

# Contraceptive failure rates in France: results from a population-based survey

C. Moreau<sup>1,2,3,4,6</sup>, J. Trussell<sup>1,5</sup>, G. Rodriguez<sup>1</sup>, N. Bajos<sup>2,3,4</sup> and J. Bouyer<sup>2,3,4</sup>

<sup>1</sup>Office of Population Research, Princeton University, Wallace Hall, Princeton, NJ 08544, USA; <sup>2</sup>Institut National de la Santé et de la Recherche Médicale, Unit 822 Epidemiology, Demography and Social Sciences, Le Kremlin-Bicêtre, F-94276, France; <sup>3</sup>Institut National d'Etudes Démographiques, Paris, France; <sup>4</sup>Univ Paris-Sud, Faculté de Médecine, Le Kremlin-Bicêtre, F-94276, France; <sup>5</sup>The Hull York Medical School, Hull, UK

<sup>6</sup>Corresponding address. Tel: +1-609-258-6968; Fax: +1-609-258-1039; E-mail: cmoreau@princeton.edu

**BACKGROUND:** Despite the widespread use of highly effective contraceptive methods in France, one in every three pregnancies is unintended, of which 65% occur while using contraceptives. In the USA, 49% of pregnancies are unintended, half of which result from contraceptive failure. This study provides estimates of method-specific failure rates among French women. **METHODS:** We use data from the 2000 Cocon Study, a population-based cohort, comprising a representative sample of 1689 women aged 18–44 years who described their contraceptive history. Piecewise-constant hazards models were used to estimate method-specific contraceptive failure rates during the first 5 years of contraceptive use. A random effect was introduced to take into account the fact that some women contribute more than 1 contraceptive episode. These same models were used to assess the effects of socio-demographic characteristics on the probability of contraceptive failure among pill, intrauterine device (IUD) and condom users. **RESULTS:** Overall, 2.9% of women experienced a contraceptive failure in the first year of use and 8.4% in the first 5 years of use. The IUD had the lowest first year failure rate (1.1%), followed by the pill (2.4%), the condom (3.6%), fertility awareness methods (periodic abstinence or safe period by temperature) (7.7%), withdrawal (10.1%) and spermicides (21.7%). These failure rates varied little by user characteristics. **CONCLUSIONS:** Lower failure rates among French women compared with those reported for US women suggest differences in contraceptive practices which need to be further explored.

*Keywords:* contraceptive failure; contraceptive efficacy; population-based survey; France

## Introduction

Despite the widespread use of highly effective contraceptive methods it is estimated that 49% of pregnancies are unintended in the USA: there were 3.1 million in 2001 alone, the last year for which data are available (Finer and Henshaw, 2001). Half (48%) of these pregnancies were due to contraceptive failure, while the other half occurred to the small minority (11%) of women not using any method of contraception (Finer and Henshaw, 2001; Mosher *et al.*, 2004). A similar pattern is observed in France despite a high prevalence of use of highly effective reversible methods of contraception [in 2000, 82% of contraceptive users were using the pill or the intrauterine device (IUD) (Bajos *et al.*, 2003)]. A recent population-based survey in France found that one in three pregnancies was reported as unintended, of which 65% occurred among women who were using contraceptives at the time they got pregnant (Bajos *et al.*, 2003). These results reflect the difficulties women experience when using contraceptive methods that require adherence such as taking a pill each day or using a condom at each act of intercourse.

