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ORIGINAL PAPER

The incidence of and risk factors for shoulder dystocia in a tertiary Greek maternity hospital: a retrospective case-control study

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Abstract

Aim: We aimed to determine the incidence of and risk factors for shoulder dystocia in Greek tertiary maternity settings. *Design:* A retrospective case-control study. *Methods:* Study of women who gave birth at the University Hospital of Larissa in Greece between 2019 and 2024. We matched every case of women with shoulder dystocia with ten women giving birth without shoulder dystocia. We compared the maternal demographics and the perinatal outcome between cases and controls. *Results:* A total of 1,536 vaginal births were identified over the study period. There were 21 documented cases of shoulder dystocia (1.4% incidence rate) matched with 210 uncomplicated vaginal births. The median age of women with shoulder dystocia was 28 years (IQR = 25–31), 42.9% were nulliparous, and the median gestational age was 39+2 weeks. There was no postpartum hemorrhage, and perineal trauma was comparable between women with and without shoulder dystocia. No neonates with shoulder dystocia were admitted to the neonatal unit and there were no stillbirths. More than 70% of cases with shoulder dystocia occurred during the afternoon and evening hours. The percentage of male neonates was significantly higher in cases with shoulder dystocia (76.2% vs. 51%; p = 0.02). The only independent predictor for shoulder dystocia was birthweight (OR = 1.24; 95% CI, 1.09–1.40). *Conclusion:* The incidence of shoulder dystocia and perinatal outcomes are in line with the literature. These local data reflect an efficient maternity service provision and can be used as a benchmark for future comparisons and evaluation, since there is no other similar study within Greek clinical settings that reports on shoulder dystocia.

Keywords: maternal outcome, neonatal outcome, shoulder dystocia, vaginal birth

Introduction

Shoulder dystocia is by definition a vaginal cephalic birth that requires additional obstetric maneuvers to deliver the body of the fetus after the head has been delivered and gentle traction has failed to effect birth (Royal College of Obstetricians and Gynecologists [RCOG], 2012). Another more objective diagnosis of shoulder dystocia based on the use of fetal head-to-body delivery time of more than 60 seconds has also been proposed (American College of Obstetricians and Gynecologists [ACOG], 2017; RCOG, 2012). It is essentially characterized by the anterior fetal shoulder becoming wedged and impacted behind the maternal pubic symphysis following the birth of the fetal head. Due to the compression of the umbilical cord between the fetal body and the side walls of the maternal pelvis, there is a limited blood supply to the fetal brain, thus exposing the fetus to significant brain hypoxia, which may inadvertently lead to death (Maternal and Child Health Research Consortium, 1998).

According to the literature, the incidence of shoulder dystocia varies widely, with reported rates ranging from 0.15% to 3% (Jeppegaard et al., 2024; Tsikouras et al., 2024) and can reach up to 20% in neonates with a birth weight exceeding 4500 g (RCOG, 2012). This obstetric complication may occur unexpectedly even when there are no risk factors present and the outcome may be severe maternal complications, neonatal morbidity,

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and mortality (RCOG, 2012). Risk factors that have been suggested involve pre-pregnancy factors such as maternal short stature and obesity, and intrapartum factors such as induced labor, oxytocin use, prolonged second stage of labor, and instrumental vaginal delivery (Jeppegaard et al., 2024; RCOG, 2012). Maternal complications that may occur in the event of shoulder dystocia are severe perineal trauma and postpartum hemorrhage, while the neonate may suffer bone fractures, neurological injury of the upper extremities, cerebral palsy or even death (Jeppegaard et al., 2024; RCOG, 2012).

It has been reported that the availability of guidelines for shoulder dystocia management alone is insufficient to ensure sound and effective obstetric practice (Johansen et al., 2021). It has been proposed that consistent educational sessions and hands-on simulation training with recorded participation by healthcare professionals should be introduced to enhance knowledge and maintain clinical competencies (National Health Service [NHS] Litigation Authority, 2010; Papoutsis et al., 2024). The NHS Litigation Authority (2010) report identified neonatal brachial plexus injury as the third most frequently litigated obstetric complication in the UK, with 46% of these cases linked to substandard care. The report indicated that the staff involved did not adequately perform the necessary childbirth maneuvers to relieve the impacted fetal shoulder. Consequently, the literature supports the use of mandatory, regular simulation training for all maternity staff in the management of shoulder dystocia (Crofts et al., 2007; Mannella et al., 2016; Papoutsis et al., 2024; Siassakos et al., 2010). The impact of this simulation training on neonatal outcomes has shown mixed results; nevertheless, most studies have reported a significant reduction in birth-related neonatal trauma (Gurewitsch Allen, 2016).

