Temporal Trends in Human Sperm Counts: Findings and Implications

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In 1992 Carlsen et al. published their paper (Carlsen et al. 1992), claiming that there is a decline in sperm concentration, at least in Europe and the USA. This question remained controversial, even after 25 years. A definitive meta-analysis was critical given the predictive value of sperm count for fertility, morbidity, and mortality. In 2017, we published the first systematic review and meta-regression analysis on trends in human sperm count (Levine et al. 2017). We aimed to answer the question: have human sperm counts, as measured by sperm concentration (SC) and total sperm count (TSC), declined?

Following a pre-defined protocol, 7518 abstracts were screened and 2510 full articles reporting primary data on SC were reviewed. A total of 244 estimates of SC and TSC, sampled in 1973–2011, were extracted for meta-regression analysis. The slopes of SC and TSC were estimated as a function of sample collection year using both simple linear regression and weighted meta-regression models, adjusted for pre-determined covariates and modification by fertility ("unselected by fertility" vs. "fertile") and geographic group ("Western," including North America, Europe, Australia, and New Zealand vs. "other").

SC declined significantly between 1973 and 2011. There was a significant decline in SC between 1973 and 2011 among Unselected Western (−1.38 million/ml/year; −2.02 to −0.74; $p < 0.001$) and among Fertile Western (−0.68; −1.31 to −0.05; $p = -0.033$). Among Unselected Western studies, the mean SC declined, on an average, 1.4% per year with an overall decline of 52.4% between 1973 and 2011. Trends for TSC and SC were similar, with a steep decline among Unselected Western (−5.33 million/year; −7.56 to −3.11; $p < 0.001$), corresponding to an average decline in mean TSC of 1.6% per year and an overall decline of 59.3%. Results changed minimally in multiple sensitivity analyses, and there was no statistical support for the use of a nonlinear model and no sign of "leveling off."

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In summary, this comprehensive meta-regression analysis reports a significant decline in human sperm counts between 1973 and 2011, driven by a 50–60% decline among men unselected by fertility from Western countries.

The study was well accepted by the scientific community and it seems like there is now a consensus that sperm counts indeed declined, at least among Western men. However, the causes and the implications of sperm counts decline remained under discussion. This decline goes together with other disturbing male reproductive health trends (Skakkebaek 2017), such as the potential increase in congenital malformations of the male reproductive system, decrease in testosterone, and increase in testicular germ cell tumors as well decreased fertility and increases in miscarriage rates. In addition, low sperm count has been found to be associated with increased morbidity and mortality (Jensen et al. 2009).

The study received wide attention, as manifested by an Almetric score of 4021. However, this interest was not translated into further resources for research or in changes in public policy regarding male fertility, despite calls from the scientific community (Barratt et al. 2018; Levine et al. 2018). The contribution of sperm count decline to reduced fertility is not clear, as well as its reversibility and future trends (Skakkebaek et al. 2019).

Is there a chance that this decline would lead to the extinction of the human species? Given the extinction of multiple species, often associated with man-made environmental disruption, although unlikely, this is a possibility we must address. While the exact causes for the sperm count decline deserve further investigation, the United Nations noted the sperm count decline could be seen as a sign for the existential nature of our own toxification (www.ohchr.org/EN/NewsEvents/Pages/DisplayNews.aspx?NewsID=25232&LangID=E).

Our efforts should be, not primarily be focused on predicting the future, but on shaping it. The immediate need is a concentrated effort to understand the complex causes of human sperm count decline and its implications. Most importantly, we need to identify the concrete steps needed on both the global and local level, to target the root causes of the decline, reverse this trend, and secure our future. We must act now. With the implications of sperm disruption for future generations, these changes may well be irreversible. When the extinction of the human species is at stake can we really take the risk?

Conflict of Interest None.

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