Potential fertility gains from reducing IVF waiting times amid ongoing fertility postponement: A simulation study

Introduction

Fertility is declining across high-income countries, posing challenges for societal sustainability and leaving many individuals with fewer children than they desire (Beaujouan and Berghammer 2019; Bloom et al. 2024). Childbearing is increasingly delayed, rising by roughly one year per decade in OECD countries, with average maternal age now exceeding 31 years in several countries (OECD 2024). This postponement reflects broader social transformations, including rising educational attainment, changing partnership patterns, economic uncertainty, and competing life priorities (Ní Bhrolcháin and Beaujouan 2012; Cooke et al. 2012). As individuals postpone childbearing, their likelihood of achieving the desired family size decreases (Habbema et al. 2015).

Fertility postponement has contributed to a growing reliance on assisted reproductive technologies (ART), with global ART cycles increasing from approximately 140 000 in 1991 to more than 3.2 million in 2018 (Adamson et al. 2023). The contribution of ART to fertility is also increasing at the country level; for example, ART accounted for about 5% of the total fertility rate (TFR) in Norway in 2018 (Chanfreau et al. 2025).

Couples increasingly approach fertility clinics at ages when natural fecundity is already in steep decline, and more patients are starting treatment at ages when their chances of success are sharply reduced, with demand continuing to rise (HFEA 2024). Yet, despite rising demand, publicly funded systems have not expanded capacity at the same rate, resulting in waiting lists that coincide with higher treatment ages. This overlap underscores the need to understand the combined effects of postponed childbearing and delayed access to care on reproductive outcomes.

In many publicly funded healthcare systems, waiting times for IVF treatment are common, typically ranging from six months to over a year depending on the region (Pereira 2025). These delays are particularly consequential because fecundity declines steeply with age, so waiting periods can substantially reduce the likelihood of a successful pregnancy (Vitagliano et al. 2023). Delays may be even longer when donor gametes are required, particularly in regions with limited availability; in Finland, for example, some recipients currently face waits of up to two years (Vesalainen 2024). External shocks can further exacerbate delays. During the COVID-19 pandemic, for instance, fertility treatments were paused or postponed worldwide due to safety restrictions and the prioritization of urgent care (Cutting et al. 2022).

Understanding how waiting times affect fertility outcomes is critical both at the individual-level and for policymakers. Allocating more resources to assisted reproductive technologies, such as IVF, and thereby reducing waiting times, is one approach to support individuals who wish to have children and to address the societal challenges of low fertility.

Background: Timing of IVF and fertility outcomes

The timing of attempts to conceive has a strong impact on reproductive success. In a simulation study, Habbema et al. (2015) showed that in order to achieve a desired family size with a high probability (90% chance), couples should start trying no later than age 23 for three children, 27 for two children, and 32 for one child. If IVF is an option, couples can start later — up to age 28 for

three children, 31 for two children, and 35 for one child — while still maintaining a high likelihood of achieving fertility intentions. This suggests that ART can partially compensate for age-related fertility decline, but only within a limited window.

Earlier research has mainly focused on the impact of waiting time in ART on age-specific success rates. In a modelling study, a six-month delay in starting IVF was estimated to reduce live births by approximately 0.4%, 2.4%, 5.7%, 9.5%, and 11.8% among women aged <30, 30–35, 36–37, 38–39, and 40–42 years, respectively, while a 12-month delay caused even greater declines (0.9%, 4.9%, 11.9%, 18.8%, and 22.4%) (Bhattacharya et al. 2020). Similarly, Eijkemans et al. (2017) found that a one-year delay reduces live birth probability by nearly 4 percentage points in 38-year-old women, while 30-year-olds generally maintain high chances of pregnancy (Eijkemans et al. 2017). In contrast, brief delays of up to a few months (91–180 days vs. 1–90 days) do not significantly affect outcomes, even among women with diminished ovarian reserve or aged 40+ (Romanski et al. 2020). These findings indicate that the effect of waiting time is highly age-dependent: very short waits have little clinical impact, but prolonged delays increasingly reduce success among older women.

Studies examining the cumulative impact of delays over the life course, or the broader population level effects on fertility, are comparatively scarce. Habbema et al. (2009) examined the effect of earlier IVF implementation — initiating treatment after one year rather than three years of unsuccessful attempts to conceive — and found an increase of 0.08 increase in TFR with IVF introduction and an additional 0.04 increase with earlier initiation. However, this study was based on 2002 data and a static mean age for the onset of attempts to conceive, and therefore did not capture the consequences of later reproductive timing observed today. Consequently, timely ART initiation has likely become increasingly critical for achieving intended fertility.

Data and Methods

We simulated the fertility outcomes among 10 000 women representing the full population of treatment seekers under alternative waiting-time scenarios prior to treatment initiation. The simulated population of 10 000 women corresponds approximately to the number who would ever pursue fertility treatment in a population of about 0.8 million individuals, assuming an infertility prevalence of 12.5% and that half of affected women seek medical help (Datta et al. 2016). This number is also of a similar order of magnitude to the annual number of women starting IVF treatment in the UK (Bhattacharya et al. 2020).

The age distribution at the first treatment visit was generated from a right-skewed log-normal distribution with a mean of approximately 35 years, reflecting the age pattern typically observed in empirical datasets (e.g. HFEA 2024), see Figure 1. Ages were truncated to the range 25–45 years. To explore the impact of ongoing fertility postponement, additional scenarios were simulated in which the treatment-seeking population ages, with mean ages set at 30 years (historical), 35 years (current), and 40 years (projected future) to represent past, present, and potential future populations. This approach allows us to evaluate how delays interact with the age structure of treatment seekers and to estimate their cumulative impact on population-level fertility outcomes, rather than focusing solely on age-specific or per-cycle effects.

