



School of Business,
Economics and Law
UNIVERSITY OF GOTHENBURG

WORKING PAPERS IN ECONOMICS

No. 231

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Revised version, April 2008*

ISSN 1403-2473 (print)
ISSN 1403-2465 (online)

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* Revised version of Working Paper "The personal and general risks of age-related female infertility: Is there an optimistic bias or not?" No. 231, October 2006, University of Gothenburg.

Age-related risk of female infertility: A comparison between perceived personal and general risks

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Abstract.

Based on a survey of a random sample of Swedish females aged 20-40 this paper investigates: (1) whether women have correct perception of the age-related risk of female infertility, (2) whether the perceptions of the personal risk and the general risk in the own age group differ from each other, and (3) which factors can explain the difference between the stated personal and general risks if there are any. The results show that women do know that the likelihood of being infertile increases with age, while they clearly overestimate the general risks for women older than 34. The results also show that mothers have a too optimistic picture of their own fertility, while non-mothers have not. Several factors that explain differences between the stated personal and general risks are discussed.

Keywords: personal risk, general risk, female infertility, optimistic bias

JEL Classification D81, I10, J13

Financial support from the Iris Foundation is gratefully acknowledged. The author would like to thank Fredrik Carlsson, Lennart Flood, Olof Johansson-Stenman, Åsa Löfgren, Peter Martinsson, Katarina Nordblom, Katarina Steen Carlsson, Sven Tengstam and seminar participants at University of Gothenburg and at the IAREP/SABE 2006 for many useful comments.

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1. Introduction

The mean age of first-time mothers has been increasing steadily during the last three decades in Western countries. In Europe, the highest average age of first-time mothers is found in San Marino (30.4 years) followed by the Netherlands, Spain, and Sweden (29 years) (Council of Europe, 2004). This means that the average age of Swedish first-time mothers is now more than five years higher than 30 years ago (Statistics Sweden, 2005). However, neither the desire to have children nor the number of children couples want to have has changed during the last decades (Statistics Sweden, 2001; Lampic et al., 2006), meaning that the outcome of not becoming pregnant can be assumed to be highly negative for many women. Since the average age of first-time mothers has been increasing, it is possible that women believe that the risk of not becoming pregnant is lower than it really is. This was actually found in a public health study by Lampic et al. (2006), who showed that female and male university students in Sweden underestimate the general risks of age-related female infertility.¹ (Infertility is defined as a state where a healthy couple of childbearing age does not use any type of contraceptive and tries to become pregnant, but does not become pregnant during a period of 12 months (Infomedica, 2004)). It is worth noting that this risk is very individual and that there is currently no medical test that can investigate the true risk level of infertility in a specific woman. Some women can easily become pregnant at age 40, while others are involuntarily childless already at 25 (Infomedica, 2004). An awareness of the infertility risks is also important because infertility treatments are costly. And more importantly, the current assisted reproduction technologies cannot totally compensate for the natural age-related decline in fertility (Leridon, 2004). On the other hand, according to Menken (1985) the age-related infertility has not increased over time but the problem receives today more attention than before among both the health care and couples who want to have a child.

This article approaches the issue of infertility by investigating (1) whether women have correct perception of the age-related risk of female infertility, (2) whether the perception of the personal and the general risk in the own age group differ from each other, and (3) which factors can explain the difference between the stated personal and general risks if there are any. Thus, the present study contributes to the existing literature in the following ways: As far

¹ Many previous studies have examined the influence of different economic factors on number of births (Becker, 1981; Heckman and Walker, 1990; Hoem, 2000; Löfström, 2003; Adserá, 2004; Björklund, 2006), while others have looked at the timing of births (Gustafsson and Wetzels, 2000; Martin, 2000 and Gustafsson, 2001 and 2005). The article by Lampic et al. (2006) is the only study we are aware of that investigates women's risk perception about female age-related infertility.

as we know, this study is the first to analyze the *relative* risk perception in the context of the risk of age-related female infertility, and to study reasons why women's risk perceptions might differ between personal and general risk of infertility. Moreover, there is lack of knowledge about how aware women are about the risk levels.

It is well known that estimation of risk is difficult and several studies have found that people do not have correct perceptions about risks. Two often reported biases are that small probabilities are overestimated while large probabilities are underestimated, and that more sensational risks are easily exaggerated while estimates of more ordinary risks tend to be too low (Slovic et al., 2000a. See Benjamin et al., 2001 for counterarguments about underestimation of general risks for the own age group). For example, Black et al. (1995) report that 40 to 50 year old women highly overestimate their probability of dying of breast cancer. The risk of age-related female infertility is neither small nor large and it is not sensational either, but the possible risk of not becoming pregnant may still be a highly sensitive issue for many women. However, although people are less aware of the magnitude of the risks, they generally are well aware of the relative risk of different activities (van der Pligt, 1996). Thus we hypothesize that: *Women between 20 and 40 years of age are aware that the risk of female infertility increases with age, but they do not have a correct perception of the magnitude of this general risk at different ages.*

It is known that people often state lower risks for themselves than for other individuals (Sjöberg and Fromm, 2001; Sjöberg, 2002). According to van der Pligt (1996), people may experience that they have more control over their personal risk than the general risk. The more a person experiences that she has control, the greater the deviation between the perceived personal and general risks. This positive self-image, i.e. that people think they are better than others, is also well documented (Svenson 1981; Taylor and Brown 1988; Santos-Pinto and Sobel, 2005). Explanations found in the literature include that people in general overestimate their abilities, that a positive self-image increases happiness, and that a personal experience can both increase and decrease the feeling of personal invulnerability. That people tend to see themselves as less vulnerable to most kinds of risks compared to other people is called "optimistic bias".² Thus, an optimistic bias is not dependent on actual risk levels, but

