Do Induced Abortions Affect the First Birth Probability?
A National Register-Based Study of Danish Women

Marie-Louise H. Hansen
Louise Stage
Lisbeth B. Knudsen
Niels Keiding

Research Report 09/10
Department of Biostatistics
University of Copenhagen
Do Induced Abortions Affect the First Birth Probability?
A National Register-Based Study of Danish Women

Marie-Louise H. Hansen¹, Louise Stage¹, Lisbeth B. Knudsen², Niels Keiding³

Abstract

Objective: The focus of this paper is to study, on a national basis, how the event of an induced abortion modifies the transition to first birth for Danish women aged 20-39 years in the period 1982-2001, taking into account also educational level, family situation, and urbanisation.

Data and methods: The data are obtained by linking several national public registers in Denmark, using the unique personal identification number. Initially, a logistic regression analysis is employed in order to model the first birth probability in a given year. Secondly, the long-term effect of an induced abortion is examined by cumulative first birth probabilities, derived from a life table analysis.

Main findings and conclusion: Previous abortions increased the first birth probability, though this effect was almost entirely confined to single women. For cohabiting and married women, previous abortions had a minimal or no effect on the first birth probability.

¹ M.Sc. in Public Health, Department of Biostatistics, Institute of Public Health, University of Copenhagen, Denmark
² Professor, Department of Sociology, Social Work and Organization, Aalborg University, Denmark
³ Professor, Department of Biostatistics, Institute of Public Health, University of Copenhagen, Denmark
Table of Contents

1.0 Background
   1.1 The Danish setting
   1.2 Fertility and abortion patterns in Denmark
   1.3 Couples

2.0 Data and Covariates
   2.1 Study Population
   2.2 Covariates

3.0 Methods
   3.1 Logistic regression analysis
   3.2 Life table analysis

4.0 Results
   4.1 The first birth probability in a given year
      4.1.1 The final logistic regression model
   4.2 The long-term effect of a first abortion on a first birth
      4.2.1 Age
      4.2.2 Age and Educational level
      4.2.3 Age and Family situation
      4.2.4 Age and Birth cohort
      4.2.5 Age and Urbanisation
   4.3 Summary of the results

5.0 Discussion
   5.1 Strengths and Limitations
      5.1.1 National register based study
      5.1.2 Time of recording
      5.1.3 Birth and abortion in the same year
   5.2 Important results
      5.2.1 Abortions and Educational level
      5.2.2 Abortions and Family situation

6.0 Conclusion

7.0 References
1.0 Background

Having the first child is a milestone in every person’s life. First-time mothers and fathers face a whole range of new considerations that previously have not been relevant to them. The decision whether or not to commence childbearing and the timing of the first child are influenced by a number of factors of biological, emotional and practical nature. In the Western world where contraception is widely used and abortion on request is available, the choice of childbearing is by many considered a conscious decision for women and couples alike (Knudsen et al. 2003; Rasch et al. 2001). Most women want children and have certain notions of what kind of parent they want to be and how their lives should be at the time of childbearing (see e.g. (Lampic et al. 2006; Svanberg et al. 2006; Virtala et al. 2006)).

There is an obvious disparity embedded in the choice of motherhood versus the choice of induced abortion. At pregnancy, women have to make an active decision on either having a baby or undergoing an induced abortion. Either choice will presumably affect her future life considerably, and it is therefore interesting to learn more about the dynamics between induced abortions and first births.

To our knowledge, very little has been published on the possible effect of previous induced abortions on subsequent first births among nulliparous women. Thus, the scope of this study is further motivated as a contribution to a new field of research.

In Denmark, linking of the national register on induced abortions with several other registers is possible by the use of the unique personal identification number. Linking these registers offers a remarkable insight into the childbearing behaviour of Danish women, which enables us to shed light on a possible effect of previous induced abortions on subsequent first births.

The focus of this study is if and how previously induced abortions affect the transition from having no children to having the first child among Danish women in the 1980s and 1990s. The study examines both the first birth probability in a given calendar year and the long-term effects of previous abortions on subsequent first births.

---

4 A literature search was performed on 16 June 2008, which did not reveal any relevant Scandinavian articles (see also Knudsen 2002). One article from Romania was identified and will be referred to (Muresan 2008). However, the comparability of Denmark and Romania in regard to societal, economic and fertility trends is limited.

5 Nulliparous women are defined as women who have never given birth to a live-born child.
1.1 The Danish setting

In many ways, the Danish welfare state constitutes the societal framework in which Danish women make decisions regarding childbearing and family formation. The Danish welfare state is often referred to as an example of a “social democratic welfare regime”, a term introduced by Esping-Andersen (Esping-Andersen 1990). A characteristic of the “social democratic welfare regime” is family-friendly policies such as day-care facilities, parental leave schemes and economic support for families with children (Greve 2007). Furthermore, emphasis is on the individual, allowing women to actively take part in the labour force, to be educated and to continue work life even after starting a family (Knudsen 2003). Compared to other countries, Danish women have been and still are active in the labour force to a very high degree; e.g. in 1984, 78% of women between 25-49 years were employed (Björnberg 1999). Also, the educational level of Danish women is high and has been increasing during recent decades (Andersson et al. 2008; Jacobsen 2004). The educational difference between men and women has become less pronounced over the latest decades, and in 1994 the number of female university students for the first time exceeded the number of male university students (Statistics Denmark 2007; Statistics Denmark and Ligestillingsrådet 1999).

The family situation in the 1980s and 1990s in Denmark was characterized by a decrease in the proportion of married couples and an increase in the proportion of single and cohabiting women and women living in consensual unions. In the period 1980-2000, the proportion of married 20- to 49-year-old men and women decreased by 18 percentage points – from 61% in 1980 to 43% in 2000 (Statistics Denmark 2005). In the same period, the proportion of 20- to 49-year-old single women increased from 16% to 20%, while the proportion of cohabiting women increased from 11% to 13%. Finally, the proportion of women living in consensual unions, in the same age-group, increased from 2% to 8% (Statistics Denmark 2005). The increase was particularly evident during the 1980s.

While it became more and more common to live together without becoming married the overall fertility rate of women outside of marriage increased for women over the age of 20 years (Knudsen 1999). However, like in many late societies, during the same period there was a tendency to try out more partners, and to live with them, before engaging in a more permanent relationship (Beck 1997; Giddens 1992). Thus, over the years, the cohabiting category may increasingly be composed of a proportion of women for whom the relationship is more tentative, and family formation
therefore not an option, and another proportion of women for whom family formation is highly relevant. Cohabitating women may therefore comprise a very heterogeneous group.

In Denmark, induced abortions are legal and cost-free. The law from 1973⁶ states that all women above the age of 18 have the right to have their pregnancy terminated on demand at a public hospital at no private cost. The procedure has to take place before the end of the 12th week of pregnancy. Induced abortion after the 12th week requires a special permit (Knudsen, Gissler, Bender, Hedberg, Ollendorff, Sundström, Totlandsdal, & Vilhjalmdottir 2003).

1.2 Fertility and abortion patterns in Denmark

In Denmark, the period Total Fertility Rate (pTFR)⁷ declined drastically from the mid-1960s and hit a historical low in 1983 just below 1.4. The decline pertained to all age-specific fertility rates. During the late 1980s and 1990s, the pTFR increased and stabilised. In 2000 the pTFR in Denmark was 1.8 (Statistics Denmark 2007). However, the age-specific fertility rates in the 1980s and 1990s showed two different trends, with a continued decrease among women below 25 years and an increasing fertility among women older than 25 years. The increasing age of first time mothers reflects the continuing age-specific decrease in fertility of younger women. In 1981, the average age of women giving birth for the first time was 24.8 years, and 20 years later in 2001 the average age had increased to 28.3 years (Statistics Denmark 2007). Inspection of the cohort Total Fertility Rate (cTFR) reveals that decreasing pTFR was mainly due to a delay of the first birth of certain cohorts, which has partly been compensated for at higher ages (Knudsen 2003).