Aim

We conducted a retrospective study to determine the incidence of shoulder dystocia in a tertiary maternity hospital in Greece and to compare this with existing literature data. We aimed to collect local data and evaluate maternity services in the management of shoulder dystocia, as no comparable study has been conducted in Greece. We also sought to identify any potential predictors of shoulder dystocia and compare them with the risk factors referenced in the literature for maternal populations from other countries.

Methods

Design

This retrospective case-control study involved a review of medical charts for women who delivered at the University Hospital of Larissa, Greece, between May 2019 and March 2024. The hospital's birth register for the study period was manually searched by the investigator (NC) to identify women who had experienced shoulder dystocia.

Sample

Once a case of shoulder dystocia was identified, the individual birthing notes were retrieved, along with the birthing notes of the previous five vaginal births and the subsequent five vaginal births, so that every one woman with shoulder dystocia (group of cases) was matched with ten women without shoulder dystocia (control group). The study received ethical approval from the Institutional Review Board of the University of Thessaly in Greece (No. 637/08.07.2024).

Data collection

All women who had a vaginal birth of a singleton, term fetus in cephalic presentation during the study period were considered eligible for inclusion. Women with preterm birth, multiple gestation, or non-cephalic presentation were excluded. Data manually extracted from the women's birthing notes included maternal demographics, labor characteristics, neonatal outcomes, maternal outcomes, and the obstetric maneuvers employed to manage shoulder dystocia.

Data analysis

Quantitative variables were expressed as mean (standard deviation) and median values (interquartile range), while categorical variables were expressed as absolute and relative frequencies. Logistic regression analysis, using a stepwise method (p for entry = 0.05, p for removal = 0.10), was employed to identify independent factors associated with the occurrence of shoulder dystocia. ROC (Receiver Operating Characteristic) curves analysis was used to estimate the predictive ability of any quantitative independent factors associated with the occurrence of shoulder dystocia. The AUC (Area Under the Curve) value was also calculated, along with sensitivity and specificity, to identify the optimal cut-offs. All reported p-values were two-tailed. Statistical significance was set at $p < 0.05$, and analyses were conducted using SPSS statistical software (version 26.0).

Results

A total of 1,536 vaginal births were recorded at the maternity unit of the University Hospital of Larissa from May 2019 to March 2024, of which 21 were documented cases of shoulder dystocia (1.4%). In accordance with our study design, 210 vaginal births without shoulder dystocia during the same period were selected as the control group for comparison with the 21 cases. Table 1 presents the maternal demographics and labor characteristics of the study participants. Among the 21 women who experienced shoulder dystocia, the median age was 28 years (IQR, 25–31), 42.9% were nulliparous, and none had a history of previous shoulder dystocia or gestational diabetes mellitus. Labor was induced in 28.9% of occasions, and the median gestational age was 275.5 days (IQR = 273–280) or the equivalent of 39+2 weeks of gestation. Oxytocin was administered intrapartum in 66.7% of women with shoulder dystocia, whereas epidural analgesia was recorded in only 4.8% of the cases. The rate of episiotomy was nearly doubled in births complicated by shoulder dystocia (66.7% vs. 35.7%). In the 21 women with shoulder dystocia, no postpartum hemorrhage was observed, and the rates of perineal trauma were comparable with the rates of perineal trauma in women without shoulder dystocia. The duration of the first and second stages of labor for women with shoulder dystocia was greater compared to women without shoulder dystocia, although this finding did not reach statistical significance. Among cases of shoulder dystocia, 71.4% occurred during the afternoon (12:00–18:00) and evening (18:00–24:00) hours, compared with 61.8% of uncomplicated vaginal births during the same period.