² This definition comes from van der Pligt (1996). Another name for the optimistic bias is "unrealistic optimism" (Weinstein 1980). Moreover, when the person they compare themselves with becomes less abstract (such as a

instead refers to a person's perception of her own risk relative to her perception of other people's risk levels. We therefore hypothesize that: *Women perceive themselves as less vulnerable to the risk of age-related infertility than other women their age.*

It is not sufficient to only investigate whether the risk perception differs between stated personal and general risks. It is as important to study what explains the potential differences. Especially older women and mothers may have private information that helps them make more correct predictions of their own risk of infertility. If mothers really have a lower than average personal risk, then stating a lower personal than general risk can't be defined as a bias. On the other hand, people who have no experience of a particular negative life event tend to be more positive than others considering this event (Perloff and Fetzer, 1986; Weinstein, 1987; Slovic et al., 2000b). Weinstein found that those who believe that they are at a lower risk than others think that if the problem has not yet occurred it is unlikely to appear in the future. He also claims that this behaviour is not limited to any particular age, sex or education. In the case of infertility, a woman who has become pregnant easily before has a positive personal experience and may therefore think that she is more fertile than other women her age. Moreover, the more important people consider an attribute, the more they perceive that they have it (Dunning et al., 1991). Therefore, it is possible that the more important it is for a woman to be fertile per se and/or have a child, the more likely she might perceive that she is able to become pregnant. We hypothesize that: *The difference between the stated personal and general risk depends on a woman's own previous experience of becoming pregnant, on how important she perceives of being fertile per se and on whether she wants to have children.*

The best way to investigate women's risk perceptions is to ask them, which is why this study uses a survey method where 1,800 questionnaires were mailed out to a random sample of 20-40 year old women living in Sweden. The respondents were asked to state the risks of female infertility in four different age groups (20-24, 25-29, 30-34 and 35-40 years). They were also asked to estimate their own personal risk of infertility.

"sibling" or "your closest friend"), people usually rate themselves and the other person as equally vulnerable (Perloff and Fetzer, 1986).

The remainder of this paper is organized as follows. Section 2 presents facts of infertility and the actual risk levels of age-related infertility, and Section 3 describes the survey and its design. Section 4 reports the descriptive statistics and the empirical results from the analyses of the three hypotheses, while Section 5 discusses the results and concludes the paper.

2. Facts of infertility and the actual risk levels

The risks used as ‘actual’ risks of age-affected infertility in this paper are estimates based on age-specific pregnancy rates with natural insemination in modern populations, where the infertility risk levels are collected by interviewing over 7,600 women in the U.S. The interviews are performed by the National Survey of Family Growth (NSFG) and collected in 2002.³ According to the 2002 study the infertility risk is 7 percent for 20-24 year old women,⁴ 11 percent for 25-29 year old women, 17 percent for 30-34 year old women and 23 percent for 35-40 year old women (Chandra et al, 2005). Data from retrospective surveys such as the NSFG are seen as being most trustworthy even if it may be difficult for a woman to remember exactly when she began trying to become pregnant (Högberg, 1998).⁵ A European study in which infertility levels are in line with the levels of NSFG surveys is ‘Netherlands Fertility and Family Survey’ from 1998. It shows that 14-20 percents of the women under 30 years and about 21-23 percent of women aged 30 and older did not become pregnant within 12 months (Steenhof and de Jong, 2001). The reason for using the risk estimates from the NSFG 2002 survey and, not from the Netherlands survey, is that the NSFG survey has been

³ The NSFG survey measures the infertility rates of women who had not become pregnant during the 12 months (or more) preceding the time of the interview. Surgically sterilised couples are excluded from the survey. There are some possible sources of estimation bias in the NSFG survey. Their assumption that all couples using contraceptives are fertile may decrease the overall estimate of infertility, and it is also possible that couples choosing to be sterilized have a higher than average fertility rate, boosting the NSFG overall estimate since this group was excluded from their study.

⁴ The youngest age-group in the 2002 survey is very large (15-29 years) and it also includes 15-19 year old women, who we perceived to be far too young to participate in this study. Therefore we divide the age groups according to the NSFG 1976 survey, i.e. 20-24, 25-29, 30-34 and 35-40 years. We also use the risk for 20-24 year old women from the NSFG 1976 survey. The risks in the 2002 survey are 11 % for 15-29 year old women, 17 % for 30-34 year old women, 23 % for 35-40 year old women, while they in the 1976 survey are 7 % for 20-24 year old women, 11 % for 25-29 year old women, 16 % for 30-34 year old women, and 23 % for 35-40 year old women, i.e. very similar levels (National Center for Health Statistics, 1987).

