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

Over the last two decades, changes can be observed in reproductive patterns in the Czech Republic: a decrease in total fertility rate below replacement level and a continuous increase in the age of the mother at first childbirth. The combined continuous postponement of childbearing and decline in female fecundity with age is leading to an increase in the number of women seeking assisted reproductive treatment. Assisted reproductive technologies (ART) can be used to enable fertility in infertile couples or offset the decrease in fertility due to falling fecundity related to the postponement of childbearing. The aim of this article is to estimate the impact of ART on birth rates and on future demographic development in the Czech Republic. It will also analyse one selected aspect relating to the development of ART, and that is the proportion of multiple births. Further, it will assess the extent to which ART compensates for the fall in fecundity associated with the later age at which women attempt to give birth naturally. Ultimately, it will project the use of ART in the Czech Republic, showing the estimated share of ART on the future development of the total fertility rate and the proportion of children born following ART. In the Czech Republic, the proportion of children born following ART has recently been around the non-negligible level of 3.5 %. Our analysis of data from 2008 to 2012 shows that the importance of ART for the fertility rate increased simultaneously with an increase in the fertility rate until 2009. Assisted reproduction made the greatest contribution to the total fertility rate in 2009 and 2010. Moreover, the high proportion of multiple births resulting from an increase in the use of ART fell as efforts were made to reduce the number of embryos transferred in an assisted reproductive cycle.

Fecundity begins to fall slowly but consistently in women aged 30, and at the age of 35 it begins to decrease rapidly (Alviggi et al., 2009; Leridon, 2004). Leridon and Slama (2008) have estimated that postponement of the first attempt at pregnancy by 2.5 years may be accompanied by a fall in fertility of 5 % and a rise of over 30% in the number of couples seeking infertility treatment. Recent data shows that in Europe 1–6 % of all live births are achieved through assisted reproduction and this trend is on the increase (Kupka et al., 2014). Many authors consider assisted reproduction to be an increasingly important factor in future fertility trends (for example, Hoorens et al., 2007; Kocourková, Burcin, Kučera, 2014; Sobotka et al., 2008). Sobotka et al. (2008) found that in Denmark final fertility among women has risen on average by 0.05 children per woman through the use of assisted reproduction. Hoorens et al. (2007) estimate that if the use of assisted reproduction in the UK

rose to Danish levels, total fertility rate would rise by approximately 0.04 children per woman. Leridon (2004) and Leridon and Slama (2008) used data from France and Habbema et al. (2007) used data from the Netherlands to quantified the extent to which the use of reproductive medicine compensates for falling fertility resulting from postponement of the first attempt at pregnancy. The results of their simulated models suggest that despite the not insubstantial contribution of assisted reproduction to successful fertility at a later age, the fall in fecundity cannot be entirely substituted by this method. Not only does the ability to become pregnant naturally decrease with age but so too does the success rate of assisted reproduction. The risk of involuntary abortion also rises significantly. Kocourková, Burcin and Kučera (2014) have shown that assisted reproduction may have more of an effect on fertility when performed on younger women.

With the growing number of women undergoing assisted reproduction, there is a significant increase in the proportion of multiple births. This is considered to be one of the main problems associated with the use of assisted reproduction methods (Soini et al., 2006). Advances in reproductive medicine have, however, meant that in recent years single embryos have more frequently been successfully transferred thus preventing the undesirable risks (health, financial etc.) associated with the birth of two or more children (Kupka et al., 2014; Soini et al., 2006).

Data

The data on assisted reproduction in the Czech Republic is held in the National Register of Assisted Reproduction (NRAR) managed by the Institute of Health Information and Statistics of the Czech Republic (IHIS CR). The register includes data on all women who were monitored while receiving in vitro fertilisation treatment (IVF) or related treatments (intra cytoplasmic sperm injections – ISCI, frozen embryo transfer – FET, egg donation – ED). The register also contains information on the progression of the treatment cycle (IHIS CR, 2015). Using the information provided by the reproductive centres and the women's birth number[1], the information provided by the NRAR can be compared with that held in the National Register of Mothers at Childbirth or the National Register of Newborns to obtain information on the success of the cycle.

[1] a number allocated to all citizens at birth in the Czech Republic

The data available from the NRAR contains figures on the number of cycles of assisted reproduction according to the woman's age, method and number of embryos transferred in the calendar years of 2008–2012 and the number of deliveries resulting from these cycles according to age of women and parity. To ascertain the importance of the method of assisted reproduction in relation to fertility, it was therefore necessary to convert the number of deliveries into the number of live births and to calculate the number of births by woman's age in relation to calendar year. A number of premises were taken into consideration. Firstly, that the number of assisted reproductive births according to woman's age and parity displayed the same level of mortality as naturally conceived births. Equally, that the cycles of assisted reproduction, whether they were successful and subsequent births were distributed equally throughout the calendar year. The calculations were made using data for Czech citizens only.

