Review Article

Falling Sperm Counts in the Past 40 Years among Western Men: A Review Article

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Abstract:

Background: Recently so many studies have documented a concerning decline in semen quality among men in Western countries over the past few decades. This decline, characterized by reduced sperm concentration, motility and morphology, has been linked to a range of potential factors. Lifestyle changes, such as increased obesity rates, sedentary lifestyle and exposure to environmental pollutants are believed to contribute significantly. Additionally, factors such as poor diet, high levels of stress and exposure to endocrine disrupting chemical may also play a role. This deterioration in semen quality raises a concern about male infertility. The purpose of this review is to address the main disorders of semen quality, its aetiologies and steps which are essential to overcome the issues. Further research is crucial to fully understand the underlying mechanisms and to develop strategies to mitigate the impact of low quality semen on the reproductive health.

Key words: Semen quality, Reproductive health, Male infertility.

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Introduction:

Sperm count trends have been a feature in scientific literature, with some publications emphatic about a fall in semen parameters and its implication on male fertility, and others critical of these findings.

Sperm counts are derived from examination of semen, also referred to as semen analysis. The world health organization (WHO) has published a manual that is aimed at standardizing the handling of semen so that a global practice may be established. The 5th centile values were given in the WHO laboratory manual for the examination and processing of human semen in 2021 as follows:

Parameter	5th centile value
Semen volume	1.4 milliliters
Total sperm number	39 million per ejaculate
Sperm concentration	16 million per milliliter
Total motility	42 %
Progressive motility	30 %
Nonprogressive motility	1 %
Immotile spermatozoa	20 %
Vitality	54 %
Normal forms	4 %

Do semen analysis findings act as proxies for male fertility potential? There is still uncertainty about this. According to Kumar and Singh (2015), they do and according to Tong et al (2022), they do not. Male factor infertility accounts for 50% of infertility cases (Kumar and Singh, 2015), thus the importance of understanding this relationship cannot be over emphasized. If there is a relationship between

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declining sperm counts and male infertility then declining sperm counts may herald a potentially disruptive public health issue that may be felt in all areas of human endeavor.

It has been noted by many researchers that sperm count has been steadily declining since the 1930s in the western world (Levin et al, 2017), and a global concern on this subject was ignited by a publication by Carlsen et al (1992). Carlsen and colleagues published a systematic review of 61 studies from 1938 to 1990 where they were able to demonstrate a fall in both sperm count and semen volume in the preceding five decades.

Despite these findings and concerns, very few studies are able to elucidate the etiological factors for this decline and its geographical distribution. Obesity, industrialization, chronic diseases and some lifestyle factors have been speculated to be possible causes (Mann, Shiff and Patel, 2020).

This essay aims to review the available literature to assess the current evidence for and against the supposed reduction in semen quality. Beginning with Carlsen et al (1992) study, research supporting this hypothesis will be reviewed first, including an assessment of findings and a critical analysis of any flaws in their methodology. Research that does not find evidence of a decline in semen quality will then be considered in the same way.

Evidence for declining sperm counts:

Carlsen et al (1992) conducted a systematic study of 61 publications from 1938 to 1990 on sperm counts and concluded that there had been a decline in sperm counts by about 50%. Semen volume was also found to be reduced. Mean seminal volume was recorded in 46 out of the 61 studies and was found to have dropped from 3.40 milliliters to 2.75 milliliters in the period between 1940 and 1990. The Carlsen study analyzed data on 14947 men with no history of infertility. The majority of these studies were from the United States and Europe; 28 and 16 studies respectively. Three studies were from South America. From Africa, there were four studies which came from Nigeria, Tanzania and Libya. Four studies were from three Asian countries; Hong Kong, Thailand and India. Only 80 men were included from the populous nation of India. One study was from Australia and two studies were from the Middle East. The period of abstinence was recorded as three days in 32 studies. The rest of the 29 studies had no period of abstinence recorded. The decline in sperm counts was found to be from 113 million per milliliter in 1940 to 66 million per milliliter in 1990.

A subsequent reanalysis of the Carlsen Study by Swan et al (1997) confirmed the decline in sperm counts. These workers utilized 56 studies covering results published between 1938 and 1990 excluded from the Carlsen et al (1992) meta-analysis, three non- English-language studies and two studies that included men who conceived only after an infertility workup. In their report, Swan et al (1997) highlighted a greater decline in sperm counts in European men compared to their North American counterparts; 3% and 1.5% decline per year respectively.

Again, Swan et al (2000) demonstrated a decline in sperm counts when they analyzed data from 101 studies from 1934 to 1996. In this study, they included 47 more English language studies to the number of studies they looked at in 1997. They found their results to be very similar to the Carlsen et al (1992) results. As a result of this finding, they concluded that a decline in sperm count as seen by Carlsen and colleagues was not confined to the studies Carlsen and colleagues selected to include in their study.