The general abortion rate⁸ rose immediately after liberalisation of the act, peaking in 1975 and declining ever since, from approximately 18.7 abortions per 1,000 women in 1981 to 12.2 abortions per 1,000 women in 2001. The decreasing general abortion rate pertains to all age-groups (Statistics Denmark 2007). A recent Danish study shows that the risk of an induced abortion decreases after

---

⁶ Act no. 350 of 13 June 1973 on pregnancy interruption [https://www.retsinformation.dk/Forms/R0900.aspx?s21=lov+om+svangerskabsafbrydelse&s22=%7c10%7c 22-09-08.]

⁷ The number of live births which 1,000 women would bear during the fertile age (15–49 years) given that none of the 1,000 women die prior to their 50th year and that they at every age-group give birth to children according to the age-specific fertility rates in the given year.

⁸ The general abortion rate is defined as the number of legally induced abortions in the relevant year compared to the number of women at the age of 15–49 years. The rate is normally expressed per 1,000 women (Statistics Denmark 2007).
the age of 20, when adjusting for calendar year, women’s number of children and previous abortions, residence and family situation (Hansen et al. 2008).

The proportion of nulliparous women seeking induced abortion in Denmark increased from approx. 33% of all the women right after the legislation came into force in late 1973 to about 50% of the women in the 1990s (Knudsen 2000; Knudsen and Wielandt 2000). Based on these aggregate data, it has been concluded by some that Danish women used induced abortions as a means to postpone the onset of childbearing for nulliparous women rather than ending it (Knudsen & Wielandt 2000). However, recent Danish findings based on individual level data have shown that the risk of an abortion for women with no children decreased from 1981 to 2001, while in the same period the risk for women with children increased (Hansen, Mølgaard-Nielsen, Knudsen, & Keiding 2008). This discrepancy is explained by the increasing average age at first birth, which yields a larger proportion of women with no children in the latter part of the period, and hence a higher proportion of abortion seeking women with no first birth. The new findings suggest that abortions were actually increasingly used as a means to end rather than postpone childbearing. This is a consequence of the calendar year but also a consequence of the women’s birth cohort, which means that the trend is more pronounced among women from younger cohorts (Hansen, Mølgaard-Nielsen, Knudsen, & Keiding 2008).

Unless otherwise specified, in this article, the term ‘abortions’ refers to legally induced abortions.

1.3 Couples
Throughout this article, only women’s history and choices will be discussed. However, clearly the choice of childbearing is not the women’s alone. In case of pregnancy, the choice of whether or not to accept the pregnancy is most likely made by men as well as women (Thomson et al. 1990; Thomson 1997). Thomson (1997) found that the male partner’s desires and intentions influenced both women’s intentions and the couple’s births. In case of a disagreement between couples regarding childbearing, there seemed to be a tendency towards not intending or not having children.

Furthermore, research on fecundity has discussed the possible impact of deteriorating semen quality. Jensen et al. (2008) suggested that among a segment of Danish men the semen quality is so poor that it contributes to the widespread use of assisted reproduction (Jensen et al.
Skakkebæk et al. 2006). Sobotka et al. (2008) found that assisted reproductive treatment may have a relatively small, but non-negligible and increasing effect on cohort fertility in Denmark, which is strongest for first birth rates (Sobotka et al. 2008). Both fecundity and assisted reproduction are of importance for the women’s choice of a first birth. A low fecundity presumably reduces first birth rates, while assisted reproduction on the other hand may increase or stabilise first birth rates.

Also, in more indirect terms, women are highly influenced by being in a relationship, sharing their lives with someone, and by their partner’s income and education. A German study by Kreyenfeld (2002) found that the effect of the women’s education on the transition to second childbirth actually disappeared when the partner’s education was included. This study was carried out in West Germany within an institutional framework that could be characterised as a “male-breadwinner regime”. In contrast, a Danish study by Gerster et al. (2007) found that both women’s, as well as the men’s, education determined second birth rates. The effect of the woman’s education became somewhat smaller when including the partner’s education, but it was still significant. These contradictory findings could very well be explained by the different societal frameworks of Germany and Denmark.
2.0 Data and Covariates

2.1 Study population
The data used in this study stem from a number of national public registers in Denmark, primarily from the Registry of Legally Induced Abortions and the National Discharge Register (Andersen et al. 1999) in the Danish National Board of Health and the Fertility Database in Statistics Denmark (Knudsen 1998). From these, information was extracted and data linkages performed by use of the unique personal identification number in order to establish the Fertility of Women and Couples Dataset.

The Fertility of Women and Couples Dataset (FWCD) includes socio-demographic information on all woman in her fertile age (13-49 years) living in Denmark in the period 1980-2001, collected annually from Statistics Denmark. Information on all live births as well as stillbirths stem from the Medical Birth Register and civil registration, while information on legally induced abortions is based on separate registrations in the health services. Until 1995 all induced abortions in Denmark had to be notified to the Danish National Board of Health by the performing hospitals. Based on these notifications, the Register of Legally Induced Abortions was established. After 1 January 1995, information on induced abortions was collected from the National Discharge Register (Rasch et al. 2005). The compilation of events of both births and abortions was done through the creation of the FWCD (Knudsen and Murphy 1999; Kohler et al. 2002).

The study population comprises all native born9 women above the age of 19 from birth cohorts 1961-1981 who were resident in Denmark on 1 January in a given year in the period 1 January 1982 to 31 December 2001.

As mentioned before, abortion on demand was legalized in Denmark in 1973. The Register of Legally Induced Abortions includes information on women in the fertile age – in this context defined as 13-49 year-old women. Thus, women from birth cohort 1961 is the first birth cohort who are eligible to be included in the registers as they turn 13 years in 1974 – the first year of registration. In 1982, women above 20 years cannot be included, since the law and register were not

9 We use the definition of Statistics Denmark: Native Danish women are women with least one parent who is a Danish citizen and born in Denmark, regardless of the women’s own country of birth and citizenship (http://dst.dk/Vejviser/dokumentation/times/ennegruppe/enn/variabel.aspx?sysrid=160252&timespath=186571|22-09-08).
in place from the beginning of their reproductive period, and full information on the women’s abortion parity was therefore unavailable. This means that we have information on 20-year-old women every year from 1982 to 2001, whereas we only have information on eg 35-year-old women from 1996 to 2001. The consequent triangular shape of data places some constraints in the comparisons of age groups over time. In some of the analyses, we only report abortion rates for women aged 20-35. This is because even though we have some data on the 36- to 39-year-old women, it is not enough to determine a development over time.

Teenage pregnancies and/or teenage abortions call for considerations of a different focus than the same events in older age-groups. Also, fertility and abortion trends among non-Danish citizens are different from those of native born women (Rasch, Knudsen, & Gammeltoft 2005). Thus, teenagers and non-Danish citizens were excluded from this study, in order to strengthen the interpretations. Furthermore, women registered in same-sex partnerships (0.08% of the total data population in 2001) were excluded. Registered same-sex partnerships were only introduced in Denmark in 1989.

