

Title: The Evolution of Mean Paternal Age in a Long Perspective – Are today's father really older than back in the days?

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Introduction

There is strong evidence that advanced paternal age is associated with detrimental outcomes in historical as well as in contemporary populations (e.g. see Arslan et al., submitted for a systematic study). Many pathways appear to be responsible for this phenomenon. Kong et al. (2012) show that among the population of Iceland, sperm quality decreases with age due to accumulation of DNA copy errors in the male germline. Alternatively, Price (2008) argues that the paternal age effect is explainable due to decreased parental investment and household quality among elder parents. A further study suggests that paternal loss explains the paternal age effect (Myrskylä et al. 2014). Beside these 'true' age effects which are causally linked with offspring outcomes, some studies argue there are also spurious relationships. For example, paternal (as well as maternal) age correlates with the number of siblings and the corresponding increased risk of cross infections and sibling competition (Barclay & Myrskylä 2014). Given the importance of paternal age and its associated effects, it is therefore important to determine whether the increases in paternal age at first child birth observed in recent decades among many Western populations (Martinez et al. 2012) also indicate changes in paternal age on average. In the second half of the 20th century men started to become fathers at younger ages when compared to men today. However, families during this time also had more children and stopped reproduction later. To this point, it has been little studied to what extent this altered reproductive behavior affected mean paternal age. Just a few studies have addressed whether there is a significant difference between current and historical mean paternal age (e.g. Bray & Gunnell (2006) for the UK from 1980 to 2003), and a systematic study among many populations covering more than one generation is lacking. This study aims to rectify this. One problem in the study of paternal age is that although many datasets provide comprehensive information on maternal age at child birth (including records of civil administrations, clinical records, and surveys), little or in some cases no information is given on paternal age. In this project we strive to systematically collect information on time trends on mean paternal age at birth from various sources (official statistical publications, surveys,

censuses (via pointer variables); population reconstitutions). For countries/periods, for which such information is not available, we attempt to estimate mean paternal age based on calculations from mean maternal age and sex-differentials in age at first marriage. The research topic is highly relevant for public health, because it is so far unknown to what extent advanced mean paternal age is contributing to the morbidity and mortality of Western populations today.

Data & Methods

There are only few studies which have focused on paternal age at childbirth. Direct information on mean paternal age is for instance available for England and Wales 1964-2013 (Office for National Statistics 2009); France 1899-2005 (Institut national de la statistique et des études économiques 2005) and Belgium 1939-1995 (Eggerickx & Sanderson 2010). In most databases, reliable information on mean paternal age is missing. However, since fathers tend to be on average two to three years older than mothers, mean paternal age at childbirth can be estimated more or less accurately from mean maternal age. The relationship between maternal and paternal age appears to be robust in historical (Tomka 2013) as well as in contemporary European populations, and is also reflected by the gap in male and female age at first marriage (see Figure 1). We therefore calculate mean paternal age at childbirth by mean maternal age plus the difference between male and female age at first marriage. The reliability of this method is tested empirically using the datasets where maternal and paternal ages are recorded. Datasets and collections where mean paternal age at childbirth can be estimated from maternal age are for instance available at IPUMS International and the European Historical Population Samples Network.

