

The impact of assisted reproduction on fertility trends in the Czech Republic

Jiřina Kocourková, Boris Burcin, Anna Šťastná, Luděk Šídlo

The rapid increase in the use of ART in EU countries serves to confirm its growing importance concerning fertility trends, particularly in low fertility countries (Grant et al. 2006, Hoorens et al. 2007, Ziebe et al. 2008, Habbema et al. 2009, Präg et al. 2017). The postponement of childbearing constitutes one of the main reasons for the increasing use of ART which, conversely, may well be one of the factors that is contributing to the increase in the female childbearing age. While ART is likely to reduce the incidence of involuntary childlessness (Te Velde et al. 2012), it acts to offset only a part of the effect of increasing infertility due to fertility postponement. ART cannot make up for all the births lost via the natural decline in fertility after the age of 35 (Leridon 2004). Despite these findings, there remains a lack of more detailed studies on this theme, principally due to the limited amount of data available, i.e. a significant gap exists in terms of the existing level of knowledge of the impact of the use of ART on fertility trends.

The aim of this paper is to assess the recent demographic impact of the use of ART on fertility timing and the fertility level and its potential with respect to future fertility trends in the Czech Republic, a country with a relatively high proportion of children born following ART (Chambers et al. 2012, Adamson et al. 2013, Kocourková et al. 2014, Dyer et al. 2016). A unique database of mothers who gave birth in the Czech Republic between 2013 and 2017 was employed for the demographic analysis. The shift to later childbearing in the Czech Republic was particularly vigorous after 1990 at which time the TFR fell sharply from 1.86 in 1990 to 1.13 in 1999 and the mean age at first birth increased from 22.5 in 1990 to 25 in 2000. Currently, the Czech Republic is characterised both by a late childbearing pattern, with the mean age of mothers at first childbirth standing at 28 years, and a relatively recovered fertility level of close to 1.7 children per woman.

While ART is easily available in the Czech Republic, single women do not have direct access to this method. Women who apply for ART are required to provide the agreement of their male partner; however, this does not mean that they must be married or in a cohabiting relationship. Until 2012 no age limit was set for access to ART, i.e. Czech legislation even permitted the use of ART for women over reproductive age. In 2012, however, legislation was introduced limiting the ART access age to 50 years. The costs of ART are reimbursed up to a certain age via the Czech statutory health insurance system. Legislation on the reimbursement of ART costs by health insurance companies was introduced in 1997 (a maximum of 3 cycles up to the age of 39). Since April 2012 it has been possible to claim reimbursement for up to 4 treatment cycles provided that only one embryo is transferred during the first two cycles.

Via the use of data on births obtained from the Czech Statistical Office and the Institute of Health Information and Statistics of the Czech Republic, we estimate the impact of ART on past and future fertility trends in the Czech Republic. The reporting of data on ART cycles to the Institute of Health Information and Statistics of the Czech Republic is compulsory for all reproductive centres/clinics according to legislation introduced in 2006. We employed individual-level data for the period 2013-2017 obtained from the National Register of Mothers at Childbirth and the National Register of Assisted Reproduction that was subsequently linked via the women's birth identification numbers in order to identify those mothers with Czech citizenship who gave birth following an embryo transfer in the Czech Republic. We excluded ART-children born to non-Czech women. ART-births were identified by means of embryo transfer that included all types of ART procedure, i.e. IVF, ICSI, egg donation (ED) and frozen embryo replacement (FER).

The number of live births following ART increased steadily between 2013 and 2017 (Table 1). In 2017 around 3.7 thousand children were born following ART, representing 3.3% of all live births. The increase of 1 thousand ART- live births in 2013 was reflected in an increase in the proportion of ART- live births of almost 0.8 percentage points. Thus, the number of ART-live births increased more rapidly than did the total number of live births. Figure 1 shows that the proportions of ART-live births of all live births increased significantly with the age of the mothers. While differences between the age groups of mothers increased slightly in the period under study, a clear "jump" is evident at around the age of 45 years. While less than 10% of children were born following ART to mothers aged 40-44, almost 40% of live births followed ART

with concern to the 45-49 age group. That said, only small proportions of the total number of children born were to mothers aged 40-44 (2.5% - 3.6%) and 45-49 (0.1% - 0.2%). Table 2 illustrates a significant increase in the TFR between 2013 and 2017 from 1.46 to 1.69 and from 0.03 to 0.05 with respect to the ART TFR. As a result, the relative impact of ART on the TFR increased to almost 3%.

