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Decline in semen parameters from 2000 to 2016 among Bangladeshi men attending a tertiary care hospital

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Abstract

Introduction: The objective of this study was to analyze longitudinal changes in semen parameters of Bangladeshi men. We hypothesized that semen parameters declined for this population. Methods: We retrospectively analyzed semen data from men aged 18-44 years who sought care for general sperm quality or update on fertility status at an infertility clinic in Dhaka, Bangladesh, from January 2000 to June 2016 (n = 13,810). Samples with incomplete data were excluded (n = 143). The WHO normal criteria and semen analysis procedures were used to evaluate parameters of the remaining 13,667 specimens. Samples with missing values on sperm concentration (n = 817) were excluded from concentration analyses. Age and duration of abstinence at testing were recorded and adjusted for. Data were imported into SAS® 9.4 statistical software. Temporal significance was investigated using one-way ANOVA for mobility parameters and Chi-square test for raw concentration. Logistic regression analyzed the effects of confounders on azospermia and raw concentration, while median regression modeling adjusted confounders for concentration, total motility, and rapid linear (RL) mobility. Results: Age distribution was significantly correlated with annual parameter changes (concentration, total motility, and RL mobility: β = 0.0001). Adjusted total motility and RL mobility declined by 2% from their maximum values to end of the study (P < 0.0001). Raw concentration lacked clear trends and was unaffected by adjustment. Azospermia increased by 10% between the 2000-2010 and 2011-2016 participants (odds ratio = 1.10 [95% CI 1.04–1.16]). Conclusion: In agreement with the hypothesis, Bangladesh makes attending this clinic have experienced decline in semen parameters (total motility and RL motility) and increased frequency of azospermia.

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Introduction

Changes in sperm quality indicators — sperm count, percentage of sperm motility, sperm density, and normal sperm morphology — have been explored globally over the last two to three decades.[1] Longitudinal and cross-sectional studies in Israel showed that the average sperm parameters in the nation have dropped over the last 25 years, with significant decreases of total motile sperm counts per ejaculate and percentage mobility.[2] A retrospective analysis of semen in men in the Netherlands showed a significant decrease in sperm mobility and increase in immotile sperm from 1977 to 1995.[3] Another study highlighted Japan and Denmark as having the lowest semen indicators in the world. This study, as well as a review on all sperm-density studies done from 1934 to 1996, concluded that while geographical location of nations may result in regional disparities for semen quality, parameters have declined for overall and in both regions.[3-5]

While semen data are available for most of the global communities, South Asian countries lack research studies. A 2007 study conducted by the infertility unit at the Bangladesh Sheikh Mujib Medical University found that about 62% of couples attending the infertility unit faced primary infertility, while 39% experienced secondary infertility. Semen analyses results from this study indicated that among the male partner, oligospermia, or sperm concentration of <20 x 10^6 sperm/mL, was the most common, while severe oligospermia (concentration <10 x 10^6 sperm/mL) was present in 33.3% of cases.[6] In 2010, an estimated 3 million Bangladeshi couples were infertile, and 60% of those couples, the male partner was responsible.[6]

The objective of this study was to analyze changes in semen quality of a subset of the Bangladesh male population attending an infertility clinic between 2000 and 2016. Through this study, we hope to evaluate whether there is an observable decline of semen parameters in Bangladeshi males, as determined by trends recorded for motility, morphology, and concentration. Based on trends observed in the global community, we hypothesized that there is a temporal decline in semen parameters for the study population.

Materials and Methods

The Ethical Review Committee of the Diabetic Association of Bangladesh approved the protocol of this study (Memo no: BADAS-ERC/EC/16/0091). Participants were required to provide signed consent for their analysis results to be included in the study database and received signed analysis reports for their personal records.

Study population and participants

Data collection for this study was conducted in the Centre for Assisted Reproduction (CARE) at the Bangladesh Institute of Research and Rehabilitation for Diabetes, Endocrine and Metabolic Disorders (BIRDEM) from January 2000 to June 2016. CARE is one of the largest infertility clinics in Bangladesh and a major clinic for infertility referrals. A majority of patients at CARE reside in Dhaka, Bangladesh, but services are also provided to patients from other regions in the country and those visiting from overseas.

The overall study population consisted of 13,953 participants. A total of 143 participants were excluded from analysis due to incomplete data. 6187 datasets did not have quantitative sperm concentration values and were excluded from raw concentration analyses. Data is not available for 2006 and thus data from 2000 to 2005 and 2007 to June 2016 is included.

