



Maternal and neonatal outcome after vaginal breech delivery of nulliparous versus multiparous women of singletons at term—A prospective evaluation of the Frankfurt breech at term cohort (FRABAT)



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ARTICLE INFO

Article history:

Received 17 March 2020

Accepted 24 March 2020

Keywords:

Vaginal delivery

Breech

Delivery mode

Nulliparous

ABSTRACT

Introduction: The best way to deliver a term breech infant is still a much discussed topic among obstetricians. The question whether nulliparity should be considered an exclusion criterion for an intended vaginal breech delivery is not fully answered.

Objective: We compared maternal and neonatal outcome of intended vaginal breech deliveries of nulliparous versus multiparous women at term.

Study design: We conducted a prospective case-control study between January 2004 and December 2016. 1046 women expecting singletons at term with favorable pelvic measurements were enrolled in the study.

Results: Neonatal morbidity and mortality was not significantly different in deliveries of nulliparous (n = 647) versus multiparous (n = 399) women. Nulliparous women had a significantly higher rate of a cesarean section during labor than multiparous women. Maternal birth-injury rates and the use of epidural anesthesia were significantly higher comparing vaginal births of nulliparous (n = 384) versus multiparous (n = 331) women.

Conclusion: Nulliparity seems not be an exclusion criterion for intended vaginal breech birth at term. It is still important to inform the women of an increased risk of a cesarean section during labor. A clinical management built on this evidence might reduce negative implications for future pregnancies.

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Introduction

The safest way to deliver a term breech infant is still a frequently discussed topic among obstetricians around the world. Since up to 4% of fetuses are in breech presentation at term, a substantial number of patients seek counseling regarding the most successful and safest mode of delivery. Most clinicians would recommend an elective cesarean section in this clinical scenario according to general consensus and in fear of future medico-legal consequences. An attempt for a vaginal delivery would only be reasonable in a specialized center, if the fetal weight is estimated in the normal range and if the woman experienced a vaginal delivery before.

Evidence is sparse and inconsistent on clinically relevant inclusion and exclusion criteria for a vaginal breech approach. In the Term Breech Trial [1] no significant relationship of parity and neonatal morbidity and mortality could be detected. In the PREMODA study [2], on the other hand, a significant association between the parity of the mothers, maternal age, birth weight, gestational age and adverse fetal outcomes was observed. Hence, most international guidelines recommend a planned cesarean section to deliver a breech baby of a nulliparous patient at term [3–6]. We therefore decided to take a more detailed look at “nulliparity” as an exclusion criterion for a vaginal breech birth. This prospective case-control study was designed to evaluate the safety and success of vaginal breech births at term in nulliparous compared to multiparous women. We hypothesize that [1] the rate of neonatal morbidity and mortality - with special attention to hypoxia and adverse neurological outcomes - associated with vaginal breech delivery is higher of nulliparous compared to multiparous women and [2] nulliparous women have a higher likelihood to be subjected to cesarean section within the course of the delivery.

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Materials and methods

This prospective case-controlled study was conducted between January 2004 and December 2016 with approval of the Ethics Committee of the Goethe University, Frankfurt (Internal Reference Number: 420/11 and 127/11). We evaluated anonymized data routinely collected during patient care.

In our center providing subspecialty perinatal care, 1046 patients presented with a breech fetus at term (>37 weeks of gestation). Women were counseled regarding their options for delivery (external cephalic version, vaginal births and cesarean section) following a standardized protocol. Nulliparous patients who decided on a vaginal approach were subjected to Magnetic Resonance Imaging (MRI) for pelvic assessment. We measured the obstetric conjugate (CVO, from the sacral promontory to the backside of the bottom edge of the symphysis pubis in the mid-sagittal plane) representing the pelvic inlet as well as the intertuberous distance representing the pelvic outlet (Klemm et al.) [7].

A patient's intent for a vaginal breech delivery, an estimated fetal weight of 2500 g, an adequate fetal weight gain after the last ultrasound, and – specifically for nulliparous women – a CVO of 12 cm or greater as well as an intertuberous distance greater than 11 cm were mandatory for the inclusion in this study. Exclusion criteria were a gestational age of less than 37 + 0 weeks, an estimated fetal weight under 2500 g, nulliparous women with an inadequate pelvis, lethal congenital malformations or a previous cesarean section.

