ELSEVIER

Evolution and Human Behavior 22 (2001) 1–10

Evolution and Human Behavior

Induced abortion ratio in modern Sweden falls with age, but rises again before menopause

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Received 12 April 2000; accepted 26 July 2000

Abstract

A woman's reproductive value decreases over her reproductive life span and it is therefore predicted that the likelihood of termination of investment in a child decreases with increasing age. An eventual increase in termination ratio in the oldest age groups, as is often found in abortion statistics, could depend on older women on average having larger families rather than on age per se. We used data on abortions and births in Sweden during 1994 to investigate how abortion ratio is related to age and parity of women. We found that age-specific abortion ratio is U-shaped (i.e. that it is highest for the youngest and for the oldest age groups) in each parity class from zero to four children but that age-dependence breaks down in higher parity classes (5, ≥ 6). Thus, for each of the parity classes 0–4, the incidence of abortion decreases with age up to a point, but increases again as women approach menopause. This late increase in induced abortion ratio seems to depend on age per se. The data indicate that abortion ratio is an inverse function of fertility, and that investment in new reproduction gradually decreases as a woman approaches menopause. Assuming grandmothering as an important driving force in human life history evolution, such a pattern might indicate that the transition from behavioural investment in one's own children to one's grandchildren is a gradual process similar to the decline in ovarian function. © 2001 Elsevier Science Inc. All rights reserved.

Keywords: Abortion ratio; Sweden; Age; Parity; Menopause

Family planning, i.e., a reduction in realised family size, is not a new phenomenon in human societies. Methods for contraception, abortion, and infanticide are widespread and

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PII: S1090-5138(00)00057-X

some of these may be historically quite old (Laughlin, 1994). The adaptive significance of family planning has mostly been discussed in the context of infanticide. Indeed, killing of newborns has been widespread in various societies (reviewed in Dickemann, 1975), particularly in the context of closely spaced babies, twinning, sex preferences, malformations, and adverse ecological conditions (Daly & Wilson, 1988; Hausfater & Hrdy, 1984 Hrdy, 1992). Colinvaux (1982) has suggested that infanticide is an important means for controlling the number and spacing of progeny in humans, because continuous sexual activity may lead to an excess of the number of births that would reduce the number of offspring surviving to adulthood.

It is predicted that the reproductive effort of an individual should increase towards the end of its lifespan in animal species in which reproductive value declines with age (Charlesworth, 1980; Charlesworth & Leon, 1976; Emlen, 1970; Fisher, 1930; Michod, 1979; Stearns, 1976; Williams, 1966). In line with this, the probability of maternal infanticidal behaviour has been predicted to decrease with increasing female age because of falling residual reproductive value (Daly & Wilson, 1988). Thus, if circumstances are unfavourable, a young mother is more likely than an old mother to kill her baby, because there are more future reproductive opportunities for the young mother. Two empirical studies (Ayoreo of Bolivia and Paraguay: Bugos & McCarthy, 1984; modern Canadians: Daly & Wilson, 1988) have confirmed that the incidence of infanticide in humans is a decreasing function of maternal age, although the latter of these studies, on modern Canadians, shows a slight increase in the rate of infanticide in the oldest age category, over 39-years-old (Daly & Wilson, 1988, p. 63). The authors discuss whether this slight increase is reliable (since it includes only three women), but do not preclude that an elevated risk of infanticide could occur in older mothers as an effect of many previous children or birth defects. They conclude that ideally, the prediction of maternal age should be tested with birth order and infant quality controlled, and that the strongest expectation concerns a healthy, first-born child.

In modern Western societies, infanticide is extremely rare, probably because modern techniques have made contraception and abortion the favoured means of family planning. The aim of the present study is to show how, in a country with free abortion, the incidence of abortion changes with age and parity. Following from the expectation that termination of investment in a child is less likely with declining reproductive value, our prediction was that abortion ratio should decrease as a function of maternal age, at least for nulliparous women (see also Hill & Low, 1992). One assumption underlying this expectation is that the psychology surrounding abortion is similar to that surrounding infanticide (see also Lycett & Dunbar, 1999). Thus, if an older woman is expected to be less likely to kill a healthy first-born child, she should also be less likely to abort a healthy first foetus.