We used the following age-dependent per-cycle probabilities of a live birth: 32% at age 25 years, 35% at age 30 years, 30% at age 35 years, 15% at age 40 years and 5% at age 45 years (Habbema et al. 2015). Success rates for intermediate ages were obtained by linear interpolation (Figure 1).

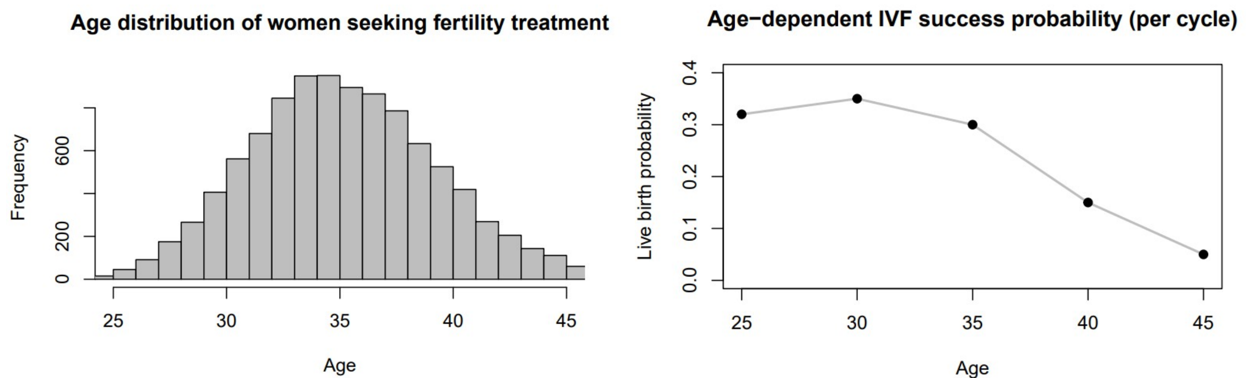

Figure 1: Age distribution of women seeking fertility treatment and age-dependent IVF success probability (per cycle)

We modelled three waiting-time scenarios prior to stating IVF treatment:

1. Immediate access (0-year waiting time)
2. Moderate delay (1-year waiting time)
3. Extended dealy (2-year waiting time)

The simulation was performed as follows. Each woman's age at treatment start was calculated by adding the waiting-time scenario to her baseline age. They were assumed to undergo up to three IVF cycles, consistent with the number typically offered in public fertility programmes (ref). Treatment cycles were spaced three months apart (0.25 years). For each cycle, a Bernoulli trial was conducted using the woman's age-specific probability of live birth to determine cycle outcome. If a live birth occurred in a given cycle, the woman was excluded from subsequent cycles. For each woman, the cumulative probability of live birth across up to three IVF cycles was recorded.

We assumed no treatment discontinuation between cycles and did not explicitly model multiple births. Treatment demand was not modelled in this analysis, although future extensions may consider the implications of increasing maternal age on the demand for fertility treatment.

Preliminary results

Table 1 presents the simulated probabilities of live birth under the three waiting-time scenarios for the population seeking fertility treatment as this population ages. Mean ages of 30, 35, and 40 years represent different stages of this trend: 30 years reflects young treatment-seekers, 35 years corresponds to current observed patterns, and 40 years illustrates an extreme case if postponement contrinues.

For a single IVF cycle, the population with a mean age of 30 years had a 32.6% probability of live birth with immediate access, decreasing slightly to 31.8% and 30.2% under 1-year and 2-year delays, respectively. The population with a mean age of 35 years experienced larger reductions, from 26.6% (0-year delay) to 24.1% (1-year delay) and 21.8% (2-year delay). If postponement

continues and the mean age of treatment-seekers rises to 40 years, waiting times have even greater impact, reducing probabilities from 17.3% to 14.7% and further to 12.9%.

Cumulative probabilities across up to three IVF cycles show a similar but more pronounced pattern. For the historical population (mean age 30 years), cumulative probabilities decreased modestly from 68.6% (immediate treatment) to 67.7% (1-year delay) and 65.9% (2-year delay). Among current treatment seekers (mean age 35 years), cumulative probabilities declined from 57.7% to 55.1% and 51.1%, and for a much older treatment-seeking population (mean age 40 years), from 38.8% to 35.9% and 31.1%.

These results illustrate that the impact of waiting times is magnified as the treatment-seeking population ages, highlighting the increasing consequences of fertility postponement on population-level outcomes.

Table 1: Simulated probability of having a live birth by age at treatment initiation and waiting-time scenario. Results are shown for a single IVF cycle (left) and the cumulative probability across up to three cycles (right) under no delay (0 years), moderate delay (1 year), and extended delay (2 years).

	1 cycle			3 cycles		
Mean initial treatment age	0 years	1 year	2 years	0 years	1 year	2 years
30 (historical)	32.6%	31.8%	30.2%	68.6%	67.7%	65.9%
35 (current)	26.6%	24.1%	21.8%	57.7%	55.1%	51.1%
40 (future)	17.3%	14.7%	12.9%	38.8%	35.9%	31.1%

Next steps: In the current simulations, demand is held constant at 10 000 women, even as the mean age of treatment seekers increases. In reality, both demand and age are likely to rise over time. We will incorporate projected increases in demand alongside shifts in the age distribution. Estimates of future demand could be informed by population-level studies on infertility prevalence and ART uptake, such as the GBD projections of infertility (Liang et al. 2025).

Conclusion

Reducing IVF waiting times could substantially reduce childlessness among women seeking treatment, especially when the treatment-seeking population ages. Policies addressing treatment delays may therefore improve both individual and population-level reproductive outcomes.

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