Table 1: Live births and live births following ART, Czech Republic 2013-2017

	2013	2014	2015	2016	2017
Total number of live births	106,751	109,860	110,764	112,663	114,405
Number of live births following ART	2,677	3,061	2,957	3,171	3,737
Live births following ART (in %)	2.51	2.79	2.67	2.81	3.27

Figure 1: Births following ART by the age of the mother, Czech Republic 2013-2017

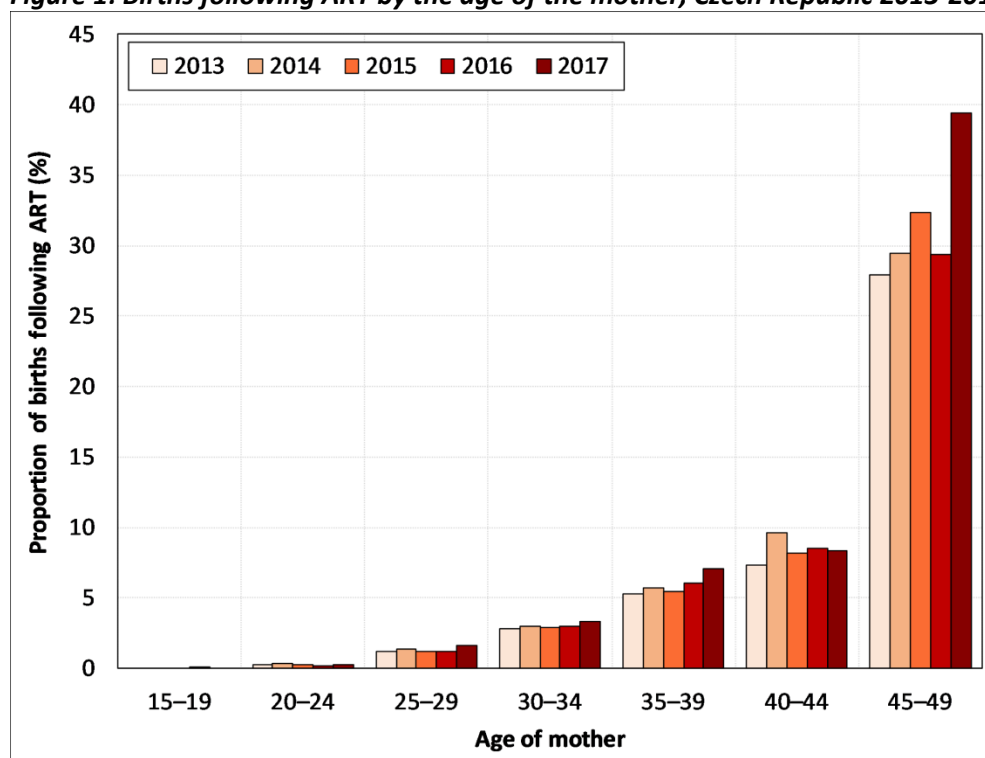


Table 2: The impact of the use of ART on the total fertility rate and on the mean age of mothers at childbirth, Czech Republic 2013-2017