1. Material and methods

The first abortion legislation in Sweden was passed in 1938 and permitted abortion on ‘medical, humanitarian, and eugenic grounds.’ This legislation was successively liberalised over the next decades, and the final Abortion Act, passed in 1974, entitles a woman to have an abortion on request, provided that it is carried out before the end of the 18th week of pregnancy. In 1980, the Government appointed a committee to evaluate the effects of the 1974 Abortion Act. The report by the Abortion Committee was published in 1983 (SOU, 1983), and one conclusion from this report was that a free abortion law precludes the need of (often dangerous) illegal abortions. The report includes a study based on interviews of 3789 abortion-seeking women.

Swedish abortions are registered with The National Board of Health and Welfare. For each abortion, the woman's age and previous number of children as well as previous number of abortions are registered, whereas the marital or cohabitation status of the woman is not. Data on abortions for the year 1994 were obtained from the publication Abortions 1994 (1995) where data are presented for the conventional age groups ($\leq$ 19, 20–24, 25–29, 30–34, 35–39, 40–44, and 45+) and where, within each age group, the number of previous children that an individual has had is controlled.

Data on live births during 1994 for each age and parity category were recorded in the publication Population Statistics 1994 (1995b). In 1994, the proportion of immigrants (persons born abroad) in the Swedish population was 10% (Population Statistics 1994, 1995a), but abortion statistics have not been partitioned into ethnic groups. We used the sum of the number of abortions and number of live births as a measure of the number of pregnancies. Thus, we did not include still births in this measure, the main reason being that the data on still births were not fully categorised according to both age and parity. However, since still births constituted no more than 0.31% of all births in 1994 (Population Statistics 1994, 1995b), their inclusion would not greatly influence the number of pregnancies.

Abortion ratios have been presented as the number of abortions per 1000 pregnancies. It should be noted that there is a certain time lag between abortions and births. Thus, because the majority of abortions (95%) are carried out within the first trimester (SOU, 1983), abortion rates should optimally be calculated using the births from a time period 6 months ahead. This would be particularly important if there is variation in birth rates among seasons (Lummaa, Lemmetyinen, Haukioja, & Pikkola, 1998) and a shorter time period is used. Using records for the whole year, such seasonal variation is likely to be cancelled out.

The Nordic countries have similar abortion laws and registration routines and are therefore suitable for a comparison of abortion ratios. In 1993, abortion ratios were highest in Sweden, Denmark, and Norway, with about 20% of abortions per known pregnancies, and lowest in Finland and Iceland, with ratios at about 14% (Abortions 1994, 1995).

We used non-parametric statistics, starting with log-linear analysis of multidimensional contingency tables (STATISTICA 4.1 for Macintosh; see Sokal & Rohlf, 1995; Zar, 1999, for a general description of log-linear analysis). First, we looked for an interaction between age group, parity, and abortion. Second, we looked for an interaction between age group and abortion within each parity group. Finally, comparisons between specific age groups within parity groups were made using 2×2 contingency tables.

2. Results

In 1994 there were 32,293 abortions in Sweden and there were 112,257 live births. When plotting the number of abortions per 1000 pregnancies against maternal age (Fig. 1), a U-

