



# SES differences in marital fertility widened during the fertility transition—evidence from global micro-level population data

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## Abstract

The decline in human fertility during the demographic transition is one of the most profound changes to human living conditions. To gain a better understanding of this transition we investigate the association between socioeconomic status (SES) and marital fertility in different fertility regimes in a global and historical perspective. We use data for a large number of women in 91 different countries for the period 1703–2018 (N = 116,612,473). In the pre-transitional fertility regime the highest SES group had somewhat lower marital fertility than other groups both in terms of children ever born (CEB) and number of surviving children under 5 (CWR). Over the course of the fertility transition, as measured by the different fertility regimes, these rather small initial SES differentials in marital fertility widened, both for CEB and CWR. There was no indication of a convergence in marital fertility by SES in the later stages of the transition. Our results imply a universally negative association between SES and marital fertility and that the fertility differentials widened during the fertility transition.

**Keywords** SES · Child–woman ratio · Marital fertility · Fertility transition

**JEL classification** J13

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## Introduction

Understanding the global fertility transition has been one of the main research tasks in demography. An important part of this research has focused on socioeconomic differences in fertility in a broader sense. The importance of women's education has been at the forefront of this research (Bongaarts 2003; Caldwell 1982; Castro Martín and Juárez 1995; Cleland 2002; Jejeebhoy 1995; Schultz 1997), even though there has also been studies on fertility differentials by other dimensions of socioeconomic status (SES), often occupation or wealth.

SES differentials in fertility are important for a number of reasons. On a more general level, they tell us something about the living conditions of men and women in different groups in society. Exactly what they tell us is, however, highly context-dependent. In some contexts, high (male) fertility reflects high status and living standards (see Skirbekk 2008), while in other contexts it may reflect low standards of living and insecure living conditions, or possibly lack of agency and control over living conditions. SES differences in fertility could also be important for socioeconomic mobility and stratification through SES-specific human capital investments in children (Blake 1989) and by affecting the social structure of the population with implications for socioeconomic inequality (Mare 1997, 2011; Mare and Maralani 2006). Moreover, fertility differentials by SES, and how they evolved over the fertility transition, are important to fully understand the causes of the fertility decline; one of the most important discontinuities in human history (Dribe et al. 2017).

The conventional wisdom seems to be that the SES differences in fertility reversed during the fertility transition: i.e., the upper classes had higher fertility prior to the transition, and lower fertility after the transition (Clark and Hamilton 2006; Cummins 2013; Skirbekk 2008). This change has been explained by the higher-status groups acting as forerunners in the decline (Haines 1989; Livi-Bacci 1986). More recent studies of historical Western populations have, however, questioned the universality of high marital fertility for high-status groups before the transition, while at the same time confirming that the high-status groups were forerunners in the transition (e.g., Dribe et al. 2014, 2017; Dribe and Scalone 2014). Earlier and more universal marriage in higher-status groups could have contributed to higher completed fertility in these groups, but was not generally a result of higher marital fertility.

Even though some previous studies analyzed SES differentials in fertility in individual countries or comparing a group of countries (e.g., Rodriguez and Cleland 1981), there has not been much research taking a broader comparative perspective on this issue across both time and space. An important exception is Skirbekk (2008), who aimed at such a long-term comparison in a meta-analysis of previous studies and using data from the Demographic and Health Surveys (DHS), the Family and Fertility Survey (FFS) and the World Value Survey (WVS). In this study most of the analysis was made comparing fertility of high-status and low-status groups in the different samples to get an idea of how the differentials developed globally from pre-transition to post-transition.

We extend this research by looking at SES differentials in fertility in a global and historical perspective. Our aim is to establish the basic patterns across a wide range

of contexts, spatially and temporarily. The analysis is based on nation-wide micro-level census data from IPUMS for 91 countries covering the period 1703–2018 ( $n = 116,612,473$ ).

We measure SES by husband's occupation, which is more universally available across countries and periods than either education or income. The class scheme used captures different life chances of people more broadly, related to both economic power and prestige (Erikson and Goldthorpe 1992; Van Leeuwen and Maas 2011). It measures basic differences in living standards, but also differences in attachment to formal labor markets, costs and benefits of children, exposure to external influences and other factors of importance for fertility decisions. The stage of the fertility transition is indicated by fertility regime, defined based on the total fertility rate (TFR) in the country and year of the census.