We included a total of 1046 patient – 647 nulliparous and 399 multiparous women – in this study (Fig. 1). The state database – Perinatalerhebung Hessen – was used to identify breech births between January 2004 and December 2016 and relevant data was extracted for each mother and neonate. Additional information regarding demographic characteristics or study outcomes (e.g. admission to the neonatal intensive care unit (NICU) for more than 4 days after birth) was gathered from electronic medical records and discharge letters.

Experienced obstetricians, who were certified for 'Maternal-Fetal Medicine' by the German Medical Board, cared for the patients. The vaginal breech delivery was mainly conducted in an upright position since Louwen et al. [8] documented favorable maternal and fetal outcomes associated with this approach. Rarely, the obstetrician in charge chose to turn the mother in a dorsal position to perform manual assistance when required. All birth positions were included in this study. The trial of labor was aborted and a cesarean section was performed when non-reassuring or ominous fetal heart tone tracing, arrest of labor during first or second stage of delivery or maternal exhaustion occurred.

As primary outcomes, we investigated "neonatal morbidity" and "mortality" after breech birth of nulliparous versus multiparous women represented by the following variables: APGAR scores, neonatal death, admission to the NICU after delivery as well as pH

and base excess of the cord blood. As secondary outcome measures of interest, we evaluated "spontaneous breech birth" or "birth by cesarean section during labor" as well as maternal morbidity. Also, numerous maternal and fetal demographic variables were collected such as the Body Mass Index (BMI), age of the mothers at birth, epidural anesthesia during birth, maternal birth-injury, weeks of gestation at delivery as well as the sex, length, head circumference and weight of the infant.

Differences of patients' characteristics between the two groups – nulliparous versus multiparous patients – were tested using Pearson's chi-squared test and Fishers exact test. Odds ratio and respective confidence intervals were obtained using JMP software (SAS Institute, Cary, USA). In cases of steady value scales (e.g. age, BMI), mean and standard deviation were calculated and Student's *t*-test was applied (with Welch's correction in cases of unequal variances) using JMP software (SAS Institute, Cary, USA).

Results

In Table 1, we present the demographic characteristics of our 1046 participants comparing nulliparous (NP) versus multiparous (MP) women. NP patients were significantly younger (31.5 versus 33.4 years in MP). Between both groups, the mean BMI (body mass index), the rate of gestational diabetes and the number of patients with internal preconditions were not significantly different. NP delivered at 39.9 weeks of gestation compared to MP patients who delivered babies with a mean gestational age of 39.8 weeks. The frank breech was the most common fetal position in both groups (Table 1).

Neonatal outcomes

Neonatal morbidity and mortality were not significantly different in all deliveries of NP versus MP women. More precisely, there was no significant difference between the groups regarding the rate of 5 min APGAR below 4 (NP: 0.4 %, MP: 0.0 %, $p = 0.116$), a stay at the NICU > 4 days (NP: 3.4 %, MP: 1.4 %, $p = 0.224$) or neonatal injuries caused by the delivery (NP: 0.6 %, MP: 0.2 %, $p = 0.442$). Neither did we detect a significant difference in the frequency of perinatal asphyxia (NP: 0.38 %, MP: 0.1 %, $p = 0.399$) or neurological deficits (NP: 0.5 %, MP: 0.3 %, $p = 0.969$) (Table 3). We repeated our statistical analysis comparing 399 multiparous women with a randomly chosen subgroup of 399 nulliparous cases aiming to compare equal sample sizes. Here, neonatal morbidity and mortality was also not significantly different. (Data not shown)

In order to refine our analysis of neonatal adverse outcomes, we applied a score adapted from the PREMODA study [2]. When one or more of the following criteria were met, we defined the case as an adverse outcome: death within 1 year after delivery, intubation >24 h, 5' APGAR < 4, stay in a NICU > 4 days, seizure <24 h after birth or

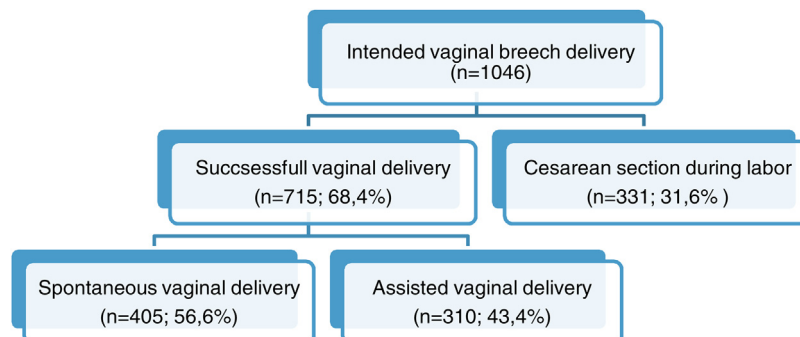


Fig. 1. Trial design showing data for successful vaginal deliveries.