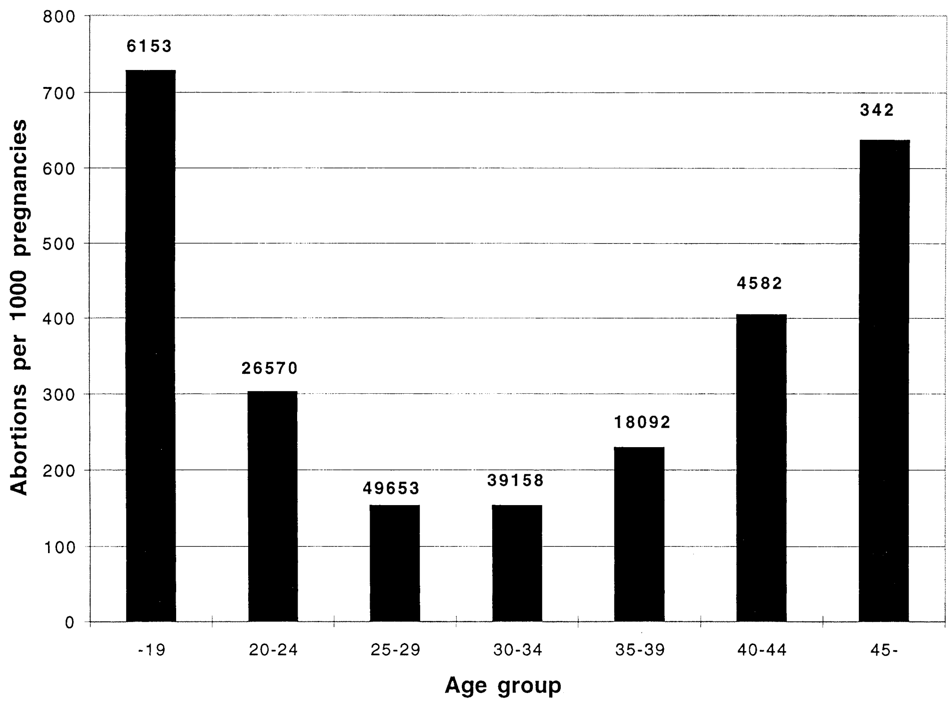

Fig. 1. Number of induced abortions per 1000 pregnancies in different age classes in Sweden 1994. Sample sizes above each bar refer to the total number of pregnancies (number of abortions plus live births).

formed curve was found where the highest abortion frequencies were found in the youngest and in the oldest age categories. Thus, although the majority of abortions, in absolute numbers, occurs in mothers aged 20–39, the probability of abortion for a pregnant woman is much higher for women below and above that age span.

The reason for an abortion may differ between younger and older women. For instance, older women may be more likely than younger ones to choose an abortion because they already have the number of children they desire. It is therefore necessary to control for age and for the number of previous children.

Fig. 2 shows the likelihood of abortion with regard to the number of previous children for the whole 1994 sample. The abortion rate is much lower for women with one child than for any of the other categories. This indicates that a family size of two children is the norm in Sweden. Abortion ratio also seems to decrease among the highest parity classes.

When each parity category is divided according to female age groups, the same pattern as in Fig. 1 is seen (Fig. 3). Thus, for each category from zero up to five children, the highest abortion ratios are found in the youngest and the oldest groups, whereas for women with six or more children, the only notable peak in abortion ratio is for the youngest age group.

A log-linear analysis, where abortion (yes/no) was used as the response variable and age group and parity as design variables, showed a strong interaction between the three variables (Table 1, last row). Thus, the effect of age on abortion ratio is influenced by parity.

