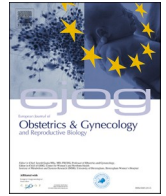


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Full length article



Parents' age and total fertility rate in selected high-income countries from Europe and North America, 1990–2020

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ABSTRACT

Objective: To provide a comprehensive picture of trends in parents' age and total fertility rate in selected most populous high-income countries from Europe and North America.

Study design: Data were retrieved from official statistics published by the United Nations, the World Bank, the European Union (EU), and by national health statistics offices.

Results: Mean maternal age at birth showed increasing trends in all considered countries; in 2020, the highest mean age was observed in Italy (32.2) and Spain (32.3), and the lowest one in the USA (28.8). Mean maternal age at first birth also showed upward trends. In the 1990s, mean age at first birth ranged from 25.5 to 26.9 years, except for the USA where it was below 25 years. The countries with the highest average maternal age at first birth were Italy and Spain, reaching 31 years over the most recent years. Data on mean paternal age at birth were scant. In Germany (2019) it was 34.6 and in the USA (2014) 27.9 years. In Italy, mean paternal age increased from 34.2 in 2000 to 35.5 in 2018, in the UK from 30.7 in 1990 to 33.4 in 2017, and in Canada, a decrease was observed from 29.1 in 2006 to 28.3 in 2011. Finally, Sweden and the USA had the highest fertility rates, around two children in some years, while Italy and Spain had the lowest ones, with less than 1.5 children over the whole period.

Conclusions: Monitoring of trends in reproductive factors is crucial to gain insight into society from a cultural and sociological point of view and to analyze the impact of these changes on reproductive health and related conditions.

Introduction

A woman's reproductive life course includes her age at menarche and menopause, the age at which she starts and stops having children and the number of children. These reproductive factors have relevant impact on diseases and conditions related to the endocrine system [1], as well as on the risk of hormone-related cancers, such as breast [2–5], endometrial [2,6–8], and ovarian cancer [2,9–13]. Since the incidence of some of these diseases is increasing, it is of interest to monitor the trends in reproductive factors.

Major changes in reproduction have occurred in high-income countries in Europe and North America in the last century. Average maternal and paternal ages at birth increased, family size decreased, and survival of very low birth weight infants increased due to advancements in

neonatal medicine [14,15].

Advanced maternal age represents a risk factor for female infertility, pregnancy loss, chromosomal abnormalities, stillbirth, and obstetric complications [16]. However, women are now delaying childbearing more than ever before. Paternal age has also increased, but the impact of advanced paternal age on reproductive risks has been poorly investigated [17].

To provide a comprehensive picture of trends in maternal and paternal age, age at first pregnancy, and total fertility rate (i.e., the average number of children per woman) in selected most populous high-income countries from Europe and North America, we summarized the data available in national and international databases on these trends.

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Table 1
Mean maternal age at any birth in selected countries and calendar year.

Year	Country										
	France	Germany	Italy	Spain	Denmark	Finland	Norway	Sweden	UK	USA	Canada
1990	28.3 ¹	–	28.9	28.9	28.5	28.9	28.1	28.6	27.7	26.4	27.8
1995	28.9	–	29.8	30.0	29.2	29.3	28.8	29.2	28.2	26.9	28.3
2000	29.4	28.8	30.4	30.7	29.7	29.6	29.3	29.9	28.5	27.2	29.0
2005	29.7	29.5	30.9	30.9	30.2	29.9	29.8	30.5	29.1	27.4	29.7
2010	30.0	30.4	31.3	31.2	30.6	30.2	30.1	30.7	29.5	27.7	30.2
2015	30.4	30.9	31.7	31.9	31.0	30.6	30.7	31.0	30.3	28.5	30.7
2020	30.8	31.3	32.2	32.3	31.4	31.2	31.4	31.3	30.6 ²	28.8	–

¹ France metropolitan; ² The last year available is 2018.