Table 1
Characteristics of the study population and presentation of Breech in labour.

Characteristic	Nulliparous (n = 647)	Multiparous (n = 399)	P value
Age (mean, st.dev.)	31.5 (4.1)	33.4 (4.6)	<0.0001
BMI (mean, st.dev.) *	23.2 (3.7)	23.1 (4.2)	0.18
Pregnancy duration in weeks (mean, st.dev.)	39.9 (8.4)	39.8 (8.3)	0.0001
Gestational diabetes, diet	22 (3.4 %)	18 (4.5 %)	0.36
Gestational diabetes, insulin	13 (2.0 %)	6 (1.5 %)	0.55
Cervical insufficiency	4 (0.6 %)	5 (1.2 %)	0.28
Internal preconditions (Hypertension, Anemia, Hypo- and Hyperthyroidism etc.)	88 (13.6 %)	71 (17.9 %)	0.07
Fetal birth weight g (mean, st.dev.)	3342.0 (430.5)	2286.6 (414.8)	0.067
Type of breech (n, %)			0.0065
Frank	405 (62.6 %)	234 (58.6 %)	
Complete	43 (6.6 %)	46 (11.5 %)	
Incomplete	61 (9.4 %)	49 (12.3 %)	
Footling	29 (4.4 %)	11 (2.7 %)	
Oblique Lie	2 (0.3 %)	5 (1.2 %)	
Missing data	107 (16.5 %)	54 (13.5 %)	

birth trauma (e.g. bone fracture, excluding hematoma). Using the adapted PREMODA score, we also detected no significant differences between the two groups (NP: 4.0 %, MP: 1.6 %, $p = 0.126$).

We evaluated perinatal morbidity specifically related to the delivery by excluding cases with adverse outcomes related to causes not related to the birth process such as amniochorionitis, neonatal malformations or infections. Here, the newborns of the intended vaginal deliveries of nulliparous women also did not show a significant higher perinatal morbidity than the newborns of multiparous women (Odds Ratio 1.52, CI 5 %–95 % 0.88–1.64) (Table 3).

We conducted a sub-analysis by restricting our investigation only to the neonatal outcomes after successful vaginal delivery. Here, infants of nulliparous ($n = 384$) women were compared to the offspring of multiparous patients ($n = 331$). 5' APGAR, long stays on the NICU (>4 days), perinatal asphyxia or rates of birth injuries were not significantly different between the two groups. The analysis did indicate that neonates of nulliparous women had a significant higher rate of short time adaption problems with breathing and bradycardia compared to their counterparts (NP: 3.22 %, MP: 1.26 %, $p = 0.0349$). Also, using the adapted PREMODA score (Table 5) or an equal sample size in both groups (331 women chosen by random selection as described before), no significant differences in neonatal outcomes were detected.

Mode of delivery

715/1046 (68.4 %) women experienced a vaginal birth, 331/1046 (31.6 %) of patients were subjected to a cesarean section during labor. The rate of cesarean sections was significantly higher in the group of nulliparous women with 40.65 % compared to 17.04 % in the multiparous group (OR of 2.385, 5 %–95 % CI 1.88–3.02, $p < 0.0001$). When we analyzed the clinical indications for cesarean sections during labor, the percentage of procedures due to maternal exhaustion was significantly higher in the group of nulliparous women than in multiparous patients (NP: 3.9%; MP: 2.1% $p = 0.0098$). No other significant differences were detected (Table 2).