Most available information on contraceptive failure comes from clinical trials. Clinical trials have the advantage of collecting prospective data from women who are closely monitored, and failure rates during perfect (correct and consistent) contraceptive use can be estimated; however, such trials almost surely do not reflect conditions under which contraceptive methods are actually used (or misused) in the general population. The second source of information is provided by population-based surveys that are more likely to reflect the typical conditions of use of contraceptives but may fail to provide as accurate information on use as do clinical trials. A few studies, mostly conducted in the USA using data from the National Survey of Family Growth (NSFG), have been performed using this later approach (Trussell *et al.*, 1990; Trussell and Vaughan, 1999). Contraceptive failure rates during typical use vary by user characteristics (age, parity and social background) (Schirm *et al.*, 1982; Ranjit *et al.*, 2001); this finding suggests that contraceptive failure rates may also vary by country with different contraceptive practices. In advanced industrial societies, only one Australian study, using data

from the national Australian Fertility Survey, has produced contraceptive failure rates estimates based on a similar methodology (Bracher and Santow, 1992). However, that study focused only on contraceptive failure rates during the first use of the method.

This study provides estimates of method-specific failure rates among women in France. In addition to differences by method used and by duration of use, the analysis explores the differences in failure rates by women's social and demographic background characteristics.

## Materials and Methods

### Data

We use data from the 2000 Cocon Study, a population-based survey exploring contraceptive practices and recourse to abortion in France. The methodology of this study has been described in detail elsewhere (Bajos *et al.*, 2004). Here, we present only the main methodological issues. A two-stage probability sampling method was used to identify a representative sample of 2863 French-speaking adult women (aged 18–44 years). An initial sample of 14 704 households including at least one eligible French-speaking woman between the ages of 18 and 44 years was selected at random from the telephone directory, which was first stratified by region. One eligible woman per household was then randomly selected. The response rate was 74.6%. The sampling procedure included a second phase designed to over-represent women who had an abortion or an unintended pregnancy in the 5 years prior to the survey. All women who met these criteria were selected (sampling proportion = 100%,  $n = 1034$ ), while only a fraction of the other women were randomly selected (sampling proportion = 19%,  $n = 1829$ ).

Of the 2863 women in the sample, three out of five women ( $n = 1689$ ) were randomly selected to answer the set of questions on lifetime contraceptive history in order to reduce the mean length of the questionnaire for the other participants in the study. Analyses were performed among this subgroup of women. Interviews, which lasted an average of 40 min, were collected via computer-assisted telephone. The questionnaire was designed to collect detailed information on the women's contraceptive and reproductive histories, from the first sexual intercourse to the date of the interview.

In the pregnancy history section of the questionnaire, women were asked to specify for each of their pregnancies, the outcome, the date the pregnancy ended and whether the pregnancy was intended or unintended. An unintended pregnancy was defined as 'not being planned at all' or 'being planned later,' in addition, a pregnancy was classified as unintended if the woman 'did not remember if she had planned to become pregnant at that time'. Depending on the pregnancy outcome, the starting date of the pregnancy was calculated as the end date of the pregnancy minus the duration of the pregnancy, where that duration was 268 days for live or still births, 42 days for ectopic pregnancies, 53 days for elective induced abortions, 65 days for spontaneous abortions and 105 days when pregnancies were terminated for medical reasons. Because women who were pregnant at the time of the survey were not asked whether their current pregnancy was intended or not, every woman's record was censored nine months before the date of the interview.

Using the above reproductive history as a chronological scale to help women remember their contraceptive history, they were then asked to describe all contraceptive episodes and periods of non-contraceptive use within each reproductive interval (time from first intercourse to first pregnancy, time between two consecutive pregnancies, or time from last pregnancy to the date of the interview).

For each contraceptive episode, women reported the type of method used and the starting and ending date of that episode.

As probes to ensure more complete reporting, the questionnaire further included questions exploring contraceptive practices at first sexual intercourse and at the time of the survey. If different from the first and last episode reported in the contraceptive history, an additional contraceptive episode was added at the beginning or end of the history. A similar probe was asked about contraceptive use at the time of the start of each unintended pregnancy. If different from the contraceptive episode described in the contraceptive history, an additional contraceptive episode was added before that pregnancy.