2.2 Covariates
The data include information for every calendar year from 1982-2001 about a woman’s age as of 1 January, her birth cohort, the event of a birth and/or an induced abortion in that year, municipality of residence, family situation and highest level of education attained so far.

The urbanisation variable is based on information on women’s place of residence and is composed of four categories: the Capital Area, the Urbanised Province, the Close Periphery and the Distant Periphery according to the classifications of Tonboe (2001), cf. Thygesen, Knudsen & Keiding 2005. The family situation variable describes the women’s position within a household and is categorised into: single, married and cohabiting. According to this variable, divorced women, if not living together with a partner, are categorised as single. Married women have to live with their partners in order to be registered as married. Furthermore, single women might have a partner but are still categorised as single if they are not living together. Thus, it is not so much the woman’s marital status as it is her living arrangement that are pivotal to the classification of the women’s family situation variable. The variable indicating women’s highest level of education attained is

11 Completed years
categorised in three categories: Basic (basic school), Secondary (general education, vocational training and vocational education) and Tertiary\(^\text{12}\) (short-term higher education, medium-term higher education, Bachelor degree, Master degree and PhD level).

\(^{12}\)The group of women with a tertiary education in their early 20s mainly accounts for women with a short-term higher education, such as laboratory technicians.
3.0 Methods
In order to shed light on the relationship between a woman’s induced abortions and a subsequent first birth, the analyses are twofold. Firstly, we focus on the first birth probability in a given calendar year, studying how it varies according to the women’s current abortion parity. This is attained by a multiple logistic regression analysis. Secondly, we look forward from the abortion, describing the distribution of the waiting time to the first birth in a life-table analysis.

3.1 Logistic regression analysis
The influence of several explanatory variables on the probability of having a first birth in a relevant year was estimated by logistic regression analysis. In this paper we use the logistic regression model descriptively, to attempt to capture primary structures in the data. Use of confidence intervals and p-values derived from the model is difficult with the large data set.

First, in logistic regression the variance is a fixed function of the mean and therefore the usual maximum likelihood estimates of variation are derived from the estimates of the mean, not from the actual variability in the data. This is in contrast to statistical models based on the normal distribution, where the variance has its own freely varying parameter. For large data sets one will in practice almost always find lack of fit, in the form of overdispersion (Dean 2005) or otherwise, and the usual maximum likelihood estimates of variability are not robust to the resulting model misspecification. We found it beside the point to enter into elaborate generalizations of the estimation procedure in this publication.

Secondly, the standard intuition concerning p-values, e.g. the conventional 5% level, was developed by R.A. Fisher in the 1920s and 1930s when he revolutionised statistics by analysing small data sets from his agricultural experiments; the tradition from the 19th century and from Karl Pearson who studied larger data sets was to require much stronger effects to claim statistical significance. For the large datasets in demography adherence to the Fisherian ‘5%’ conventions will lead to focusing on differences too small to be of demographic interest.

The model selection process is based on preliminary descriptive analyses of first birth rates (results not shown) in order to capture relevant associations in data. Furthermore, the model selection derived from the main focus of the study: the relation between previous abortions and first births.
Only relevant two-way interactions have been examined. Interactions of a higher order are difficult to interpret and have therefore been omitted. In order to illustrate the interactions graphically, the odds ratio (OR) values of the interaction (including the main effects of both covariates) have been plotted on a logarithmic scale. Furthermore, in order to ensure that a sufficient number of birth cohorts have reached the age of 20, only calendar years from 1986 and onwards are included in the logistic regression analysis.

3.2 Life table analysis

In order to estimate the age-at-abortion-specific first birth probability subsequent to a first abortion, a discrete life table analysis was employed. The age-at-abortion-specific life table analysis includes an analysis of women with no abortions (yet) at a given age as a control-group. Thus, women who have had an abortion and women who did not have an abortion at the same age are compared in order to see if the cumulative probability of a first birth differs between the two groups. In this analysis, changes in family situation, urbanisation and abortion parity during follow-up are ignored, since the purpose of the life table analysis is to assess the predictive power of the event of an abortion.

The data do not contain information on the exact date of abortions and births, only the calendar year in which they occur. In all of the age-at-abortion- or no-abortion-specific life tables, the first birth probability in year 0 is fixed at 0, even though some women might have a first abortion and a first birth in the same year. As before mentioned, data are discrete and it is not possible to determine the sequence of the two. Therefore, it has been chosen to only analyse the first birth probability of women who have had an abortion at a given age and who do not give birth within the same year, this will be discussed further in section 5.1.3. Likewise, in the case of the controls, women who have a first birth eg at the age of 22 years are disregarded in the control group of 22 years-old women with no abortions.
Women who did not have a national register address\textsuperscript{13} in Denmark on 1 January in a given year are censored the year they leave, even though they might return to Denmark. This has been done in order to ensure that no events which might have happened while being away are disregarded.

\textsuperscript{13} Statistics Denmark defines a permanent address as the place where a person sleeps with some regularity, when he/she is not abroad on holidays or business trips, or as the place where a person has his/her belongings (http://www.dst.dk/HomeUK/Guide/documentation/Varedeklarationer/emnegruppe/emne.aspx?sysrid=00075722-09-08).
4.0 Results

4.1 The first birth probability in a given year

The table below shows the different fitted models that were examined in a logistic regression analysis. The final model includes the main effects and interactions identified by the preceding models as relevant.

Table 1: Model selection process. The different models, the interactions, and which models are included in the final model.

<table>
<thead>
<tr>
<th>Model</th>
<th>Interactions</th>
<th>Included in final model?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Model 2</td>
<td>Calendar year * Age</td>
<td>Yes</td>
</tr>
<tr>
<td>Model 3</td>
<td>Education * Age</td>
<td>Yes</td>
</tr>
<tr>
<td>Model 4</td>
<td>Family situation * Age</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Family situation * Calendar year</td>
<td>Yes</td>
</tr>
<tr>
<td>Model Abo1</td>
<td>Abortion parity * Age</td>
<td>No</td>
</tr>
<tr>
<td>Model Abo2</td>
<td>Abortion parity * Calendar year</td>
<td>No</td>
</tr>
<tr>
<td>Model Abo3</td>
<td>Abortion parity * Education</td>
<td>No</td>
</tr>
<tr>
<td>Model Abo4</td>
<td>Abortion parity * Urbanisation</td>
<td>No</td>
</tr>
<tr>
<td>Model Abo5</td>
<td>Abortion parity * Family situation</td>
<td>Yes</td>
</tr>
<tr>
<td>Final model</td>
<td>Calendar year * Age</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Education * Age</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Family situation * Age</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Family situation * Calendar year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Abortion parity * Family situation</td>
<td></td>
</tr>
</tbody>
</table>

The data comprise app. 4 million person years, and among these 304,000 first births were identified. In all of the models, the reference category is that for a 28-year-old single woman in 2001 with a basic school education, no previous abortion who lives in the Capital Area. Only the results of the final model are included in the article.

4.1.1 The final regression model

The results of the previous models led us to fit a model which consisted of all the main effects and 6 two-way interactions. However, the estimates of this model showed that an interaction between women’s age and abortion parity (model Abo1) no longer seemed relevant. Further analyses showed that the interaction between women’s age and abortion parity was explained by the interaction between women’s age and educational level (model 3). Thus, the final model consists of all the main effects and five two-way interactions, cf. Table 1.