⁵ The other two ways to measure infertility risks are: age-specific pregnancy rates in natural populations (populations where contraception and abortion are not allowed or used) and age-specific pregnancy rates with artificial insemination in modern populations. The major disadvantage of studies done in natural populations is that the type of data is hard to compare with more modern data, while artificial insemination ends up boosting infertility rates and is therefore often criticized since the probability of becoming pregnant artificially is much smaller compared to using unprotected intercourse (See e.g. Bongaarts, 1982). A study of artificially inseminated women reports that 26-27 % of women 30 or younger, 39 % of women aged 31-35, and 46 % of women aged 36-40 did not become pregnant within a one-year period. (Schwartz and Mayaux 1982). A study by Tietze (1957) reports the shares of natural population (Hutterites) from the first half of 20th century: 3 % of

conducted six times during the 1973-2002 period and the infertility levels are nearly the same in all of the NSFG surveys, indicating robustness. Another reason is that the NSFG survey is well documented, has a high response rate among women (80 %) and it separates among women who are sterilized, who have tried to become pregnant longer than 3 years, who are fecund but for whom a pregnancy is dangerous, and those who are infertile according to the definition of infertility (Chandra et al., 2005). However, the Netherlands survey has the advantage of reporting risk levels of both first and second pregnancies. Therefore, we use the results of the Netherlands survey when analyzing the second hypothesis of this study.

3. The survey and survey design

In order to answer the first hypothesis (whether women have correct perception of the age-related risk of female infertility) the respondents were asked to estimate the average risks, expressed in percents, for women in four different age groups (20-24, 25-29, 30-34 and 35-40 years) of *not* becoming pregnant during a one-year period despite regular unprotected sexual intercourse. All questions were open-ended. For example, the question about the general risk for the age group 20-24 stated in the questionnaire read:

Question 1. I *believe* that the average risk for a 20-24 year old woman of *not* becoming pregnant during a time period of one year is.....%

The other questions about general risks were identical with the example above, but the age group was different in each case. (The scenario and all the risk questions are included in the Appendix). The respondents were also asked to estimate their own risk of infertility. The corresponding question for measuring respondents' personal risk perception read:

Question 5. Imagine that you want to try to become pregnant. How great, do you *believe*, is your *personal* risk of *not* becoming pregnant during a time period of one year?.....%

The second hypothesis (whether the perceptions of the personal risk and the general risk in the own age group differ from each other) is tested by comparing the stated personal risks

women aged 20-24 were permanently infertile, while the corresponding shares of women aged 25-29, 30-34 and 35-39 years were 5.3 %, 9.0 % and 22 %.

with the general risks that the respondents stated for their own age groups, and not by comparing the stated risks with any available actual risks. It is also worth noting that the woman in her own age group to whom the respondents were asked to state the risk of infertility for might be either a mother or a woman without children. In order to make this comparison as strict as possible, the question about the personal risk immediately followed the questions about the general risks on the same page in the questionnaire. To be able to answer the third hypothesis (which factors can explain the possible difference between the stated personal and general risks), and since we hypothesize that the women's risk perceptions depend on their own previous experiences of becoming pregnant and whether they want to have a/another child or not, the respondents were asked whether they had children and whether (and if so when) they would like to have a/another biological child. Moreover, the importance of being fertile per se might also affect the risk perception. If important, it is possible that a woman states lower risks than those who perceive it less important. Therefore, we also asked the respondents how important they perceive being fertile is, regardless if they want to have children or not.

The survey (1,800 questionnaires) was sent out by mail to a random sample of women 20-40 year old women in November 2005 in Sweden. Postcards were sent out as a single reminder 10 days after the final questionnaires had been mailed out. Because infertility may be a sensitive issue for many, the respondents were kept completely anonymous.⁶

4. Results

4.1 Descriptive statistics

The overall response rate was 47 percent after adjusting for those who had moved. Because the main objective of the paper is to compare the stated personal and general risks, respondents who did not answer the risk questions (17 individuals), sterilized women (12 individuals), and the respondents who misunderstood the question about personal risk (9

⁶ The first pilot survey consisted of 45 questionnaires e-mailed in October 2004 to a sample of women aged 20 to 40. The resulting revised questionnaire was tested by a focus group, and then a second pilot study was performed, consisting of 200 questionnaires sent out in October 2005 by regular mail to a random sample of 20 to 40 year old women living in Sweden. The questionnaire was again revised based on the comments and the results of the second pilot study.

individuals) are excluded from the analysis.⁷ It is likely that several persons reported the *chance* of becoming pregnant instead of the *risk* of *not* becoming pregnant, i.e. the claimed risks clearly decreased with increasing age. The respondents who confused the chance to and risk not to become pregnant are excluded from the analysis (23 individuals), since it is hard to say whether they inverted all risks or only the general risks.

Table 1. The descriptive statistics for the whole sample.

Variable	Description of the independent variables	Mean	Std. Dev.
Mother	=1 if the respondent has children	0.53	0.50
Mother, no more children	=1 if the respondent has children and does not want/ does not know if she wants more children.	0.35	0.48
Mother; a child within 3 years	=1 if the respondent has children and wants to have a child within 1-3 years.	0.13	0.33
Mother; a child but do not know when	=1 if the respondent has children and wants to have a child but does not know when.	0.05	0.21
Non-mother; no children *	=1 if the respondent has not children and does not want/ does not know if she wants to have a child.	0.07	0.25
Non-mother; a child within 3 years	=1 if the respondent does not have children but wants to have a child within 1-3 years.	0.16	0.36
Non-mother; a child but do not know when	=1 if the respondent does not have children yet wants to have a child but does not know when.	0.23	0.42
Friends/relatives over 35	=1 if the respondent has close friends or relatives who became pregnant ≥ 35 years old.	0.73	0.44
Fertility is important	=1 if the respondent thinks that being fertile is important regardless of wishing to have a child.	0.74	0.44
Sure; personal risk	=1 if the respondent feels very or quite sure about her personal risk level.	0.42	0.49
Age 25	=1 if the respondent is 25-29 years old.	0.22	0.42
Age 30	=1 if the respondent is 30-34 years old.	0.26	0.44
Age 35	=1 if the respondent is 35-40 years old.	0.32	0.47
Big city	=1 if the respondent lives in Stockholm, Gothenburg or Malmö, i.e. in one of the 3 biggest cities in Sweden.	0.32	0.47
University	=1 if the respondent has a university education.	0.45	0.50
Student	=1 if the respondent is a student.	0.19	0.39
Partner	=1 if the respondent is married or cohabiting.	0.71	0.45
Income	= The monthly pre-tax income of the respondent, expressed in 1000 SEK. ⁸	17.14	9.03
No. of women	748		