Table 2 shows that none of the neonates with shoulder dystocia were admitted to the neonatal intensive care unit and no stillbirths were documented. In addition, there were no cases of brachial plexus injury identified in the neonates that were born with shoulder dystocia. When compared to the control group, the percentage of male neonates was significantly higher in cases with shoulder dystocia (76.2% vs. 51.0%; p = 0.02). The mean neonatal birth weight was also significantly higher in cases of shoulder dystocia compared to the neonates born without shoulder dystocia (3,564.8 ± 429.6 g vs. 3,142.2 ± 539.5 g; p = 0.001). Maneuvers used to manage shoulder dystocia included the McRoberts maneuver in three cases (14.3%), a combination of the McRoberts and Rubin-I (suprapubic pressure) maneuvers in 12 cases (57.1%), and in six cases (28.6%) no maneuver was recorded in the maternal notes (Table 2).

Multiple logistic regression analysis in a stepwise method showed that neonatal birth weight was the only independent predictor of the occurrence of shoulder dystocia (OR = 1.24; 95% CI, 1.09–1.40). ROC analysis revealed that neonatal birth weight had a significant predictive value for shoulder dystocia with AUC = 0.74 (95% CI, 0.63–0.85; p < 0.001) (Figure 1). The optimal cut-off value of neonatal birth weight as a predictor of shoulder dystocia was estimated to be 3,335 g (sensitivity 81%, specificity 64.3%).

Table 1 Maternal demographics and labor features in women with (N = 21) and without (N = 210) shoulder dystocia (Part 1)

		Shoulder dystocia				
		No (N = 210)		Yes (N = 21)		
		N	%	N	%	P
Maternal age	mean (SD) median (IQR)	29.8 (6.6)	31 (26–35)	28 (5.8)	28 (25–31)	0.211+
Parity	0	73	34.9	9	42.9	0.470‡
	≥ 1	136	65.1	12	57.1	
Gestational age (in days)	mean (SD) median (IQR)	270.1 (14.7)	273 (267–278)	274.9 (6.8)	275.5 (273–280)	0.157+
Onset of labor	induction of labor	74	35.4	6	28.6	0.531‡
	spontaneous onset	135	64.6	15	71.4	
ARM / SROM	ARM	123	62.4	12	60.0	0.830‡
	SROM	74	37.6	8	40.0	

ARM – artificial rupture of membranes; SROM – spontaneous rupture of membranes; SD – standard deviation; IQR – interquartile range; +Student's t-test; ++Mann-Whitney test; ‡Pearson's chi-square test; ‡‡Fisher's exact test

Table 1 Maternal demographics and labor features in women with (N = 21) and without (N = 210) shoulder dystocia (Part 2)

		Shoulder dystocia				
		No (N = 210)		Yes (N = 21)		
		N	%	N	%	P
Amniotic fluid	clear	140	89.7	14	100.0	> 0.999‡‡
	mildly meconium stained	10	6.4	0	0.0	
	moderately stained	4	2.6	0	0.0	
	severely meconium stained	2	1.3	0	0.0	
History of previous shoulder dystocia	no	210	100.0	21	100.0	-
	yes	0	0.0	0	0.0	
Pre-existing DM / GDM	no	205	97.6	21	100.0	> 0.999‡‡
	pre-existing DM	3	1.4	0	0.0	
	GDM	2	1.0	0	0.0	
Epidural analgesia	no	188	89.5	20	95.2	0.703‡‡
	yes	22	10.5	1	4.8	
Time duration from placement of epidural analgesia to full dilatation of cervix (onset of 2nd stage) (in minutes)	mean (SD) median (IQR)	162.9 (111.3)	160 (90–210)	196 (0)	196 (196–196)	0.581++
Oxytocin use	no	57	27.1	7	33.3	0.546‡
	yes	153	72.9	14	66.7	
Total time duration of oxytocin use (in minutes)	mean (SD) median (IQR)	173.3 (158.7)	135 (36–265)	187.6 (166.8)	132.5 (45–340)	0.625++
Assisted (instrumental) delivery	no	190	90	18	85.7	0.487‡
	yes	20	10	3	14	
Time of the day at delivery	early morning (00:00–06:00)	35	16.7	2	9.5	0.626‡‡
	late morning (06:00–12:00)	45	21.5	4	19.0	
	afternoon (12:00–18:00)	85	40.7	8	38.1	
	evening (18:00–24:00)	44	21.1	7	33.3	
Duration of the first stage of labor (minutes)	mean (SD) median (IQR)	469.1 (269.8)	377.5 (285–630)	596.3 (333.6)	560 (320–872.5)	0.418++
Duration of the second stage of labor (minutes)	mean (SD) median (IQR)	25.5 (33.6)	15 (10–25)	33.8 (30.7)	20 (12.5–46)	0.099++
PPH	no	209	99.5	21	100.0	> 0.999‡‡
	yes	1	0.5	0	0.0	
Perineal trauma	no	169	80.5	16	76.2	0.578‡‡
	yes	41	19.5	5	23.8	
Cervical tears	no	203	96.7	21	100.0	> 0.999‡‡
	yes	7	3.3	0	0.0	
Vaginal tears	no	187	89.0	19	90.5	> 0.999‡‡
	yes	23	11.0	2	9.5	
Episiotomy	no	135	64.3	7	33.3	0.005‡
	yes	75	35.7	14	66.7	
Placental delivery	spontaneous	186	98.9	21	100.0	> 0.999‡‡
	retained placenta	2	1.1	0	0.0	