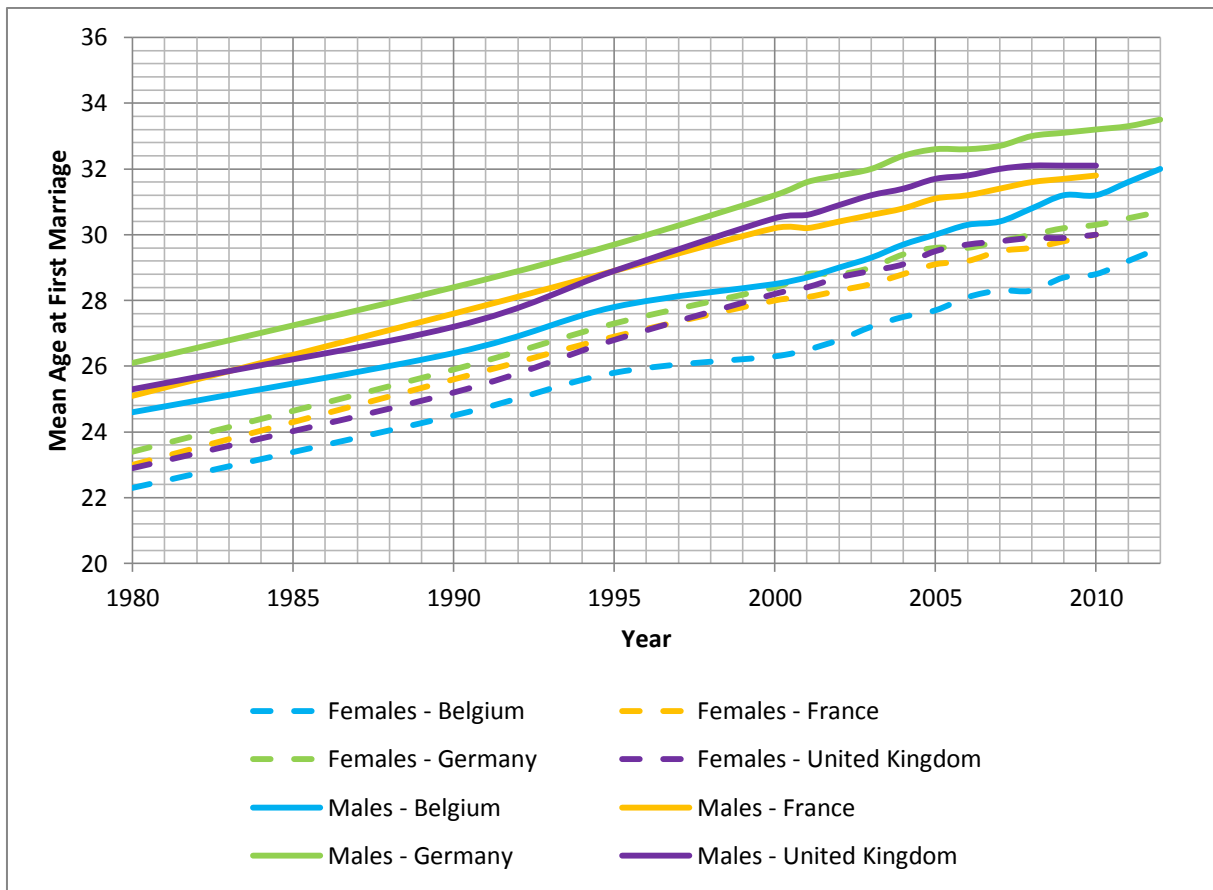


Figure 1 – Mean male and female ages at first marriage for Belgium, France, Germany and United Kingdom. Source: United Nations Economic Commission for Europe

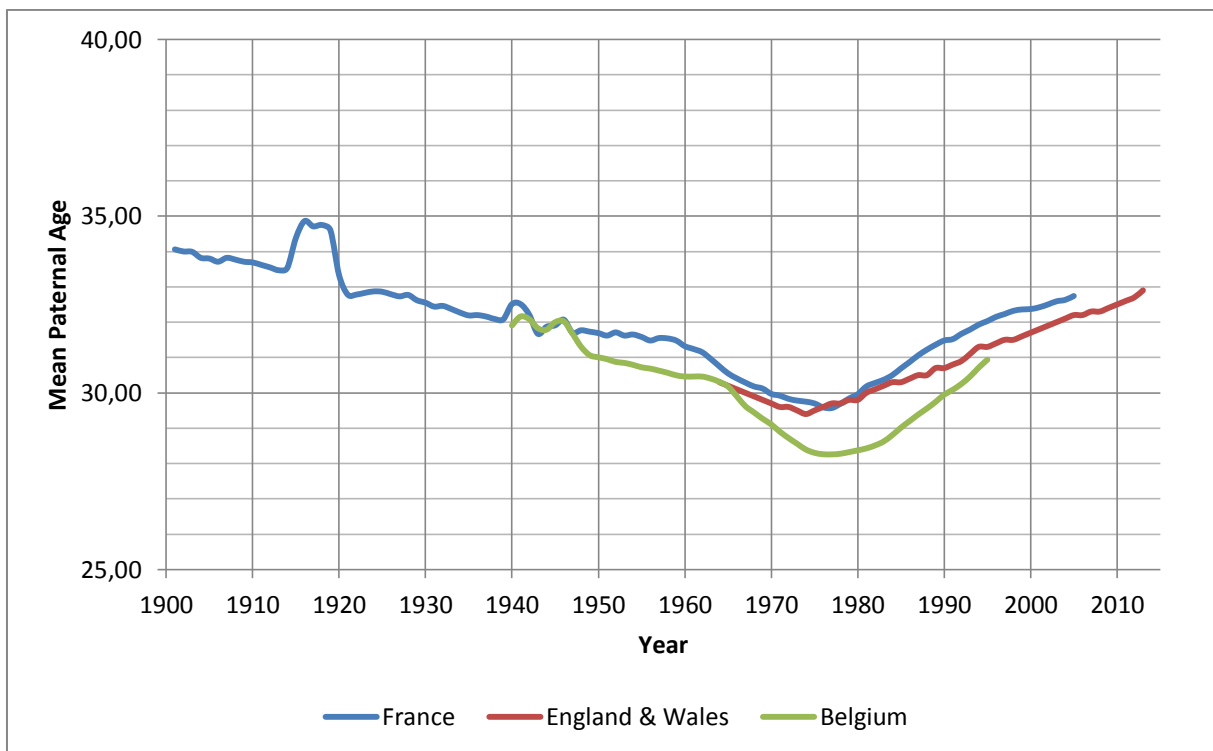


Figure 2 – Mean paternal age at first child birth for Belgium (1939-1995), England & Wales (1964-2013) and France (1899-2005).

Preliminary Results and Discussion

Given the increases in mean paternal age in recent decades and the detrimental outcomes associated with it, this is an important issue for public health (Bray & Gunnell 2006). The main reason for this recent increase is the postponement of parenthood for both men and women (Schmidt et al. 2012), and if only data from the last third of the 20th century is used the increase appears to be dramatic. However, our results indicate that mean paternal (as well as maternal) age around 1900 was substantial higher than current levels and that today's paternal age level is comparable with that in the nineteen twenties. In the 18th and 19th centuries, men and women usually married in the middle/end of their twenties (Tomka 2013) and consequently ages at first childbirths were also relatively high. Families often produced children close until wife's menopause, and late end of reproduction together with late marriage resulted in high mean ages at childbirth. The concurrence of the fertility decline during the 20th century with decreases in age at first childbirth resulted in lower mean paternal as well as maternal ages, which hit the bottom in the nineteen seventies.

However, our preliminary results certainly not give the all-clear regarding the consequences of increasing paternal age for public health. We have not considered changes in variances, yet. Our future investigations will also focus on the questions whether the fraction of very old fathers has increased over time.

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