Partial results

In the period observed, 2008–2012, the number of cycles of assisted reproduction performed in the Czech Republic was around approximately 12.3 to 13.5 thousand annually. The deliveries from these cycles, with the exception of 2011, numbered more than 3,500 (Tab. 1). The significant fall in number of deliveries following assisted reproduction, and hence also the success rates of assisted reproduction, in 2010 and 2011 (Tab. 1) is highly likely to be linked to amendments to the legislation on the donation of tissue and organs which removed the obligation to record birth numbers in the register in mid-2010. Although this obligation was reinstated a year later, the data lack continuity and this may have led to underestimations of the outcomes of assisted reproduction (IHIS CR, 2015).

The use of assisted reproductive methods is affected by the legislation. In the Czech Republic, reproductive medicine is regulated by the Law on Specific Health Services 373/2011 Coll. (Czech Republic, 2011). The measures contained within this law reflect expert recommendations on the need to reduce the number of embryos transferred (see, for instance, Soini et al., 2006). Since 2012 health insurance companies will reimburse four rather than the previous three cycles of assisted reproduction in women up to the age of 40, providing that during the first two cycles only one embryo is transferred. This legislative change (along with other incentives to reduce the number of multiple births) has had an effect on the structure of assisted reproductive cycles when analysed according to number of embryos transferred (Fig. 1). While at the beginning of the period under observation two embryo transfers were most common, accounting for 70 % of transfers, by 2012 the proportion of single and two egg

transfers was roughly equal at 49 %. During the same period, the proportion of three or more egg transfers also fell. This reduction in the number of embryos transferred was also associated with a fall in the proportion of multiple births between 2008 and 2012.

The percentage of live births following assisted reproduction rises as the age of the mother at birth increases (Fig. 2). Not only does the women's ability to fall pregnant decrease with age, but we can also expect that up to a certain age most women will attempt to become pregnant naturally, and so they tend to seek out reproductive medicine services less. In mothers aged 35 or older, the proportion of live births following assisted reproduction exceeds 5 %. A sharp growth in the proportion of life births following assisted reproduction is discernible among women aged 45 and over. However, here we need to take account of the fact that in the Czech Republic the number of live births to women of this age group is very low and that the law (Czech Republic, 2011) only permits assisted reproduction for women up to the age of 50.

In the Czech Republic, fertility rates following assisted reproduction are highest amongst women aged between 30 and 35 (Fig. 3); hence, up to the age when women most frequently have children (CZSO, 2014). After the age of 25 there is a discernible rise in fertility rates following assisted reproduction. There is then a marked fall at the age of 35 and once women exceed the age of 39 the fertility rate falls to negligible levels. In this distribution, there were no significant changes in the years under study (Fig. 3). The tendencies noted stem not only from the indisputable fall in success rates for assisted reproduction in women aged 35 and over (Alviggi et al., 2009) but also from the fact that assisted reproduction cycles are only reimbursed for women aged up to 40.

Contrary to expectations, in recent years the Czech Republic has not seen an increase in the estimated number of births following assisted reproduction (Tab. 2). The data available indicate that during the period under analysis this indicator peaked in 2010 when more than 4,300 children were born as a result of assisted reproduction; that is, around 3.7 % of all live births. In 2012 this represented more than a thousand live births less (a 0.7 % fall in the number of live births following assisted reproduction as a percentage of all live births). This trend is linked to the marked fall in multiple births resulting from some methods of assisted reproduction.

Although the proportion of children born following assisted reproduction is not high, it has a discernible impact on total fertility. For instance, in 2011 total fertility rate following assisted

reproduction was around 0.045 children per woman; in the absence of assisted reproduction total fertility rate would not have exceeded 1.4 children per woman (Tab. 2). The highest fertility rate following assisted reproduction in the period under observation occurred in 2009 and 2010 when it was more than 0.05 children per woman. It fell by more than a tenth in 2012, which is again linked to the falling proportion of multiple births following assisted reproduction and the probable underestimation of the number of births in women undergoing some assisted reproductive methods of fertility treatment.

Preliminary conclusions

The results obtained correspond to the findings of a number of studies conducted in other developed countries (e.g. Habbema et al., 2009; Hoorens et al., 2007; Sobotka et al., 2008). In the Czech Republic, assisted reproduction has become an important factor affecting various aspects of fertility. Although in the time period under observation, 2008–2012, there was no significant rise in the proportion of children born following the use of some methods of assisted reproduction, there is no denying the potential of assisted reproduction to affect future trends in fertility given the ever increasing age of mothers at first birth.