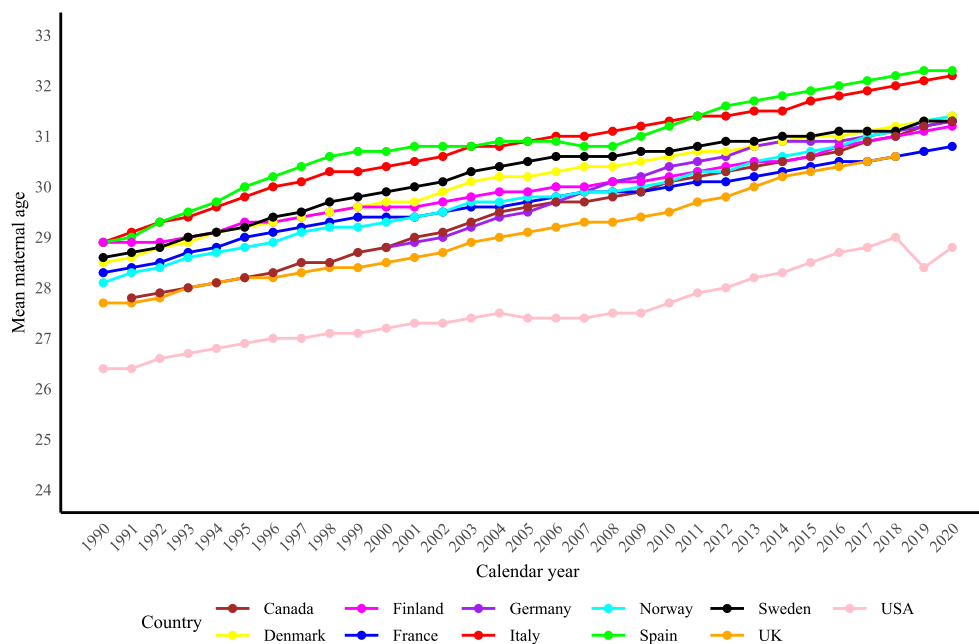


Fig. 1. Trend of mean maternal age at birth in selected countries, 1990–2020.

Methods

Data retrieval

We searched for official statistics published by the United Nations, the World Bank, the European Union (EU), and by national health statistics offices. In particular, we retrieved data from the following databases: Istituto Nazionale di Statistica (ISTAT) for Italy, European Statistical Office (Eurostat) for the other European countries, Centers for Disease Control and Prevention and the National Center for Health Statistics for the USA, Statistics Canada, and the United Nations Economic Commission for Europe (UNECE). We obtained the most recent available data and the range of years may vary from country to country.

Table 2
Mean maternal age at first birth in selected countries and calendar year.

Year	Country										
	France	Germany	Italy	Spain	Denmark	Finland	Norway	Sweden	UK	USA	Canada
1990	–	26.9	26.9	26.8	26.3	26.5	25.8 ¹	26.3	25.5	24.2	25.8
1995	28.1	28.1	28.0	28.4	27.3	27.2	26.4	27.3	26.1	24.5	26.4
2000	27.8	29.0	28.6	29.1	28.1	27.4	26.9	28.2	26.5	24.9	27.0
2005	28.5	29.6	29.6	29.3	28.8	27.9	27.7	29.0	27.2	25.2	27.5
2010	28.1	28.9	30.3	29.8	29.0	28.3	28.0	28.9	27.7	25.4	27.8
2015	28.4	29.5	30.8	30.7	29.2	28.8	28.9	29.2	28.7	26.4	28.7
2020	28.9	29.9	31.4	31.2	29.8	29.5	29.8	29.7	29.0 ²	27.0 ³	29.4 ³

¹ First year available is 1991; ² The last year available is 2018; ³ The last year available is 2019.

Total fertility rate is expressed as number of births among women aged 15 to 44, in the absence of consideration of cohort composition. The websites from which we retrieved the data for each country and reproductive factor considered are listed in [Supplementary Table S1](#).

Since the databases used in this study are publicly available, no ethical approval was required for the current analyses. No human participant was involved and the informed consent was waived.

Results

[Table 1](#) reports the mean maternal age at birth in the selected countries from 1990 to the most recent available data for each subsequent calendar quinquennium, corresponding data per single calendar

