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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 sperm parameters of Bangladeshi men. We hypothesized that semen parameters declined for this population. Methods: We retrospectively analyzed semen data from men aged 18-64 years who sought care for general sperm quality or updates on fertility status at an infertility clinic in Dhaka, Bangladesh, from January 2000 to June 2016 (n = 13,953). Samples with incomplete data were excluded (n = 143). The WHO normal criteria and semen analysis procedures were used to evaluate parameters of the remaining 13,810 specimens. Samples with missing values on sperm concentration (n = 6187) were excluded from concentration analyses. Age and duration of abstinence at testing were recorded and adjusted for. Data were imported into SPSS 14 statistical software. Temporal significance was investigated using one-way ANOVA for mobility parameters and Chi-square test for raw concentration. Logistic regression analysis the effects of confounders on azoospermia and raw concentration, while median regression modeling adjusted confounders for concentration, total motility, and rapid linear (RL) motility. Results: Age distribution was significantly correlated with annual parameter changes (concentration, total motility, and RL motility P = 0.0001). Adjusted total motility and RL motility declined by 20% from their maximum values to end of the study (P = 0.0001). Raw concentration lacked clear trends and was unaffected by adjustment. Azoospermia increased by 10% between the 2000-2010 and 2011-2016 participants (odds ratio = 1.10 [1.04–1.16]). Conclusion: In agreement with the hypothesis, Bangladesh males attending this clinic have experienced decline in semen parameters (total motility and RL motility) and increased frequency of azoospermia.

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Full Text

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 decrease of total motile sperm counts per ejaculate and percentage motility.[2] A retrospective analysis of semen in healthy Israeli men identified a significant decrease in sperm count and increase in immotile sperm from 1977 to 1995.[4] 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 1994 to 1998, concluded that while geographical location of nations may result in regional disparities for semen quality, parameters have declined for overall and in both regions.[5][6]

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 Bangabandhu 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, oligozoospermia, or sperm concentration of < 20 × 106 sperm/mL, asthenozoospermia, or sperm motility of < 40%, and normal morphology of < 40% were the most frequent abnormalities.[7] In 2010, an estimated 3 million Bangladesh couples were infertile, and for 60% of those couples, the male partner was responsible.[8][9]

The objective of this study was to analyze changes in sperm quality of a subset of the Bangladeshi 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 Bangladesh 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/ERREC/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 Diabetics, Endocrine and Metabolic Disorders (BIRDEM) from January 2000 to June 2016. CARE is one of the largest infertility clinics in Bangladesh and a major center 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 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 Examination and Processing of Human Semen (4th and 5th ed.).[10] Participants provided semen samples through masturbation or intercourse at the on-site masturbatorium. 3–5 days of abstinence before sampling was advised, and duration was recorded. Samples were liquefied for 30 min and then gently aspirated 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 Grade A sperm lacked movement. Total motility was calculated as Grade A sperm + Grade B sperm. Rapid linear (RL) motility only accounted for the percentage of Grade A sperm.

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 35.4 ± 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 5.2 ± 3.8 days and 1.0 ± 0.38, respectively. All semen parameters (concentration, total motility, RL motility, and normal morphology) appeared to vary significantly with age (P < 0.0001) and duration of abstinence (P = 0.05). Significance of difference between annual means and medians was found through parametric one-way ANOVA tests, while raw concentration significance was determined through Chi-square distribution analysis. P < 0.05 was considered statistically significant. Patients with missing quantitative concentration data or incomplete records (n = 6187) were excluded from concentration analyses. Data was imported into SPSS 14 statistical software. Temporal significance was investigated using one-way ANOVA for mobility parameters and Chi-square test for raw concentration. Logistic regression analysis the effects of confounders on azoospermia and raw concentration, while median regression modeling adjusted confounders for concentration, total motility, and rapid linear (RL) motility. Results: Age distribution was significantly correlated with annual parameter changes (concentration, total motility, and RL motility P = 0.0001). Adjusted total motility and RL motility declined by 20% from their maximum values to end of the study (P = 0.0001). Raw concentration lacked clear trends and was unaffected by adjustment. Azoospermia increased by 10% between the 2000-2010 and 2011-2016 participants (odds ratio = 1.10 [1.04–1.16]).