*= the reference group in the ordered probit regression (Section 4.3)

⁷ The most common misunderstanding was that a pregnant woman stated 100 % as her personal risk of infertility. She was logically thinking that it is not possible for her to become pregnant one more time during the next 12 months but her personal risk is certainly not 100 %. Sterilized women were excluded in the NSFG 2002 survey as well.

⁸ At the time of the survey 7.50 SEK \approx 1 USD.

As reported in Table 1, 53 percent of the respondents answering this survey have children. About 29 percent of the respondents want to have a child within the next 1-3 years, and 13 percent are mothers wishing to have another child. On the other hand, 7 percent of the non-mothers and 35 percent of the mothers do not wish to have (more) children. About 73 percent of the respondents have close friends or relatives who have become pregnant at the age 35 or later, confirming the fact that Swedish women are today older when becoming pregnant. A large majority, 74 percent of the respondents, feel that being fertile per se is important, i.e. regardless of whether they wish to have a child (children) or not. Furthermore, 42 percent of the women feel quite sure or very sure about their personal risk levels. When comparing the descriptive statistics of the respondents with the national statistics, we find that the numbers of respondents in each age group correspond well with the shares of women of these ages living in Sweden.⁹ Similarly, in terms of the share of women who have children, it is the same in this study as at the national level (Statistics Sweden, 2002).¹⁰ However, the share of respondents with a university education is significantly higher in this study than in Sweden as a whole (Statistics Sweden, 2004). We therefore have to test whether this overrepresentation affects the stated risks or not, which is not the case. We therefore proceed with the whole sample. The three hypotheses presented in the introduction will now be investigated one by one.

4.2 Perceptions of the general and personal risks of age-related female infertility

The first hypothesis is: *Women between 20 and 40 years of age are aware that the risk of female infertility increases with age, but they do not have a correct perception of the magnitude of this general risk at different ages.*

The answers to the general risk questions are used to investigate whether women are aware of the relationship between age and infertility. Table 2 reports the mean and median stated

⁹ The differences between the means are bootstrapped 1000 times for each variable. By using the percentile method and the 95 % confidence interval, it can be shown whether the means significantly differ from each other at the 5 % significance level. (The 95 % confidence interval is created by calculating relevant percentiles, which in this case are the 2.5th and 97.5th percentiles. These make the lower and upper bounds for the 95 % confidence interval). It should be noted that the advantage of the percentile method is that it makes no assumption about the underlying distribution (Efron and Tibshirani, 1998).

¹⁰ About 80 % of 35-40 year old women living in Sweden have children younger than 18 years (Statistics of Sweden, 2002), while 80 % of the respondents in the sample aged 35-40 have children. About 41 % of women aged 20-44 years in Sweden have university education (Statistics Sweden, 2004).

general and personal risk levels for the four age groups (20-24, 25-29, 30-34 and 35-40 years). Since it is highly plausible that the perceptions of women with and without children differ, the stated risks are reported separately for mothers and non-mothers. Furthermore, since the reported infertility distributions are skewed, both the mean and median values are reported and commented on. The actual risks according to the NSFG 2002 survey are also reported in the table.

the

Table 2. The stated mean and median general and personal risks of infertility compared to the actual risk levels from the NSFG survey (2002). Results of the whole sample, and of the sample divided between mothers and non-mothers.

Age group	Actual risks NSFG 2002	Stated mean risks, whole sample	Stated mean risks, mothers	Stated mean risks, non- mothers	Stated median risks, whole sample	Stated median risks, mothers	Stated median risks, non- mothers
<i>General risks</i>							
20-24 years	7 %	13 %	12 %	14 %	10 %	10 %	10 %
25-29 years	11 %	18 %	17 %	19 %	15 %	15 %	15 %
30-34 years	17 %	27 %	26 %	29 %	25 %	25 %	25 %
35-40 years	23 %	40 %	38 %	42 %	40 %	40%	40 %
<i>Personal risks</i>							
Age							
20-24 years		17 %	6 %	18 %	10 %	5 %	10 %
25-29 years		21 %	16 %	23 %	10 %	10 %	15 %
30-34 years		23 %	19 %	34 %	15 %	10 %	30 %
35-40 years		34 %	32 %	43 %	30 %	25 %	45 %
No. of women		748	397	351	748	397	351

As can be seen from Table 2, the stated mean and median infertility risks increase with age. A majority (61 %) of the respondents report higher risks for the older age groups and 95 percent report higher or equal risks for the older age groups, meaning that women know that the risk of infertility increases with age. Although the mean stated general risks significantly differ from the actual risks,¹¹ the median stated general risks for women younger than 30 are close to the actual risks, indicating that women are relatively well aware of the risks for 20-29 year old women. Knowing that actual risk levels coming from different sources differ a bit, and that respondents usually round their answers to the nearest five percentage unit (Manski, 2004), it is wise to allow for some deviation in the risk perceptions without calling them over- or underestimations. On the other hand, both the median and mean stated risks for the oldest age group (35-40 years) are 40 percent, which is a clear overestimation. The stated mean and

¹¹ The null hypothesis that the mean stated general risk in the sample is equal to the mean actual risk is tested using the bootstrapping method. By using the percentile method and the 95 % confidence interval, it can be shown that the stated mean general risks are significantly higher than the mean actual risks at the 5 % significance level for each age groups.

median general risks are robust across the respondent ages in this study: Both the mean and median risks and the standard deviations are nearly identical with and without the respondents younger than 30. Furthermore, whether or not a respondent is a mother does not affect the perception of the general risks; the stated median general risks are exactly the same in the two groups. The first hypothesis seems to be true: women are aware that the risk increases with age. However, the magnitude of the general risk for women aged 35 or older is overestimated.