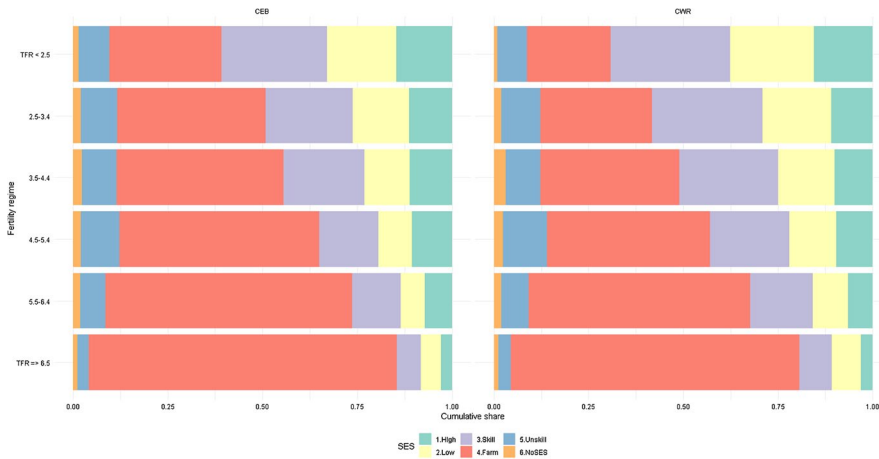
We use two measures of marital fertility, the Child–Woman Ratio (CWR) defined as the number of children under 5 to married women aged 15–54 in the census, and the number of children ever born (CEB) to married women aged 45–54. The CEB is a measure of completed fertility and the CWR is a measure of net marital fertility and is determined by both number of children born and infant and child mortality. Historical censuses, in particular, often lack information on CEB and in the analysis of such contexts we rely on CWR. Supplementary Tables S1–S4 show the means and distributions of CWR and CEB by SES and fertility regime in the different analytical samples. Supplementary Tables S10 and S11 show the absolute and percentage distributions of the selected women for the different analytical samples by country and fertility regime. Considering the pre- and early-transition phases, most of the selected cases were located in Central and Southern America, South-East Asia, and Africa, whereas for the late- and post-transition regimes the main part of the women lived in Northern America, Europe, and China.

Figure 1 displays the SES distributions by fertility regime for women in the main samples for CEB and CWR, respectively. Supplementary Tables S5 and S6 also show the distributions of all women by fertility regime, and demonstrate the dominance of being in transition or in post-transition, while only a small share of the sample refers to the pre-transition regime.

## Data and methods

### IPUMS data

We relied on census microdata from IPUMS ([www.ipums.org](http://www.ipums.org), Kugler and Fitch 2018). Some of the IPUMS databases comprised of only a sample of the census, while others were full count and included all individuals enumerated. These census databases provided a large set of data on harmonized and uniformly coded demographic and socioeconomic variables. Harmonized sample designs, consistently constructed variables, and uniform variable coding greatly facilitated the analysis and the possibility of comparing fertility differentials by SES across space and time at a global level (Kugler and Fitch 2018; Ruggles 2014; Ruggles et al. 2015).



**Fig. 1** Distribution of women by fertility regime and SES in the CEB and CWR analyses (CEB:  $n = 11,372,584$ ; CWR:  $n = 116,612,473$ ). See Supplementary Tables S3–S4 for number of women in each fertility regime and in each SES group

The collected datasets covered a period from 1703 to 2018. It should be noted that only two censuses were available before 1800 (Iceland 1703 and Denmark 1787). Data between 1703 and 1911 came from the North Atlantic Population Project, which is part of IPUMS, covering Canada, Denmark, Germany, Iceland, Norway, Sweden, United Kingdom and the United States (Ruggles et al. 2011). Data between 1960 and 2018 came from IPUMS International and covered countries from all world regions. Finally, we used the census samples for the United States in 1900, 1910, 1920, 1930, 1940, and 1950 from IPUMS USA.

We included all IPUMS samples with information on the number of own children under age five in the household and husband's occupation. In the end, we restricted our main analysis to 314 census samples from the IPUMS collections covering a period from 1703 and 2018, covering 91 countries (Supplementary Table S9). We included more than 116 million married women (or in a union) between age 15 and 54, taking into account more than 75 million children under age 5.