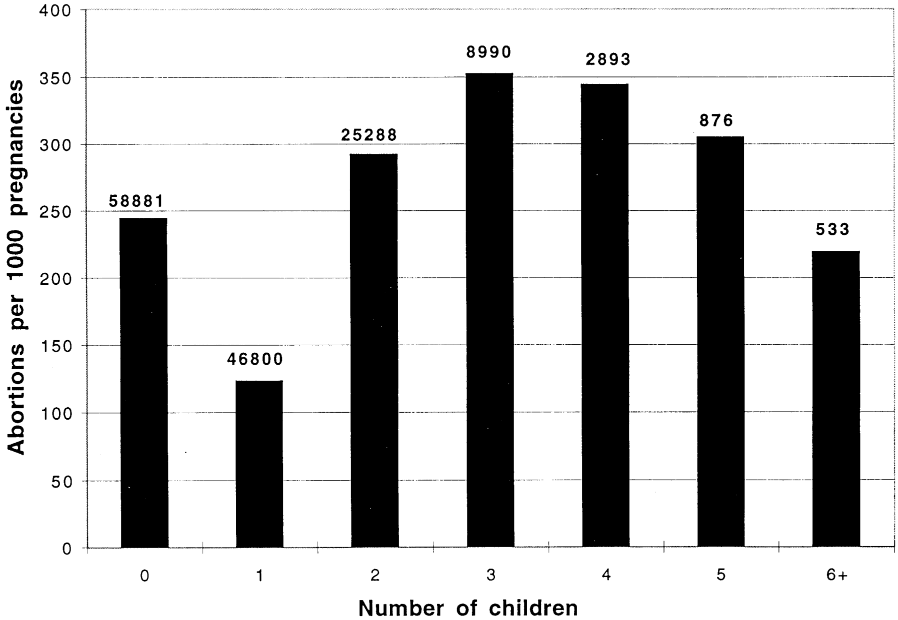

Fig. 2. Number of induced abortions per 1000 pregnancies in relation to parity (number of previous children) in Sweden 1994. Sample sizes refer to the number of pregnancies in each category.

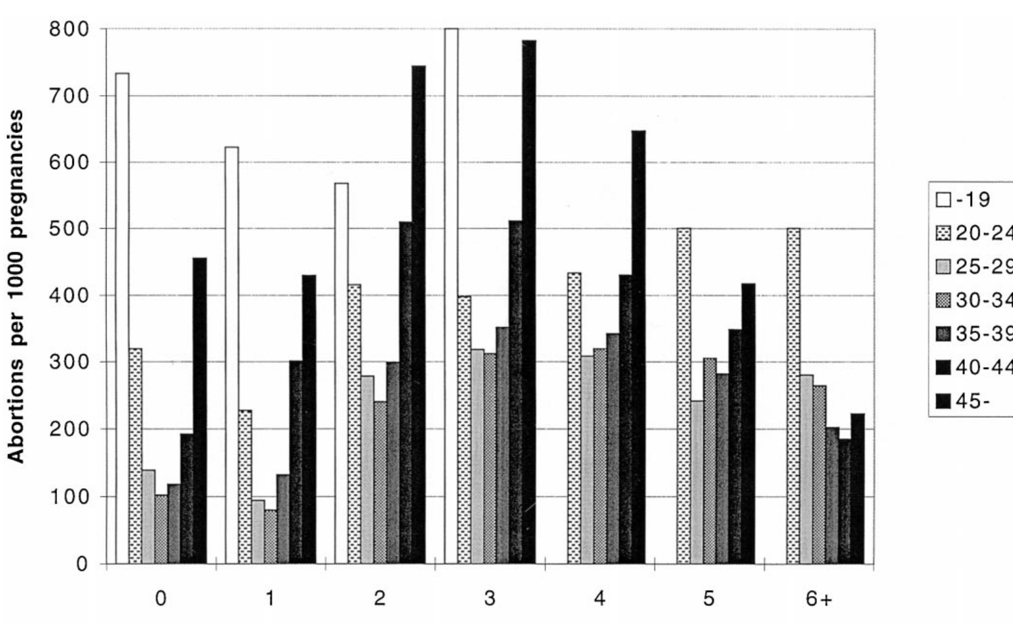

Fig. 3. Number of induced abortions per 1000 pregnancies in relation to age group and parity in Sweden 1994. Sample sizes are found in Table 2.

Table 1
Results from log-linear analysis of the relationship between age group and parity (previous number of children) and the likelihood of having an induced abortion

Effect	*df*	χ^2	*P*
Age group	6	114,214.0	<.000001
Parity	6	174,932.5	<.000001
Abortion	1	47,271.2	<.000001
Age group × parity	36	34,847.4	<.000001
Age group × abortion	6	11,976.2	<.000001
Parity × abortion	6	5208.5	<.000001
Age group × parity × abortion	36	378.9	<.000001