Sengupta et al (2017) in their meta-analysis of data from 1965 to 2015 report a decline in mean sperm concentration counts in European men of 32.5% during the 50 years. They utilized data from 54 studies, the majority of which came from the United Kingdom, Germany and Denmark. Regarding the number of men included in the studies, 68.51% of the studies had a population of less than 500 men, and only 16.67% of the studies had a population greater than 1000 men. In addition, most of the information on semen characteristics was from men whose samples were at andrology laboratories (44.44%), from infertility clinics (22.22%) and 33.34% from epidemiological studies.

The mean sperm concentrations in the Sengupta studies showed a drop from 91.48 million/ml in 1985 to 61.75 million/ml in 2015. Comparing the mean sperm concentration of 61 million/ml to the current World Health Organization (WHO) reference of 16 million/ml, we can see that the drop in sperm concentration remains way higher than the WHO 16 million/ml. This should thus cause very little if any, concern about fertility.

Furthermore, Sengupta and colleagues admit that there are problems in their findings in that they were unable

to account for confounders such as habits like alcohol intake and smoking and also levels of stress in the men included in the studies. They also did not have data on the occupation of the men. The other problem they highlight is that of selection bias because some of the men included in the study were those attending infertility clinics.

Yet another study on a European population was published in 2007. Sripada et al (2007) reported a decline in sperm counts from data obtained over 12 years on men from North-East Scotland. The men selected for the study were those that had greater than 20 million per milliliter sperm density. The relatively stable population, large sample size, and the use of a single laboratory to process all the samples are the main strengths of the study.

A large systematic review and meta-analysis by Levine et al (2017) involving 185 studies from 1973 to 2011 showed a drastic drop in sperm concentration and total sperm count by 52.4% and 59.3% respectively in the studies done in Europe, Australia and North America. They did not see any decline in sperm counts in studies from South America, Asia and Africa.

The table below summarizes the evidence for declining semen parameters of sperm counts and semen volume

Study	**Decline in Sperm counts**
Carlsen et al, 1992	47million/ml in 52 years 0.65ml seminal volume in 50 years
Swan et al, 1997	3% each year in Europe 1.5% each year in North America
Swan et al, 2000	Seen in Europe and North America to a lesser extent than 1997 review. No decline in other countries
Sripada et al, 2007	Seen in over 12 years No decline seen in motility
Sengupta et al, 2017	32.5% over 50 years.
Levine et al, 2017	52.4% over 38 years (sperm concentration) 59.3 % (Total sperm counts) Seen in Europe, Australia and North America Not seen on Asia Africa and South America.

Evidence for no decline in sperm counts:

MacLeod and Wang (1979) in their study of a population of 15000 men in the United States concluded that semen volumes have been stable at about 3.2 milliliters from 1966 to 1976. They also stated that the numerical aspects of the semen analysis of patients attending their infertility clinic have been stable over the same ten-year period mentioned above.

Younglai et al (1998) in their study of men attending eleven university fertility centers in Canada, observed that individual centers did not show significant trends in semen quality in the 13 years of the study. The population of men they studied was 48968 from 1984 to 1996. Linear regression analysis was the statistical method used. When the same statistical method was applied to include all the 11 centers, it was noted that there was a small but significant downward trend in the semen parameters. They were led to conclude that, 'Secular trends in sperm density are dependent on the statistical method used for analysis'.

Jorgensen et al (2012), in their study of Danish men, found there was an increase in sperm counts over a period of 15 years, from 1996 to 2010. The study population of 4867 consisted of men averaging 19 years of age. The men were invited from the general Danish population in the Copenhagen area. They were given an incentive of 65 Euros. Median sperm concentration over the 15-year study was found to have increased from 43 to 48 million per milliliter. The total sperm count was found to have increased from 132 to 151 million per ejaculate. The strengths of the study were, semen was handled according to WHO guidelines; the study population was the general Danish population without fertility issues and it was a prospective study. The study did not, however, have previous data from the past dealing with the same subject and on a similar population in Denmark to compare with.

Conclusion:

With review of the current body of research available, the conclusion that there is a decline in sperm counts in the West cannot be rejected. The weight of the evidence does suggest that this conclusion is correct, but is by no means unanimous or without flaws. More research needs to be undertaken in countries beyond the West. Global standardization of semen collection and analysis protocols would be of significant benefit to address some of the issues in previous studies. Ultimately, there is more work to be done to have any chance of reaching a global consensus and finding what, if anything can be done about it.

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