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Elise de La Rochebrochard

► **To cite this version:**

Elise de La Rochebrochard. Sterility, fecundity: what about the men?. Population et sociétés, 2001, 371. hal-02197259

**HAL Id: hal-02197259**

**<https://hal.science/hal-02197259>**

Submitted on 30 Jul 2019

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## Sterility, fecundity: what about the men?

Élise de la Rochebrochard \*

Human reproduction is based on the sexual union of a man and a woman. Nonetheless, scientific research on fertility (births), fecundity (the ability to give birth) or contraception (birth control) is mainly devoted to women and practically ignores men. Some studies on male fecundity have been carried out, however. These focus on the role of men in three aspects of human fecundity: couple infertility, the question of a possible male fecundity decrease with age and the hypothesis that the fecundity of younger male generations may be diminishing.

### ◆ The role of men in couple infertility

Thanks to effective contraception methods and abortion, couples can choose to have children when they "feel ready for it". However, once this decision has been taken, they cease to be in control of the situation: some may conceive right away, others may take longer, and some never succeed; in addition, though most pregnancies lead to the birth of the child, others can be prematurely terminated due to miscarriage. Succeeding in having a child is a lottery; there is no way of predicting *a priori* which couples will have problems and which will not. No biological indicator can determine whether a couple is more or less likely to succeed. To measure fecundity, one calculates *a posteriori* the proportion of successful couples among all those that are trying to conceive (probability of success). At the age of 25, the probability of success is, on average, of 25% per cycle (the time required for conception ranges from 3 to 6 months). If pregnancy has not occurred after a year, the couple is considered to be having trouble conceiving. In this case, the term

used is infertility: the couple probably has a low fecundity, whereas real cases of sterility — couples who have no chance of conceiving at all — are rare. To give the reader an idea of the extent of this problem, 13 to 14% of French couples have seen a physician once in their lives for infertility problems, but only 3% to 5% are diagnosed as being actually sterile [1].

For a long time, the causes of infertility were automatically attributed to the woman, men being *a priori* considered fecund (unless they were impotent). However, research findings of the last 30 years yield a very different picture: the origins of infertility seem to be more equally shared by men and women. Thus, in a survey conducted among infertile couples in three regions of France at the end of the 1980s [1], a male fecundity disorder was diagnosed in 6 out of 10 couples, and a female fecundity disorder in over 7 out of 10 couples (see table 1). These studies show that infertility, to a large extent, is also a male problem.

In fact, instead of considering infertility as having a male or female source, these studies show it to be a problem pertaining to the couple. Indeed, in 4 out of 10 cases of infertility (see table 1), the problem was diagnosed as being related to both the man and the woman. The difficulty experienced by most of these couples in conceiving was not so much due to him or her as to their specific combination: indeed, if either partner had been instead with a very fecund person, a "compensation" phenomenon might have made it possible for the couple to have a child.

### ◆ The question of age for men

The tendency to postpone childbirth observed in developed countries raises the issue of the impact of age on fecundity: until what age is it possible to delay child-

\* INSERM (French National Institute of Health and Medical Research).

**Table 1 – Distribution of origins of infertility**

Origin of infertility	For 100 couples
Combined (male and female)	38
Only female	34
Only male	20
Origin unknown	8

Source [1] Survey among 1,686 couples having consulted a gynaecologist or an obstetrician (either independent or working in a hospital) between July 1988 and June 1989 in three French departments (Indre-et-Loire, Loire-Atlantique, Haute-Vienne) for an infertility problem (defined as a period of at least 12 months during which conception was hoped for but did not happen). The origins of infertility were evaluated on the basis of the 1,318 couples of which both partners were examined by a physician.

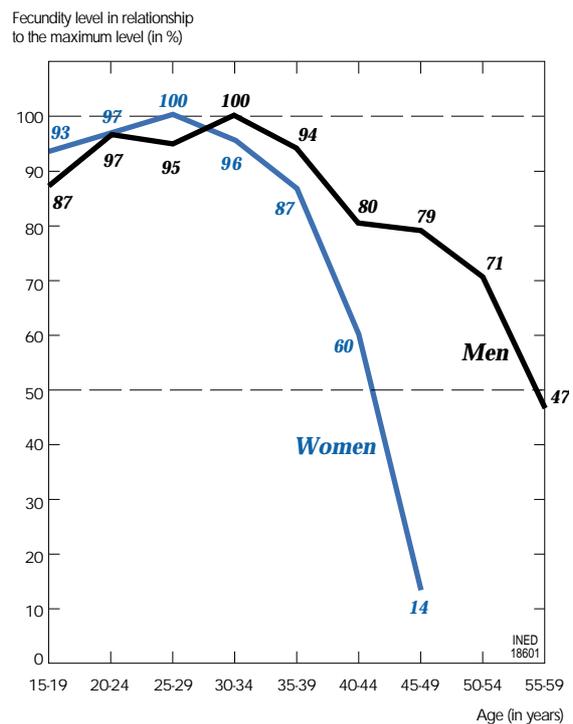
birth? What are the risks involved for those who choose to have children later in life?