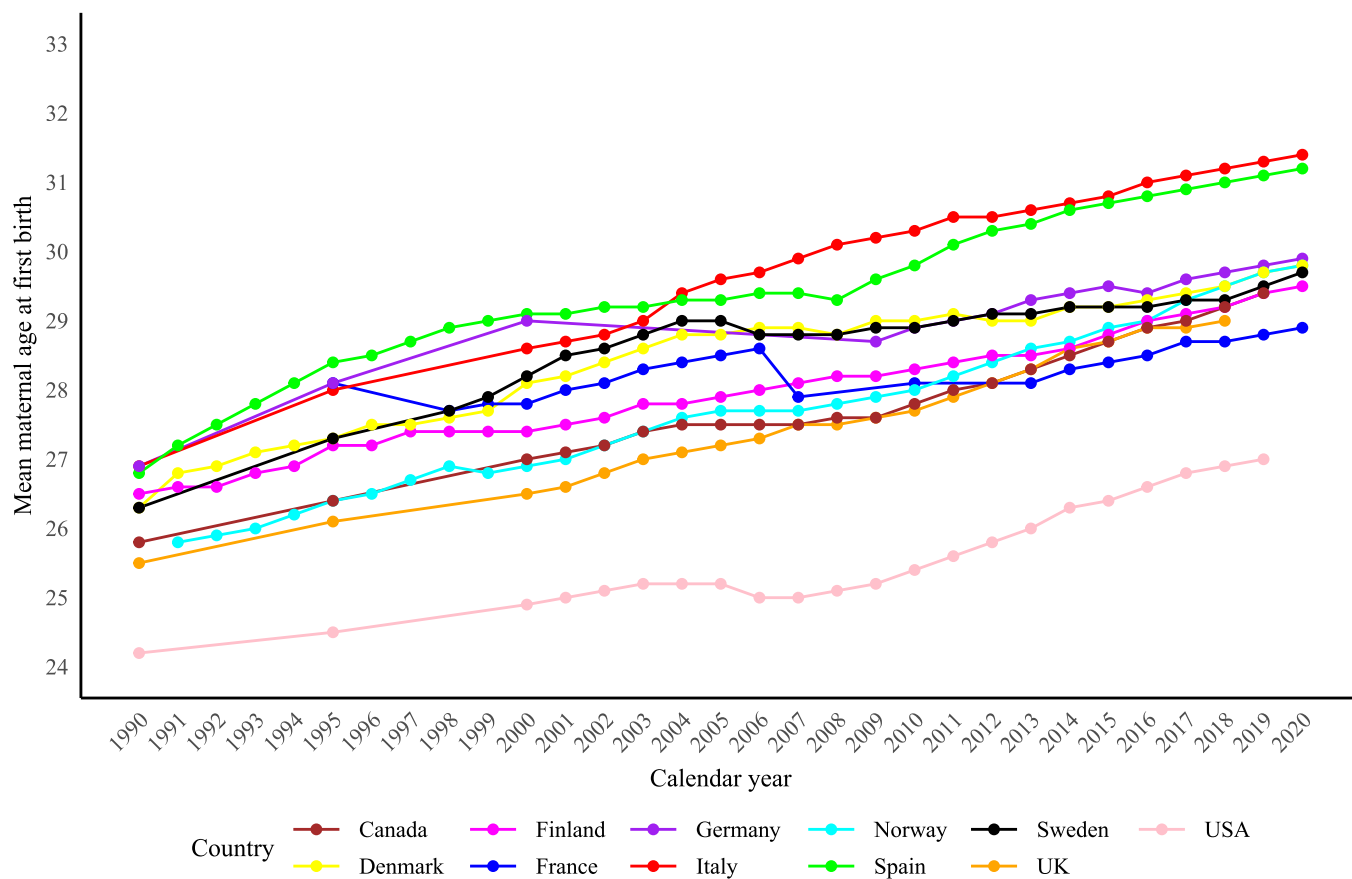


Fig. 2. Trend of mean maternal age at first birth in selected countries, 1990–2020.

Table 3

Mean paternal age at birth in selected countries and calendar year.

Year	Country				
	Germany	Italy	UK	USA	Canada
1990	–	–	30.7	–	–
1995	–	–	31.3	–	27.8
2000	–	34.2	31.7	–	–
2005	–	34.6	32.2	–	29.1 ⁴
2010	–	35.0	32.5	–	28.3 ⁵
2015	–	35.3	33.2	27.9 ³	–
2019	34.6	35.5 ¹	33.4 ²	–	–

¹ The last year available is 2018; ² The last year available is 2017; ³ The only year available is 2014; ⁴ The year available is 2006; ⁵ The last year available is 2011.

year are given in Fig. 1 and Supplementary Table S2. This information was available for the entire period under consideration for most countries except Germany and the USA. There was an increasing trend in all countries; in 2020, the highest mean age of mothers was observed in

Table 4

Total fertility rate (average number of children) in selected countries and calendar year.

