

# Are semen parameters worsening? Comparing semen parameters 10 years apart

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## ABSTRACT

**Background:** Semen parameters, especially sperm count and motility have been said to be diminishing over time with implications for fertility and infertility treatment. **Objective:** The objective of this study was to study semen parameters 10 years apart and describe any observed change. **Design:** A retrospective study carried out at Nordica Fertility Centre, Lagos, Nigeria. Semen parameters of 100 consecutive men who sought fertility treatment on account of infertility in 2003 and semen parameters of 100 consecutive men who also sought fertility treatment at the center in 2013 on account of infertility were analyzed and compared. A paired *t*-test was performed to ascertain whether sperm counts have diminished over the last decade. The World Health Organization semen values were used as standard. **Main Outcome Measures:** They are sperm count, motility, and mean progressive motility. **Results:** The mean sperm count in the 2003 group was  $34.6 \times 10^6/\text{ml}$  (range: 0.1–105.0  $10^6/\text{ml}$ ) compared with  $21.8 \times 10^6/\text{ml}$  (range: 0.1–80.0  $10^6/\text{ml}$ ) in the 2013 group. The mean motility was 47.9% in the 2003 group and 45.3% in the 2013 group. The mean progressive motility in the 2003 group was predominantly graded as good (50% good, 44% fair, 2% poor, 4% no motility) while in the 2013 group, the predominant grade of mean progressive motility was fair (15% good, 81% fair, 4% poor). Normal morphology was more commonly seen in the 2013 group compared to the 2003 group. Mean semen volume was 2.7 and 2.6 ml in 2003 and 2013 groups, respectively. The mean difference in sperm count (mean = 12.8, standard deviation = 31.6,  $n = 100$ ) was significantly  $>0$  providing evidence that sperm counts have diminished in the last decade. **Conclusion:** There was a statistically significant 37% drop in mean sperm count and mean progressive motility worsened in the last decade. These may have far-reaching effects on infertility and its treatment.

**Key words:** Male infertility, semen parameters, sperm count

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## INTRODUCTION

Semen parameters, especially sperm count and motility, have been said to be diminishing over time with implications for fertility and infertility treatment. A decrease of about 2% per year in sperm count was reported in a study of 1350 Parisian sperm donors over the past 23 years with younger men having the poorest quality semen.<sup>1</sup>

Infertility can be a distressing and frustrating problem for men and their partners. Male infertility is rising alarmingly. Regrettably in some parts of the world, particularly

Sub-Saharan Africa, much of the blame of infertility is placed squarely on the female. However, the fact is that up to half of all cases of infertility may be related to male factor.<sup>2</sup> A study carried out in 2012 by Jorgensen *et al.* showed that just one in four men had optimal semen quality.<sup>3</sup> Worldwide, sperm counts are estimated to have dropped by 50% since the 1930s.<sup>4</sup> Average sperm counts of 100 million, 75 million, and 50 million/ml were reported in 1950, 1970, and 1990, respectively.<sup>1</sup> A 1992 meta-analysis of 61 studies on semen quality published over a 50-year

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period (1938–1991) involving almost 15,000 men from 23 different countries showed approximately 50% decline in sperm counts ( $113 \times 10^6/\text{ml}$  -  $66 \times 10^6/\text{ml}$ ).<sup>5</sup>

In the 1940s, most young men routinely produced an average of 100 million sperm cells/ml of semen well above values needed for reliable, timely impregnation of their partners.<sup>6</sup> Currently, many men have been observed to produce much less. This shows the magnitude of the problem of male infertility. Should we be bothered that there could be a sperm crisis? Are sons likely to be less fertile than their fathers?