As a next step, we investigated the effect of age on abortion ratio within each parity group (sample sizes in Table 2), and found significant effects for the groups of zero to four children (0: $\chi^2=9719.8$, $df=6$, $P<.0001$; 1: $\chi^2=1759.3$, $df=6$, $P<.0001$; 2: $\chi^2=636.7$, $df=6$, $P<.0001$; 3: $\chi^2=197.0$, $df=6$, $P<.0001$; 4: $\chi^2=31.3$, $df=6$, $P<.0001$), but no significant effects for the groups of five ($\chi^2=5.8$, $df=6$, $P=.45$) and six or more ($\chi^2=5.1$, $df=6$, $P=.53$) children. Thus, for the parity groups 0–4, there is a significant effect of age, but for the higher parity groups (in which the numbers are much smaller), no significant effect of age is found.

For each parity group showing a significant age effect, we compared abortion ratios in the age group with the lowest ratio with that of the next older age group (Fig. 3), and found significant differences for parity groups 0–3 (0: $\chi^2=7.1$, $df=1$, $P<.01$; 1: $\chi^2=98.8$, $df=1$, $P<.001$; 2: $\chi^2=62.5$, $df=1$, $P<.001$; 3: $\chi^2=10.4$, $df=1$, $P<.001$). For the group with four previous children, no significant difference in abortion ratio was found between the age group 25–29 years and the next two older age groups, but the difference between the age groups 25–29 and 40–44 years was significant ($\chi^2=12.6$, $df=1$, $P<.001$). Thus, in parity groups 0–4, abortion ratios increased significantly in the later reproductive age groups.

Table 2
Total number of pregnancies (live births and abortions) for each parity and age group

	Parity						
Age group	0	1	2	3	4	5	≥6
–19	5740	339	30	5	0	0	0
20–24	17,629	7123	1476	229	30	6	2
25–29	20,894	18,758	7501	1901	416	79	25
30–34	10,729	14,392	9300	3187	1070	295	144
35–39	3278	5121	5466	2669	978	323	218
40–44	578	1011	1398	921	365	161	135
45–	33	56	117	78	34	12	9

There were in total 288 abortions in various age classes for which parity was unknown.

3. Discussion

Our results show that age-specific abortion ratios are highest for the youngest and oldest women with family sizes of zero to four children and that in larger families, age-dependence seems to break down. Thus, abortion ratio increases in older women, independently of whether there are zero or up to four previous children.

In a previous study of age-specific abortion ratio, Hill and Low (1992) concluded that abortion ratio is an inverse function of pregnancy rate, but that there are different reasons for the high incidences of abortions at the two age extremes. A young woman tends to have an abortion to postpone childbearing, often because she is unmarried, whereas an older woman tends to choose abortion to regulate family size. This explanation for the U-shaped curve generally found for age-specific abortion ratio is also found elsewhere (SOU, 1983). However, using material from Aberdeen, Scotland, that only took into account first pregnancies, Hill and Low concluded that abortion ratio did indeed decrease with increasing age. Specifically, it decreased from age 16 to 25 and remained low but did not decrease further after age 25. However, in that study, age groups over 35 had been pooled.

The present study shows that induced abortion ratio does indeed decrease with age, but only up to a certain point after which it increases again. For women with zero to three children, this increase starts from the age group 35–39 years. Thus, the explanation most often found for the rising abortion ratio in the older age groups, namely that these women tend to already have a large family, does not hold as a general explanation. If it were true, the U-shaped curve would not be expected for women with zero or one child.