At a first glance, these results seem totally opposite to those by Lampic et al. (2006), who found that female and male university students in Sweden underestimated the general risk of age-related female infertility. One explanation to the deviation is that the risk levels they consider as actual are much higher than the levels used in this study.¹² Another reason might be that their sample consists of only 401 individuals who all are young students. However, when comparing the stated general risk levels in the Lampic et al. study with the stated mean general risks in this study and only including female students, the results confirm the fact that women to a high extent overestimate the age-related risks of infertility. Actually, a larger and, not smaller, share of the female students in the Lampic et al study overestimated the risks compared to both the actual risk levels used in their study and the actual risk levels according to NSFG survey 2002, indicating that it is the male students who underestimated the risk of infertility in the study of Lampic et al.¹³

While the stated mean and median general risks are nearly the same regardless of whether the respondent is a mother or not, the stated personal risks are quite different. Mothers state significantly lower personal risk levels compared to childless respondents.¹⁴ It is possible that the non-mothers older than 29 have personal experience of difficulties of becoming pregnant, which could partly explain why they state higher personal risks. However, it is more difficult

¹² They use 21-30 % as the actual risk level for women at the age of 25-30 years and 41-50 % for women at the age of 35-40 years. These risk levels are based on artificial insemination of 751 women with azoospermic husband (van Noord-Zaadstra et al., 1991).

¹³ The study by Lampic et al. (2006) included 222 and this study 147 female students. 26 % of the female students in the Lampic et al. study stated risks higher than 30 % for women at the age group 25-30 years, while only 9 % of respondents in this study did the same. Similarly, 46 % of the respondents in the study of Lampic et al. stated risks higher than 50 % for the women in the age group 35-40 years, while the corresponding share of the respondents in this study is 15 %.

¹⁴ The difference between the mean stated personal risks for mothers and women without children are tested as before with the percentile method. The results show that the mean stated personal risks of the non-mothers are significantly higher than those of the mothers at the 5 % significance level for all age groups.

to explain why childless women aged younger than 30 (which constitute 71 % of the non-mothers) state significantly higher personal risks as well. Therefore, we in the next section investigate further the difference between stated personal and general risks.

4.3 Comparisons between stated personal and general risks for other same age women

The second hypothesis is: *Women perceive themselves as less vulnerable to the risk of age-related infertility than other women their age.*

The second hypothesis is tested by comparing the stated personal risk with the stated general risk for the respondent's own age group. The strength of this comparison is that it does not depend on actual risks, but we can concentrate on the *relative* risk perceptions of the women. Table 3 reports the shares of all respondents, by age group, stating a lower, same, and a higher mean personal risk than the general risk for other same age women.

Table 3. Shares of the respondents, by age group, who stated a lower, same, and higher risk for themselves compared to same age women, whole sample. Standard deviations are in parentheses.

The age of the respondent	Share of women with lower personal risk	Share of women with same personal risk	Share of women with higher personal risk
20-24 years	30 % (46 %)	37 % (48 %)	33 % (47 %)
25-29 years	36 % (48 %)	33 % (47 %)	31 % (46 %)
30-34 years	56 % (50 %)	24 % (43 %)	21 % (41 %)
35-40 years	49 % (50 %)	27 % (44 %)	24 % (43 %)
Whole sample	44 % (50 %)	29 % (46 %)	26 % (44 %)
No. of women	330	220	198
Total no. of women	748		

As we can see in Table 3, the shares of women with lower, same or higher personal risk are very similar for women under 30 years, while women who are older more often perceive that their risk is lower compared to same age women: 49-56 percent of the 30-40 years olds stated a lower personal risk, while only 30 percent of the youngest women did the same. A Chi-Square goodness-of-fit test is used to test whether these observed differences are due to chance or if they are real differences. The null hypothesis is that 1/3 of the respondents feel they are at lower risk, 1/3 that they have the same risk and 1/3 that they are at higher risk than other same age women. These tests show that significantly more than one-third of the

respondents in the whole sample and in the two oldest age groups stated lower personal risks. The results are confirmed when the null hypothesis is that 1/2 of the respondents experience that they are at lower risk and 1/2 that they are at higher risk than other same age women. This means that a majority of the respondents stated a lower personal risk than a general risk for a woman their age.¹⁵ So, according to the definition of optimistic bias, it is present among women older than 29.

We also want to investigate whether our result of optimistic bias prevail when we divide the sample between mothers and non-mothers and analyze the groups separately. According to Steenhof and de Jong (2001), women manage to become pregnant sooner with their second child than with their first child. It is also known that women who already have one or more biological child(ren) have a lower risk of age-related infertility in developed countries (Wulff et al., 1997; Högberg, 1998), although age does matter for the probability of a second pregnancy as well. Women aged 33-42 fail more often to become pregnant a second time compared to younger women (Steenhof and de Jong, 2001). Therefore it is important to investigate respondents with and without children separately. Table 4 reports the shares of mothers and non-mothers, by age group, who stated lower, the same, and higher personal risks relative to the risk for other same age women.

