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ORIGINAL ARTICLE

Evaluation of the relationship between fetal sex and primary cesarean section rates

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ABSTRACT

Objective: To investigate the existence of a relationship between fetal sex and primary cesarean section (C/S) rates.

Material and Methods: The demographic characteristics, birth records, and medical characteristics of 58,897 patients who gave birth in our hospital between January 2013 and December 2022 were retrospectively evaluated. A total of 14,045 patients who had a C/S during their previous births were excluded from the study. C/S rates and indications were evaluated according to the presence of male and female fetuses. Pregnancy outcomes of pregnant women in adolescent and adult groups were also assessed.

Results: The mean birth length and birth weight in the adult group were found to be significantly higher ($p<0.001$ and $p=0.008$, respectively). The 1st-minute and 5th-minute APGAR scores of the adult group were significantly higher than those of the adolescent group ($p<0.001$ and $p<0.001$, respectively). A significant difference was found in the probability of primary C/S delivery between male and female fetuses in both the adolescent and adult age groups, with a significantly higher C/S rate observed in male fetuses ($p<0.001$ and $p<0.001$, respectively).

Conclusion: C/S rates are becoming a public health problem in developing countries. It should be kept in mind that fetal sex influences pregnancy outcomes and C/S rates. Additionally, the frequency of some maternal, perinatal, and neonatal complications may be higher in adolescent mothers.

Keywords: Adolescent pregnancy, adult pregnancy, male sex, primary cesarean section.

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INTRODUCTION

There are many studies in the literature investigating the relationship between fetal sex and pregnancy outcomes.[1–3] Pregnancy complications such as spontaneous abortions, intrauterine death, premature rupture of membranes, and premature birth have been found to be associated with male fetuses during pregnancy.[4–6] Feinstein et al.[7] suggested that pregnancies with male fetuses were associated with higher rates of birth difficulties, Hershkovitz et al.[8] reported that pregnancies with male fetuses were associated with higher rates of cord problems, and Sheiner et al.[9] found that pregnancies with male fetuses were associated with higher rates of fetal distress.

Several studies have identified a relationship between adverse pregnancy outcomes and fetal sex. In particular, the risk of preterm birth and macrosomia has been found to be high in male fetuses.[10] Various possibilities have been proposed to explain this negative association, but the most likely reason is the higher fetal birth weights of male fetuses compared to female fetuses.[11] Due to pregnancy complications, the rate of cesarean section (C/S) has increased in pregnant women carrying male fetuses.[12]

The exact mechanisms underlying the relationship between increased complications during pregnancy and fetal sex are not clear. The aim of our study was to investigate the existence of a relationship between fetal sex and primary C/S rates.

MATERIAL AND METHODS

The study was designed as a retrospective study in accordance with the Declaration of Helsinki, and informed consent forms were obtained from all patients. The study was initiated after receiving approval from the hospital ethics committee (Number: 2023/169). Patient confidentiality was maintained throughout the research process, and all data were de-identified to ensure privacy.

This retrospective electronic health records system-based study aimed to investigate the outcomes of patients undergoing vaginal delivery and C/S at Buca Seyfi Demirsoy Training and Research Hospital between January 2013 and December 2022. The demographic characteristics, birth records, and medical characteristics of infants from a total of 58,897 patients were extracted for analysis. The inclusion criteria for the study encompassed all patients who delivered a singleton infant, with the delivery mode being either vaginal or primary C/S, and with the infant weighing more than 500 grams during the specified study period. A total of 14,045 patients who had previously undergone C/S during a prior delivery were excluded from the study. Other exclusion criteria included multiple pregnancies and patients who had experienced medical or spontaneous miscarriages. The primary endpoint was defined as the difference in C/S rates, considering the sex variable, with a specific focus on whether the patients were adolescents.

Statistical Analysis

Descriptive statistics, such as means, standard deviations, and percentages, were used to summarize the demographic and clinical characteristics of the study population. Comparative analyses between subgroups were conducted using appropriate statistical tests, including t-tests for continuous variables and Chi-square tests for categorical variables. Cohen's d effect size measurements and phi coefficients (ϕ) were used to interpret the significance of statistical differences. The odds ratio (OR) was calculated using logistic regression when a statistically significant difference was demonstrated. Statistical significance was defined as $p<0.05$. The statistical analysis was conducted using the SPSS version 23 software package (IBM Corporation).