DM – diabetes mellitus; GDM – gestational diabetes mellitus; PPH – post-partum hemorrhage; SD – standard deviation; IQR – interquartile range; +Student's t-test; ++Mann-Whitney test; ‡Pearson's chi-square test; ‡‡Fisher's exact test

Table 2 Neonatal features with (N = 21) and without (N = 210) shoulder dystocia, and the obstetric maneuvers that were applied to manage the shoulder dystocia

		Shoulder dystocia				
		No (N = 210)		Yes (N = 21)		
		N	%	N	%	P
Gender of newborn	male	107	51.0	16	76.2	0.027‡
	female	103	49.0	5	23.8	
Birth weight	mean (SD) median (IQR)	3142.2 (539.5)	3230 (2920–3480)	3564.8 (429.6)	3590 (3350–3740)	0.001+
Live birth / stillbirth	live birth	209	99.5	21	100.0	> 0.999‡‡
	stillbirth	1	0.5	0	0.0	
Nuchal cord	no	157	75.1	13	61.9	0.189‡
	yes	52	24.9	8	38.1	
Admitted to NICU	no	198	95.7	21	100.0	> 0.999‡‡
	yes	9	4.3	0	0.0	
Maneuver(s) applied to manage shoulder dystocia	not recorded in maternal notes	-	-	6	28.6	-
	Mc Robert's maneuver	-	-	3	14.3	
	Mc Robert's maneuver AND Rubin-I maneuver	-	-	12	57.1	

NICU – neonatal intensive care unit; SD – standard deviation; IQR – interquartile range; +Student's t-test; ‡Pearson's chi-square test; ‡‡Fisher's exact test

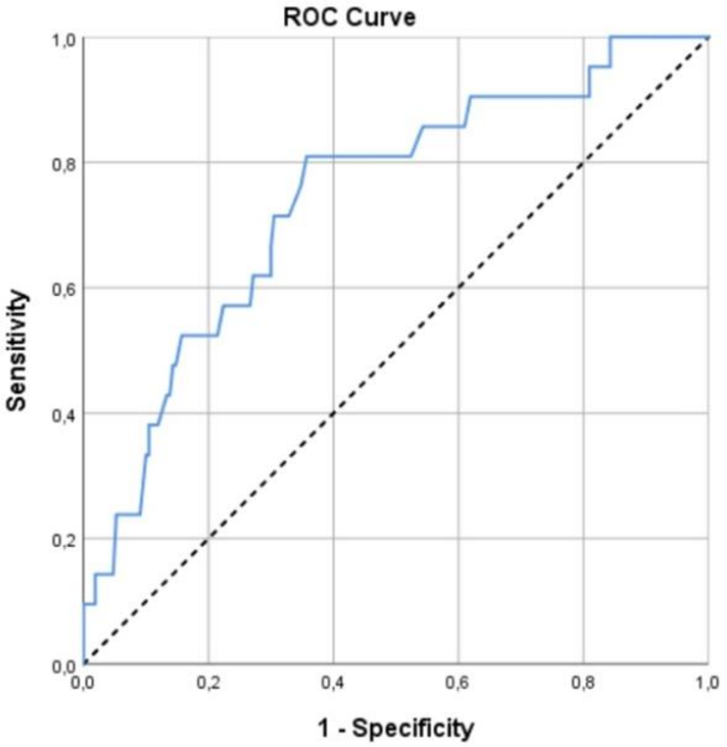

Figure 1 The ROC curve for the predictive value of neonatal birth weight for the occurrence of shoulder dystocia