### Indirect fertility measure

The main disadvantage with census data is the cross-sectional perspective. Furthermore, many of the IPUMS samples lacked information to compute standard (age-specific) fertility rates, because they did not contain records of births, but only of the children present in the family. All censuses included in the analysis had information about the number of surviving children present in the household at the time of the census. We used this information to calculate the child–woman ratio (CWR). The CWR has traditionally been defined as the number of children aged 0–4 per 1,000 women aged 15–54 (Shryock and Siegel 1976). Because age distributions are commonly available in aggregate census reports, most cross-sectional studies of fertility considering socioeconomic conditions in historical populations have relied on

CWRs (see, e.g., Haines 1979). The children under age five were born during the five years before the census when the women were up to five years younger. The CWR can be viewed as a measure of net fertility (i.e., fertility adjusted for mortality in the first five years of life). In many ways, this is a more informative measure of fertility, as we expect that the families cared more about the number of surviving children than the number of births. Previous research has documented that SES differentials in marital fertility in historic Sweden were large enough to be robust to probable SES differentials in infant and childhood mortality (Dribe and Scalone 2014; Scalone and Dribe 2017). Furthermore, since the fertility transition was a decline not only in marital fertility but also in the number of children surviving, our focus on net fertility also makes substantive sense.

In addition to the number of children under five, some censuses included information on children ever born. We used this information to analyze completed fertility for about 11 million women aged 45–54 considering 51 million children ever born. This is a direct measure of fertility and the comparison between CEB and CWR gave valuable information about the robustness of the results based on CWR.

### SES classification

Occupational titles were used to define socioeconomic status (SES). Information on individual occupational class was registered in the microdata (OCCISCO) according to a modified IPUMS version of the International Standard Classification of Occupations scheme for 1988 (ISCO88). In the case of multiple occupations, OCCISCO related to the occupation in which a person spent more time or earned more.

The OCCISCO was classified in the following categories: (1) Legislators, senior officials and managers; (2) Professionals; (3) Technicians and associate professionals; (4) Clerks; (5) Service workers and shop and market sales; (6) Skilled agricultural and fishery workers; (7) Crafts and related trades workers; (8) Plant and machine operators and assemblers; (9) Elementary occupations; (10) Armed forces; (11) Other occupations, unspecified.

The census samples from IPUMS USA did not include OCCISCO standard but the more detailed 1950 Census Bureau occupational classification system (OCC50). We created a transcode table to convert the OCC50 codes into the OCCISCO scheme, based on the information from the 1880 census in the IPUMS USA which included both the OCC50 and the OCCISCO variables.

We grouped the OCCISCO categories into the following SES classes: “Higher managers and professionals” (OCCISCO 1–2), “Lower managers, professionals, clerical and sales personnel” (3–5 and 10), “Skilled workers” (7 and 8), “Farmers and fishermen” (6), “Unskilled workers” (9), and No SES (11). The SES of married women was based on their husband’s SES.

Even though different SES positions did not mean exactly the same thing in different contexts, the basic characteristics of the groups are comparable across contexts. In general, those in higher occupations performed highly skilled, white-collar tasks, while farmers worked land owned by themselves or rented from larger land-owners or the state. Research on social stratification has shown that occupational

ranking (based on prestige) is remarkably similar across countries and over time (Hout and DiPrete 2006; Treiman 1977), which seems to imply that, at least in broader terms, occupation-based class schemes such as the one used in this study, capture important aspects of social stratification that can be compared across contexts. However, some details and specificities are always obscured when forcing diverse contexts into a common framework.

SES differentials in marital fertility were estimated for different fertility regimes. These regimes were defined based on the total fertility rate in the country and year of the census and categorized in the following way: less than 2.5 children per woman, 2.5–3.4, 3.5–4.4, 4.5–5.4, 5.5–6.4, 6.5 and higher (<https://www.gapminder.org/data/>; <https://data.worldbank.org/>). TFR over 6.5 is considered pre-transition, 5.5–6.4 early-transition, 4.5–5.4 mid-transition, 3.5–4.4 mid/late-transition, 2.5–3.4 late-transition, and less than 2.5 post-transition (see Bongaarts 2003 and Eloundou-Enyegue et al. 2017 for similar but not identical categorizations of transition phases). It should be noted that pre-transitional levels of total fertility varied considerably across time and space, which means that the categories labeled pre-transition and early-transition do not include any data points for pre- and early-transition Western countries (see Supplementary Table S9). In the sensitivity analysis, we estimate separate models for the historical and the contemporary samples to assess the impact of this classification problem on the overall interpretations.