Conclusion: In agreement with the hypothesis, Bangladesh males attending this clinic have experienced decline in semen parameters (total motility and RL motility) and increased frequency of azoospermia.

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Our study shows that for Bangladesh men, there has been a decline of 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. 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 may be solely responsible for the shift in normozoospermia because more participants qualified for the diagnosis. No significant differences were found between the WHO 1999 and 2010 parameters, frequencies compared. The increase in frequency of axospermia participants from 10.9% of the 2000–2010 cohort to 14.9% of the 2011–2016 cohort indicates a slight decrease in concentration across the population. This finding is consistent with past meta-analyses of international literature that describe semen concentration trends over the last few decades.[7] We recently studied on concentration trends also show decreased parameters in countries not previously studied, such as Israel, India, and New Zealand.[2,12,13] However, adjusted and unabated new concentration analyses do not indicate a clear trend of decline in concentration for our study population.

The effect of risk factors on semen quality in our study participants may not be conclusive because there was only a clear trend of decline in motility. However, it is important to acknowledge that other factors such as potentially associated with semen quality. Literature extrapolates that there is a potential for decline in semen quality due to endocrine disruptor exposure, which is associated with increased industrialization, especially in developing countries.[1] Regions of widespread industrialization generally experience higher rates of oligozoospermia than other areas.[14] Occupational and environmental exposure to toxicants also contribute to semen quality via the effects of xenosteroids on reproductive hormones which help describe how the burden of male infertility may be reduced and prevented. There is a need for global action to solidify an understanding of declining semen holistically in order to combat specific causes for the prosperity of future generations. Moreover, improvement of the WHO parameters to provide a clearer definition for trends. Controlled studies tracking life course exposures of males in Bangladesh that are supplemented with extensive patient history, semen quality, lifestyle factors, and effects of clinical fertility care.

Conversely, several improvements were needed in the study design and dataset. Although it was previously described that normozoospermia and azoospermia increased with time, characterization of the diagnoses was limited by the absence of raw concentration readings across the study period. If these data were available, the qualifications for oligozoospermia stratification could be described more accurately. It is also important to note that sample size did not remain consistent throughout the study. There was a fluctuation of participants during the second half of the study. Therefore, the increase in frequency of axospermia may have offset the expected decrease in normozoospermia. Moreover, there appeared to be a bi-modal pattern between 2000 and 2004, which may or may not be associated with the reduced sample size compared to post-2008 data. Association could be the explanation for this decline because the parameters would not have been affected by the WHO criteria changes until 2010, but sample size is not a conclusive factor because none of the factors other than mortality showed association.

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 influential risk factors (i.e. exposure to toxins, prevaxing health conditions, environmental factors, and drug use) is not clear. All the study participants were from a single clinic, thus limiting generalizability of our results. Moreover, we were unable to follow single participants over time and determine whether multiple datasets represented a single participant due to a lack of paternity identifiers. Significant measurement bias exists where the WHO 2010 semen parameters have been deemed as unreliable from emerging studies because they are determined by the world population at large, thus potentially not providing a true measure for the burden of infertility as differed regionally.[10] An absence of raw concentration counts for 6187 participants makes it difficult to assess whether the laboratory technician’s classification of oligozoospermia versus normozoospermia is consistent over time. Although consistently reported by a single laboratory, it may reflect the accuracy of semen parameter readings.

This study provides a rationale for conducting observational studies on male infertility in the context of Bangladesh and neighboring South Asian countries. We established the trend of decline in motility and slight increase in axospermia in a clinic population, the next step might be to determine whether this is also true for the overall population and evaluate the reasons for trends. Controlled studies tracking life course exposures of males in Bangladesh that are supplemented with extensive patient history and lifestyle factors, and effects of xenosteroids on reproductive hormones may help describe how the burden of male infertility may be reduced and prevented. There is a need for global action to solidify an understanding of declining semen holistically in order to combat specific causes for the prosperity of future generations. Moreover, improvement of the WHO parameters to provide a clearer definition for infertility as varied for ancient cultures to improve intervention targets of male partners significantly.

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Conflicts of interest:
 There are no conflicts of interest.

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