As Kocourková and Burcin (2012) have shown, Czech women undergo assisted reproduction at a younger age compared to women generally in Europe. Whilst it is true that the proportion of children born following assisted reproduction increases sharply with the age of the woman, the greatest fertility following assisted reproduction is concentrated amongst women aged between 30 and 34. This trend has not changed markedly and any further shifts in the age at which maximum fertility following assisted reproduction occurs will most likely be linked not only to improvements in treating infertility in older women but also to any changes in the legislation.

Legislative change has already manifested itself in the reduction in number of embryos transferred per assisted reproductive cycle. This has positively contributed to the fall in multiple births in the Czech Republic. Similar efforts can also be observed in other developed countries. For instance, in Sweden the proportion of multiple births following assisted reproduction in 2010 was just below 6 % (Kupka et al., 2014).

One of the limitations affecting the results presented here on the impact of assisted reproduction on fertility in the Czech Republic is the quality of the available data. While the

Institute of Health Information and Statistics states that its data covers almost all cycles of assisted reproduction, the data on births, in particular, may be underestimated. It is also not possible to ascertain whether the woman conceived spontaneously following assisted reproduction. Some women who undergo assisted reproduction may opt for fertility treatment earlier than is necessary (Hoorens et al., 2007). It has been suggested that 15 to 35 % of women who undergo assisted reproduction could have conceived naturally (Sobotka et al., 2008). As far as the middle values in this distribution (25 %) are concerned, the estimated level of total fertility rate following assisted reproduction in the Czech Republic could be reduced to 0.039 children per woman in the maximum years.

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Tab. 1: Number of cycles of assisted reproduction and estimates of related number of deliveries, Czech Republic, 2008–2012

	2008	2009	2010	2011	2012
Number of cycles	13,510	12,802	12,977	12,277	12,993
Number of deliveries	4,224	4,526	3,818	3,079	3,829
Success rate (in %)	31.3	35.4	29.4	25.1	29.5

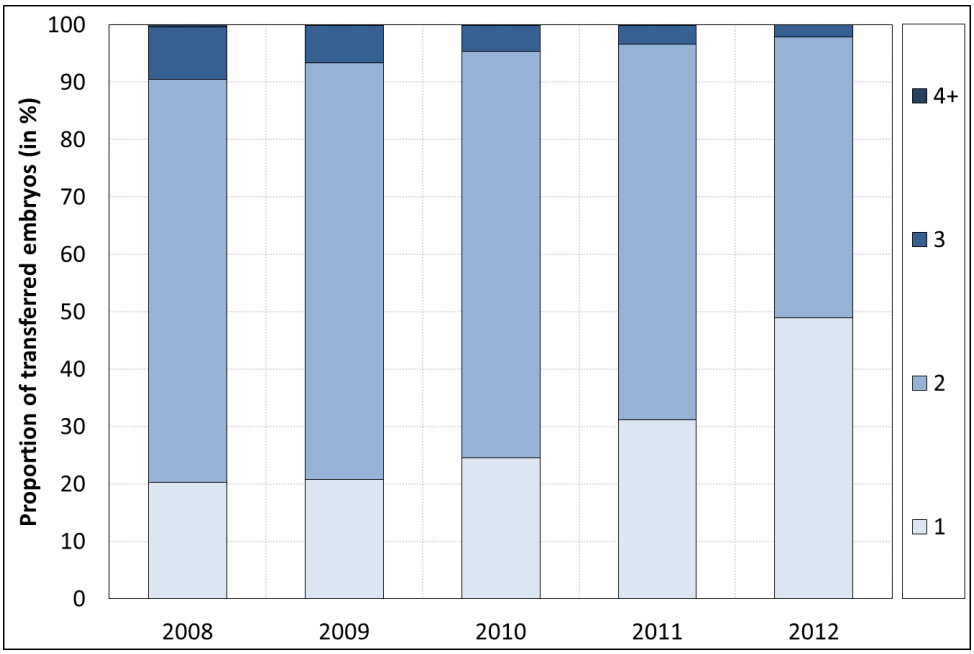
Data source: IHIS CR (2014)

Tab. 2: Estimated contribution of assisted reproduction to fertility, Czech Republic, 2008–2012

	2008	2009	2010	2011	2012
Average age of mother at first birth	27.3	27.4	27.6	27.8	27.9
Total number of live births	119,570	118,348	117,153	108,673	108,576
Number of live births following assisted reproduction	3,923	4,299	4,350	3,633	3,266
Percentage of live births following assisted reproduction (in %)	**3.28**	**3.63**	**3.71**	**3.34**	**3.01**
Total fertility rate	1.497	1.492	1.493	1.426	1.452
Total fertility rate following assisted reproduction	**0.047**	**0.052**	**0.053**	**0.045**	**0.041**