Table 4. The shares of the mothers and non-mothers, by age group, who stated lower, the same, and higher risks for themselves relative to other same age women. Standard deviations are in parentheses

The age of the respondent	Lower personal risk		Same personal risk		Higher personal risk	
	Mothers	Non-mothers	Mothers	Non-mothers	Mothers	Non-mothers
20-24 years	73 % (47 %)	27 % (44 %)	9 % (30 %)	39 % (49 %)	18 % (40 %)	34 % (48 %)
25-29 years	53 % (50 %)	28 % (45 %)	23 % (42 %)	38 % (49 %)	24 % (43 %)	34 % (48 %)
30-34 years	65 % (48 %)	30 % (46 %)	19 % (39 %)	38 % (49 %)	16 % (37 %)	32 % (47 %)
35-40 years	54 % (50 %)	31 % (47 %)	25 % (44 %)	31 % (47 %)	21 % (41 %)	38 % (49 %)
Whole sample	58 % (49 %)	28 % (45 %)	22 % (42 %)	38 % (49 %)	20 % (40 %)	34 % (48 %)
No. of women	231	99	88	132	78	120
Total no. of mothers/non-mothers	397	351				

¹⁵ The respondents who stated the same personal and general risk for their own age group are excluded from this alternative test.

The results show large differences between the risk perceptions of mothers and non-mothers. For example, 58 percent of all mothers believe that they are at a lower risk than other same age women, while the corresponding share of respondents who do not have children is only 28 percent. The difference is even larger when comparing mothers and non-mothers younger than 25 years (73 % respective 27 %). Thus, the optimistic bias is significant for mothers in all age groups at the 1 percent level for both the 1/3 and 1/2 null hypotheses. On the other hand, there is no optimistic bias at all among the non-mothers regardless their age. Non-mothers are evenly distributed among the three groups in Table 4. Since the respondents were asked to state a general risk for a same age woman who was neither defined as a mother nor a non-mother, we expected that more of the respondents would state equal personal and general risks than what was the case.

Another interesting question is whether the mothers' perception of *how much* lower risk they have is realistic compared to actual risks. By using the results of the 1998 Netherlands Fertility and Family Survey we are actually able to investigate that. This survey presents fertility rate statistics for both first and second pregnancies, which makes it possible to see how much lower the risk of fertility is for second time mothers compared to first time mothers in four different age groups. Unfortunately, the Netherlands survey age groups for first pregnancies are not the same as the age groups used to measure the success rate of second pregnancies. Therefore, we compare the infertility rates for only two age groups, i.e. for women aged under and over age 30.¹⁶ Table 5 reports the mean values of general and personal risks stated by mothers and the actual risk levels for first and second pregnancies according to the Netherlands survey.

Table 5. Estimated actual infertility risk according to the Netherlands survey 1998, and perceived general and personal risks stated by Swedish mothers.

Age group	<i>The Netherlands survey 1998</i>			<i>Mothers</i>		
	General risk of infertility for 1 st pregnancy	General risk of infertility for 2 nd pregnancy	Difference between the risk levels	Stated mean general risk	Stated mean personal risk	Difference between the stated risk levels
< 30 years	18-20 %	14-15 %	4-6 %	14 %	11 %	3 %
≥ 30 years	23 %	21 %	2 %	32 %	25 %	7 %
No. of mothers	397					

¹⁶ The age groups used to report the success rate of first pregnancies are 15-21, 22-25, 26-29 and 30-40 years, while the age groups used to report the success rate of second pregnancies are 18-24, 25-28, 29-32, and 33-42 (Steenhof and de Jong, 2001).

Table 5 shows that, according to the Netherlands survey, the actual risk of secondary infertility is 4-6 percent lower than the risk of primary infertility among women younger than 30 years, while it is only 2 percent lower for women aged 30 or older. Hence, the age matters for the likelihood of a second pregnancy. The last three columns summarize the results of our study for the two age groups. Mothers state significantly lower general risks for the younger age group and significantly higher risks for the older age group compared to the risk levels of the Netherlands survey. However, our main interest is the difference between the stated general and personal risks. The results show that mothers state 7 percent lower mean personal than general risks for women older than 30, while the difference between the risks for first and second pregnancies according to the Netherlands study is only 2 percent. Thus, mothers, aged 30 and older, have a too optimistic picture of how much easier it is to become pregnant the second time compared to the first time.¹⁷ This finding is in line with the results by Perloff and Fetzer, 1986, Weinstein, 1987, and Slovic et al., 2000b. People who have no experience of a particular negative life event tend to be more positive than others considering this event.

4.3. Factors behind the difference between the stated general and personal risks

The third hypothesis is: *The difference between the stated personal and general risk depends on a woman's own previous experience of becoming pregnant, on how important she perceives of being fertile per se and on whether she wants to have children.*

To be able to see what affects the probabilities that the stated personal risks differs from the stated general risks for same age women, the respondents are divided into three different groups. In the analysis we use an ordered probit model, where the dependent variable is whether the respondents state a lower, equal, or higher personal risk than their stated general risks for other same age women. Table 6 shows the marginal effects of the ordered probit model.