Using all of the above information, we were able to reconstruct a contraceptive and reproductive history for each woman. The total number of episodes for a given woman (including pregnancies) varied from 1 to 33, while the number of contraceptive episodes (including episodes with no contraception) varied from 1 to 23.

We evaluated effectiveness for six categories of contraceptive methods as shown in Table 1. Dual method-specific failure rates (pill and condom,  $n = 244$  episodes; condom and other barriers,  $n = 123$  episodes) were not computed because we were unsure of the sequence of use of these methods, in particular if they were used at the same time or sequentially. These episodes were however included in the estimation of contraceptive failure rates for all reversible methods. As only 44 episodes of female sterilization were identified in the sample, they were not included in the analysis. In all, 6155 contraceptive episodes were available for analysis, ranging from 1 to 294 months of use. The mean duration of use was 38.2 months.

We estimate the proportion of women who experienced an unintended pregnancy while using a contraceptive method by duration of use for the first 5 years of method use. For three categories of contraceptive methods (withdrawal, spermicides and fertility awareness, i.e. periodic abstinence or safe period by temperature), the number of users was insufficient to calculate failure rates for 5 years of use. In all, we were able to identify 519 contraceptive failures, of which 468 occurred during the first 5 years of use.

We assessed the effect of socio-demographic characteristics on the probability of contraceptive failure for the three most common contraceptive methods represented in our sample (the pill, the IUD and the condom). Age of respondents at the beginning of each contraceptive episode was defined in five categories (<20, 20–24, 25–29, 30–34 and 35–44 years). Parity at the start of a contraceptive episode was divided into two categories (no children, one child or more). We also categorized women according to whether or not they had had an unintended pregnancy prior to the start of each contraceptive episode. Finally, women were classified by level of education (less than high school graduation, high school graduation or more) according to their highest qualification obtained at the time of the survey in 2000.

### Data analysis

We first estimated Kaplan–Meier life-table probabilities of method-specific contraceptive failure for the first 5 years of method use. We then computed these estimates using piecewise-constant hazards models to take into account 'the woman effect' in the analysis. In these models, we first partition the duration of method use into  $n$  time intervals assuming that the probability of contraceptive failure is constant within each time interval. The intervals were chosen in order to closely approximate the Kaplan–Meier estimates. Thus, we defined closely spaced boundaries (3, 6, 9 and 12 months) at the beginning of use of a method (first year of use) where the risk of failure varies rapidly over time and longer time intervals (18, 24, 30, 36, 48, 54 and 60 months) where the risk changes more slowly (second year to the fifth year of use). Finally, we took into account the fact

**Table 1:** Distribution of contraceptive episodes by method

Contraceptive method	Episodes, <i>n</i> (%)	Total exposure (months)	Mean time of use (months)	Median time of use (months)	Unintended pregnancies ( <i>n</i> )
All episodes of reversible contraceptives	6155 (100)	220 189	38.2	23.3	519
Pill	3270 (32.1)	135 287	43	29.7	230
IUD	788 (8.3)	36 474	54.9	35.5	61
Condom	929 (9.5)	17 018	18.5	6.6	96
Withdrawal	280 (3.1)	5949	22.8	11.3	36
Spermicides or sponges	128 (1)	2027	13.2	5.1	25
Fertility awareness <sup>a</sup>	173 (1.6)	4074	24.8	15.9	23
Pill + condom	244 (2.8)	9499	40.6	30	7
Condom + other barrier methods <sup>b</sup>	123 (1)	4297	40.4	18.4	17

<sup>a</sup>Fertility awareness, periodic abstinence (31.6%), safe period by temperature or Ogino (68.4%); <sup>b</sup>Condom and other barrier methods, condom + withdrawal (28.8%), fertility awareness methods (29.3%), spermicides (11.1%), emergency contraceptive pills (7.6%), withdrawal + fertility awareness methods (13.2%) and other combinations (10%). IUD, intrauterine device.

that some women contribute more than one contraceptive episode by introducing a random effect at the woman's level. This random effect represents unobserved factors, such as fecundity or accident-proneness that affect a woman's risk through all her episodes and thus produce intra-woman correlation in contraceptive outcomes. The term is assumed to have a gamma distribution (i.e. a generalization of an exponential distribution) and is shared by all episodes of the same woman. The resulting model is called a shared frailty model in the survival analysis literature (Anderson *et al.*, 1993; Cleves *et al.*, 2004). These same models were then used to assess simultaneously the effects of socio-demographic characteristics described above on the probability of contraceptive failure within the first 5 years of use.