## Analytical samples

The main analysis of net fertility (CWR) was based on 116.6 million currently married (or in union) women aged 15 to 54 from census samples registering the number of own children less than age 5 in the household and husband's occupation.

In the analysis of CEB, the sample was restricted to census years which included the information of children ever born ( $N=11.4$  million currently married women aged 45 to 54 with spouses present from census samples that report the number of children ever born).

Finally, we made a comparative analysis of CWR in the historical and contemporary samples for the early-transition, mid-transition, and mid/late-transition phases, which included 35.2 and 36.6 million women, respectively (71.1 million cases in total).

## Statistical modeling

Negative binomial regression models were estimated to assess the associations between SES and CWR/CEB, including random effects at the country level to account for unobserved national factors. The reason for choosing this model was that data were overdispersed, thereby violating the assumptions of the Poisson model. Robustness tests, however, showed high similarity between the results from the Poisson model and the negative binomial model. The `mgcv` R package was used for the statistical analyses, applying the `bam` command (Wood 2017) which allowed us to carry out the model estimation more efficiently given the very large dataset.

Results are reported as Incidence Rate Ratios (IRR), which are the exponentiated parameter estimates. The IRR is the estimated prediction of the number of children in the category relative to the reference category.

To control for several possible explanatory variables, the model also adjusted for individual characteristics. We included a basic control for women's age as it generally impacts on female fecundity. The following age groups were included: 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54. Since marital fertility could be lower for couples in which husbands were much older than their wives, the models also adjusted for the age difference between the spouses (wife older than the husband, husband at least 2 years older than the wife, husband 3–6 years older, husband more than 6 years older). In the CWR analysis we also controlled for the presence of children over age 4 as an indirect indicator of a marriage duration longer than 4 years. The census year categories were based on the following time intervals: 1700–1799, 1800–1849, 1850–1899, 1900–1954, 1955–1964, 1965–1974, 1975–1984, 1985–1994, 1995–2004, 2005–2014, 2015–2018.

### Handling missing data

We restricted the analytical sample to only include the cases with non-missing information on occupation and age of the husband. When analyzing complete fertility, we further excluded cases with missing information on children ever born. In the sensitivity analysis adjusting for educational attainment, cases with missing information on educational attainment were also excluded.

Complete information is available for the number of own children under age five, the presence of children over age four, age of woman, and census year. For some census samples (Ireland 1971, 1979, 1981, 1986, 1991, 1996, 2002, 2006, Italy 2001, Palestine 1997, Slovenia 2002), it was not possible to calculate the age difference between spouses as the data did not include the necessary age distribution by single years, but an already aggregated one. In these cases, age differences between spouses were defined as no age difference.

### Sensitivity analysis

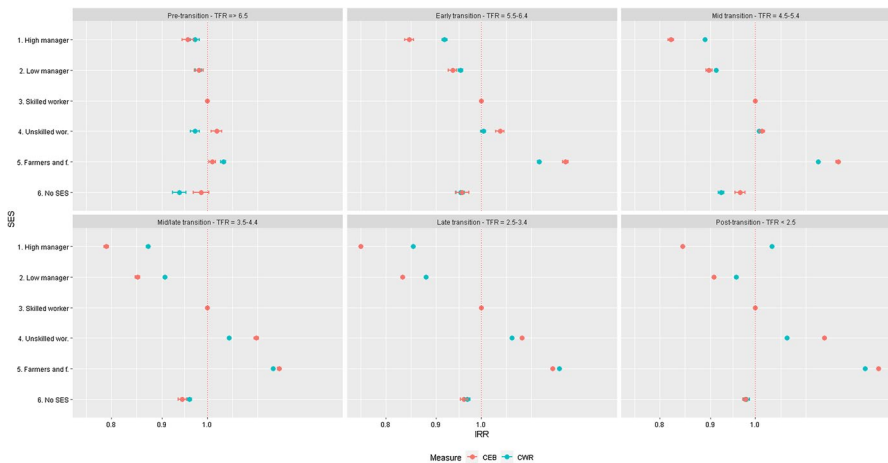
In additional models, we assessed the robustness of the main results to the adjustment for women's education, a variable that has often been the focus of analysis of fertility differentials. As not all the microcensus data reported the information on educational attainments, the analysis was further restricted to only the IPUMS International samples which provided information on the woman's educational attainment ( $N = 79.2$  million women aged 15–54 for the CWR analysis and  $N = 10$  million women aged 45–54 for the CEB analysis). According to the IPUMS standard, the information on woman's educational attainment was coded in terms of the level of schooling completed (less than primary school, primary school, secondary school, and university).