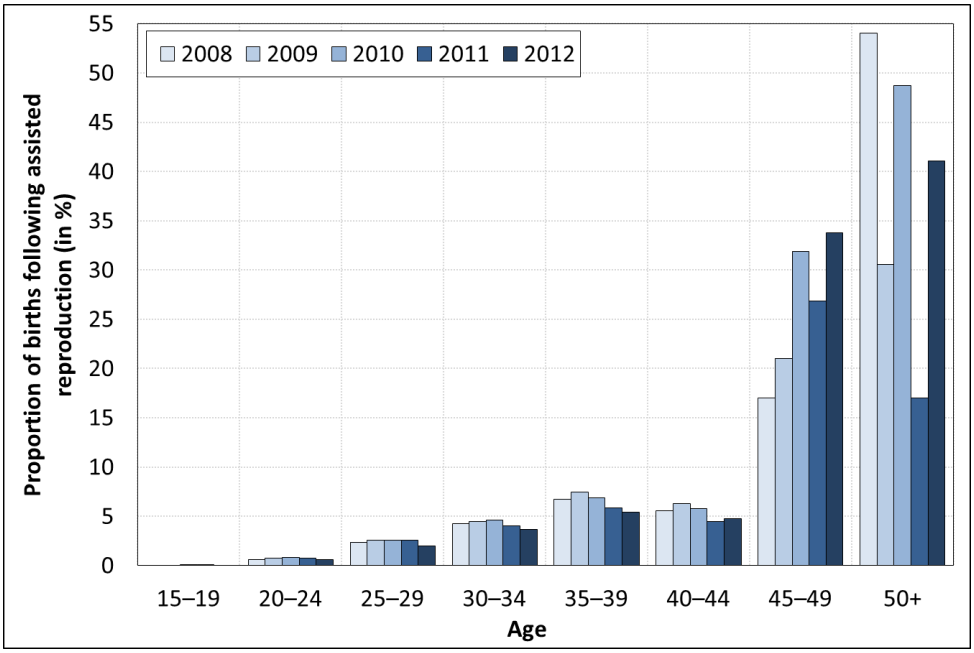
Data source: CZSO (2014) and IHIS CR (2014)

Fig. 1: Percentage of assisted reproductive cycles by number of transferred embryos, Czech Republic, 2008–2012



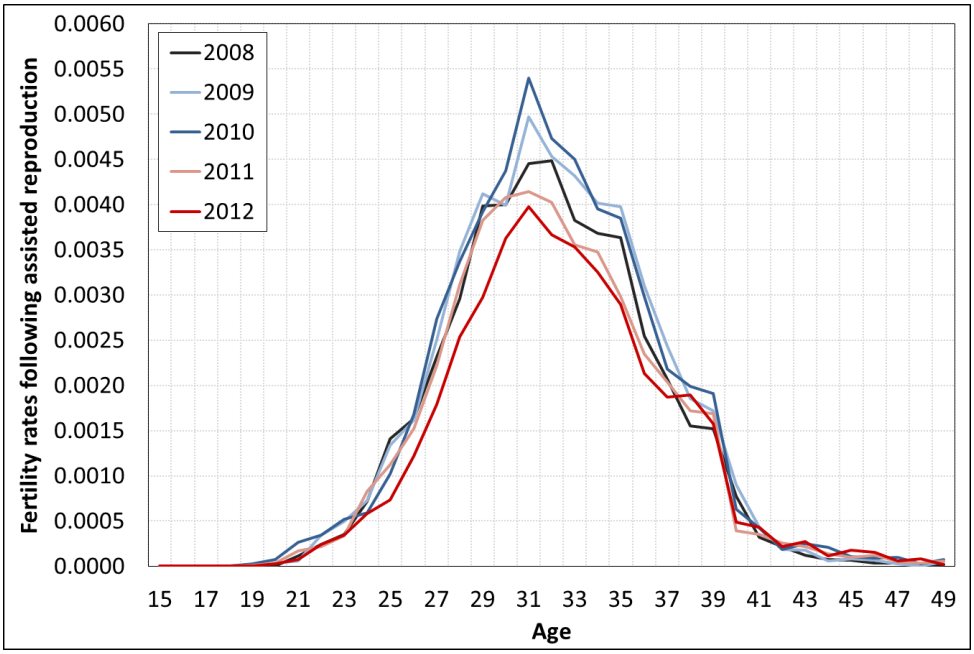
Data source: IHIS CR (2014)

Fig. 2: Estimated percentage of live births following assisted reproduction by mother's age, 2008–2012



Data source: CZSO (2014) and IHIS CR (2014)

Fig. 3: Estimated level of age specific fertility rates following assisted reproduction, Czech Republic, 2008–2012



Data source: IHIS CR (2014)