

SHORT REPORT

# Assisted reproductive technology (ART) is not an independent risk factor for breech presentation among singleton term births in Vienna, Austria

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## Abstract

Assisted reproductive technologies (ARTs) such as in vitro fertilisation (IVF) and intracytoplasmic sperm injection (ICSI) are still discussed critically, as there is no consensus on whether these treatments could be the cause of risk factors for obstetric problems such as breech presentation. The aim of this study was to test the association between ART and breech presentation among 11920 singleton term births taking place in Vienna from 2010 to 2020. In this single-centre medical record-based study, data concerning the conception mode (spontaneous versus IVF or ICSI), child presentation, birth mode, newborn sex and size as well as age, height, weight, and reproductive history of the mother were included. Three hundred twenty-six newborns (2.7%) were conceived by IVF or ICSI, and 527 newborns (4.4%) were delivered in breech presentation. Breech presentation occurred in 7.6% of IVF/ICSI children but only in 4.3% of spontaneously conceived children ( $P = 0.019$ ). ART increased the crude risk of breech presentation significantly (OR = 1.67; 95% CI 1.71 – 2.38). After adjusting for maternal age, height, number of previous births, smoking, and newborn sex, however, ART had no longer a significant impact on the risk of breech presentation. In contrast, breech presentation was significantly associated with higher maternal age as well as a lower number of previous births, but not with ART. This study shows that the adverse outcomes of IVF and ICSI pregnancies may not be due to the ART treatment alone but might also be due to the mostly higher age and lower parity of the mothers using ART.

**Keywords:** in vitro fertilisation; birth outcome; breech presentation; maternal age

Louisa Brown, the first child conceived in vitro, was born 45 years ago. At that time, a successful in vitro fertilisation (IVF) was a sensation, now assisted reproductive technologies (ARTs), such as IVF and intracytoplasmic sperm injection (ICSI), are established methods in the treatment of infertility and helped millions of involuntarily childless couples (Chang *et al.*, 2020; Wyns *et al.*, 2017). Nevertheless, this technique is still discussed as a risk factor for preterm birth, foetal growth restriction, and several obstetric problems (Berntsen *et al.* 2019; Helmerhorst *et al.*, 2004; Koudstaal *et al.*, 2000; Malchau *et al.*, 2014; Pandey *et al.*, 2012; Zadori *et al.*, 2003). It is still unclear whether these problems are directly related to ART use (Romundstad *et al.*, 2008; Stern *et al.*, 2015; Valenzuela-Alcaraz *et al.*, 2016), because these adverse effects are mainly associated with multiple pregnancies, which are more common after ART treatment. A typical obstetric problem associated with ART is breech presentation (Noli *et al.*, 2019; Romundstad *et al.*, 2009; Schieve *et al.*, 2007; Slavov, 2021). Two recently published studies characterised by huge sample

**Table 1.** Maternal and Newborn Characteristics among Term Births According to Conception (Spontaneous versus Assisted Conception)

Variable	All		Spontaneous		Assisted [ICSI + IVF]		P-value
	n		n		n		
	Mean/n	SD/%	Mean/n	SD/%	Mean/n	SD/%	
<b>Mothers</b>							
<b>Age (years)</b>	30.5	5.5	30.3	5.5	34.7	5.6	0.001
<b>Body height (cm)</b>	165.5	6.3	165.5	6.3	167.2	6.4	0.001
<b>Prepregnancy weight (kg)</b>	65.8	14.3	65.8	14.3	67.4	13.8	0.036
<b>Prepregnancy BMI</b>	24.01	4.88	24.01	4.89	24.13	4.76	0.662
<b>Weight at birth (kg)</b>	80.1	14.4	80.1	14.4	81.3	14.0	0.116
<b>Gestational weight gain (kg)</b>	14.3	5.8	14.3	5.8	13.9	5.2	0.299
<b>Number of previous births</b>	1.80	0.97	1.81	0.97	1.35	0.70	0.001
<b>Smoking</b>							
Yes	1582	13.3%	1563	13.5%	19	5.8%	0.001
No	10338	86.7%	10031	86.5%	307	94.2%	
<b>Newborns</b>							
<b>Gestational week</b>	39.4	1.1	39.5	1.1	38.7	0.9	0.001
<b>Birth mode</b>							
Spontaneous vaginal	10249	86.0%	9994	86.2%	255	78.3%	0.001
Cesarean section	1671	14.1%	1600	13.8%	77	21.8%	
<b>Child presentation</b>							
Cephalic	11393	95.6%	11090	95.7%	303	92.9%	0.019
Breech	527	4.4%	504	4.3%	23	7.6%	
<b>Birth weight</b>	3458.1	456.7	3458.8	457.3	3430.1	434.8	0.241
<b>Birth length</b>	50.9	2.1	50.9	2.1	50.9	2.0	0.269
<b>Head circumference</b>	34.4	1.4	34.4	1.4	34.2	1.4	0.047
<b>Newborn sex</b>							
Male	6109	51.3%	5958	51.4%	151	46.3%	0.040
Female	5810	48.7%	5635	48.6%	175	53.7%	