One potential problem, as previously mentioned, is the different levels of pre-transitional fertility in Western and developing countries, which lead to

misclassification of samples in the fertility regimes, e.g., that pre-transition Western populations were defined as early- or mid-transition. To assess the importance of this problem for our overall interpretation, we compared the SES patterns in CWR by fertility regime in historical samples (1920 and before) and contemporary samples (after 1920).

## Results

The overall patterns for CEB and CWR were similar, but not identical (Fig. 2, Supplementary tables S7–S8). In the pre-transition period (TFR > 6.4) there was a weak SES gradient in CEB, and no gradient in CWR, although farmers and fishermen had higher marital fertility. In the early-transition period (TFR 5.5–6.4) the SES differences had widened considerably for both CEB and CWR. In the mid-transition regime (TFR 4.5–5.4) the SES differences had widened further, but then remained fairly constant in subsequent regimes. From mid/late-transition (TFR 3.5–4.5) to post-transition (TFR < 2.5) higher managers and professionals had IRR for CEB of about 0.8 (0.755–0.843) with skilled workers as the reference category (IRR = 1.000) and the unskilled workers had IRR about 1.1 (1.100–1.175). In other words, the unskilled workers had about 40% higher CEB than the higher managers and professionals in contexts from mid/late-transition to post-transition (39%–46%), while the difference was only about 7% in the pre-transition period (IRR = 0.957 for higher managers and professionals and 1.023 for unskilled workers).



**Fig. 2** Incidence Rate Ratios (IRR) from random effects negative binomial regression models for CWR and CEB in the main samples (CEB:  $n = 11,372,584$ ; CWR:  $n = 116,612,473$ ). 99% confidence intervals are marked. Models are adjusted for age of woman, age difference between spouses, census years and number of children over age 4 present in the census. Random effects are at country level. Married/In union women aged 15–54 years for CWR and aged 45–54 for CEB. See Supplementary Tables S7 and S8 for the full set of model estimates



Looking more specifically at differences between CWR and CEB, the SES differences were in most cases smaller for CWR than for CEB, and especially the lower fertility for the highest SES group was not as accentuated for CWR as for CEB.

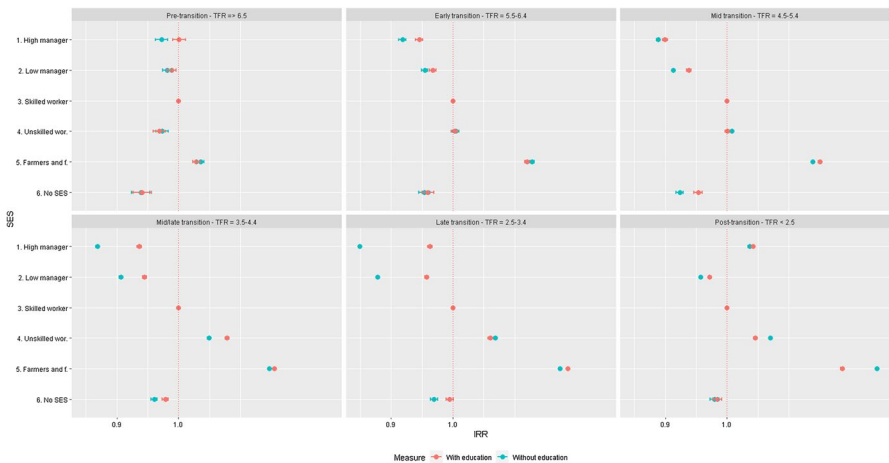
The pattern in the SES differentials across fertility regimes did not change much when the models were adjusted for educational attainment of women (Figs. 3, 4). The sample size was reduced due to missing information on education in many censuses ( $N=79,202,087$  for CWR and  $10,007,270$  for CEB). The SES differences, net of educational attainment, were minor without a clear pattern in the pre-transition regime, but then grew progressively in subsequent fertility regimes.

Looking at a comparison of CWR between historical (census before 1920) and contemporary (census 1920 and later) contexts within the same fertility regime revealed highly similar patterns (Fig. 5). There was an approximately linear inverse relationship between SES and net marital fertility in all fertility regimes, and in both historical and contemporary contexts.