All the fitted models contain main effects for calendar year, age, educational level, family situation, abortion parity, urbanisation.
Since almost all the covariates are included in one or more interactions, the main effects of the covariates are not to be interpreted individually. In fact, only women’s urbanisation is not included in an interaction. Hence, unlike the rest of the covariates it is possible to interpret the estimates of the main effect of urbanisation. Women who lived in the Urbanised Province in the beginning of the year had an 11% higher probability of a first birth compared to women living in the Capital Area. In comparison, women living in the Close and Distant Periphery had a 27% higher probability.

The calendar year, women’s age, educational status, family situation and abortion parity all seem to influence the probability of a first birth, but they are all modified by one or more covariates. The following tables and figures show the OR values of the interactions in the final model.

Women’s age and calendar year

Table 2: The final model - OR values for the interaction between women’s age and calendar year, selected ages and years.

<table>
<thead>
<tr>
<th></th>
<th>1987</th>
<th>1989</th>
<th>1991</th>
<th>1993</th>
<th>1995</th>
<th>1997</th>
<th>1999</th>
<th>2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 20</td>
<td>1.38</td>
<td>1.41</td>
<td>1.27</td>
<td>1.23</td>
<td>1.18</td>
<td>1.05</td>
<td>0.95</td>
<td>0.90</td>
</tr>
<tr>
<td>Age 22</td>
<td>1.62</td>
<td>1.86</td>
<td>1.71</td>
<td>1.46</td>
<td>1.37</td>
<td>1.13</td>
<td>1.02</td>
<td>1.02</td>
</tr>
<tr>
<td>Age 24</td>
<td>1.51</td>
<td>1.77</td>
<td>1.75</td>
<td>1.57</td>
<td>1.45</td>
<td>1.17</td>
<td>1.03</td>
<td>1.02</td>
</tr>
<tr>
<td>Age 26</td>
<td>1.44</td>
<td>1.47</td>
<td>1.39</td>
<td>1.36</td>
<td>1.18</td>
<td>1.06</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Age 28</td>
<td>1.21</td>
<td>1.21</td>
<td>1.22</td>
<td>1.09</td>
<td>1.00</td>
<td>1 (ref.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age 30</td>
<td>0.90</td>
<td>0.95</td>
<td>0.86</td>
<td>0.88</td>
<td>0.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age 32</td>
<td>0.75</td>
<td>0.69</td>
<td>0.66</td>
<td>0.75</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age 34</td>
<td>0.41</td>
<td>0.46</td>
<td>0.48</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age 36</td>
<td>0.33</td>
<td>0.36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age 38</td>
<td>0.20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2 shows that the calendar years affect the probability of a first birth differently depending on the age of women. Roughly, the probability decreases for women under 30 years from 1987 to 2001, while for women above the age of 30 it is only slightly decreasing or even constant in the same period. This reflects the increasing average age of first time mothers. E.g. in 2001, 26- to 28-year-old women had the highest probability of having a first birth. In contrast, in 1997, the 25- to 27-year-old women had the highest probability.

Women’s age and educational level
Table 3: The final model - OR values for the interaction between women’s age and educational level, selected ages.

<table>
<thead>
<tr>
<th>Age</th>
<th>Basic school</th>
<th>Secondary education</th>
<th>Tertiary education</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0.90</td>
<td>0.23</td>
<td>0.15</td>
</tr>
<tr>
<td>22</td>
<td>1.02</td>
<td>0.47</td>
<td>0.27</td>
</tr>
<tr>
<td>24</td>
<td>1.02</td>
<td>0.80</td>
<td>0.63</td>
</tr>
<tr>
<td>26</td>
<td>1.00</td>
<td>1.14</td>
<td>1.13</td>
</tr>
<tr>
<td>28</td>
<td>1 (ref.)</td>
<td>1.39</td>
<td>1.62</td>
</tr>
<tr>
<td>30</td>
<td>0.84</td>
<td>1.32</td>
<td>1.70</td>
</tr>
<tr>
<td>32</td>
<td>0.75</td>
<td>1.24</td>
<td>1.76</td>
</tr>
<tr>
<td>34</td>
<td>0.48</td>
<td>0.92</td>
<td>1.47</td>
</tr>
<tr>
<td>36</td>
<td>0.36</td>
<td>0.73</td>
<td>1.31</td>
</tr>
<tr>
<td>38</td>
<td>0.20</td>
<td>0.54</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Women with a basic school education have the highest probability of a first birth in the early and mid-20s, but subsequent to the late 20s the probability decreases. By contrast, women with a secondary and tertiary education have a relatively low, but increasing, probability in the early 20s. Their probability peaks around the age of 29, after which the probability decreases again; however, not as much as for women with a basic school education in the same ages.

Calendar year and family situation

Table 4: The final model – OR values for the interaction between calendar year and family situation, selected years.

<table>
<thead>
<tr>
<th>Calendar year</th>
<th>Married</th>
<th>Cohabiting</th>
<th>Single</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>14.18</td>
<td>7.37</td>
<td>1.30</td>
</tr>
<tr>
<td>1989</td>
<td>11.70</td>
<td>6.54</td>
<td>1.28</td>
</tr>
<tr>
<td>1991</td>
<td>11.73</td>
<td>6.32</td>
<td>1.21</td>
</tr>
<tr>
<td>1993</td>
<td>12.33</td>
<td>6.55</td>
<td>1.21</td>
</tr>
<tr>
<td>1995</td>
<td>13.99</td>
<td>6.85</td>
<td>1.22</td>
</tr>
<tr>
<td>1997</td>
<td>14.00</td>
<td>6.37</td>
<td>1.09</td>
</tr>
<tr>
<td>1999</td>
<td>14.20</td>
<td>6.17</td>
<td>1.00</td>
</tr>
<tr>
<td>2001</td>
<td>14.47</td>
<td>6.23</td>
<td>1 (ref.)</td>
</tr>
</tbody>
</table>

The trend within a given calendar year is clear: married women have the highest probability of a first birth, followed by cohabiting women and single women. Within the three family situations, the probability does not vary according to calendar year for the first couple of years; i.e. the probability of a first birth decreases evenly and regardless of family situation. However, from the early 1990s the probability of married women begins to increase, which is in contrast to the probability of single women, which continues to decrease. This means that the difference in the probability of a first birth between married women and single women has actually grown during the 1990s.

Women’s age and family situation
Table 5: The final model - OR values for the interaction between women’s age and family situation, selected ages.

<table>
<thead>
<tr>
<th></th>
<th>Married</th>
<th>Cohabiting</th>
<th>Single</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 20</td>
<td>19.26</td>
<td>4.65</td>
<td>0.90</td>
</tr>
<tr>
<td>Age 22</td>
<td>21.33</td>
<td>5.24</td>
<td>1.02</td>
</tr>
<tr>
<td>Age 24</td>
<td>19.71</td>
<td>5.45</td>
<td>1.02</td>
</tr>
<tr>
<td>Age 26</td>
<td>17.01</td>
<td>5.74</td>
<td>1.00</td>
</tr>
<tr>
<td>Age 28</td>
<td>14.47</td>
<td>6.23</td>
<td>1 (ref.)</td>
</tr>
<tr>
<td>Age 30</td>
<td>9.71</td>
<td>5.80</td>
<td>0.84</td>
</tr>
<tr>
<td>Age 32</td>
<td>6.48</td>
<td>4.92</td>
<td>0.75</td>
</tr>
<tr>
<td>Age 34</td>
<td>3.15</td>
<td>3.38</td>
<td>0.48</td>
</tr>
<tr>
<td>Age 36</td>
<td>1.72</td>
<td>2.11</td>
<td>0.36</td>
</tr>
<tr>
<td>Age 38</td>
<td>0.58</td>
<td>1.09</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Table 5 shows that the difference between the OR’s of cohabiting and single women is rather stable over the different ages. Thus, women’s age does not seem to influence the effect of being single or cohabiting on the probability of a first birth differently. The probability of single and cohabiting women increases slightly during the early and mid-20s, peaks around the age of 27, and then decreases. However, this is not the case for married women. The probability of married women peaks at the age of 22 and then decreases rather drastically, especially after the late 20s. From the age of 28-38, the probability of married women drops by a factor 25, while for both cohabiting and single women it only drops by a factor 5. Thus, for married women, age has a much higher impact on the first birth probability compared to that of single and cohabiting women.