Year	Country										
	France	Germany	Italy	Spain	Denmark	Finland	Norway	Sweden	UK	USA	Canada
1990	1.77	1.45	1.33	1.36	1.67	1.78	1.93	2.13	1.83	2.08	1.83
1995	1.74	1.25	1.19	1.16	1.80	1.81	1.87	1.73	1.71	1.98	1.67
2000	1.89	1.38	1.26	1.22	1.77	1.73	1.85	1.54	1.64	2.06	1.51
2005	1.94	1.34	1.34	1.33	1.80	1.80	1.84	1.77	1.76	2.06	1.57
2010	2.03	1.39	1.46	1.37	1.87	1.87	1.95	1.98	1.92	1.93	1.64
2015	1.96	1.50	1.35	1.33	1.71	1.65	1.72	1.85	1.80	1.84	1.60
2020	1.83	1.53	1.24	1.23	1.67	1.37	1.48	1.66	1.56	1.64	1.40

Italy (32.2) and Spain (32.3), and the lowest one in the USA (28.8). In the USA, maternal age at birth increased from 26.4 years in 1990 to 28.8 years in 2020, while it exceeded 30 years elsewhere in most recent calendar years.

Mean maternal age at first birth shows similar findings, and upward trend emerged in all countries. In the 1990s, the mean age at first birth ranged between 25.5 and 26.9 years, for most countries, except for the USA with a value below 25 years. The countries with the highest average maternal age at first birth were Italy and Spain, reaching 31 years over the most recent period. In the other countries, it gradually increased but did not reach 30 years (Table 2 by subsequent calendar quinquennium, Fig. 2 and Supplementary Table S3 by year).

Table 3 shows the mean paternal age (years) at birth in selected countries with available information and calendar years. In Germany, data were only available for 2019 (34.6 years) and in the USA only for 2014 (27.9 years). In Italy, paternal age increased from 34.2 to 35.5 years between 2000 and 2018. In the UK, it increased from 30.7 to 33.4 years between 1990 and 2017. In Canada, it was 29.1 in 2006 and 28.3 in 2011.