Discussion

The reported incidence of shoulder dystocia varies widely (RCOG, 2012). Large population-based studies report rates between 0.58% and 0.70% (RCOG, 2012), whereas more recent studies report a broader range, from 0.15% to 3% (Jeppegaard et al., 2024; Tsikouras et al., 2024). In our retrospective study of 1,536 vaginal births occurring between 2019 and 2024, the incidence of shoulder dystocia was 1.4%. Although this incidence aligns with previously reported values in the literature, a larger sample size might have yielded a different incidence of shoulder dystocia. Nevertheless, the maternal demographics and labor characteristics of our sample are comparable to those of other nationwide studies of the general maternal population in Greece (Papoutsis & Chatzipanagiotidou, 2023); therefore, the 1.4% incidence of shoulder dystocia observed in our study may be considered a reliable estimate of its occurrence among Greek women in labor.

When shoulder dystocia occurs, a series of maneuvers must be performed in an orderly, sequential, and timely manner to safely and effectively disimpact the anterior shoulder from the maternal symphysis. In our study, shoulder dystocia was resolved with the application of either the McRoberts' maneuver alone or in combination with the Rubin-I (suprapubic pressure) maneuver. This indicates that shoulder dystocia in our study was managed within 30 seconds to 1 minute, as each maneuver, when applied, typically lasts no longer than 30 seconds (Hill et al., 2020). Timeliness is critical in vaginal births complicated by shoulder dystocia; indeed, 47% of neonatal deaths occurred when the head-to-delivery interval exceeded 5 minutes (Maternal and Child Health Research Consortium, 1998; RCOG, 2012). The McRoberts maneuver alone or in combination with the Rubin-I (suprapubic pressure) maneuver has a high success rate ranging between 75% to 90% of cases of shoulder dystocia (Heinonen et al., 2024; RCOG, 2012).

The local data from our study on shoulder dystocia management reflect the provision of safe, timely, and efficient maternity services within our maternity unit. We found no maternal complications or neonatal morbidity following a shoulder dystocia event. This can be explained by the fact that delivery of the impacted shoulder was achieved within 30 seconds to 1 minute, which falls well within the 5-minute time frame cited in the literature, beyond which brain hypoxia becomes clinically significant and may result in severe neonatal morbidity and mortality (Maternal and Child Health Research Consortium, 1998; Mendez-Figueroa et al., 2021). The shoulder dystocia was resolved using simple maneuvers, such as the McRoberts maneuver and suprapubic pressure, which have low complication rates and are considered among the least invasive techniques. According to the literature, neonatal trauma – such as brachial plexus injury and bone fractures – occurs in 5.2% of deliveries complicated by shoulder dystocia (Davis et al., 2023), while maternal complications are reported in 14.7% of cases (Mendez-Figueroa, 2021).

Several antenatal and intrapartum risk factors have been reported to be associated with shoulder dystocia; however, none of these, either singly or in combination, allow for the accurate prediction of shoulder dystocia (RCOG, 2012). Therefore, the literature warns that clinicians should always be aware of existing risk factors in laboring women and must always be alert to the possibility of shoulder dystocia (RCOG, 2012). In our study, we found a relationship between fetal size and shoulder dystocia, a finding that has been reported previously (Øverland et al., 2012). Mean neonatal birth weight was significantly higher in cases of shoulder dystocia compared to neonates born without shoulder dystocia (3,564.8 ± 429.6 g vs. 3,142.2 ± 539.5 g; $p = 0.001$). Multiple logistic regression analysis showed that neonatal birth weight was the only independent predictor of the occurrence of shoulder dystocia (OR = 1.24; 95% CI, 1.09–1.40). In a comparative review of national guidelines for the management of shoulder dystocia, only macrosomia (> 4.5 kg) – and not generally suspected increased birth weight – has been established as a risk factor, leading to recommendations for induction of labor only in diabetic women. Routine induction of labor based solely on suspected fetal macrosomia is uniformly not recommended (Giouleka et al., 2024).