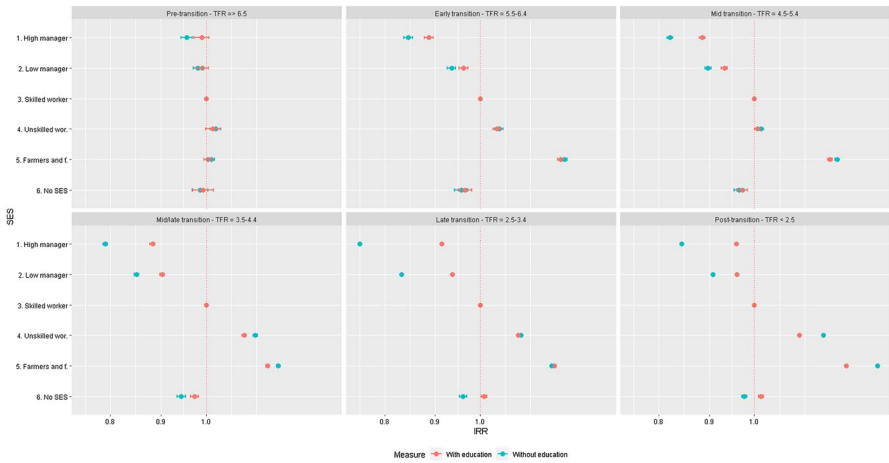
## Discussion

Understanding the long-term development of SES differentials in human reproduction is of great importance not only for explaining the fertility transition, but also to gain better knowledge of the long-term population development as well as of inter-generational socioeconomic mobility and inequality.

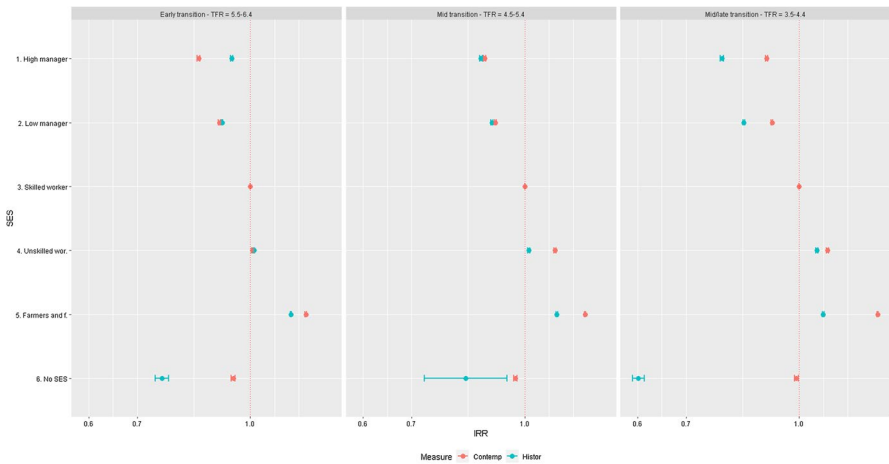
Here we investigated fertility differentials by SES in a global and historical perspective, using data for more than 116 million women in 91 countries over the



**Fig. 3** Incidence Rate Ratios (IRR) from random effects negative binomial regression models for CWR in the sensitivity samples, with and without adjusting for educational attainment ( $n=79,202,087$ ). 99% confidence intervals are marked. Models are adjusted for age of woman, age difference between spouses, census years and number of children over age 4 present in the census. Random effects are at country level. Married/In union women aged 15–54 years. See Supplementary Tables S7 and S8 for the full set of model estimates



**Fig. 4** Incidence Rate Ratios (IRR) from random effects negative binomial regression models for CEB in the sensitivity samples, with and without adjusting for educational attainment ( $n = 10,007,270$ ). 99% confidence intervals are marked. Models are adjusted for age of woman, age difference between spouses, census years and number of children over age 4 present in the census. Random effects are at country level. Married/In union women aged 45–54 years. See Supplementary Tables S7 and S8 for the full set of model estimates



**Fig. 5** Incidence Rate Ratios (IRR) from random effects negative binomial regression models for CWR in the historical (before 1920) and contemporary samples (Historical samples:  $n = 35,155,313$ ; Contemporary samples:  $n = 36,578,178$ ). 99% confidence intervals are marked. Models are adjusted for age of woman, age difference between spouses, census years and number of children over age 4 present in the census. Random effects are at country level. Married/In union women aged 15–54 years. See Supplementary Tables S7 and S8 for the full set of model estimates

period from 1703 to 2018. Our findings did not support the hypothesis that marital fertility was higher in high-SES groups before the fertility transition. In the pre-transitional fertility regime the highest SES group had somewhat lower marital fertility than other groups both in terms of children ever born (CEB) and number of surviving children under 5 (CWR). Over the course of the fertility transition, as measured by the different fertility regimes, these rather small initial SES differentials in marital fertility widened, both for CEB and CWR. Similar findings were made in a recent comparative study of SES differences in Western fertility transitions at the turn of the twentieth century (Dribe et al. 2017). There was no indication of a convergence of the SES differences in marital fertility in the later stages of the transition, or even after the transition was completed.