The cause of rising male infertility is not clearly known. However, our modern world is being affected by several factors some of which may be contributors to this issue of rising male infertility. Some of these factors include exposure to toxic chemicals that act as endocrine disruptors (xenoestrogens) such as insecticides, flame retardants, and phthalates from plastics as well as chemicals, heavy metals, X-rays in the workplace. These may affect hormones responsible for sperm production. Stress and overheating the testes such as using laptops for long periods placed on knees can affect sperm counts. Exposure to radiations from mobile phones placed in pockets near the crotch and from television sets and excessive oxidant stress have also been implicated in sperm DNA damage. Diet, obesity, and sedentary lifestyles are also factors to consider. A 2013 study from the British Journal of Sports Medicine reported that men who spent at least 20 h/week watching television had 44% lower sperm counts than those men who did not watch television. This was believed by researchers to be due to the sedentary nature of television watching. Other lifestyle issues such as increasing sexually transmitted infections, alcohol, cigarette smoking, marijuana, and use of other recreational drugs are additional factors. Semen parameters have implications for fertility and the success or otherwise of infertility treatment. This study, the first of its kind in these parts was designed to compare semen parameters of men 10 years apart and describe any observed change.

## MATERIALS AND METHODS

### Study setting and design

The study was conducted at Nordica Fertility Centre, Lagos. A leading private assisted reproduction center in Nigeria located in the densely populated cosmopolitan city of Lagos. Lagos is a business hub and has mainly government offices and banks. It also has several manufacturing industries that produce mainly household items.

The study was a retrospective cohort study. Semen parameters of 100 consecutive men who sought fertility treatment at Nordica Fertility Centre, Lagos, on account of infertility in 2003 and semen parameters of

100 consecutive men who also sought fertility treatment at the center in 2013 on account of infertility were analyzed for sperm count, motility, mean progressive motility, morphology, and semen volume and values from both groups were compared. Masturbation was the main method used for semen production; however, a few men who could not masturbate in both groups used coitus interruptus as alternative method. All semen samples were analyzed either by the head embryologist or embryologists trained by him. There was no change in the technique and equipment used throughout the period of the study. Relevant approval was obtained from the institution's review board.

### Semen analysis

All semen samples were received in the laboratory within 30 min of production. After liquefaction for 30 min or maximum of 60 min, semen samples were evaluated for sperm count, motility, and morphology. The volume of the ejaculate was determined by aspirating the liquefied sample into a graduated disposable pipette. Sperm counting and motility assessment were performed following the instructions of the counting chamber manufacturer (Makler Counting Chamber, Sefi Medical Instruments, Haifa, Israel). A volume of 3–5  $\mu\text{L}$  of semen sample was transferred to the center of the chamber. Sperm count was performed in 10 squares of the chamber. The total sperm count is the end concentration expressed as  $10^6$  spermatozoa/ml. Sperm motility was assessed in 100 random spermatozoa by characterizing them as (i) rapidly forward, fast progressive motility, (ii) moderately forward, slow progressive motility, (iii) jerky nonprogressive motility, and (iv) immotile/no movement, and the motility was expressed as percentage. A total of 200 sperm cells were characterized as morphologically normal or abnormal and the final morphology was expressed as percentage.

### Statistical analysis

The analysis was done using SPSS 17 (SPSS, Chicago, IL, USA.). A paired *t*-test was performed to ascertain whether there was any significant change in sperm counts. The World Health Organization semen values of 1999 were used as standard. These values are (i) semen volume at least 2.0 ml, (ii) sperm count at least 20 million/ml, (iii) motility at least 50%, (iv) morphology at least 14% normal forms.

### Confidentiality

Patients were assured of the confidentiality of their data. They also signed consent forms approving of this assessment as part of the infertility workup and for research and publications in journals provided their names are not used. The embryologists were not aware of the patients who produced the sperm samples neither were the patients knowledgeable of the identity of the embryologists.

## RESULTS

The mean ages of the men were 40.6 years (range: 27–68 years) for the 2003 group and 43.4 years for the 2013 group (range: 31–62 years). Both groups of men had similar occupations with civil servants being the leading occupation and majority in both groups resided mainly in the Lagos area.