Semen analysis procedures and calculations

All semen analyses were conducted by a single laboratory technician who used the same type of laboratory materials for the entire duration of the study. The methods used for semen analysis are outlined in the WHO’s Laboratory Manual for Examinations and Processing of Human Semen (4th and 5th ed).[10] Participants provided semen samples through masturbation or intercourse at on-site masturbation. 3-5 days of abstinence before sampling was advised, and duration was recorded. Samples were liquefied for 30 min and then gently vortexed before 2-3 drops were extracted. Drops were loaded into a Makler counting chamber (0.01 mm × 0.01 mm grid) and observed under a phase-contrast microscope at ×10 magnification. The laboratory technician determined morphology by adjusting the microscopic view to a higher magnification so that physical characteristics of the spermatozoa were visible. The count of sperm that were not in the normal tadpole shape or swim abnormally were considered to have abnormal morphology. The percentage of sperm with abnormal morphology was estimated based on the magnification of the grid, proportional to the overall 10 × 10 Makler chamber grid.

Statistical analyses

The dataset (n = 13,810) was imported from an electronic database into SAS® 9.4 statistical software (Cary, North Carolina) for analysis. Because normally tested showed the semen parameters to be severely skewed, median (interquartile range) was reported for parameter baseline. Age, duration of abstinence, and liquefaction were reported as mean ± standard deviation. Significance of differences between annual means and medians was found through parametric one-way ANOVA tests, while raw concentration significance was determined through the Chi-square distribution analysis. P < 0.05 was considered statistically significant. Patients with missing quantitative concentration data or incomplete records (n = 817) were excluded from the logistic regression analyses of this variable. To adjust for confounding, concentration, motility, and RL mobility were adjusted by median age of patients at the time of testing and median duration of abstinence before testing through median regression modeling.

Due to the incompleteness of the quantitative concentration dataset, qualitative azospermia concentration diagnosis was evaluated in logistic regression analyses since it is definitive. Other qualitative diagnoses such as normospermia and oligospermia were not used in analysis because the WHO criteria changed between 1989 and 2010 affected diagnosis frequencies.[2] To account for the criteria change, concentration diagnosis frequencies were adjusted separately based on the WHO’s 2010 criteria. Morphology reporting in the dataset was inconsistent through Chi-square distribution analysis. P < 0.0001 was considered statistically significant. Patients with missing quantitative concentration data or incomplete records (n = 817) were excluded from the logistic regression analyses of this variable. To adjust for confounding, concentration, motility, and RL mobility were adjusted by median age of patients at the time of testing and median duration of abstinence before testing through median regression modeling.

Results

Baseline semen characteristics, age, and duration of abstinence of the study population (n = 13,810) are shown in Table 1. The average age of participants was 35 ± 6.6 years, and age distribution was significantly correlated with annual parameter changes (P < 0.0001) [Table 1]. Duration of abstinence (P = 0.05) and liquefaction (P = 0.07) remained unchanged in annual comparisons, both averaging around 3 ± 8.8 days and 1 ± 0.8, respectively. All semen parameters (concentration, total motility, RL motility, and normal morphology) appeared to vary.
Our study shows that for Bangladesh men, there has been a decline in total motility and RL motility on semen analysis from 2000 to 2016, and the trends and magnitude of decline are more evident upon adjusting for age and duration of abstinence. The incidence of azoospermia also increased when adjusted for age and duration of abstinence.

Interestingly, the overall frequency of normozoospermia increased upon adjusting for the WHO 2010 concentration diagnosis. However, this finding does not indicate that the actual frequency of fertile males increased. The criteria changed from ≥20 × 10⁶/mL to ≥15 × 10⁶/mL, and this might be the deciding factor for this increase in normozoospermia. Moreover, other researchers have shown that male infertility is often associated with oligozoospermia or lower sperm counts. Therefore, the increase in frequency of normozoospermia might be due to a decrease in the number of infertile men, which could be associated with changes in lifestyle or environmental factors.

Among the correlated dataset, outliers who do not reside in Dhaka or have drastically different life course exposures are not eliminated. Therefore, the effect of confounding due to age and duration of abstinence is not controlled for. Moreover, the sample size was not consistent throughout the study, which could have influenced the results. It is also important to note that the study was conducted in a single clinic and the results may not be generalizable to the entire population of Bangladesh.

In conclusion, our study provides evidence for a decline in semen quality in Bangladesh men, which is likely associated with changes in lifestyle and environmental exposures. Further research is needed to understand the underlying causes and develop strategies to improve semen quality and reproductive health in the population.