¹⁷ Whether the deviation in stated risk levels in this study (7 %) significantly differs from the deviation between first and second pregnancies according to the Netherlands study (2 %) is tested as before with the percentile method. The results show that the difference is significant at 5 % significance level. Moreover, the general risk of infertility for the first pregnancy according to the Netherlands study and the general risk of infertility in our study are not the same. The average woman that the respondents were asked to state the general risk for could either be a mother or a childless woman. This risk is comparable to the weighted average of the risks for first and second pregnancies according to the Netherlands study. Therefore, the difference between the risk for first and second pregnancies would be even lower for the Netherlands study, which strengthens our results even more.

Table 6. The marginal effects of the ordered probit model. The dependent variable is whether the respondents state a lower, equal, or higher personal risk than they stated as general risks for other same age women. Whole sample.

Variable	Marginal effect	p-value	Marginal effect	p-value	Marginal effect	p-value
	<i>Women with lower personal risk</i>		<i>Women with same personal risk</i>		<i>Women with higher personal risk</i>	
Mother, no more children	0.072	0.001	-0.016	0.000	-0.056	0.422
Mother; a child within 3 years	0.016	0.387	-0.003	0.300	-0.013	0.850
Mother; a child but does not know when	0.015	0.430	-0.004	0.353	-0.012	0.863
Non-mother; a child within 3 years	-0.262	0.000	0.004	0.681	0.257	0.000
Non mother; a child but does not know when	-0.159	0.000	0.020	0.027	0.140	0.025
Friends/relatives over 35	0.057	0.002	-0.010	0.000	-0.046	0.517
Fertility is important	0.088	0.000	-0.015	0.000	-0.073	0.325
Sure; personal risk	0.129	0.000	-0.028	0.000	-0.101	0.167
Age 25	0.008	0.677	-0.002	0.650	-0.006	0.927
Age 30	0.043	0.020	-0.009	0.000	-0.033	0.625
Age 35	-0.046	0.017	0.009	0.114	0.037	0.568
Big city	0.031	0.098	-0.007	0.015	-0.024	0.723
University	-0.008	0.686	0.002	0.708	0.006	0.927
Student	0.137	0.000	-0.037	0.000	-0.100	0.154
Partner	0.082	0.000	-0.014	0.000	-0.068	0.358
Income	0.003	0.281	-0.001	0.288	-0.002	0.263
No. of women	330 (44 %)		220 (29 %)		198 (27%)	

The results in Table 6 show that the marginal effects capturing the probabilities of mothers who want more children are insignificant; the mothers who want an additional child do not significantly differ from non-mothers who do *not* want a child, i.e. from the reference group in the regression. This makes it possible for us to directly compare the probabilities of mothers and non-mothers who want to have a/another child. We find that the probability of stating a higher personal than general risk increases by 26 percentage points if the respondent who wants to have a child within three years is a non-mother than if she is a mother who wants to have more children. This indicates that non-mothers clearly believe that they have higher personal risk than other women their age. On the other hand, a mother who does *not* want to have more children is more likely to state a lower personal than general risk than all

other women.¹⁸ Hence, ranking the respondents based on their relative risk perception, we find that mothers who do *not* want to have more children are those who perceive that their risk is lowest, followed by both mothers who want to have a child and non-mothers who do not. Non-mothers who want to have a child are those who perceive themselves at highest risk.

From a policy point of view the interesting group is women who want to have a/another child, but from the risk perception point of view it is an interesting result that women who do *not* want (more) children perceive that they are at lower risk than others. It is difficult to have medical explanations for why a non-mother who is pleased to live without children would have a lower risk than a non-mother who wants to become pregnant. Unless the non-mothers who do not want to have a child (7 % of the sample) are those who know that they have difficulties to become pregnant. If so, these women's wish to remain childless might be a reaction to their higher than an average risks of infertility, indicating endogeneity problem. This argument is however less plausible for the mothers (35 % of the sample) who do not want to have more children. A better explanation is that these mothers are pleased with the number of children they already have. Thus, it is even more difficult to explain in medical terms why a mother who does not want to have more children should have lower risk than a mother who wants to become pregnant. One explanation is that these women's risk perception is affected by their decision of *not* trying to become pregnant

We also find some other interesting results. Respondents with close friends or relatives who have become pregnant at the age of 35 or later are more likely to state a risk that is lower than the risk they state for other same age women. Thus, positive experiences of persons close to oneself do matter.¹⁹ Furthermore, the probability of stating a lower personal risk increases by 9 percentage points if a respondent feels that being fertile per se is important to her, regardless of whether she wants to have (more) children or not. This is in line with Dunning et al. (1991) who state that if people perceive an attribute as important, they also perceive that they have that attribute.

¹⁸ The respondents who do not know if they want to have (more) children are also included in the variables: mother; no more children and in the reference group non -mother; no child. The others responded that they were very or quite sure about wishing to have (more) children.

¹⁹ According to Kohler (2000) individual's fertility behavior depends also on the fertility behavior of other individuals in society. Although Kohler discusses the number of births, which is somewhat different, the message is the same. Social interactions do matter for a woman's fertility behavior, her timing of births and/or her perceptions of the risk of infertility.

Summarizing the results of the third hypothesis, it seems that, in line with our hypothesis, a woman's own previous positive experience of becoming pregnant does matter for her risk perception. Mothers are more likely to state lower personal than general risks compared to non-mothers who want to become pregnant. However, the risk perception of a mother who wants to have more children does not significantly differ from the risk perception of a non-mother who does *not* want to have a child. Moreover and contrary to our hypothesis, a wish to have a child does not decrease the perception of the personal risk level; it instead increases it among all women. A possible explanation might be that, according to Weber (1994), people are sensitive to the consequences of making a misjudgement of a quantity they are asked to estimate. The more negative the outcome, the greater the cost of inadequate prevention due to the underestimation. And the outcome of not becoming pregnant is likely to be assumed to be highly negative for many women who want to have a child. Finally, if a woman perceives that being fertile is important per se she also more likely believes that she has a lower risk than other same age women. This result is in line with Dunning et al. (1991), who found that the more important people consider an attribute the more they perceive that they have it.