There are several reasons why our findings deviated from some previous findings of high fertility for high-SES groups in some Western pre-transitional contexts. First, there might have been an earlier fertility decline among the elites in Europe, which we did not capture as it occurred before our earliest census (1703). European elite groups often showed declining fertility well before such change was apparent in the general population, which was connected at least partly to urban residence (Bardet 1990; Clark and Cummins 2015; Livi-Bacci 1986; Perrenoud 1990). Second, there may have been a smaller elite group with a highly deviant behavior, which was masked by our more aggregate categories, similar to the nobility in pre-transitional Europe. Third, the higher fertility for the elite could have been a result of higher nuptiality in this group in historical Western Europe (earlier marriage, lower rates of celibacy, and higher frequency of remarriage) leading to greater numbers of children born for the high-status groups. Pre-industrial Western Europe had a distinctive (Malthusian) marriage pattern in which access to, and timing of, marriage was closely connected to economic circumstances (Hajnal 1965; Wrigley and Schofield 1981).

From a theoretical point of view, a decline in marital fertility requires that people are *ready*, *willing*, and *able* to limit family size (Coale 1973; Lesthaeghe and Vanderhoeft 2001). Family limitation must be viewed as advantageous by the families from both an economic and social perspective (*ready*), which would lower their demand for children. The demand for children depends on family income and the cost of children in relation to other goods that are directly related to SES. Especially the value of women's time is important as it is a major determinant of the opportunity costs of children in most societies (e.g., Schultz 1997). Following the process of development (e.g., industrialization, urbanization, and modernization in a wider sense), the motivation for childbearing change, and this can be expected to affect SES groups differently. On the one hand, higher consumption aspirations among high-status groups increase opportunity costs of childbearing and therefore contribute to a lower demand for children. On the other hand, because children could help working in the fields or assisting in supplementary activities from a relatively early age, the economic benefits of children may be higher among low and middle class families in rural contexts, i.e., among farmers and agricultural laborers. This could partly explain the delayed fertility decline in these groups.

A low supply of children due to high mortality also contributed to the high level of pre-transitional fertility (Easterlin 1975; Easterlin and Crimmins 1985). Following

the mortality decline, which in most contexts preceded fertility decline, the supply of children increased, which most likely contributed to the decline in marital fertility in the West, even though it is challenging to estimate the effect empirically (Haines 1998; Reher 1999; Reher and Sanz-Gimeno 2007; Reher et al. 2017; Schultz 1997). The high degree of similarity of our findings for CWR and CEB suggests that mortality decline should not be overemphasized when explaining the widening of the SES differentials in marital fertility.

To the extent that economic development increases the returns to education, demand for child quality can be expected to increase as well (Becker 1991; Schultz 1997). Larger family size could imply a dilution of resources—parental time and money—available for investments in children’s human capital, which in turn would hamper children’s chances of upward social mobility (Blake 1989). This association should lead families to substitute quality for quantity by having fewer children and investing more in each child. In economic models, this quantity–quality trade-off is a major explanation of fertility decline and a strong contributor to the transition to modern economic growth (Galor 2011).

We would expect the quantity–quality trade-off to emerge in the white-collar groups first, partly because of higher returns to education and partly because of better knowledge and information concerning the new social and economic conditions. In the urban working class, children’s labor contribution remain important for longer and may have delayed their fertility decline. Empirical studies of historic Western contexts have also confirmed that smaller family sizes in the demographic transition became increasingly associated with socioeconomic upward mobility for children (Bras et al. 2010; Van Bavel 2006; Van Bavel et al. 2011).