Among cases of shoulder dystocia, 71.4% occurred between 12:00 p.m. and 12:00 a.m., compared with 61.8% of uncomplicated vaginal births during the same period. Few studies in the literature have examined the timing of births and the potential implications for midwifery and medical staffing. A large population-based study conducted in England in 2018 found that births following induced labor most commonly occur in the hour before midnight, whereas spontaneous births after natural labor onset tend to peak around 4:00 a.m. (Martin et al., 2018). However, another population-based study from the United States in 2015 demonstrated different birth patterns, with vaginal births after spontaneous onset occurring more frequently between 12:00 p.m. and 5:00 p.m. than at other times (Mathews & Curtin, 2015). A possible explanation offered for this difference in the timing of births is that women who received intrapartum care from midwives had shorter labors than those who had care from obstetricians (Heres et al., 2000). It has been reported that in England, midwives are the primary intrapartum care providers, whereas in the United States, the proportion of women receiving midwifery intrapartum care is low (Martin et al., 2018). In our study, the fact that the majority of vaginal births – and consequently the occurrence of shoulder dystocia – occurred around 12:00 p.m.

and in the evening suggests that our current obstetric practice is likely similar to intrapartum care patterns observed in the United States; our local intrapartum care is predominantly provided by obstetricians rather than midwives, and consequently, most births occur outside the typical morning working hours. This variation in birth timing patterns across different maternal populations and obstetric practices highlights the importance of considering local data when making decisions about midwifery and medical staffing in the birthing suite.

We also found that the percentage of male neonates was significantly higher in cases with shoulder dystocia compared to those without (76.2% vs 51%; $p = 0.02$), although multiple regression analysis did not identify male gender of the neonate as an independent risk factor for shoulder dystocia. This may be explained by the fact that male neonates generally have higher birth weights than females (Antonakou & Papoutsis, 2016), and thus male sex in our study is likely confounded by increased birth weight, which emerged as an independent risk factor. Some studies have shown that male and female fetuses exhibit differences in growth and development in utero due to sex-biased gene expression, leading to divergent growth patterns, with male fetuses growing faster in utero than females (Buckberry et al., 2014; Edwards et al., 2000; Misra et al., 2009). Several studies have explored the independent effect of infant male sex on the risk of shoulder dystocia and its interaction with other risk factors (Patumanond et al., 2010). Male sex has been identified as a risk factor for shoulder dystocia, independent of other known risks, and may also amplify the effect of higher birth weight (Patumanond et al., 2010). Our study was likely underpowered to detect this effect, if present.

Among the other risk factors for shoulder dystocia reported in the literature, we identified no additional factors beyond neonatal birth weight. All study participants had no previous history of shoulder dystocia, which is associated with a 6- to 30-fold increased risk of recurrence in a subsequent vaginal delivery (Gurewitsch Allen, 2016). On the other hand, we identified a statistical trend in the duration of the second stage of labor for women with shoulder dystocia, which was greater compared to women without shoulder dystocia, although this finding did not reach statistical significance ($p = 0.09$).

Limitation of study

This study has several limitations that should be acknowledged. First, it was a retrospective case-control study, with all the inherent limitations associated with retrospective data collection. Because the birth register used to screen and identify the study population was handwritten rather than electronic, there was a high potential for misclassification bias and missing data. This limitation was indeed observed: in 6 of the 21 cases of shoulder dystocia, the obstetric maneuvers used to manage the condition were not recorded in the birthing notes. Second, the study population cannot be considered representative of the entire Greek maternal population as it involved a single center. Furthermore, shoulder dystocia is an obstetric emergency with a low incidence, meaning that a single-center study is unlikely to identify novel risk factors, which would require a larger sample size.

The main strength of our study is that it captured the local intrapartum maternity practice, allowing for conclusions to be drawn regarding the quality of maternal services provided. Furthermore, it was the first attempt in the literature to map the incidence and management of shoulder dystocia in Greece and can thus be used as a benchmark for future comparisons and analyses.

Conclusion

The incidence of shoulder dystocia and the risk factors identified in our cohort are consistent with the literature, with minimal adverse maternal and neonatal outcomes. These local data reflect effective maternity service provision and may serve as a benchmark for future comparisons and evaluations, since no other studies in Greek clinical settings have reported on shoulder dystocia. Future research could investigate the impact of in-house simulation training on shoulder dystocia, including whether documentation of the obstetric event can be improved through a mandatory electronic database and whether a more detailed analysis of the maneuvers used in management can be conducted.

Ethical aspects and conflict of interest

The study received ethical approval from the Institutional Review Board of the University of Thessaly in Greece (No. 637/08.07.2024).

The authors have no conflicts of interest to declare.

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Author contributions

Conception and design (NC, DP), data analysis and interpretation (NC, DP), manuscript draft (NC, DP, GV, AD), critical revision of the manuscript (NC, DP, GV, AD), final approval of the manuscript (NC, DP, GV, AD).

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