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Time series analysis of sperm concentration in fertile men in Toulouse, France between 1977 and 1992

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See editorial, pp 467, 506

Abstract

***Objectives*—To investigate whether sperm production has changed during the past 16 years in the Toulouse area of France.**

***Design*—Time series analysis of sperm donors' specimens between 1977 and 1992.**

***Setting*—Sperm bank of university hospital in Toulouse, France.**

***Subjects*—302 healthy fertile men candidate sperm donors more than 20 and up to 45 years old and without any infertile brothers.**

***Main outcome measure*—Spermatozoa concentration.**

***Results*—Donors' mean age at time of donation was 34·05 (SD 5·13), but this increased significantly ($P<0·001$) during the study, from 32·4 in 1977 to 36 in 1992. Mean sperm count of samples was $83·12\times10^6$/ml (SD $68·42\times10^6$/ml). Sperm concentration was positively linked to the year of donation (Pearson's coefficient $r=0·12$, $P<0·05$), but this correlation disappeared after adjustment for age of donors ($r=0·09$, $P>0.05$).**

***Conclusion*—Sperm concentration has not changed with time in the Toulouse area.**

Table 1—*Age of sperm donors by year when sample donated*

Year	No of donors	Age (years) Mean	Range
1977	11	32·4	25-42
1978	22	32·2	21-43
1979	27	31·7	24-39
1980	23	31·4	22-44
1981	25	33·4	26-41
1982	27	32·3	24-44
1983	15	35·7	28-43
1984	26	36·5	26-44
1985	17	35·2	27-41
1986	17	37·2	30-44
1987	14	35·2	21-44
1988	14	34·6	27-39
1989	21	34·4	27-43
1990	17	35·5	27-44
1991	15	34·5	25-43
1992	11	36·0	30-43

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Introduction

Several studies have suggested that the sperm count of healthy men has declined in the past few decades. Carlsen *et al* recently reported a decrease in sperm count and volume in the past 50 years.[1] This decrease was confirmed by Auger *et al* in the Paris area of France and was associated with qualitative alterations of sperm—that is, decreased motility of spermatozoa and fewer normally shaped spermatozoa.[2] Moreover, other studies have reported increases in the incidence of cryptorchidism[3] and testicular cancer.[4,5]

Several hypotheses have been suggested to explain this decrease in sperm quality—for example, environmental exposure to harmful compounds[6] such as oestrogens or compounds with oestrogen-like activity.[7] In order to investigate potential environmental factors, we analysed the quality of semen supplied by donors to our sperm bank in south west France, a less populated area than Paris and one with different water supplies and air quality.

Methods

We studied the first ejaculates from healthy unpaid candidate sperm donors that were collected between 1977 and 1992 in our centre (Centre d'Etude et de Conservation des Oeufs et du Sperme Humain Midi-Pyrénées). All the donors had previously fathered at least one child. We excluded donors aged less than 20 and over 45 as age can affect the characteristics of sperm[8] and excluded donors with an infertile brother.[2]

Donors provided semen samples by masturbation at the laboratory after a recommended period of sexual abstinence of three to five days. The samples were analysed as described previously.[9] Sperm counts underwent logarithmic (base 10) transformation before statistical analysis, which was done with the PCSM package (Delta Soft, Meylan, France).

Results

We included 302 candidate donors in the study: 113 lived in the Toulouse conurbation, 64 lived in smaller cities, 115 lived in small towns or rural areas, and 10 came from other parts of France. The donors' mean age at the time of donation was 34·05 (SD 5·13, range 21-44), but this increased significantly ($P<0·001$) during the study from 32·4 in 1977 to 36 in 1992 (table 1).