RESULTS

The mean ages of the adolescent and adult groups were 18.03±1.11 years and 26.95±5.11 years, respectively. The mean age of the adult group was found to be significantly higher ($p<0.001$). The mean pregnancy durations of the adolescent and adult groups were 275.4±10.9 days and 276.0±9.7 days, respectively. The mean pregnancy duration of the adult group was found to be significantly longer ($p<0.001$). The mean birth lengths of the adolescent and adult groups were 49.41±1.82 cm and 49.72±1.71 cm, respectively. The mean birth length in the adult group was found to be significantly longer ($p<0.001$). The 1st-minute and 5th-minute APGAR scores of the adult group were significantly higher than those of the adolescent group ($p<0.001$ and $p<0.001$, respectively) (Table 1).

Table 1: Evaluation of neonatal outcomes between groups

	Adolescents (n=5405) Mean±SD	Adults (n=39.447) Mean±SD	p	Cohen's effect size (d)
Maternal age (year)	18.03±1.11	26.95±5.11	<0.001	0.07
Pregnancy duration (days)	275.4±10.9	276.0±9.7	<0.001	0.06
Birthweight (g)	3198.7±459.4	3329.6±472.6	0.008	0.28
Head circumference (cm)	35.39±0.81	35.41±0.82	0.530	NA
Birth length (cm)	49.41±1.82	49.72±1.71	<0.001	0.18
Apgar 1st minute	7.93±0.51	7.95±0.43	<0.001	0.06
Apgar 5th minute	8.94±0.42	8.96±0.37	<0.001	0.05

SD: Standard deviation; N/A: Not available.

Table 2: Analysis of comparing vaginal and cesarean delivery across different age groups

	Female fetus n (%)	Male fetus n (%)	p	Phi coefficient (ϕ)	Odds ratio (OR)
Adolescents			<0.001	0.057	1.329
NSVD	2163 (50.3)	2140 (49.7)			
C/S	476 (43.2)	626 (56.8)			
Adults			<0.001	0.042	1.231
NSVD	15.678 (50.3)	15.518 (49.7)			
C/S	3719 (45.1)	4532 (54.9)			

NSVD: Normal spontaneous vaginal delivery; C/S: Cesarean section.

Table 3: Cesarean delivery rates among primigravid patients stratified by fetal sex

C/S indication	Age groups	Female fetus n (%)	Male fetus n (%)	p	Phi coefficient (ϕ)	OR
Failure to progress	Adolescents	89 (40.5)	131 (59.5)	0.004	0.050	1.506
	Adults	515 (45.7)	611 (54.3)	0.002	0.031	1.216
Cephalopelvic disproportion	Adolescents	81 (42.0)	112 (58.0)	0.022	0.040	1.414
	Adults	551 (49.5)	563 (50.5)	0.484	0.007	1.048
Fetal distress	Adolescents	142 (44.8)	175 (55.2)	0.052	0.033	1.261
	Adults	569 (42.5)	771 (57.5)	<0.001	0.056	1.389
Suspicion of macrosomia	Adolescents	24 (28.9)	59 (71.1)	<0.001	0.068	2.515
	Adults	211 (40.0)	317 (60.0)	<0.001	0.050	1.540

C/S: Cesarean section; OR: Odds ratio.

Excluding patients with repeated C/S, among the remaining 36,807 patients, there was a significant difference in the likelihood of male fetuses being born via primary C/S delivery compared with female fetuses. A detailed breakdown of cesarean delivery rates for various indications, each examined by fetal sex, was provided. A significant difference was found in the probability of primary C/S delivery between male and female fetuses in both the adolescent and adult age groups, with a significantly higher C/S rate in the male sex (p<0.001 and p<0.001, respectively) (Table 2).

When the indications for C/S in primigravid patients were evaluated separately, the indications for male fetuses were found to be significantly higher in all subgroups. However, no significant difference was found between the adolescent and adult groups among patients who underwent C/S for the indication of cephalopelvic disproportion (p=0.484). Another noteworthy result was that among patients who underwent C/S for the indication of suspicion of macrosomia, the male sex ratio was quite high and significant in both the adolescent and adult groups (Table 3).