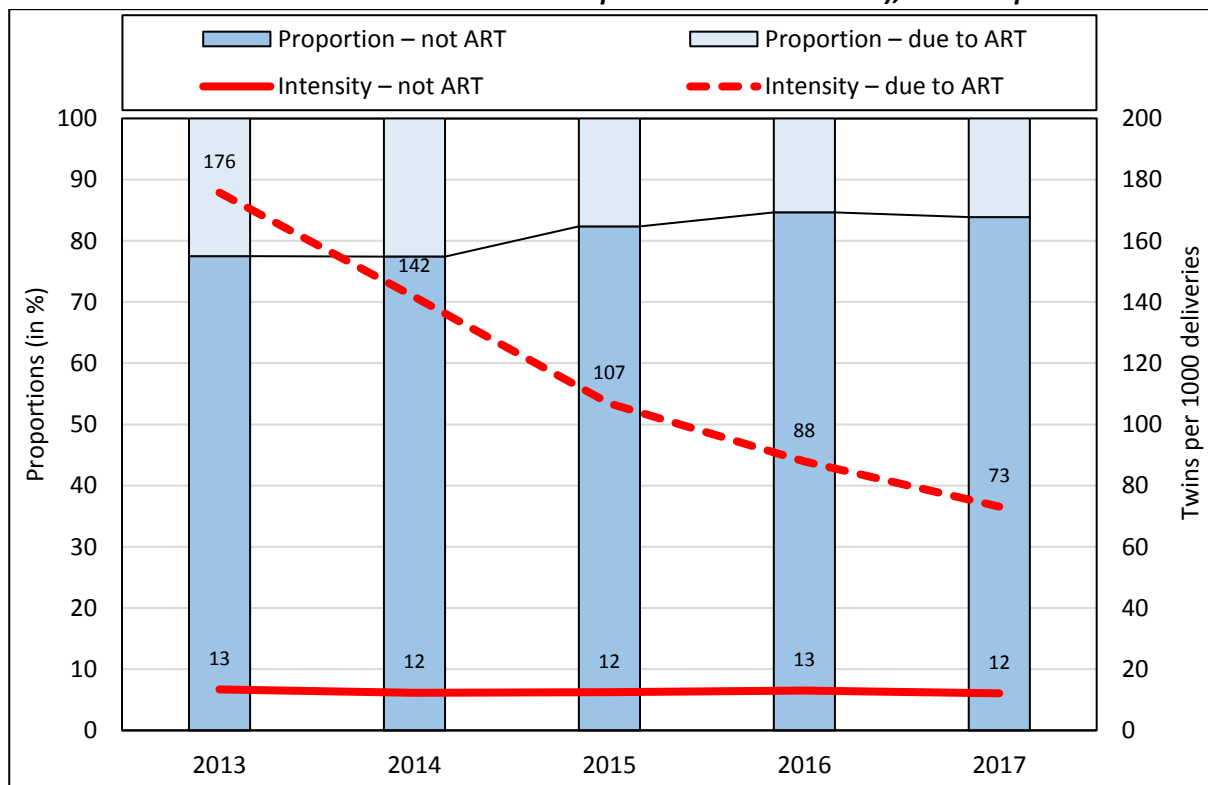
	2013	2014	2015	2016	2017
Total fertility rate	1.456	1.528	1.570	1.630	1.687
Total fertility rate following ART	0.033	0.039	0.038	0.041	0.050
Total fertility rate without ART	1.423	1.489	1.532	1.589	1.637
Mean age of mothers at childbirth	29.86	29.94	29.99	30.02	30.11
Mean age of mothers at childbirth following ART	34.04	34.26	34.37	34.56	34.45
Mean age of mothers at childbirth without ART	29.76	29.83	29.88	29.87	29.89

The second aim was to quantify the effect of the use of ART on birth timing. The increase in the non-ART TFR and the ART TFR was accompanied by an increase in the mean age of mothers at childbirth (MAB). The ART MAB reached 34.45 years in 2017, which was significantly higher than the non-ART MAB (see Table 3).

Since we can calculate the non-ART-fx and ART-fx separately for the period 2013 to 2017, it is possible to determine how much of the increase in the MAB was due to changes in the timing of fertility and how much was due to changes in the fertility structure according to ART and non-ART using the decomposition method (Kitagawa 1955, Sivková and Hulíková 2012). The increase in the MAB from 2013 to 2017 of 0.16 was decomposed into two components, i.e. the effect of timing and structure, which revealed that fertility postponement accounted for 82% of the increase in the MAB while the increase in the use of ART accounted for just 18%. Nevertheless, the contribution of the increasing use of ART to the ongoing childbearing postponement process remains significant.