In a refined sub-analysis, we compared all successful vaginal deliveries of nulliparous ($n = 384$) patients to the group of multiparous women ($n = 331$). The analysis revealed that women giving birth to their first child had a significantly higher overall rate of birth injuries (NP: 44.1 %) compared to multiparous women (MP:

30.1 %, $p = <0.0001$). When the severity of perineal lacerations was compared, the percentages of perineal tears grade III and IV showed no significant difference between the two groups (NP: 1.4 %, MP: 0.7 %, $p = 0.307$). The frequency of manual assisted vaginal birth was higher in the group of the nulliparous (NP: 27.3 %) compared to multiparous (MP: 16.9 %) women. A higher percentage of nulliparous than multiparous women (NP: 37.1 % versus MP: 19.0 %) gave birth under epidural anesthesia (Table 4).

Discussion

Since some international guidelines still recommend “nulliparity” as exclusion criterion for a vaginal breech birth, we designed this study to challenge this common clinical practice and take a more detailed look at the safety and success of vaginal breech births at term in nulliparous compared to multiparous women. Our data showed that neonates of nulliparous women had no increased overall morbidity associated with vaginal breech birth. We documented a significant higher rate of neonatal short-time adaption problems (1-min APGAR) compared to their counterparts born by multiparous women.

In 2017, a retrospective analysis of a small vaginal breech cohort was conducted in Portugal. Here, neonatal outcomes were compared of 1262 elective cesarean sections (95.1 %) with 65 vaginal deliveries (4.9 %). The authors described a low neonatal morbidity in the vaginal breech group with impairment lasting only short term and indicating good overall outcomes. Hence, their data support our results of low neonatal morbidity after vaginal breech birth. However, their results have to be seen critically - as commented by the authors themselves. Lack of data concerning important outcomes such as the duration of the hospital stay for newborns admitted to the NICU and hypoxia might have compromised their results. Data regarding umbilical cord blood analysis as an important quality measure were only available in 10 % of neonates in each group [9]. The higher rate of short-time adaption problems of the neonates born by nulliparous women could be linked to an on average prolonged first and second stage of labor compared to multiparous women [10–12] as delay in the labor progress can increase the need for intervention and adversely affected fetal outcome [13]. In the PREMODA study [9], aiming to describe the neonatal morbidity and mortality for the entire population according to the planned mode of delivery, the authors did not conduct a detailed comparison of nulliparous and multiparous women. But the parity of the women was among other factors such as maternal age, gestational age, birth weight and status of the maternity ward, described as a factor associated not only with

Table 2
Outcome cesarean section.

Cesarean (n, %) (OR, 95 % confidence interval)	263 (40.65 %) (2.385, 1.88–3.02)	68 (17.04 %)	< 0.0001
Reason for cesarean (n, %)	% of cesarean	% of cesarean	
Maternal wish	13 (4.9 %)	7 (10.3 %)	0.098
Delay in stage 1	97 (36.8 %)	23 (33.8 %)	0.64
Delay in stage 2	78 (29.7 %)	14 (20.6 %)	0.14
Abnormal fetal heart tones or doppler	84 (31.9 %)	27 (39.7 %)	0.23
Placental reason	3 (1.1 %)	2 (2.9 %)	0.28
Cord prolapse	10 (3.8 %)	4 (5.9 %)	0.45
Bleeding or premature birth indicators	4 (1.5 %)	0 (0.0 %)	0.31
Maternal reason	3 (1.1 %)	0 (0.0 %)	0.38
Perceived cephalopelvic disproportion	7 (2.7 %)	1 (1.5 %)	0.57
Chorioamnionitis	8 (3.0 %)	2 (2.9 %)	0.97
Other fetal reason	1 (0.4 %)	0 (0.0 %)	0.61
Vaginal delivery (n, %)	384 (59.35 %)	331 (82.96 %)	< 0.0001

Table 3
Intended vaginal breech deliveries – neonatal outcome.