5. Conclusions and discussion

The desire of having children has not changed during the last decades, while the average age of first-time mothers has increased steadily in several Western countries (Council of Europe, 2004). Therefore, this study, based on a random representative sample of Swedish females 20-40 years of age, attempts to find out whether women are aware of the magnitudes of age related infertility risks. Both the individuality of the risk and the fact that the actual risk levels might differ depending on the used estimation method make the risk levels more difficult to state. Even if it can be hard to interpret the results of this study as exact risk levels, the trend is clear. Swedish women are well aware of the risk levels for young women but they clearly overestimate the risks for women older than 34.

There are several potential reasons why women overestimate the general risks for women over 34 years. Firstly, the age of 30 is often described as 'critical' (Steenhof and de Jong, 2001). Other studies indicate that the female age-related infertility increases somewhat before age 30 and then significantly more so after the age of 35 (Leridon, 2004; Infomedica, 2004). One very reasonable explanation for the overestimation of the risks is therefore that

information about the ages 30 or 35 as being ‘critical’ has reached the respondents, making them believe that the risks are even higher than they actually are.

A further objective of this paper was to investigate whether an individual’s perceptions of personal risk and general risk differ from each other. We found that a large majority of mothers, regardless their age, believe to be at a lower risk than an average woman of the same age, while the childless women do not. Hence, there is an optimistic bias among mothers, even if we account for the fact that mothers generally have a lower than average risk than non-mothers. Moreover, we found that mothers aged 30 and older have a too optimistic picture of *how much* easier it is to become pregnant the second time compared to the first time, which strengthens further our result about optimistic bias among mothers. These findings are also in line with the articles by Perloff and Fetzer (1986), Weinstein (1987) and Slovic et al. (2000b): People who have no experience from a negative life event tend to be more positive than others. It is also very unlikely that a majority of all childless women aged 20-40 really have higher than average risks of age-related infertility, especially among those 71 percent of the respondents without children who are younger than 30.

Consequently, the results of this study highlight several facts that are interesting from a policy point of view: Women are quite well aware of the general risks of infertility; they do not believe that the risks are lower than they are. Moreover, perceptions of the general risks do not differ between women who have children and childless women. On the other hand, we found large difference in the risk perceptions between general and personal risks among mothers who in general have too optimistic picture about their own fertility level. Thus, even if mothers are aware of the general risk levels they do not believe that the risks apply to themselves, which naturally makes it harder to inform mothers about the risk. How correct a woman’s risk perception is, matters also for other women’s risk perceptions. According to Coleman (1993) and Lampi (2007), interpersonal information channels as friends and relatives affect the general risk perception, especially when information based on the experiences of peers is concerned to be very credible (Tonn et al., 1990). This means that women, regardless whether they are mothers or not and whether they want to become pregnant or not, spread information (correct or incorrect) from the risk of age-related infertility to other women.

Finally, it seems that risk perceptions of infertility are also affected by psychological factors; a woman who perceives that being fertile per se is important is also more likely to perceive that she is more fertile than other same age women. Moreover, the exposure to the risk of infertility is possible to avoid if a woman does not want to become pregnant: We found that a woman who does *not* want to have (more) children is more likely to believe that her own risk is lower than average compared to a woman who wants (more) children. Further research is needed to determine whether non-exposure to a risk can explain why people perceive themselves as less vulnerable to the risk in terms of risks other than the one studied here.

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Appendix

Part 2 – Questions about the age-related risk of female infertility

Nowadays, we establish families later in life than previous generations did. The average age of Swedish first-time mothers is now 29 years, which is up five years from 30 years ago. Age affects the fertility of a woman, even if fertility is a very individual issue. *Infertility* is defined as when a woman regularly tries to but does *not* become pregnant without medical assistance during a period of one year. Although, it is possible that she becomes pregnant after for example three years, with or without medical assistance. While infertility can be due to several reasons, this study investigates only how age affects female infertility.

Questions 1-4 below are about women of different ages. Imagine that these women try to become pregnant and that their partners are perfectly fertile. I want to know what you *believe* the risk of age-related infertility is for a woman in every age group. Question 5 is about what you believe your own risk is.

The number you state as a percentage rate in questions 1-4 indicates the number of women out of 100 in that age group who will *not* become pregnant in a one year period without medical assistance, despite trying regularly. Answer the questions even if you feel unsure about the percentage rates. For this study, it is important to find out what you *believe* the risks are. You can always go back and change your answers if you like.

Question 1. I *believe* that the average risk for a 20-24 year old woman of *not* becoming pregnant during a time period of one year is.....%

Question 2. I *believe* that the average risk for a 25-29 year old woman of *not* becoming pregnant during a time period of one year is.....%

Question 3. I *believe* that the average risk for a 30-34 year old woman of *not* becoming pregnant during a time period of one year is.....%

Question 4. I *believe* that the average risk for a 35-40year old woman of *not* becoming pregnant during a time period of one year is.....%

Note: Question 5 below is about you personally.

Question 5. Imagine that you want to try to become pregnant. How great, do you *believe*, is your *personal* risk of *not* becoming pregnant during a time period of one year?.....%

Space for your own comments.....
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