The third aim concerned the relationship between the increasing use of ART and trends concerning twin births. Interestingly, the impact of ART on the TFR increased concurrently with a decrease in the number of ART twins born. It is possible to attribute the decrease in the incidence of twins over the last few years to both ART legislation itself and changes in legislation on the reimbursement of ART costs by the statutory health insurance system. While up to 2012 no conditions applied related to the number of transferred embryos and the reimbursement of ART-related costs, since 2012 women have been entitled to the reimbursement of an extra treatment cycle, i.e. four in total, provided that only one embryo is transferred during the first two cycles. As a result, the proportion of ART-twin deliveries of all twin deliveries decreased from 22.5% in 2013 to 16% in 2017. Similarly, the intensity of ART-twin deliveries fell by more than half from 176‰ of total deliveries following ART in 2013 to 73‰ in 2018, while the intensity of non-ART twin deliveries remained unchanged (12-13‰ of total non-ART deliveries).

Figure 2: Twin deliveries according to ART use (in %) and twin birth intensity (non-ART twin deliveries per 1000 non-ART deliveries and ART twin deliveries per 1000 ART deliveries), Czech Republic 2013-2017



The estimation of the future impact of ART on the TFR led to the consideration of future trends in the TFR itself. Assumptions were taken into account on differing expectations concerning the further postponement of childbearing (i.e. the continuation of the shift towards the later timing of childbearing) as well as on the future recovery of previously delayed childbearing (i.e. the extent to which births that were postponed at younger ages will take place at older ages). Three fertility forecast variants (based on the most recent available data - up to 2018; Kučera and Burcin 2019) captured potential alternative trends in future fertility postponement and recovery by 2034. Consequently, we formulated two ART fertility projection scenarios for a period of the next 15 years that are conditional on the fertility forecasts. The first

scenario was conditional on the three fertility forecast variants up to 2034, and the second was projected independently. ART fertility projection scenarios (age-specific fertility rates following ART) were estimated for each single-year age group.

The first ART scenario is based on the assumption that the proportion of ART-fx of fx by age calculated for 2017 is fixed, thus maintaining a constant value for the whole of the 2019-2034 projection period (Table 3). Therefore, any changes in ART fertility will be due solely to changes in the fertility rate and ART-fx trends at higher childbearing ages when the greater part of the incidence of ART will be dependent solely on total fertility trends. As a result, the relative impact of ART on the TFR would increase to only slightly above 3% (Table 3).

Table 3. Estimated impact of the use of ART on the TFR

	TFR	ART TFR	Relative effect of ART on the TFR (%)	MBA	ART MBA	Difference
2017	1.687	0.050	2.96	30.02	34.47	4.45
2034 - ART scenario 1 - fixed constant ART-fx/fx						
High variant	1.793	0.059	3.29	30.79	35.00	4.21
Medium variant	1.692	0.054	3.19	30.56	34.67	4.11
Low variant	1.550	0.049	3.16	30.55	34.64	4.09
2034 - ART scenario 2 - twofold increase in the ART TFR from 0.05 to 0.1						
High variant	1.793	0.099	5.52	30.79	35.52	4.73
Medium variant	1.692	0.099	5.85	30.56	35.52	4.96
Low variant	1.550	0.099	6.39	30.55	35.52	4.97

The second ART scenario was considered more realistic due to its being based on the assumption that it is unlikely that the dynamic change in the use of ART will cease completely. The second scenario assumes a twofold increase in the ART TFR from 0.05 to 0.1 between 2017 and 2034 (Table 3). As a result, the relative impact of ART on the TFR would increase to varying extents according to the fertility forecast variant, and the highest increase could exceed 6% in the case of the low fertility forecast variant.

The results show that the importance of ART increases simultaneously with increases in the TFR. A further increase in the use of ART in the Czech Republic can be expected. The estimation of the future impact of ART on the TFR showed that while increases in the use of ART would affect the TFR, the effect would be dependent on the fertility level. The most significant effect of an increase in the use of ART would be evident should the low-fertility scenario become a reality, in which case the percentage of ART live births may well approach 6.5% by 2034. In conclusion, the preliminary findings of the research confirmed that the increasing use of ART in the Czech Republic has contributed to the stabilisation of the fertility pattern rather than the strengthening of fertility postponement.