Characteristic	Nulliparous (n = 647)	Multiparous (n = 399)	P value	Odds Ratio (5 %–95 % confidence)
APGAR 5 (n, %)			0.195	
<4	4 (0.6 %)	0 (0.0 %)	0.116	
4 < 7	11 (1.7 %)	10 (2.5 %)		
NICU			0.079	
>4 days	35 (5.4 %)	15 (3.7 %)	0.224	
Up to 4 days	22 (3.4 %)	6 (1.5 %)		
Intubation >24h	6 (0.9 %)	2 (0.5 %)	0.442	
pH arterial blood <7.0	4 (0.6 %)	1 (0.3 %)	0.399	
Short time problems with breathing, bradycardia	36 (5.5 %)	12 (3.0 %)	0.055	
Birth injury	6 (0.9 %)	2 (0.5 %)	0.442	
Neurologic deficits	5 (0.8 %)	3 (0.8 %)	0.969	
Deaths	0 (0.0 %)	1 ^a (0.25%)	0.202	
Umbilical cord complication	64 (9.89 %)	40 (10.03 %)	0.944	
Death or severe perinatal morbidity (PREMODA)	42 (6.49 %)	17 (4.26 %)	0.128	1.524 (0.88–1.64)
Death or severe perinatal morbidity potentially related to delivery mode ^{b,c}	19 ^c (2.94%)	6 ^d (1.5%)	0.141	

^a Anencephaly.

^b Excluded: 20 cases of amniochorionitis, 1 case of intracranial spontaneous bleeding after delivery without birth trauma, 1 case of meconium ileus, 1 case of extensive hyperbilirubinemia, 1 case of intracranial infarction after birth, 2 cases of spontaneous pneumothorax after birth, 1 case of preexisting intracranial cysts causing neurologic deficits, 1 case of arrhythmia associated with TRAK antibodies, 1 case of cardiac malformation (ASD II^o), 1 case of pneumonal artery stenosis, 1 case of G6DPH deficiency, 1 case of blood fetomaternal transfusion complication, 1 case of sleeping myoclonism).

^c Numbers do not add up because one case can meet several criteria. 7 cases of perinatal asphyxia, 10 cases of severe problems adapting after birth, 3 cases of plexus paralysis, 1 case of clavicular fracture.

^d 2 cases of severe problem adapting after birth, 2 cases of perinatal asphyxia, 1 case of plexus paralysis after assisted vaginal birth, 1 case of clavicular fracture.

^e All neonates were dismissed from the hospital in a good overall condition.

Table 4
Vaginal breech deliveries - maternal outcome.

Characteristic	Nulliparous (n = 384)	Multiparous (n = 331) ^a	P value	Odds ratio (5–95% confidence)
Birth injury	315 (82.03 %)	215 (64.95 %)	<0.0001	1.263 (1.152–1.385)
Perineal tear	201 (52.34 %)	152 (45.92 %)	0.087	1.139 (0.980–1.325)
1st ^o perineal tear	115 (29.95 %)	104 (31.42 %)	0.687	0.95 (0.764–1.189)
2nd ^o perineal tear	77 (20.05 %)	45 (13.60 %)	0.021	1.47 (1.053–2.067)
3rd ^o and 4th ^o Perineal tear	10 (2.60 %)	5 (1.51 %)	0.306	1.724 (0.595–4.993)
Episiotomies	16 (4.1 %)	4 (1.21 %)	0.0165	
Injury of Labies or vagina	151 (39.43 %)	58 (17.52 %)	<0.0001	
PDA during birth ^a	238 (67.04 %)	122 (42.66 %)	<0.0001	1.57 (1.349–1.831)
Assisted vaginal birth	189 (49.22 %)	121 (36.56 %)	0.0007	1.346 (1.131–1.603)

^a Data incomplete; 74 Patients missing.

short-time adaption problems, but with neonatal mortality or severe morbidity with a threshold less than 0.10. One could discuss if these differences are caused by the fact that our study is based on a single center providing subspecialty perinatal care, or our patient selection where all nulliparous women were subjected to Magnetic Resonance Imaging (MRI) for pelvic assessment. In the PREMODA study, pelvimetry was performed in 82.4 % of the planned vaginal group.

With a focus on maternal outcomes and the success of the intended vaginal delivery of breech babies, our analysis revealed that nulliparous patients had a significantly greater incidence of birth injuries, higher use of epidural anesthesia and likelihood to undergo a cesarean section during labor than multiparous counterparts. We want to state that these observations are similar for cephalic deliveries and not specific for the vaginal breech deliveries [14]. Thus, clinical counseling regarding maternal outcomes and the rate of cesarean section related to nulliparity does not have to be specifically different in the context of breech birth.

Regarding study limitations we want to mention that our data were based on a single center providing high-standard obstetrical care for a specific patient clientele with a high motivation for vaginal delivery and regular contact to the medical system. With discernible regional differences in cesarean section rates, quality standards in obstetric departments as well as provider experience for vaginal breech

deliveries, some of our findings may not be representable for other hospitals or less developed countries with underserved populations.