Much research has been devoted to the impact of the woman's age on childbirth. Thus, it has been shown that fecundity decreases as the age of the woman increases. Menopause (which occurs around the age of 50, on average) marks the end of a woman's childbearing period. However, signs of decreasing female fecundity begin to appear well before menopause (figure 1): chances of conceiving decrease, while the proportion of miscarriages, ectopic pregnancies and stillborn children increases, as well as the risk of having a child with birth defects, in particular Down's syndrome.

As concerns the impact of the man's age, we know next to nothing. The press has reported famous cases of late fatherhood: Yasser Arafat became a father at 66, Charlie Chaplin at 73, etc. An American scientific journal has even reported the "authenticated" case of a man who fathered a child at the age of 94. These cases may give us the impression that the age of the father has a negligible impact on human fecundity. In reality, there are considerable variations in this respect, and the fact that some men are able to conceive at 66, 73 or even 94 does not mean that all men are able to do so.

The impact of paternal age has been determined in a specific area, that of genetic diseases [2]. As the age of the man at the time of conception increases, so does the risk for the child to develop a genetic disease, in particular those linked to a dominant autosomal mutation (1). Thus, cases of children with achondroplasia, Apert's disease or *Fibrodysplasia ossificans progressiva* occur more frequently as the father grows older. To provide a scale of reference, among 1,000 children born of fathers over 40 at the time of conception, 3 to 5 are born with a dominant autosomal mutation [2]. This risk is as high as that of Down's syndrome observed among children born to mothers aged 35 to 39 at the time of conception.

In addition, the impact of the age of the man on the

**Figure 1 – Variations in fecundity according to the age of the man and the age of the woman**

Source [4] – Estimations based on a regression carried out with 5,959 biographies of Mormon women born between 1840 and 1859.

probability of giving birth to a live baby was assessed in three studies conducted among couples who did not use birth control methods (2). The fecundity of these couples can be measured by studying births (in particular the birth rate).

Figure 1 shows the impact of the age of the man and that of the woman, as assessed in one of these studies [4]. These curves do not measure the level of fecundity but only the impact of age on fecundity. For men, fecundity is at its highest between 30 and 34 (rated 100), after which it slowly decreases. By the age of 55-59, male fecundity is twice as low (rated 47) as that observed at the age of 30-34. The couple's fecundity thus decreases as the man's age increases, even though this decrease is slower and occurs later than that linked to the age of the woman. Of course, these are initial findings and further research on this question remains necessary.

(1) A dominant autosomal mutation is a mutation affecting one of the 22 pairs of autosomal chromosomes (all the chromosomes except for the sexual chromosomes), and which asserts itself in the heterozygotic state.

(2) These studies are based on: the 1911 Irish census [3], genealogies collected by the Utah Genealogical Society among the Mormon population (women born between 1840 and 1879) [4], fertility surveys conducted at the end of the 1970s with nationally representative samples of women aged 15 to 49 in five developing countries (Côte d'Ivoire, Ghana, Kenya, Sudan, Syria) [5].

## ◆ Has male fecundity declined among the younger generations?

In 1992, a Danish team suggested the hypothesis of a decrease in sperm count over the past 50 years [6] (see figure 2). Since then, many new studies have been devoted to the subject; the hypothesis of a reduction of male fecundity has become more explicit and scientists now speak of a decline in both quantity (sperm count) and quality (motility and morphology) of human semen, and of an increase in the incidence of congenital anomalies at birth, such as cryptorchidism (3) and hypospadias (4), as well as in the incidence of testicular cancer.