The finding that the incidence of abortion increases with age after a certain point is surprising, both in the light of the predictions from life history theory (Charlesworth, 1980; Charlesworth & Leon, 1976; Emlen, 1970; Michod, 1979; Stearns, 1976; Williams, 1966) and previous infanticide data that seem to agree with this theory. It is therefore important to determine whether or not confounding variables may be responsible for the pattern found here. One factor that reduces the probability of both infanticide (Bugos & McCarthy, 1988; Daly & Wilson, 1988) and induced abortion (Lycett & Dunbar, 1999; Ney, Fung, & Wickett, 1993; Skjeldestad, 1994; Skjeldestad, Borgan, Daltveit, & Nymoen, 1994; Törnblom, Ingelhammar, Lilja, Müller, & Svanberg, 1994) is a stable relationship with a partner, i.e., the prospect of paternal investment. One question then, is whether the marriage/cohabitation pattern deviates for older women in Sweden, particularly for abortion-seeking women. The evaluation of the effects of the free abortion act that was commissioned by the Swedish Government (SOU, 1983; see Material and Methods) provides an insight into this, although our study was not based on these interview data. In the Swedish population in 1981, 60% of females aged 20–24, and about 80% of the age groups up to 40–44 were married or cohabiting (SOU, 1983). For abortion-seeking women participating in the interview ($n = 3789$), the proportion married or cohabiting increased from 19% in the age group 19 or younger, to 42% (20–24), 54% (25–29), 66% (30–34), 75% (35–39), 74% (40–44), and 82% in the age group 45–49 (SOU, 1983, p. 31). Thus, women were less often single in the older age groups and being single is therefore a more likely factor explaining the high incidence of abortion in the youngest than in the oldest groups. Ideally, however, the effect of marriage/cohabitation on age-dependent abortion ratio (see Lycett & Dunbar, 1999) should be analysed together with the effect of parity. Unfortunately, the aggregate data in the present study did not allow for such an analysis.

Women in the interview (SOU, 1983) were also asked about their main reason for seeking an abortion. Since the incidence of birth defects increases with maternal age (e.g. Forbes, 1997), we may ask whether the high incidence of induced abortion in older mothers was due to birth defects (e.g. as discovered by amniocentesis). In the four age groups covering the span 25–44 years, only 1% or 2% of the women gave birth defect as the main reason for their abortion. In the oldest age group, no one mentioned this as a reason.

So what was the main reason given for seeking an abortion? In the youngest groups, the most common reasons were socio-economic or insecurity within a relationship. In the age group 35–39 years, the most common reason given was family planning (24%), but as many as 18% in this age group stated "too old" as the main reason. In the two oldest categories, 57% and 65%, respectively, reported "too old" as the main reason for seeking an abortion.

Surely, parental investment is modulated by a number of factors, one of them being age. Although it cannot be excluded that women respond differently to a foetus than to a newborn child, this study questions the generality of the idea that older mothers should be less likely to terminate investment in a new child. The material presented here is more indicative of a pattern where abortion ratio is an inverse function of fertility, where investment in new reproduction is gradually reduced as a woman approaches menopause. If grandmothering has been an important driving force in human life history evolution (Hawkes, O'Connell, Blurton Jones, Alvarez, & Charnov, 1998), such a pattern might indicate that the transition from behavioural investment from one's own children to one's grandchildren is a gradual process analogous to ovarian function, which is known to decline gradually (Judd & Fournet, 1994; te Velde, Scheffer, Dorland, Broekmans, & Fauser, 1998). Evidence for this idea could come from testing the effect of existing children of various sex and age on the likelihood of abortion by a pregnant woman. We predict that the grandmothering path would be more effective where women have existing children who have reached at least their teens. The sex of existing children may play a role in the abortion decision if grandmothers typically invest more in their daughters' than in their sons' children, or vice versa. However, the fact that the incidence of abortion increases also in older women without previous children indicates that the abortion decision may sometimes be independent of a woman's present nuclear family size.

The fact that age-related abortion statistics from Sweden as well as from other European countries and the United States (SOU, 1983; Zimmerman, 1977) tend to show a U-shaped pattern, indicates that the phenomenon is widespread. However, to find out whether this is indeed the case, more studies that control for the number of previous children and factors such as marriage should be conducted, preferably from a wide range of cultures. Preliminary analyses of abortion and parity data from the United States in the 1980s exhibit a pattern similar to that found in the present paper (Hogård & Tullberg, unpublished data).

Acknowledgments

We thank Gabriella Gamberale-Stille, Juha Merilä, and Andy Russell for valuable comments on an earlier version of this manuscript. This study was financed by The Swedish Natural Science Research Council and The Academy of Finland.

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