The mean sperm count of the samples was $83·12\times10^6$/ml (SD $68·42\times10^6$/ml). Figure 1 shows the sperm counts according to the year of donation. Linear regression analysis between sperm count and year of donation showed a positive relation (Pearson's coefficient $r=0·12$, $P<0·05$). However, when adjustment was made for the donor's age the relation between sperm count and year of donation was no longer sig-

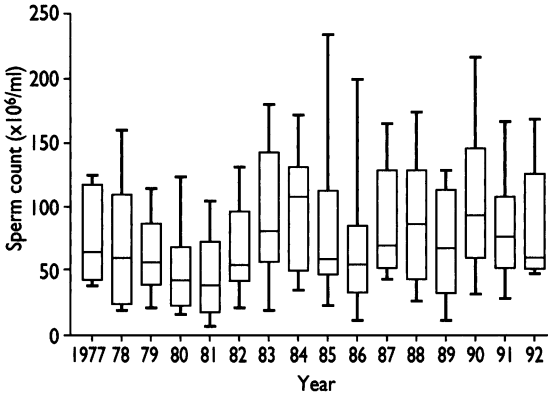

Fig 1—*Sperm count of semen samples by year when sample donated (box plots represent median and first and third quartile; bars represent 10th and 90th centiles)*

nificant ($r=0{\cdot}09$, $P>0{\cdot}05$). As the variable representing the year of donation was composite (a combination of each donor's age and his year of birth), we performed a multiple regression analysis including these variables (table 2). Only the donor's age at the time of donation contributed significantly to sperm concentration (an increase of 3·3% for each year increase in age).

Table 2—*Effects of age and year of birth on sperm concentration of semen samples from 302 fertile men studied by multiple regression analysis*

	Percentage change in regression coefficient (95% confidence interval)*	P value
Increased age (by 1 year)	3·3 (0·7 to 6·1)	0·011
Later birth year (by 1 year)	1·9 (−0·3 to 4·3)	0·09

*Converted from the antilog of the logarithmic value of the regression coefficients.

Key messages

- Several reports have suggested that sperm production is declining in men
- This decline in sperm count was recently confirmed in the Paris area of France
- We studied sperm production of healthy fertile men in the Toulouse area of south west France
- The men were recruited according to the same selection criteria as in the Parisian study, but, contrary to the Parisian results, the sperm count of the semen samples had remained constant during the past 16 years
- These discrepant findings could be explained by different environmental conditions noted between the two areas

Discussion

Contrary to the results of Auger *et al*, we did not observe a decrease in the sperm counts of semen collected between 1977 and 1992. As the conditions for recruitment of donors were identical in the two studies, both study populations were similar in age and fertility status. Donors' age at the time of donation increased during Auger *et al*'s study just as it did in ours.

The duration of sexual abstinence before donation has been shown to affect the sperm count: the longer the abstinence, the higher the sperm count.[10] Auger *et al* reported that the duration of sexual abstinence increased with donor's age.[2] We did not measure duration of abstinence in our study, and this might explain the different trends in sperm counts in ours and the Parisian study. However, when this parameter was excluded from the multiple regression analysis of the Parisian data there was still a decrease in sperm count with increasing age of donor (−2·5% (95% confidence interval −3·0% to −1·9%) per year, $P<0{\cdot}001$) or with year of birth (−2·0% (−2·9% to −1·1%) per year, $P<0{\cdot}001$) (J Auger, personal communication), though this was less pronounced than when the parameter was included (−3·3% with increasing age, −2·6% with later year of birth).[2]

The persistent differences in trends in sperm counts observed in these two studies (decreasing in the Parisian area and steady in the Toulouse area) might be due to environmental differences. In this way, differences in sperm count among men living in the London area were found to reflect differences in the water supply.[11] The Toulouse and Paris areas differed in air quality, water supply, and matters of lifestyle (such as time spent commuting and stress factors). Population density was much higher in Paris than in Toulouse (20 421 inhabitants/km^2 *v* 3032 in the city centre and 2901 *v* 491 in the suburbs), as was the density of cars and the concentration of nitrogen dioxide in the air (45 mg/m^3 *v* 30 mg/m^3 in summer and 47 mg/m^3 *v* 37 mg/m^3 in winter[12]). Industrial pollution was higher in Paris than Toulouse with regard to the output of registered waste, emission of oxidizable waste into the water, and production of sulphur dioxide.[13] Water pollution was also greater in Paris with regard to concentrations of nitrates and phosphates as well as the oxygen requirement of the organic matter present.[14]

However, sperm counts could also be affected by many other environmental factors[6,15] as well as behavioural factors.[16,17] Our findings indicate the need for further studies on environmental conditions and male reproductive function.

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