In all analysis, we used weighted observations. Weights were computed in order to take the sampling design into account as well as to reflect the social and demographic composition (age, marital status, professional activity and level of education) of the French population in the 1999 census. The total numbers reported in the tables are gross values, i.e. the number of contraceptive episodes reported. The probabilities of contraceptive failure are weighted.

Statistical analyses were performed using Stata version 9 (Stata Corporation, College Station, TX, USA). The study received the approval of the relevant French government oversight agency (the Commission Nationale de l'Informatique et des Libertés).

## Results

Table 2 displays probabilities of contraceptive failure by year of method use for all methods combined and for six separate contraceptive methods. Overall, 2.9% of women experienced a contraceptive failure in the first year of contraceptive use and 8.4% in the first 5 years of use. The IUD had the lowest

first year failure rate (1.1%), followed by the pill (2.4%), the male condom (3.3%), fertility awareness methods (7.7%), withdrawal (10.1%) and spermicides (21.7%).

The probabilities of contraceptive failures varied with duration of method use (Table 2). The failure rate for the pill was higher in the first year of use than for longer periods of use (2.4% in the first year, 1.2% in the second, 1.4% in the third, 1.1% in the fourth and 0.7% in the fifth year of use). Conversely, the failure rate for the IUD was highest in the second year of use (3.2%) and declined for longer durations of use (0.4% in the third year, 0.5% in the fourth year and 1.6% in the fifth year of use). Finally, the failure rate for the condom was highest in the first 2 years of use (cumulative failure rate of 7.8% within the first 2 years of use and 4.5% within the next 3 years (third to fifth year of use).

Five years failure rates varied little by women's characteristics (Table 3). The probability of condom failure varied by women's age: five years failure rates were highest among the 20–34 years age groups. Pill users who experienced a prior unintended pregnancy were more likely to report a pill failure than others (hazard ratio = 1.9,  $P = 0.02$ ).

## Discussion

Our probabilities of contraceptive failures among French women are strikingly lower than those reported among US women, with the exception of the IUD, for which the probability of failure is in the range of previous estimates (Trussell *et al.*, 1990; Trussell and Vaughan, 1999; Trussell, 2004a,b).

**Table 2:** Cumulative percentage of women experiencing contraceptive failure, by method and duration of use<sup>a</sup>

Contraceptive method	Duration of use (months)				
	12	24	36	48	60
Pill	2.4 (1.7–3.2)	3.6 (2.8–4.7)	5.0 (3.7–6.8)	6.1 (4.7–8.0)	6.8 (5.3–8.6)
IUD	1.1 (0.5–2.2)	4.3 (2.2–8.3)	4.7 (2.5–8.6)	5.2 (2.9–9.2)	6.8 (3.9–11.7)
Condom	3.3 (2.4–4.7)	7.8 (5.2–11.8)	9.2 (6.3–13.4)	10.2 (6.9–14.9)	12.3 (8.2–18.1)
Withdrawal	10.1 (4.3–22.5)	15.3 (8.0–28.2)	23.2 (13.1–39.1)		
Spermicides, sponges	21.7 (4.7–70.8)				
Fertility awareness	7.7 (2.6–21.5)	18.8 (9.1–36.7)			
All users of reversible contraceptives	2.9 (2.4–3.5)	5.1 (4.2–6.0)	6.5 (5.4–7.9)	7.6 (6.3–9.3)	8.4 (7.0–10.1)

<sup>a</sup>Cumulative percentage (95% Confidence intervals).

