

Inheritance of fertility is of importance for both the general understanding of kin-relations and the transmission of demographic behaviour. Previous research indicates that there is a consistent transmission of fertility between generations. This transmission can be characterized as moderate, significant and growing with time (for example Anderton et al 1987, Murphy 1999 and Murphy & Knudsen 2002). The research has however been concerned with the nuclear family only. This study aims to extend previous research by also including the effect of grandparents' and parents' siblings' fertility. The use of high quality Swedish register data is an opportunity to link large numbers ($N \approx 558\,000$) of individuals and trace the reproductive histories of extended kinship networks.

Sweden is an individualistic and gender equal welfare state with low income inequalities. Kin networks and kin support have to some extent been "crowded out" by individualistic values and government support. Intergenerational effects outside the nuclear family in Sweden are most likely on the low side compared to most contemporary developed and developing countries.

Sociological and evolutionary frameworks on intergenerational transmission

Sociological research consistently suggests that the subjective closeness and contact with maternal kin is stronger than that of paternal kin in contemporary western societies (Young 1957, Uhlenberg & Hammill 1988). Financial support has also been shown to be stronger for maternal kin (Pollet et al 2009.) A reasonable assumption is that inherited patterns in fertility should be associated with contact and parental investment from kin. If theories on females as 'kin-keepers' are correct the effect on fertility from maternal kin should be stronger, due to values related to family life in society, childhood socialization and more contact with matrilineal kin at adult ages.

Genetic inheritance of fertility is a controversial subject. Population genetics implies that fertility due to its central role for reproductive success should be optimized by evolution and individual differences ought to be relatively small (Fishers theorem). Following this most researchers in demography, sociology, biology and evolutionary anthropology/psychology have focused on societal and not on genetic explanations of intergenerational patterns in fertility. However, this has been questioned in some recent research (for example Kohler et al. 1999). The maternal bias in parental investment observed in sociological research has also been explained by evolutionary theories on human behavior (Coall & Hertig 2010), due to paternity uncertainty and/or sex-specific reproductive strategies.

If fertility behavior is inherited genetically which has been suggested by some authors the mechanism of inheritance is of relevance for the short term intergenerational transmission. If the source of inherited fertility mainly is the result of (female) reproductive physiology one would expect the observed inheritance to be stronger along maternal lines than along paternal lines. If instead the inherited patterns are unrelated to the physiology of the reproductive systems and instead relate to genetic intergenerational effects in, for example, appearance, overall health status, preferences for union formation or socioeconomic success, which in turn affects fertility, the intergenerational transmission should be less dependent on the sex of the kin.

Design of study & research question

I have used event history techniques (piecewise exponential proportional hazard models) to study the transition to first, second and third birth for my index population using separate models for males and females. Using Swedish register data the parent of any child can be linked for the entire population back to individuals born in the early 1930s and through these connections extended kinship networks for the entire population can be constructed. Using this data I can reconstruct the completed fertility of kin and its effect on current fertility can be estimated using the event history models. The data consist of the 1975-1988 cohorts born in Sweden which are followed until the end of 2007.

The aim of the study is to examine, a) if the strength of the transmission of fertility differs by the gender of the index-person, b) if the effect differs by parity and c) examine if matrilineal or patrilineal kin have similar or dissimilar effects on the transmission of fertility.

Sociological theories would suggest that matrilineal kin would be more important due to female's central role in family life in the contemporary west. Males would be expected to be less affected by this matrilineal advantage compared to females. The role of socialization would be most important for the transition to first birth. Evolutionary explanations would suggest stronger matrilineal effects due to higher investment/contact from females, it would also suggest that all effects should be stronger for female index persons. If there is a genetic component linked to (female) reproductive physiology this would also mean stronger effects for maternal kin. For both genetic and behavioral evolutionary explanations the magnitude of effects on fertility should be associated with the genetic relationship between kin.