What are the reasons for this decline? The genetic hypothesis seems unlikely: this phenomenon is occurring at a rapid pace and has been observed in different geographic areas. Studies have focused on possible lifestyle and environmental changes. Among environmental factors, researchers are investigating the possible effect of toxic chemicals, in particular hormone modifiers having an oestrogenic effect (5). Since the 1950s, the use of such chemicals has dramatically increased; they are used in many products such as pesticides, detergents, cosmetics and some prescription drugs. Thus, it seems that a number of chemicals used in agriculture, industry and in everyday life are hormone disrupters which are liable to contaminate the food chain, water and air. These toxic substances could have an impact on the male reproductive system not only at the adult stage but even during foetal development. Thus, the younger generations of boys, who might have been exposed during their mother's pregnancy, could be more strongly affected. As concerns lifestyle factors, stress, alcohol and tobacco have been put forward as possible causes. The hypothesis of an increase in the temperature of testicles is more specifically under investigation. Indeed, for a testicle to function normally, its temperature must be 2 to 4 C° lower than normal body temperature. A slight rise in this temperature (around 2°C) can alter proper testicular functioning. Different behavioural factors linked to modern lifestyles could lead to this rise in temperature: people tend to remain sitting for long periods of time, wear tighter clothes (especially underclothes), or are professionally exposed to heat (welders, ceramists, steel workers, cooks).

These studies thus raise the issue of a possible decline of male fecundity among younger generations.

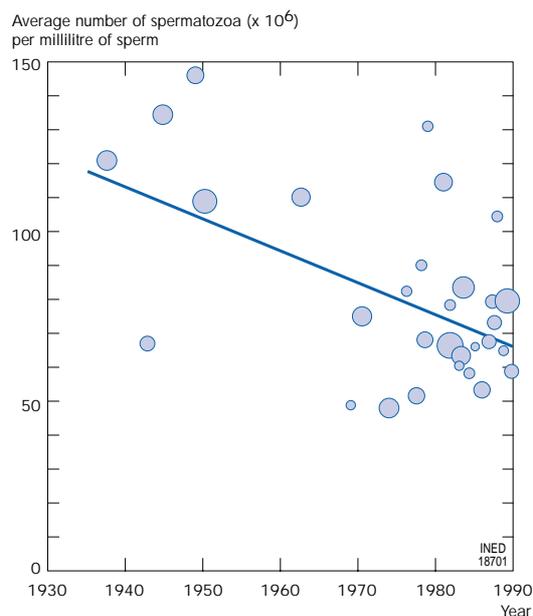
As we have seen, the issue of male fecundity presently raises more questions than it yields answers. ■

(3) Cryptorchidism – A congenital anomaly whereby one or both testicles fails to descend normally. This defect must be diagnosed as early as possible and corrected either with drugs or through surgery, in order to avoid permanent sterility and an increased risk of testicular cancer. Another name for cryptorchidism is ectopic testis.

(4) Hypospadias is a birth defect where the urethral opening is mislocated on the underside of the penis shaft rather than at the tip.

(5) Endocrine disrupters or modifiers are defined as exogenous agents that alter the production, storage, transport, metabolism, binding, action and breakdown of natural hormones.

Figure 2 – Sperm counts taken from 61 publications, according to date of publication



Interpretation: each circle represents one study (the area of the circle is proportional to the logarithm of the number of subjects observed in the study). The blue line is the linear regression line (estimated by weighting each study per number of subjects observed).

Source [6] – Data resulting from the observation of 14,947 men in 61 articles published between 1938 and 1991.

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## What's New

### The 2000 Chinese population census

According to the November 2000 census, China has a population of 1.265 billion — 1.295 billion including Taiwan (22.3 million), Hong Kong (6.8 million) and Macao (0.44 million). National minorities have exceeded the symbolic threshold of 100 million (106.4) and represent 8% of the total figure. These results were more or less expected, given the trends shown in the annual surveys carried out throughout the 1990s with 1‰ population samples. The annual growth rate has now fallen below 1% and the fertility rate below the generation replacement level. In addition, the

results of the census correspond to those of the annual survey in three respects. First, the Chinese population is ageing: 23% of the population are under 15 and 7% are 65 or more, compared to 28% and 6% respectively in the last 1990 census.

The base of the population pyramid is growing narrower; this trend, already observed in 1990 (see figure 1), is now accelerating. Second, China is an increasingly urban country: in 2000, 36% of the population lived in urban areas, 10 times more than in 1990; for the first time, the rural population has decreased in absolute terms: 807 million in 2000, against 841 million in 1990. Last, the proportion of men is on the increase: the global sex ratio (the

number of males per 100 females) was 106.7 in 2000, up from 106.0 in 1990, whereas the sex ratio at birth reached 117, up from 111 ten years earlier. Data remains too scarce for us to be able to reconstruct reality and judge the quality of the census data. However, paradoxically, due to its close similarity with the data of the annual surveys, the reliability of these figures is questionable: in the 1980s, the annual surveys underestimated births by 5 to 20%, depending on the years; why should those of the 1990s be any more reliable? As soon as detailed data becomes available, we shall be in a position to answer these questions.

Isabelle Attané (INED)

*Figure 1. – Chinese population pyramid, 1990*