**Table 3:** Factors associated with contraceptive method failure

	Pill		IUD		Condom	
	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI
Age at the start of use (years)						
<20	1				1	
20–29	1.2	(0.6–2.3)	1		2.9	(1.4–6.3)
30–34	0.7	(0.3–2.0)	1.6	(0.6–4.4)	3.4	(1.1–10.9)
35–44	0.2	(0.02–1.2)	0.3	(0.1–1.1)	0.7	(0.2–2.7)
Number of children at the start of the contraceptive episode						
0	1				1	
1 or more	1.2	(0.5–2.6)	2.2	(0.3–17.4)	0.9	(0.4–2.3)
Level of Education						
<high school graduation	1		1		1	
≥high school graduation	0.6	(0.4–1.1)	0.5	(0.1–2.5)	1.4	(0.7–2.7)
Prior unintended pregnancy	1.9	(1.1–3.1)	0.4	(0.1–2.9)	1.9	(0.9–4.1)

CI, confidence interval.

Previous studies of IUD failure rates are based on clinical trials among a selected group of potential users (Grimes, 2004; Trussell, 2004a,b). In our study, because IUDs are the second most popular form of contraception in France (accounting for 21% of all contraceptive usage (Bajos *et al.*, 2003), we were able to compute these estimates among a representative sample of users in the general population. This difference in study design seems to have little impact on the estimates, most likely because differences between perfect and typical use of the IUD are expected to be minimal (Trussell, 2004a,b).

The IUD was the most effective form of reversible contraception among French women, thus mirroring results from previous studies in the USA (Trussell, 2004a,b). In fact, while our probabilities of contraceptive failures are systematically lower than those obtained among US women (with the exception of the IUD; Trussell, 2004a,b), we nevertheless observed the same order of method effectiveness, with the exception of fertility awareness method, which we found to be more effective than withdrawal. Within this hierarchy of method effectiveness, it is surprising to observe such little variation in effectiveness between the IUD, the pill or the condom. This apparent resemblance, however, is most likely due to an underestimation of pill and condom failure rates, which will now be discussed.

A number of methodological reasons may explain the lower estimates of failure rates we found in this study, which should thus be interpreted with caution. First, our probabilities of contraceptive failures are likely to be underestimated because of underreporting of abortions estimated to be around 50% in the Cocon survey (Moreau *et al.*, 2004). This reporting rate is close to that found in the 2002 NSFG survey in the USA (Jones, 2007). Correcting for abortion reporting in the 1995 NSFG increased the 12 months overall failure rate from 10 to 13% (Fu *et al.*, 1999). Thus, the difference between our results (2.9%) and the uncorrected probability of failure among US women (10%) remains substantial. The level of underreporting of abortion in the USA depended on the type of contraceptive failure women experienced: underreporting was greater in case of barrier method failure or non-contraceptive use, and less pronounced in case of hormonal method failure. Thus, the adjustment for abortion reporting in

the NSFG had very little impact on failure rates for hormonal contraceptives, and conversely greatly affected the probabilities of failures for barrier methods, particularly in the case of spermicides (Fu *et al.*, 1999). Such variation in the effect of adjustment on method-specific failure rates rules out the possibility of applying a simple correction term for abortion underreporting in our study. An ongoing national representative survey of women undergoing an abortion in France should provide the information needed to correct our current estimates.