Data

By means of Swedish population registers, individuals can be linked to parents, grandparents and aunts and uncles. The large size of the population avoids problem associated with small samples and creates opportunities to detect also relatively weak transmissions from kin outside the nuclear family. The model use the completed fertility of kin on an individual basis (i. e. including children from multiple unions) of parents, grandparents and parents' siblings as well as the year of birth of grandmothers to control for period effects. Union stability was still high in Sweden before the 1970s. Thus using data on only the female in a union (i. e. having data on completed fertility of mothers and grandmothers) is a reasonable approximation of both parents completed family size. Because an individual's parents can have several siblings I use the mean completed fertility of all siblings of one sex in one lineage. I control for age, period and the birth year of the grandmothers in all models.

Results

I have modeled the transition to first, second and third birth for males and female index person's separately in six different models. The results in Table 1 below correspond to the increase in hazard (relative risks) for the transition to first, second and third birth caused by the increase in completed fertility by one for each category of older kin. Females consistently have stronger transmission from kin than to male index persons. For both males and females

the effect of kin on transition to first birth is stronger than later transitions, the effect is stronger for 3rd birth than 2nd birth.

Table 1: Relative Risks per child born by category of kin

Females				Males			
	1st birth	2nd birth	3rd birth		1st birth	2nd birth	3rd birth
Mother	1.21	1.05	1.13	M	1.13	1.07	1.12
Mother's Mother	1.13	1.00	1.01	MM	1.06	0.97	1.05
Mother's Sister	1.00	1.01	0.97	MS	1.06	1.02	1.00
Mother's Brother	to be est.	to be est.	to be est.	MB	to be est.	to be est.	to be est.
Father's Mother	1.13	1.00	1.00	FM	1.05	1.01	1.02
Father's Sister	1.01	1.02	1.02	FS	1.04	1.00	1.04
Father's Brother	to be est.	to be est.	to be est.	FB	to be est.	to be est.	to be est.
N=111 728 (1st birth)				N=118 048 (1st birth)			
In these early models I have used a 20% sample. The models control for duration to next birth (baseline time), age, period and year of birth for grandparents. p<0.05 for all variables							

Parents' fertility has a strong effect for all transitions but it is of particular importance for becoming a parent. There is a significant effect of both maternal and paternal grandparents' fertility for the transition to first birth but no effect for later transitions. Uncles/aunts fertility also has an impact on the transition to first birth but not for later transitions. The effect of maternal and paternal lines is of similar strength for most types of kin, suggesting only minor asymmetry on kin effects and the transmission of fertility. Male index persons have weaker transmission rates from both parents and grandparents compared to females. Surprisingly, for males the various maternal effects are stronger than the paternal effects. Males also have an independent effect of parent's siblings' fertility in contrast to female index persons.

Conclusions

The strength of fertility transmission is stronger for female index persons than for males (in particular for the first birth) supporting the importance of females as kin-keepers in contemporary Sweden. The strong findings on the timing of first birth suggest that both sociological and possible genetic transmission of fertility is mainly linked to becoming a parent. Most couples in Sweden quickly have a second child after their first birth which likely explains the weak effects of kin on second birth. For the risk of a third birth there once again is a strong effect of fertility from the parents but other kin show no effects. The findings of comparable transmission from paternal and maternal grandmothers for first birth have implications for sociological and evolutionary theories on kinship.

The results above imply that; a) sociological theory on females as kin-keepers are supported by the generally stronger kin effects females experience compared to male index persons, b) early childhood socialization, female "kin-keeping" and evolutionary theories all suggesting increased contact/closeness/investment from maternal grandmothers is not reflected in patterns on inherited fertility, c) sources of inherited fertility might, instead of earlier

mentioned sociological/evolutionary explanations, be due to socioeconomic structures in kinship or intergenerational transmission of other yet to be determined factors, d) there is no significant inheritance of female physiology/fecundity affecting fertility, e) the explanations in c) may possibly be due to genetically inherited factors affecting some inherited characteristic linked to reproductive success and not female reproductive physiology. This is however impossible to infer from this study.

The results call for more research on inherited fertility beyond the nuclear family. The results are statistically robust and the findings shed new light on earlier findings on the transmission of fertility. Future research would gain from examining socioeconomic structures in kinship that could explain the observed patterns in fertility. Research focusing on residence and proximity of kin and fertility would also improve the understanding of these mechanisms of transmission.

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