**Family situation and abortion parity**

Table 6: The final model - OR values for the interaction between family situation and abortion parity.

<table>
<thead>
<tr>
<th></th>
<th>No abortions</th>
<th>1 or more abortions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td>14.5</td>
<td>15.0</td>
</tr>
<tr>
<td>Cohabiting</td>
<td>6.2</td>
<td>7.2</td>
</tr>
<tr>
<td>Single</td>
<td>1 (ref.)</td>
<td>2.4</td>
</tr>
</tbody>
</table>
Table 6 and Figure 1 show that the number of abortions influences the probability of a birth differently depending on the women’s current family situation. For married women, the number of previous abortions does not seem to influence the probability of a first birth. This is not the case for cohabiting women, and especially not for single women. For single women, the probability increases 2.4 times if women have had one or more previous abortions. Thus, in regard to the first birth probability, a prior abortion is of much higher significance for single women than for married women.
4.2 The long-term effect of a first abortion on a first birth

Only women who have their first abortion as 20- to 30-year-old are the focus of this analysis. This is in order to ensure a relevant period of follow-up subsequent to the first abortion. Equally, only 20- to 30-year-old women who have not had an abortion are included as controls. Furthermore, women who gave birth or had an induced abortion before the age of 20 are excluded. The data comprise 611,000 women and among these 6,400 (1.1%) have had a first abortion and 21,800 (3.6%) have had a first birth.

4.2.1 Age

Figure 2 shows the cumulative age-specific first probability for 22 and 26 years-old women with a first or no abortions. Tables 7a and 7b show the cumulative first birth probability of women who at a given age have a first or no abortion, respectively, at the end of the 3\textsuperscript{rd}, 7\textsuperscript{th}, 11\textsuperscript{th} and 15\textsuperscript{th} year of follow-up.
Figure 2: Cumulative age-specific first birth probability for 22 and 26 years-old women with a first or no abortion

Table 7a: Cumulative first birth probability for women with a first abortion at a given age by the end of the 3rd, 7th, 11th and 15th year, selected ages.

<table>
<thead>
<tr>
<th>Age at 1st abortion</th>
<th>3rd year</th>
<th>7th year</th>
<th>11th year</th>
<th>15th year</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>20%</td>
<td>54%</td>
<td>76%</td>
<td>83%</td>
</tr>
<tr>
<td>22</td>
<td>24%</td>
<td>59%</td>
<td>77%</td>
<td>84%</td>
</tr>
<tr>
<td>24</td>
<td>31%</td>
<td>65%</td>
<td>78%</td>
<td>83%</td>
</tr>
<tr>
<td>26</td>
<td>34%</td>
<td>65%</td>
<td>74%</td>
<td>...</td>
</tr>
<tr>
<td>28</td>
<td>37%</td>
<td>61%</td>
<td>69%</td>
<td>...</td>
</tr>
<tr>
<td>30</td>
<td>38%</td>
<td>59%</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

Table 7b: Cumulative first birth probability for women with no abortions at a given age by the end of the 3rd, 7th, 11th and 15th year, selected ages.

<table>
<thead>
<tr>
<th>Age with no abortion</th>
<th>3rd year</th>
<th>7th year</th>
<th>11th year</th>
<th>15th year</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>15%</td>
<td>47%</td>
<td>70%</td>
<td>79%</td>
</tr>
<tr>
<td>22</td>
<td>24%</td>
<td>56%</td>
<td>73%</td>
<td>78%</td>
</tr>
<tr>
<td>24</td>
<td>32%</td>
<td>61%</td>
<td>72%</td>
<td>76%</td>
</tr>
<tr>
<td>26</td>
<td>35%</td>
<td>59%</td>
<td>67%</td>
<td>...</td>
</tr>
<tr>
<td>28</td>
<td>33%</td>
<td>52%</td>
<td>58%</td>
<td>...</td>
</tr>
<tr>
<td>30</td>
<td>27%</td>
<td>41%</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
Overall, as seen in Figure 2 and Table 7a, the cumulative first birth probability, for women with a first abortion, increases the higher the age at the first abortion. This is most evident regarding the first 9-10 years of the follow-up period. The same trend is, albeit with some modifications, evident for women with no abortions at a given age, cf. Figure 2 and Table 7b.

Figure 2 shows that compared to women with no abortions at the same age, women with a first abortion initially have (slightly) lower cumulative probability of a first birth, but at longer follow-up this probability becomes substantially higher for those with an abortion. This trend is regardless of the women’s age. On average, 6-8 percentage points differentiate the cumulative first birth probability at the end of a given year depending on whether the women have had an abortion or not at a given age. Moreover, this difference increases the older the women are, so that for women in the late-20s the difference between the cumulative first birth probabilities in a given follow-up year is higher than for women in the early 20s, cf. Figure 2.

4.2.2 Age and Educational level
Due to the relatively low number of women recorded as having attained a tertiary level of education in the early 20s, the first birth rates of these women should be interpreted with caution.

Figures 3a-3d show the cumulative first birth probability according to abortion parity and educational status for selected ages.
3a) 22 years

Cumulative first birth probability

Years

3b) 24 years

Cumulative first birth probability

Years
3c) 26 years

Figure 3a-3d: Cumulative age-specific first birth probability according to the women’s educational level and whether or not the women have had a first abortion or not, selected ages.
Table 8a: The cumulative first birth probability for women with a first abortion at a given age and educational level by the end of the 3rd, 7th, 11th and 15th year, selected ages.

<table>
<thead>
<tr>
<th>Edu. Level</th>
<th>3rd year</th>
<th>7th year</th>
<th>11th year</th>
<th>15th year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basic</td>
<td>Secondary</td>
<td>Tertiary</td>
<td>Basic</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>26%</td>
<td>15%</td>
<td>17%</td>
<td>60%</td>
</tr>
<tr>
<td>22</td>
<td>27%</td>
<td>23%</td>
<td>22%</td>
<td>59%</td>
</tr>
<tr>
<td>24</td>
<td>32%</td>
<td>29%</td>
<td>34%</td>
<td>58%</td>
</tr>
<tr>
<td>26</td>
<td>24%</td>
<td>35%</td>
<td>37%</td>
<td>50%</td>
</tr>
<tr>
<td>28</td>
<td>30%</td>
<td>38%</td>
<td>40%</td>
<td>47%</td>
</tr>
<tr>
<td>30</td>
<td>30%</td>
<td>40%</td>
<td>41%</td>
<td>41%</td>
</tr>
</tbody>
</table>

Firstly, as seen Figures 3a-3d and Table 8a, the cumulative first birth probability of women with a first abortion depends on the women’s educational level at the time of the abortion. Overall, women with a basic education have the lowest cumulative first birth probability throughout the entire follow-up period, whereas women with a secondary or tertiary education have the highest cumulative first birth probability. Whether women have a secondary or tertiary education at the time of the abortion does not seem to matter substantially. This trend pertains to almost all ages.

