

# Offspring sex ratio of subfertile men and men with abnormal sperm characteristics

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**Previous work has suggested an association between male subfertility and a female-biased offspring sex ratio. This study of the reproduction of men who had a semen analysis at the Sperm Analysis Laboratory in Copenhagen in the period 1963–1993 showed that the subfertile men had an offspring sex ratio as expected (51.0% boys versus 51.3%,  $P = 0.56$ ), and within the cohort, the offspring sex ratio had no material association with particular semen characteristics. Our results thus suggest that no important association exists between general male subfertility and a female-biased offspring sex ratio.**

*Key words:* female-biased/male subfertility/offspring sex ratio

## Introduction

The decrease in the sex ratio (proportion of males) among newborn infants in many populations (Møller, 1996) and the possible decrease in semen quality (Carlsen *et al.*, 1992) lead to the question of whether these temporal trends are independent phenomena or, alternatively, somehow connected to each other (Møller, 1996, 1998; James, 1997). Associations have been indicated between testicular cancer and a female-biased offspring sex ratio (Møller, 1998) and between subfertility and subsequent risk of testicular cancer (Møller and Skakkebak, 1999). In the present study we examined on a cohort basis the influence of subfertility and abnormal semen characteristics on the offspring sex ratio.

## Materials and methods

Information on men (born 1945–1980) with possible fertility problems, who had a semen analysis done at the Sperm Analysis Laboratory in Copenhagen in the period 1963–1993, was obtained. The cohort comprised 32 440 men of whom 15 218 had one or more children either before attending the laboratory or after. The cohort was linked with information on reproduction from the Fertility Database at Statistics Denmark. Men who visited the laboratory for a reason other than fertility problems (e.g. semen examination following a

vasectomy) were excluded from the analysis. For men who had multiple semen tests, only the first test was used in the analysis. The total population of Danish men born in the period 1945–1980 ( $n = 1\,488\,957$ ) served as a basis of comparison. The number of children of the men who had attended the Sperm Analysis Laboratory was 25 738 and the number of children of men in the comparison group was 1 250 952.

Following the linkages, information for each man was available on date of birth, dates of birth of children, date of first semen analysis, sperm concentration (million/ml), sperm motility (poor, good), morphologically abnormal spermatozoa (%) and date of death. The cohort was stratified with respect to the semen characteristics according to the World Health Organization classification of subfertility (WHO, 1999). The statistical analyses were done by contingency tables and  $\chi^2$  tests.

## Results

The results are shown in Table I. Overall, the cohort members produced offspring with a sex ratio that was about as expected, both before attending the Sperm Analysis Laboratory [51.1% males, not significant (NS)] and after (50.7% males, NS). Similarly, internal comparisons within the cohort showed no statistically significant dependence of the offspring sex ratio on the measured semen concentration, semen motility or on the proportion of morphologically abnormal spermatozoa. The data were suggestive of a weak to moderate association with low semen concentration (50.6% male offspring versus 51.1% in the men with 20 million/ml or higher), but also this contrast was far from reaching statistical significance ( $P = 0.48$ ).

## Discussion

The present study found no association between semen characteristics and sex ratio. This suggests that no material association exists between general male subfertility and a female-biased offspring sex ratio, as had been hypothesized (Møller, 1996, 1998; Møller and Skakkebak, 1999). In consequence, the temporal trends in sex ratio (Møller, 1996) and in sperm concentrations (Carlsen *et al.*, 1992) may have no or only limited biological association with each other, despite the apparent links of both subfertility and female-biased offspring sex ratios to testicular cancer. However, heterogeneity among subfertile men in regard to their offspring sex ratio may exist, for example subfertile men destined to suffer testicular cancer are expected to have an excess of daughters (Jacobsen *et al.*, 2000).

**Table I.** Sex ratio of 25 738 children, born in the period 1958–1993, fathered by 15 218 men, born 1945–1980, who had semen analysis in the period 1963–1993

	Children born before semen analysis			Children born after semen analysis			Total		
	Male	Female	Male (%)	Male	Female	Male (%)	Male	Female	Male (%)
Concentration ( $10^6/\text{ml}$ ) <sup>a</sup>									
0–20	2063	2009	50.7	828	819	50.3	2891	2828	50.6
$\geq 20+$	7400	7055	51.2	2691	2607	50.8	10 091	9662	51.1
Motility <sup>a</sup>									
Poor	297	276	51.8	174	166	51.2	471	442	51.6
Good	5330	5112	51.0	1570	1546	50.4	6900	6658	50.9
Proportion abnormal (%) <sup>a</sup>									
75–100	618	587	51.3	350	332	51.3	968	919	51.3
0–75	8812	8409	51.2	3191	3111	50.6	12 003	11 520	51.0
Total <sup>b</sup>	9578	9176	51.1	3541	3443	50.7	13 119	12 619	51.0

<sup>a</sup>Numbers do not add to the totals because of missing values.

<sup>b</sup>No significant differences found compared with a fixed male proportion of 51.30% based on all births in Denmark in the period 1958–1993.

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