To test group differences, *t*-tests were computed. For categorical variables,  $\chi^2$  tests were applied.

sizes (Chen *et al.*, 2023; Londero *et al.*, 2023) revealed a significant association between ART and breech presentation. In previous studies, however, it was discussed whether ART is truly an independent risk factor for breech presentation or whether factors such as older maternal age, nulliparity, or preterm birth, which are typical of ART pregnancies, might increase the risk for breech presentation independent of ART (Romundstad *et al.*, 2009). Therefore, we tested the hypothesis: ART is not an independent risk factor for the increased prevalence of breech presentation among singleton term births, but ART-associated factors such as higher maternal age, nulliparity, and gestational week increase the risk of breech presentation.

In this single-centre and medical record-based study, we analysed the association patterns between the mode of conception and child presentation among 11920 singleton term births

**Table 2.** The Associations Between Birth Presentation and Maternal as well as Newborn Parameters among Singleton Term Births

	Odds ratio	P-value	95% CI
Breech presentation			
ART (IVF or ICSI)	1.19	0.461	0.76–1.86
Maternal age	1.02	0.016	1.00–1.04
Maternal height	1.03	<0.001	1.01–1.04
Number of previous births	0.81	<0.001	0.74–0.88
Smoking	1.06	0.704	0.80–1.39
Sex	1.14	0.157	0.92–1.32
Birth weight	1.00	0.014	0.99–1.00
Gestational week	0.60	<0.001	0.55–0.66

Logistic regression analysis.

(>37 weeks of gestation) taking place between 2010 and 2020 at the Donaustadt Clinic in Vienna, Austria. We hypothesise that child presentation among singleton term births is not associated with the conception mode.

Our dataset included information regarding the conception mode (spontaneous or assisted (IVF or ICSI)), maternal age, height, prepregnancy weight status, gestational weight gain, smoking, number of previous births, caesarean section, and newborn sex and size (birth weight, birth length, and head circumference). Data analysis was carried out using SPSS version 27.0. (IBM, Austria). To test group differences, *t*-tests were computed. For categorical variables,  $\chi^2$  tests were applied. To evaluate the association of child presentation and conception mode, logistic regression was performed.

Three hundred twenty-six mothers (2.7%) conceived via either ICSI or IVF. Five hundred twenty-seven children (4.4%) were delivered in breech presentation. Table 1 demonstrates significant differences between ART and spontaneously conceived pregnancies. Mothers pregnant via ART were significantly older, taller, and heavier before pregnancy. Spontaneously conceiving mothers had experienced significantly more births and were more likely to be smokers. ART was significantly positively associated with a shorter pregnancy, although only term births have been included, an increased cesarean section rate, and more female offspring. No significant differences in newborn size apart from head circumference could be observed. ART increased the crude risk of breech presentation significantly (OR = 1.67; 95% CI 1.71 – 2.38). At first glimpse, these results plead for an independent positive association between ART and breech presentation. After adjusting for maternal age, height, parity, smoking, newborn weight, gestational week, and newborn sex, ART had no longer a significant impact on the risk of breech presentation. The logistic regression indicates a significantly positive association between breech presentation and maternal age, maternal height, birthweight, gestational week as well as the number of previous births, but not with ART (Table 2). Consequently, our hypothesis was corroborated by our results. Our results partly follow those of several other studies (Berntsen *et al.*, 2019; Helmerhorst *et al.*, 2004; Koudstaal *et al.*, 2000; Malchau *et al.*, 2014; Pandey *et al.*, 2012; Slavov, 2021; Wyns *et al.*, 2017; Zadori *et al.*, 2003) but contrast with the recently published studies by Chen *et al.* (2023) and Londero *et al.* (2023). In our study, the increased rates of breech presentation in ART-conceived newborns cannot solely be explained by ART treatment itself. While older maternal age increased the risk of breech presentation significantly, a higher number of previous births (OR = 0.84) and a higher gestational week – even among term births – (OR = 0.60) led to the greatest decrease in the risk of breech presentation.

We are aware that our sample size is tiny in comparison with those of Chen *et al.* (2023) and Londero *et al.* (2023), and that this fact is a major limitation of our study. Nevertheless, we could verify our hypothesis. For our sample, the higher rates of breech presentation among IVF and ICSI pregnancies may not be due to the ART treatment alone but might be due to the mostly higher maternal age, the lower parity, and shorter pregnancy among women suffering from infertility (Table 2).

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**Competing interests.** The authors have no conflict of interest to declare.

**Ethical standard.** The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of Vienna (responsible for Public Hospitals) (Protocol number: EK 19-274-VK 18 March 2020).

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