To be *able* to control fertility requires knowledge about contraceptive methods, which most research seems to assume had existed well before the fertility decline, though it is unclear to what extent such methods were actually practiced within marriage in Western societies (McLaren 1990; Santow 1995; Van de Walle 2000; Van de Walle and Muhsam 1995). It is important to note that the fertility transition in the Western world took place before the widespread introduction of modern contraceptives (David and Sanderson 1986; Szreter 1996, pp. 389–424; Szreter and Garrett 2000).

In the developing world the situation is quite different. Fertility decline has always been much more connected to contraceptive use than in the West, and family planning programs, including information about, and dissemination of, contraceptive devices has played an important role (Bongaarts et al. 1990; Cleland 2001; Hirschman 1994; Montgomery and Casterline 1993; Rosero-Bixby and Casterline 1993; Westoff et al. 1989). This larger role played by contraception in developing contexts, has also led to a strong focus on women and women’s education as important for the ability to control fertility. Literate, and better educated, women are expected to be more open to information about contraception and how to use it, and also better able to process such information and put the new methods to use (Castro Martín and Juárez 1995; Cleland 2002).

That people are able to limit fertility does not mean that they are *willing* to do so. This requires a change in attitudes, making it socially and culturally acceptable to practice contraception within marriage (Carlsson 1966; Cleland 2001; Cleland

and Wilson 1987; Lesthaeghe 1980; Lesthaeghe and Surkyn 1988). This process necessitates considerable social interaction in communities or networks that transcend geographical boundaries (Bongaarts and Watkins 1996; Casterline 2001; Garrett et al. 2001; González-Bailón and Murphy 2013; Kohler 2001; Montgomery and Casterline 1996; Szreter 1996). Innovation processes are often closely linked to SES with higher-status groups being innovators or early adopters, while lower-status groups are laggards (Rogers 1962). This is also consistent with the widening of the SES differences in marital fertility during the transition. Previous research on developing contexts has also confirmed a positive association between education and contraceptive use, as well as with the use of more effective modern methods (Castro Martín and Juárez 1995; Cleland 2002).

All three conditions—*ready*, *willing*, and *able*—need to be fulfilled in order to initiate fertility decline. This implies that the latest fulfilled condition determines the start of the transition (Lesthaeghe and Vanderhoeft 2001; Lesthaeghe and Neels 2002). The development of SES differentials over the course of the transition is consistent with this model. The small initial SES differences before the transition widened when marital fertility started to decline as vanguard groups began to limit family size, while others remained laggards (Bongaarts 2003; Eloundou-Enyegue et al. 2017; Rodriguez and Cleland 1981). More specifically, high-SES groups were fore-runners, followed by the mid-SES groups, and finally the low-SES and the farmers. These widening SES differences were quite independent of the educational status of the women, and were similar in historical and contemporary contexts.

Our study had a number of limitations. The wide range of contexts forced us to use quite broad indicators of SES and abstracting from much of the context specificities, which are necessary for a full understanding of the process. It can also be questioned if the social class scheme used is equally relevant for all contexts under study. We are confident that the class scheme captures important differences in living standards and social status across contexts even if they do not measure all aspects of stratification in individual societies.

As we used census data, the fertility measures were also quite crude but nonetheless indicated the broader differences in fertility behavior that are the focus of the study. A further limitation is the cross-sectional nature of the data, which did not allow a longitudinal analysis of the reproductive process.

## Conclusions

Our findings clearly contradict the view that high SES was associated with high marital fertility before the fertility transition. Instead, there was a weak negative relationship between SES and marital fertility also in the pre-transitional regime. Over the course of the fertility transition, as measured by the different fertility regimes, the SES differentials widened, and there was no indication of a convergence in marital fertility in the later stages of the transition. Indeed, also in the post-transition period, when TFR was below 2.5, we found a similar negative relationship between SES and marital fertility. These findings imply that there is a universal negative gradient in marital fertility with respect to SES under very different fertility regimes, which

in turn reflects fundamental differences in conditions related to childbearing, such as costs and benefits of children and attitudes and knowledge surrounding deliberate fertility control within marriage.

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**Author contributions** MD and FS conceived and designed the study. FS prepared the dataset and did the statistical modeling. MD and FS analyzed the data. MD wrote the main sections of the paper and FS wrote the method section and produced all graphs and tables. Both authors approved the final version.

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**Data availability** This research was conducted using publically available data from IPUMS (ipums.org; Minnesota Population Center 2019; Ruggles et al. 2020).

**Code availability** The R code used for preparing the dataset and for statistical analysis is available from FS upon request. A detailed description of the scripts is available in Supplementary Notes.

## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

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