study, or manifested interest but never scheduled a study visit. The remaining 222 men (73%) participated in the study. One man with a history of testicular cancer was azoospermic and was not included in our analysis. Motility data were excluded for one man for whom the time between collection and semen analysis exceeded 30 minutes. The analysis reported here includes the 219 men with complete data on all study outcomes and covariates. The study protocol included a physical examination, blood and semen samples, and completion of a brief questionnaire. Subjects received $75 upon completion of all study components. The University of Rochester Research Subjects Review Board (#RSRB00025182) approved the study, and written informed consent was obtained from all subjects before their participation.

Physical Examination

An andrologic examination of each participant was performed and weight and height assessed on the same day as semen and blood sampling. The presence of varicocele or other abnormalities was noted, and testicular size was estimated using Prader's orchidometer (Andrology Australia).

Serum Hormone Analysis

Blood samples were drawn from a cubital vein, centrifuged, and the serum was separated, stored, and frozen at −80°C. All samples were analyzed for serum hormones at the Andrology Laboratory at the Rigshospitalet (Copenhagen, Denmark). Samples were shipped to Copenhagen on dry ice and stored at −20°C until hormone analysis was performed using previously described methods (34, 35). Briefly, all hormone assessments were done June–August 2010 to reduce intralaboratory variation. Serum levels of FSH, LH, and sex hormone–binding globulin (SHBG) were determined using time-resolved immunofluorometric assays (DELFIA; PerkinElmer). Intra- and interassay variations were both <5% in each of the three assays. Serum T levels were determined using a time-resolved fluoroimmunoassay (DELFIA; PerkinElmer) with intra- and interassay variation <8%. Estradiol was measured by radioimmunoassay (Pantex) with an intra-assay variation of <8% and an interassay variation of <13%. Inhibin b levels were determined by a specific two-sided enzyme immunometric assay (Oxford Bio-Innovation) with intra- and interassay variation of 13% and 18%, respectively. Free testosterone (cFT) was calculated from total T and SHBG using a fixed albumin level of 43.8 g/L as described by Vermeulen et al. (36).

Semen Collection and Analysis

Semen collection and analysis methods have been described previously (33). Briefly, subjects collected semen samples by masturbation at the clinic and were asked to report the time of the previous ejaculation. Abstinence times reported to be >240 hours (n = 8) were truncated at 240 hours. Sample processing was initiated within 30 minutes of collection. One man with long time to analysis was excluded from motility analyses. Ejaculate volumes were estimated by specimen weight, assuming a semen density of 1.0 g/mL. Motility was analyzed using the World Health Organization 1999 criteria (37); the percentages of all sperm that were classified as motile ("A+B+C") were used in all analyses. Sperm concentration was determined by hemocytometer (Improved Neubauer; Hauser Scientific). Two chambers of the hemocytometer, using one dilution, were counted and the average used in this analysis. We also calculated the total sperm count (TSC) (volume × sperm concentration) and the total motile count (TMC) (volume × sperm concentration × percent sperm classified as A+B+C). Smears for morphology were made, air-dried, fixed, and shipped to the University Department of Growth and Reproduction at the Rigshospitalet (Copenhagen, Denmark). The slides were Papanicolaou stained and assessed using strict criteria (38) reporting the percentage of normal spermatozoa. To increase consistency and comparability of methods over the course of the study, six sets of duplicate semen samples