In regard to women with no first abortion at a given age, the control group, the trend between the cumulative first birth probabilities according to educational level is more or less the same. However, for women in the late 20s the difference between women with a secondary and tertiary education is more distinct among the control group than for women with a first abortion.

Secondly, within a given age and educational level, women with a first abortion have a higher cumulative first birth probability compared to the control-group. This pertains to the entire follow-up period, excluding the initial years.

Furthermore, Table 8a illustrates that for women with a basic school education the younger the age at the first abortion, the higher the cumulative first birth probability in a given year of the follow-up period. For women with a secondary or tertiary education the trend is the reverse. The older they are at the first abortion, the higher the cumulative first birth probability in a given year of the
follow-up period. This means that women with a basic school education have their children faster after a first abortion the younger they are at the time of the abortion or no abortion, although not in the initial years. Women with a secondary or tertiary education have their children faster after a first abortion, especially in the initial years, the older they are at the time of the abortion or no abortion. For women in the control group, the trend is similar, cf. Table 8b.

4.2.3 Age and Family situation

Figures 4a-4d show the cumulative first birth probability according to the women’s family situation and previous abortions for selected ages.
4a) 22 years

4b) 24 years
Figures 4a-4d: Cumulative age-specific first birth probability according to the women’s family situation and whether or not the women have had a first abortion or not, selected ages.
Table 9a: The cumulative first birth probability for women with a first abortion at a given age and family situation by the end of the 3rd, 7th, 11th and 15th year, selected ages.

<table>
<thead>
<tr>
<th>Family Status</th>
<th>3rd year</th>
<th>7th year</th>
<th>11th year</th>
<th>15th year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singl</td>
<td>Married</td>
<td>Cohabiting</td>
<td>Singl</td>
<td>Married</td>
</tr>
<tr>
<td>Age</td>
<td>20</td>
<td>18%</td>
<td>34%</td>
<td>28%</td>
</tr>
<tr>
<td>22</td>
<td>21%</td>
<td>46%</td>
<td>31%</td>
<td>56%</td>
</tr>
<tr>
<td>24</td>
<td>25%</td>
<td>52%</td>
<td>41%</td>
<td>60%</td>
</tr>
<tr>
<td>26</td>
<td>28%</td>
<td>55%</td>
<td>43%</td>
<td>61%</td>
</tr>
<tr>
<td>28</td>
<td>31%</td>
<td>52%</td>
<td>49%</td>
<td>59%</td>
</tr>
<tr>
<td>30</td>
<td>34%</td>
<td>46%</td>
<td>47%</td>
<td>58%</td>
</tr>
</tbody>
</table>

As illustrated in Figures 4a-4d, for women with a first abortion at a given age, the cumulative first birth probability differs depending on whether the women are married, cohabiting or single at the time of the abortion. In general, single women have the lowest cumulative first birth probability and married women the highest. To some extent, the cumulative probabilities of married and cohabiting women resemble each other, especially after the initial years of the follow-up period. This trend also pertains to women with no abortions at a given age. However, as shown in Figures 4a-4d and Tables 9a and 9b, the difference between single and married/cohabiting women is larger for women with no abortion compared to women with a first abortion. Thus, the difference between single and married/cohabiting women is modified by a first abortion, mainly because the first birth probability of single women increases considerably if women have an abortion at a given age.

As illustrated in Figure 2, having an abortion at a given age is associated with a higher first birth probability at the end of any given year of the follow-up period compared to the control-group. However, Figures 4a-4d and Tables 9a and 9b show how it becomes a bit more complicated when taking into account the women’s family situation. Thus, if single women have a first abortion their first birth probability increases notably when compared to single women with no abortion. This is especially apparent if the women have the first abortion at a late age. In contrast, for married and cohabiting women a first abortion does not seem to increase the first birth probability radically.
some of the young age-groups and early years after the abortion or no abortion, women with no abortion actually have the highest cumulative first birth probability.

Table 9a shows that for women with a first abortion, the older the women are the higher the cumulative first birth probability by the end of the year, especially in the initial years after the abortion. The trend among women in the control-group is less distinct.

4.2.4 Age and Birth cohort
Each age-specific first birth curve in Figure 2a and 2b is a result of a number of different cohorts. Thus, a potential cohort effect might be masked by the multiple cohorts. Therefore, in order to disentangle any birth cohort effects we constructed age-at-abortion-specific cumulative first birth probabilities according to the women’s birth cohort. Overall the analysis showed that the women’s cumulative first birth probability does not depend notably on her birth cohort. Therefore, no age-at-abortion-specific first birth probabilities according to the women’s birth cohort are shown.

4.2.5 Age and Urbanisation
When the age-at-abortion-specific cumulative first birth probabilities are stratified on urbanisation, no substantial difference is found; neither between the four urbanisation categories, nor within the two abortion parities. Therefore, no age-at-abortion-specific first birth probabilities according to urbanisation are shown.

4.3 Summary of the results
All of the covariates, except the women’s level of urbanisation, are included in one or more interactions in the final logistic regression model. The effect of the abortion parity is modified by family situation. For married women the effect of women’s abortion parity on the first birth probability seems minimal, while abortion parity seems to influence the first birth probability of single women to a much higher degree. Thus, for single women a previous abortion increases the first birth probability notably.

The life table analysis reveals that at all ages the first birth probability is higher for women with an abortion compared to women without an abortion, a 6-8 percentage point difference, except for the
initial years of the follow-up period. Furthermore, the first birth probability do not seem to depend on the women’s birth cohort

Stratified on educational level, the life table analysis shows that within a given age and educational level women with a first abortion have the highest cumulative first birth probability compared to women without a previous abortion. Regardless of abortion parity, women with a secondary or tertiary education have the highest cumulative first birth probability and women with a basic school education hold the lowest, except for some of the younger ages. Furthermore, in general women with a basic school education have a first birth faster following the abortion or no abortion the younger they are, whereas women with a secondary or a tertiary education have their first birth faster the older they are at the time of the abortion or no abortion.

Stratified on family situation, it is seen that within a given age, single women with an abortion have a markedly higher cumulative probability of a first birth compared to single women without a previous abortion. In contrast, the picture is more blurred for married and cohabiting women with and without an abortion. In general, throughout the entire follow-up period, regardless of abortion parity, married women have the highest cumulative probability, followed closely by cohabiting women, while single women have the lowest cumulative probability of a first birth. After the initial years following the abortion, the cumulative first birth probabilities of cohabiting women and married women to some extent resemble each other.

The final model in the logistic regression analysis shows increasing first birth rates with decreasing level of urbanisation. However, no difference between women living in the Close and Distant Periphery was observed, when compared to women in the Capital Area.
5.0 Discussion

In the previous sections, a number of analyses have been employed in order to examine the relation between women’s previous abortions and first births. Furthermore, other sections of the article have briefly presented the societal framework for Danish women’s childbearing in the 1980s and 1990s. The following section will discuss some of the results within the focus of the article in the light of this societal framework. Firstly, however, some general considerations regarding the composition of data and the conditions and choices made in the analyses will be discussed.

5.1 Strengths and Limitations

5.1.1 National register-based study

The data used in the study stem from national public registers in Denmark, cf. Section 2.1. As a result, the recording of data is not dependent on the women’s memory or their motivation to participate, and thus the risk of recall bias and selection bias is non-existing. The registers provide us with substantial information about every cohort from 1961-1981 and offer a remarkable insight into the childbearing behaviour of these women. However, at the same time the analyses are also restricted to the information contained in the registers, and certain confounders and perspectives cannot be examined, such as attitudes towards childbearing and abortions.