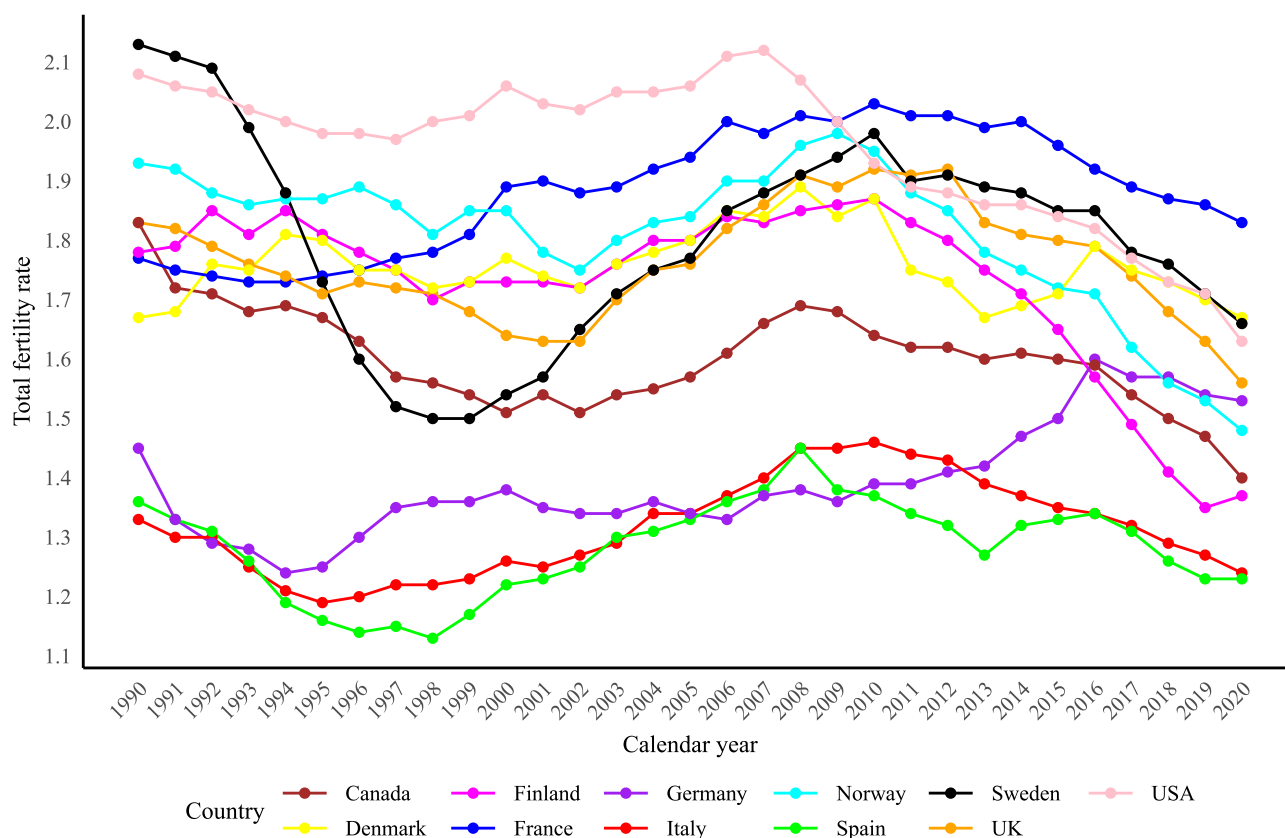


Fig. 3. Trend in total fertility rate (average number of children) trend in selected countries, 1990–2020.

Table 4 reports the total fertility rate every five calendar years, Fig. 3 and Supplementary Table S4 by single year. France, Sweden, and the USA reported the highest fertility rates, reaching on average two children in some years, while Italy and Spain the lowest ones, with less than 1.5 children over the entire period considered.

Discussion

We observed a linear and continuous increase in the average maternal age at birth and at first birth in all countries considered, as well as in paternal age, though data were scantier. Fertility rates also tended to decline, though with some exceptions. There were noticeable differences across countries, with Southern European ones showing the highest maternal ages and the USA a markedly lower one. In 2020 the lowest fertility rates were around 1.2 in Italy and Spain, and the highest one (1.8) in France.

Changes in human reproduction occurring in high-income countries reflect profound changes in the society. In particular, women tend to delay childbirth due to the pursuit of educational and career goals, and a lack of social services to support working mothers. Additionally, the increased divorce and remarriage rates, as well as the availability of assisted reproductive technologies, contribute to the growing number of late births.

Advanced maternal age was defined as over 35 years, due to the convergence of the increased risk for chromosomal anomalies. There is no universal definition of advanced maternal age and a different age limit could be determined for each adverse perinatal outcome [18]. Advanced maternal age represents a risk factor for female infertility, pregnancy loss, chromosomal abnormalities, stillbirth, and obstetric complications [16]. Moreover, advancing age is related to an increased risk of gestational diabetes [19] and hypertensive disorders [20]. Some of these conditions, such as chromosomal abnormalities, are now controlled by prenatal tests [21–23]. However, women aged 40 or over

have been reported to have favorable pregnancy and neonatal outcomes, not appreciably different to younger ones [24].

Delaying childbearing also resulted in older fathers. Female biological fertility declines with age due to a constant and substantial decrease in the number and quality of oocytes, while men continue to produce sperm throughout their lifespan, although their quantity and quality may decline. Advanced paternal age has been associated with infertility and other reproductive risks, even if this topic has been less studied [25].

Delaying childbirth involves a decrease in the number of children. The total fertility rate dropped drastically in many countries over the last decades [26]. Beyond the availability of family planning programs, the total fertility rate is also affected by cohort effects (not considered in the present work), level of education, social and religious status, and contraceptive use. All these aspects undergo strong changes over time and vary across countries.

The differences across countries may at least in part be influenced by different investments in family policies, as well as to the type of implemented family policies. In Europe, family policy spending was above 3 % of the gross domestic product (GDP) in the Nordic countries, France, Great Britain, and some Eastern European countries, while in some Southern Mediterranean countries it was below 2 % of the GDP [27]. Different types of family policies may have differential effects. In an analysis of data from 20 countries over the period 1997 to 2007, Billingsley and colleagues [28] concluded that expanding social investment-oriented policies is related to higher first conception probabilities, whereas expanding passive family support leads to lower first conception probabilities. He argued that policies that offer to stay out of the labour market for a long time, as passive family support policies do, may be seen by women as harmful for their future employability.

Monitoring of the trends of reproductive habits, apart from representing an insight into society from a cultural and sociological point of view, is of fundamental relevance for analyzing the impact of these changes on reproductive health and related conditions.

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CRedit authorship contribution statement

Giovanna Esposito: Writing – original draft, Methodology, Formal analysis, Data curation. **Fabio Parazzini:** Writing – review & editing, Supervision, Conceptualization. **Liliane Chatenoud:** Writing – review & editing, Formal analysis, Data curation. **Claudia Santucci:** Writing – review & editing, Formal analysis, Data curation. **Carlo La Vecchia:** Writing – review & editing, Supervision, Conceptualization. **Eva Negri:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ejogrb.2024.05.031>.

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