- Good = Rapidly forward, fast progressive movement
- Fair = Moderately forward, slow progressive movement
- Poor = Jerky movement.

Normal morphology was more commonly seen in the 2013 group compared to the 2003 group though both groups averaged normal morphology. The mean difference in sperm count (mean diff = 12.8, standard deviation = 31.6,  $n = 100$ ) was significantly  $>0$ ,  $t(99) = 4.056$ , one-tailed  $P = 0.000$  providing evidence that sperm counts have diminished in the last decade.

## DISCUSSION

The two groups studied were of similar ages. The mean sperm count was higher in the 2003 group compared with the 2013 group. This decrease in sperm count over the decade studied was statistically significant. This finding is in keeping with several reports from Spain, Scotland, France, Norway, Italy, Denmark, Belgium, Germany, Austria, Greece, Israel, Tunisia, China, and Canada that allude to the fact that sperm concentrations of men from those countries have been diminishing over time.<sup>7</sup> To our knowledge, this study is the first of its kind from Nigeria. In terms of percentage, it represented a drop of 37% or 3.7%/year. This was similar to the 1995 French publication by Auger *et al.* in which a 30% (2.1%/year) drop in sperm counts from 89 to 60 million/ml of healthy fertile Parisian sperm donors was reported during a 20-year period (1973–1992).<sup>8</sup> Furthermore, a study by Rolland *et al.*, of 26,609 men who were not known to be infertile between 1989 and 2005 reported one-third drop (1.9%/year) in sperm counts from a mean of 73.6 million/ml in 1989 to 49.4 million/ml in 2005.<sup>9</sup> Our finding of 3.7% drop/year was higher than the 1.9% and 2.1% drop/year reported by Rolland *et al.* and Auger *et al.*, respectively. This may further buttress the alarming worsening of semen parameters, particularly the count. Overall in our study, motility and semen volume were similar in the two groups; however, the percentage of motile sperms dropped by 0.5% per year. Auger *et al.* also found no change in semen volume as well as a similar drop of 0.6% per year in sperm motility in their study.<sup>8</sup> The mean progressive motility, however, was predominantly good (50%) in 2003 but was mostly fair (81%) in 2013. This may suggest that sperm quality in terms of both progressive motility and count has declined over time. In our study, normal sperm morphology was more common in the 2013 group. Borges *et al.* observed a

change in sperm morphology in their study; however, many studies failed to find such association, and in fact in some studies, morphology was not investigated because of high inter-observer variation.<sup>7</sup>

The causes of this decrease in sperm quality over time have not been identified; however, it is likely that environmental factors and lifestyle changes as well as infections of the male reproductive organs, especially sexually transmitted ones, may play a role. Nigeria has become relatively more industrialized and civilized over time with more affluence and change in diet and lifestyle generally. Factors such as obesity and its effect on male fertility cannot be ignored as sedentary lifestyles have become more common. Nigeria is also an oil producing country. This and other occupational, chemical, and radiation exposure must not be ignored. Lagos is not directly in the oil producing region though crude oil has recently been discovered in the Lagos area. Lagos is also an overpopulated city with traffic congestions, air pollution, and stress. The use of medications, especially herbal concoctions, is relatively common among men in Lagos, especially those trying to conceive.

The findings from our study may have resulted in the rise in male infertility that has been noticed for some time now. In our center, up to 50% of cases of infertility have a male factor contribution. This problem of diminishing sperm quality could result in an increased prevalence of infertility and need for assisted reproduction.

## CONCLUSION

The study concludes that there has been significant worsening of sperm counts and poorer mean progressive motility of sperms over the last decade. Other semen parameters appear essentially unchanged. These findings could have far-reaching effects on male fertility, infertility, and its treatment. Further prospective studies on semen parameters taking note of the participants' specific occupations, exposures, lifestyles, and diet conducted in the general population could add to the strength of this study where possible preventive measures must be put in place to stem this trend.

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## Conflicts of interest

There are no conflicts of interest.

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