As previously mentioned, induced abortions in Denmark are legal, cost-free and until the end of the 12\textsuperscript{th} week of pregnancy no special permission is required. Therefore, illegal non-registered abortions probably only account for very few cases, if any. Thus, there is no reason to believe that the registration of abortions in these data should not reflect the actual number of abortions in Denmark.

Data do not provide information on whether the abortion was performed before or after the 12\textsuperscript{th} week of pregnancy, the point at which special permission is required. As mentioned in section 1.2, this permission is only given under certain circumstances, and the reasons for choosing an abortion after the 12\textsuperscript{th} week are probably different from the reasons for choosing an abortion earlier in the pregnancy. Therefore it would be helpful to be able to identify the time of the abortion. However, induced abortions after the 12\textsuperscript{th} week only account for a small proportion of the total number. Only about 4\% of all induced abortions from 1995 to 2001 were performed after the 12\textsuperscript{th} week, and of these approx. 1-1.6\% were due to risk of severe diseases of the foetus (The Danish National Board
Therefore, the small magnitude of abortions due to these circumstances should presumably not cause problems when interpreting the impact of induced abortions on first births.

5.1.2 Time of recording

As mentioned in Section 3.0, the time of the recording of the different covariates differ in the two analyses, corresponding to the two different questions asked in the two different analysis. In the logistic regression analysis we study whether the first birth takes place in a particular year, and the covariates are recorded in the beginning of that year, while in the life table analysis we are interested in follow-up from the event of the abortion, and the covariates are recorded at the time of the first abortion. An example of the differences between the logistic regression analysis and the long-term analyses is that of the first birth probability given the women’s urbanisation.

In the logistic regression analysis, women’s level of urbanisation proved to have effect on the first birth probability in a given year while simultaneously adjusting for a number of other covariates. The more urbanised, the lower the first birth probability. However, this does not seem to be the case when considering the long-term effects. The life table analysis does not display any substantial differences according to urbanisation, neither for women with a previous abortion nor for women without a previous abortion. Thus, women’s level of urbanisation is of importance to the first birth probability in a given year, a finding supported by another Danish study (Thygesen et al. 2005), while subsequent to an abortion the level of urbanisation at a given age does not influence the first birth probability in the long run.

Especially when examining the effect of different covariates in the logistic regression, a notion of intentionality has to be considered. For example, in the case of women’s level of urbanisation and first births, the causal relationship is not clear. Do women in the Capital Area have a relatively lower first birth probability simply because they live in the Capital Area? Or do women who are interested in and ready for family formation and childbearing move away from the Capital Area into the suburbs and other less urbanised parts of the country, thus resulting in a relatively lower first birth probability in the Capital Area? If the last pattern is common, the dynamics between women’s level of urbanisation and the probability of a first birth have to be interpreted with caution.
When examining the long-term effects of the covariates, the viewpoint is different. Again, we use women’s level of urbanisation to illustrate. Arguably, a substantial part of the women will change urbanisation status (move to another region) after the initial recording at baseline. However, if so, the women will still be classified according to the region in which they were initially recorded and to which they actually no longer belong.

5.1.3 Birth and abortion in the same year
As described in section 3.2, only women who had a first abortion in a given year and who did not have a first birth in the same year are included in the first birth curves. To disregard the first birth probability of women who have had a first abortion and a first birth in the same year may result in a slight underestimation of the cumulative first birth probability.

Further analyses have shown that approx. 1.3%-1.7% of all women who give birth for the first time also have their first abortion in the same year. However, because of the temporal dimension of a pregnancy, if a woman has a first birth and a first abortion in the same year, it is more likely that the birth precedes the abortion. This means that only a minor percentage of women with both events in the same year will experience that the abortion precedes the birth, which would potentially have made them eligible for the first birth curves, had continuous data on time been available. Thus, only a negligible underestimation of the cumulative first birth probability can be expected in the first birth curves.

5.2 Important results
5.2.1 Abortions and Educational level
The life table analysis showed that for women with a first abortion the cumulative first birth probability increased the older the women were at the time of the first abortion, especially in the first 9-10 years of the follow-up period. This goes for all levels of education, with the exception of women with a basic school education. Thus, in general, the probability in the initial years increased with age, a catching-up effect, while after 9-10 years the cumulative first birth probability was not influenced by women’s age at the time of the abortion. By contrast, for women with a basic school education the cumulative first birth probability decreased the older the women were at the time of the first abortion, and this trend continues throughout the study period. This result corresponds to the final model in the logistic regression analysis, which showed that the first birth probability in a
given year and age was modified by educational level. The logistic regression model showed that women with a basic school education have the highest probability of a first birth in the early and mid-20s, while women with a secondary and tertiary education have the highest probability in the late-20s.

That the cumulative first birth probability increases in the initial years in general the older the women are at the time of the abortion is in itself not surprising. The older the woman is, the higher the biological incentive to replace the abortion with a birth quickly after the first abortion. As mentioned before, female fecundity is highly associated with age. Already at the age of 25-29, there is a slight decrease in women’s ability to become pregnant. Far from all women are aware of this, but most women are aware that age has some effect on fecundity (Lampic, Svanberg, Karlstrøm, & Tydén 2006).

With age not only comes a biological incentive, but perhaps also a social and financial preparedness that makes it possible to re-embark more quickly on family formation after a first abortion. This is especially interesting if we consider the situation of women with a basic school education, and it might also explain why women with a basic school education have a relatively high first birth probability.

Women with a basic school education as the highest educational level in their early 20s are most likely women who do not intend to continue in the official educational system. In Denmark, basic school is compulsory and is usually complete at the age of 15-17. The next educational level, secondary education, typically takes 2-3 years. Thus, women at the age of 20, which is the entry age in our analyses, already had the time to attain a secondary education, since most people attend secondary education immediately after basic school (Peker 2006). They are probably more active in the labour market at an earlier age, which might contribute to a personal, social and financial preparedness that women with a secondary and tertiary education might not have in their early 20s. Also, the Danish welfare state enables women to combine work and family. With increasing age, women with a basic school education who have not had a first birth become a select group with less focus on family formation and childbearing. Thus, those who have a desire to enter motherhood also have the social and economic opportunities from an early age and probably would have done so earlier. For women with a basic school education, the social and economic situation does not change radically during their 20s; therefore the wish to have children is one of the most important
aspects when considering women’s first birth probability. This is also confirmed by the fact that the cumulative first birth probability of this group decreases with age throughout the whole period. Thus, the trend is not a “quick-starter effect”; that is, it is not because young women with a basic school education have a high first birth probability in the initial years, only to be caught up by the older women later in the period. More likely, it is a combination of a high first birth probability in the early years, and a selection process where the family-oriented women have their first child early and the less family-oriented women remain childless. This is not only evident for women with an abortion at a given age, but also for women without an abortion at a given age, i.e. the control-group.

5.2.2 Abortions and Family situation

The logistic regression analyses showed how the effect of previous abortions on the first birth probability varied according to the family situation in a given calendar year. For married women, previous abortions have no effect. For cohabiting, they have a minimal effect. For single women, previous abortions are of high importance for the first birth probability; thus if a single woman has an abortion, her probability of a first birth is much higher.