Overall, it is a strength of this study that a first systematic analysis of a large cohort of singleton breech deliveries at term was performed comparing outcomes and mode of delivery in nulliparous versus multiparous women. Based on our evidence, we can reject the initial hypothesis of a greater neonatal morbidity and mortality in NP versus MP. Hence, nulliparity does not seem to be an exclusion criterion for an intended vaginal breech delivery of singletons at term. Women should be informed about their options and probabilities when facing a decision regarding the preferred mode of delivery. In our center, we recommend a cesarean section after the onset of labor or rupture of membranes when nulliparous patients opt against vaginal delivery of their breech singleton. This clinical management is based on studies that revealed more favorable neonatal outcomes in this setting compared to planned cesarean sections [15].

To ensure the greatest safety and success for mother and child during a vaginal approach, clinical management of breech birth at term has to be based on strict patient selection according to evidence based criteria, rigorous intrapartum management protocols and provider experience. However, we hope that clinical management build on evidence of this study might reduce elective

Table 5
Successful vaginal breech deliveries – neonatal outcome.

Characteristic	Nulliparous (n = 384)	Multiparous (n = 331)	P value	Odds Ratio (5 %–95 % confidence)
APGAR 5 (n, %)				
<4	3 (0.78 %)	0 (0%)	0.1071	
4 < 7	6 (1.56 %)	9 (2.72 %)	0.1555	
NICU				
>4 days	19 (4.94 %)	11 (3.32 %)	0.2800	
Up to 4 days	12 (3.13 %)	6 (1.81 %)	0.2867	
Intubation >24h	4 (1.04 %)	1 (0.30 %)	0.2367	
pH arterial blood <7.0	3 (0.78 %)	1 (0.30 %)	0.3917	
Short time problems with breathing, bradycardia	23 (5.99 %)	9 (2.72 %)	0.0349	
Birth injury	6 (1.56 %)	2 (0.60 %)	0.2245	
Perinatal asphyxia	7 (1.82 %)	5 (1.51 %)	0.7458	
Neurologic deficits	5 (1.30 %)	2 (0.91 %)	0.3447	
Deaths	0 (0.00 %)	1 ^a (0.30%)	0.2811	
Umbilical cord complication	37 (9.64 %)	28 (8.46 %)	0.5854	
Death or severe perinatal morbidity (PREMODA)	23 (5.99 %)	13 (3.93 %)	0.2086	1.5 (0.785–2.962)
Death or severe perinatal morbidity potentially related to delivery mode ^{b,e}	13 ^c (3.39%)	5 ^d (1.51%)	0.1106	2.24 (0.807–6.221)

^a Anencephaly.

^b Excluded: 20 cases of amniochorionitis, 1 case of intracranial spontaneous bleeding after delivery without birth trauma, 1 case of meconium ileus, 1 case of extensive hyperbilirubinemia, 1 case of intracranial infarction after birth, 2 cases of spontaneous pneumothorax after birth, 1 case of preexisting intracranial cysts causing neurologic deficits, 1 case of arrhythmia associated with TRAK antibodies, 1 case of cardiac malformation (ASD II^o), 1 case of pneumonal artery stenosis, 1 case of G6DPH deficiency, 1 case of blood fetomaternal transfusion complication, 1 case of sleeping myoclonism).

^c Numbers do not add up because one case can meet several criteria. 7 cases of perinatal asphyxia, 10 cases of severe problems adapting after birth, 3 cases of plexus paralysis, 1 case of clavicular fracture.

^d 2 cases of severe problem adapting after birth, 2 cases of perinatal asphyxia, 1 case of plexus paralysis after assisted vaginal birth, 1 case of clavicular fracture.

^e All neonates were dismissed from the hospital in a good overall condition.

cesarean sections rates in the context of breech deliveries and associated negative implications for future pregnancies. In order to achieve international impact and create evidence-based guidelines, studies in multi-center settings are required.

Acknowledgements

I would like to thank our colleagues Matthias Jörgens, Mohib Adjan and Sally Schulze who provided insight and expertise that greatly assisted the research. I am also immensely grateful to my research group for their comments on an earlier version of the manuscript.

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