A second source of divergence between our study and previous estimates from the NSFG lies in the way contraceptive failures are defined. In the Cocon survey, women were asked to describe their contraceptive situation at the time each pregnancy started only in cases where the pregnancy was reported to be ‘unintended’. As a result, we only consider in this analysis contraceptive failures described as unintended pregnancies occurring while using a contraceptive method. Conversely, previous studies of contraceptive failures in the USA include all pregnancies occurring while using a contraceptive method, regardless of women’s intention to get pregnant. This distinction matters as approximately one third of contraceptive failures were reported to be intended pregnancies (Trussell *et al.*, 1999). The use of a restricted definition of contraceptive failures, limited to unintended pregnancies, reduces the probability of contraceptive failure by 29% (from 9.4 to 6.7%) (Trussell *et al.*, 1999). Under this restricted definition, however, the 6.7% US failure rate remains substantially higher than the 2.9% estimate we found in our study.

Unlike in the US studies where failure rates cover a short period of contraceptive use (5 years prior to the survey), our estimates are based on lifelong contraceptive histories from the first sexual intercourse to the time of the survey. While capturing a broader picture of women’s contraceptive history, our methodology is more likely to introduce recall bias. The comparison of contraceptive histories collected retrospectively in the Cocon survey with data from repeated cross-sectional surveys shows that women tend to underestimate the periods of non-contraceptive use and of use of natural methods (Rossier *et al.*, 2004). The authors of this comparison nevertheless conclude that the data collected in a retrospective

way remarkably mirror data collected in periodic surveys (Rossier *et al.*, 2004). Nonetheless, the reliability of contraceptive histories does not rule out the possibility of misclassification of pregnancy intentions and of recall bias with respect to women's contraceptive situation at the time of start of a pregnancy. Such biases may also, to some extent, apply to the NSFG data which were also collected retrospectively.

Finally, an important reason for underestimating contraceptive failures in the Cocon study is the fact that the survey provides no retrospective information about women's history of sexual activity. Thus, it is likely that we include in our analysis of failure rates, months in which women were using contraception but had no sexual activity and were thus not exposed to the risk of pregnancy.

Despite these limitations, the lower failure rate estimates we found among French women are likely to reflect a true variation in contraceptive effectiveness between countries, a result which needs to be further investigated. A cross national study of inconsistent pill use in five European countries shows some variation in the frequency of missed pills across countries (from 12 to 25% of women reported missing one pill or more in the last cycle of use), a difference that could ultimately result in differences in method effectiveness (Rosenberg *et al.*, 1995). The frequencies of missed pills found in the European study were generally lower than those reported in studies among women in the USA (Rosenberg *et al.*, 1998). However, these studies on adherence rely only on reported behaviours which have been shown in one study in the USA comparing self-reported data on pill-taking with data from an electronic device measuring compliance, to suffer from reporting errors (Potter *et al.*, 1996). No such study has ever been replicated in other countries, where the level of concordance between self-reported and objectively measured adherence to the pill regimen may be different.

Consistent with a previous study, which examined contraceptive failure rates during the first and second year of use (Ranjit *et al.*, 2001), we found that the probabilities of failure generally declined over time. The only exception was found in the second year failure rate of the IUD which was higher than that of first year. In all other cases, the failure rate decreased, particularly after 2 years of use, probably reflecting both the selection of the less fertile women over time as well as an improvement in the consistency of method use.

Our results show little variation in contraceptive effectiveness by user characteristics. Consistent with previous research, we found that women over 35 years were less likely to experience a condom failure than their younger counterparts (Shirm *et al.*, 1982; Trussell and Vaughan, 1999; Ranjit *et al.*, 2001). We also found that the risk of pill failure was increased in the case of prior unintended pregnancy. These preliminary results call for future research exploring the factors that influence contraceptive effectiveness, not only focusing on socio-economic characteristics, but also on situational factors such as the type of relationship with the partner or other life circumstances that evolve over time and may well affect contraceptive behaviours.

In conclusion, comparison of our results from France with that of previously published data from the USA suggest that

contraceptive effectiveness may vary across populations. These results need to be confirmed by data from other countries. Further research is also needed to improve study methodology. In this respect, longitudinal data would prove useful to limit recall bias and refine the analysis.

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