The life table analysis showed a similar trend in relation to a long-term effect of family situation. If a single woman has a first abortion her cumulative first birth probability increases considerably, compared to a single woman with no first abortion. However, the picture is more blurred for married and cohabiting women, as women without a first abortion have a higher cumulative first birth probability compared to women with a first abortion in the initial years of follow-up. Intuitively, it makes sense that the first birth probability drops after a first abortion to less than the probability of women with no abortions. Women in a relationship who have deliberately chosen not to have a first birth at a given age might be less inclined to choose to have it in the initial years after, compared to women who have not deliberately chosen not to become mothers. A certain proportion of the married or cohabiting women who have an abortion might also terminate the relationship along with the pregnancy.

A Romanian study shows that previous abortions do not seem to influence the first birth probability of Romanian women (Muresan 2008). However, Romania is characterised by a relatively high proportion of persons who choose marriage and the average age at first marriage is low (Muresan et
Childbearing outside of marriage is therefore rarer in Romania compared to Denmark, especially during Romania’s socialistic regime. Thus, it is possible that the reason why the Romanian study does not find an association between previous abortions and first births is that childbearing in Romania often occurs within a marriage, which the results of the Romanian study also confirms. This coincides with the findings of this study; that previous abortions do not affect the first birth probability of married women. However, a number of other differences between Romania and Denmark do prevail, which may impede on the comparability of findings in the two countries.

Still, the difference between women in relationships with and without abortions is not very distinct. Why does the first birth probability not depend on previous abortions for married and cohabiting women as it does for single women?

As mentioned before, the proportion of married women in Denmark fell drastically during the 1980s and 1990s; it became more common to live together in a cohabiting relationship rather than marrying one’s partner or at least to live in a cohabiting relationship a number of years prior to entering into marriage. Thus, nulliparous women who did marry during the 1980s and 1990s might have been a select group of women with a special focus on family formation and the traditional nuclear family. Not only might married women have had a special focus on childbearing and family, they may also more often have been in a situation where they both personally and financially ready to commence childbearing. An increased focus on family formation and a personal and financial readiness for children might explain why married women’s previous abortion history has no impact on their future childbearing.

The notion that married women should be a select group of women is supported by the “selection hypothesis” suggested by previous research focusing on the impact of educational status. Studies on the effect of education on second birth rates have found that the positive effect of education on the second birth rates disappeared when the possibility of selection was taken into account. Women entering motherhood either have a strong pro-family orientation or low career ambitions (Kravdal 2001; Kreyenfeld 2002) and may have completely different preferences towards childbearing (Gerster et al. 2007).
Then, why do single women with previous abortions have a higher probability of a first birth than single women with no previous abortions?

It might be argued that women with a previous abortion already had the opportunity of a first birth but deliberately chose not to go through with it. Thus, among the group of women with previous abortions, there must be a number of women with no intentions of ever having a child, along with women with no intentions of having a child in the immediate future. However, the first birth curves showed that single women with a first abortion had a markedly higher first birth probability than single women with no previous abortion, even in the initial years after the abortion. Firstly, a biological factor needs to be considered. Women with previous abortions have already proved able to conceive, and are therefore usually able to conceive again. Secondly, women with previous abortions are sexually active and therefore exposed to further pregnancies. Among women with no previous abortions, a proportion will be not sexually active and thus not exposed to a pregnancy and a first birth. By comparison, among married women, regardless of whether or not they have had previous abortions, presumably a relatively larger proportion is sexually active.
6.0 Conclusion

The results of this study offer unique insight into the association between Danish women’s previous abortions and their transition from having no children to having the first child in the 1980s and 1990s.

A positive influence of women’s previous abortions on the first birth probability was found, which was modified by women’s family situation. For single women, previous abortions increased the first birth probability. For cohabiting women, previous abortions had a minimal effect on the first birth probability, while for married women the first birth probability remained the same, regardless of whether or not the women had previous abortions. This result was found both in the logistic regression analyses and in the first birth curves, i.e. the results were not only relevant for the women’s first birth probability in a given calendar year but also for the women’s long-term first birth probability subsequent to a first abortion.

Women’s education was found to influence first birth probability with a first abortion differently according to educational level. The same was the case for the control-group. For women with a basic school education, the cumulative first birth probability decreased the older the women were at the time of their first abortion. By contrast, the first birth probability for women with a higher education increased in the initial years following the first abortion the older the women were at the time of their first abortion.

The logistic regression analysis showed that the women’s level of urbanisation had an effect on the women’s first birth probability in a given calendar year. However, the first birth curves showed that the level of urbanisation had no effect on the long-term first birth probability subsequent to a first or no first abortion.
7.0 References


Hansen, M.H., Mølgaard-Nielsen, D., Knudsen, L.B., & Keiding, N. 2008. Rates of induced abortion in Denmark according to age, previous births and previous abortions. *Submitted*


Knudsen, L.B. & Wielandt, H. 2000. Legally Induced Abortions - Experiences from Denmark Danish Center for Demographic Research.


Peker, N. 2006. Longitudinal study of young people's education. TemaPubl, 3,


The Danish National Board of Health 2004. Legalt provokerede aborter 2003 (foreløbig opgørelse). Nye tal fra Sundhedsstyrelsen, 20,


Virtala, A., Kunttu, K., Huttunen, T., & Virjo, I. 2006. Childbearing and the desire to have children among university students in Finland. Acta Obstetricia et Gynecologica Scandinavica, 85, 312-316
08/01 Siersma, V. & Kreiner, S. Monte Carlo Evaluation of Model Search in Graphical Models for Ordinal Data.

08/02 Andersen, P.K. & Pohar Perme, M. Inference for outcome probabilities in multi-state models.

08/03 Scheike, T.H. & Zhang, M. Flexible competing risks regression modelling and goodness-of-fit.


08/05 Gerds, T.A., Qvist, V., Strub, J.R. & Keiding, N. Survival analysis in dental research: The typical observational patterns.

08/06 Carstensen. B. Limits of agreement: How to use the regression of differences on averages.


08/08 Martinussen, T. & Scheike, T.H.. Covariate selection for the semiparametric additive risk model.


08/10 Martinussen, T. & Scheike, T.H. The Aalen additive hazards model with high-dimensional regressors.


08/12 Andersen, P.K., Pohar Perme, M. Pseudo-observations in survival analysis.
08/13 Frydman, H., Gerds, T., Groen, R., Keiding, N. Non-parametric estimation in an “illness-death” model when the transition times are interval-censored and one transition is not observed.

08/14 Didelez, V., Kreiner, S., Keiding, N. On the use of graphical models for inference under outcome dependent sampling.

09/01 Scheike, T.H., Martinussen, T., Silver, J. Estimating haplotype effects for survival data.

09/02 Scheike, T.H., Sun, Y., Zhang, M., Jensen, T.K. A semiparametric random effects model for multivariate competing risks data.

09/03 Nielsen, L.H., Keiding, N. Describing episodes of drug treatment from joint observation of a prescription registry and a cross-sectional survey.

09/04 Nielsen, L.H., Løkkegaard, E., Keiding, N. Importance of effect measures in the evaluation of the effect of post menopausal hormone therapy on myocardial infarction.

09/05 Cortese, G. & Andersen, P.K. Competing risks and time-dependent covariates.

09/06 Kreiner, S. & Christensen, K.B. Item screening in graphical loglinear Rasch models.

09/07 Andersen, P.K. & Væth, M. Survival analysis.

09/08 Gerster, M., Ejrnæs, M. & Keiding, N. The effect of educational attainment on ultimate fertility – does feedback play a role?

09/09 Kreiner, S., Petersen, J.H. & Siersma, V. Deriving and testing hypotheses in chain graph models.