When the indications for C/S in multigravida patients were evaluated separately, the indications for male fetuses were found to be significantly higher in all subgroups. An important point to note in the multigravida patients' group is that no significant difference was observed between the male and female fetus rates for all indications in the adolescent group. In the adult group, the male sex ratio was significantly higher in the "failure to progress" indication group (p=0.006). The male sex ratio was also significantly higher in the adult group in the fetal distress and suspicion of macrosomia indication groups (p<0.001) (Table 4).

DISCUSSION

The emergence of fetal sex occurs due to interactions among gonadal, hormonal, and genetic factors. In our study, we evaluated 36,807 pregnant women and found that the primary C/S rate was significantly higher in women with male fetuses, in the adolescent group, the adult group, and overall. The study by Yohai et al.[13] confirmed the general tendency for male fetuses to have poorer clinical performance compared to females. Additionally, the relationship between fetal heart rate patterns and fetal sex at all stages of labor showed an independent association between male fetal sex and abnormal fetal heart tracing during labor. Melamed et al.[14] reported an increased probability of unsuccessful vaginal delivery in pregnant women carrying male fetuses due to unreliable fetal heart rate.

Table 4: Cesarean delivery rates among multigravida patients stratified by fetal sex

C/S indication	Age groups	Female fetus n (%)	Male fetus n (%)	p	Phi coefficient (ϕ)	OR
Failure to progress	Adolescents	9 (34.6)	17 (65.4)	0.166	0.044	1.846
	Adults	253 (44.2)	319 (55.8)	0.006	0.018	1.267
Cephalo-pelvic disproportion	Adolescents	5 (27.8)	13 (72.2)	0.095	0.054	2.541
	Adults	198 (45.6)	236 (54.4)	0.066	0.012	1.197
Fetal distress	Adolescents	15 (33.3)	30 (66.7)	0.052	0.062	1.954
	Adults	497 (44.4)	622 (55.6)	<0.001	0.024	1.257
Suspicion of macrosomia	Adolescents	5 (27.8)	13 (72.2)	0.095	0.054	2.541
	Adults	179 (35.2)	329 (64.8)	<0.001	0.044	1.846

C/S: Cesarean section; OR: Odds ratio.

In the present study, the rate of fetal distress was found to be significantly higher in male fetuses in both adolescent and adult pregnancies. Studies in the literature have shown that the probability of male babies being macrosomic is approximately 80% higher than in female babies.[15,16] In the study conducted by de Jong et al.,[17] daily fetal growth was shown to be higher in male fetuses than in female fetuses. de Zegher et al.[18] suggested that the greater weight gain of male babies in the womb was a result of androgen effects. The data from our study are consistent with the literature, showing that the rate of pregnant women who underwent C/S with male fetuses was significantly higher in patients with the indication of macrosomia.

It is thought that aborted vaginal delivery due to a macrosomic fetus contributes to the development of fetal distress. In the study by Herman et al.,[19] it was suggested that the Y chromosome affected the fetal growth rate, making male fetuses macrosomic and increasing the metabolic rate. It is believed that male fetuses may be more sensitive to critical changes that develop during birth due to their high metabolic rate. However, the existence of a mechanism that clearly reveals the risk of higher fetal stress in male fetuses has not been proven.

In our study, the "failure to progress" rate in the primigravid patient group was found to be significantly higher in male fetuses, both in adolescents and adults. In the multigravida patient group, the "failure to progress" rate was found to be significantly higher in male fetuses in the adult group, while no difference was found in the adolescent group. In the study conducted by Kolås et al.,[20] it was determined that failure to progress (20.7%) was the second most common C/S indication. Al Rowaily et al.[21] found difficult labor to be the most common C/S indication with a rate of 35.9%. Melamed et al.[14] reported that the rates of dilation arrest and second-stage extension were higher in male sex groups. Ashwal et al.[22] found that the rate of failure to progress was not affected by fetal sex.

There are different results in the literature regarding the relationship between male fetuses and failure to progress as well as the overall rate of failure to progress. In the present study, failure to progress was among the most common C/S indications. According to the World Health Organization (WHO), the relationship between maternal and neonatal mortality rates and C/S rates has been evaluated, and no advantage has been demonstrated for C/S rates higher than 10% in the general population.[23] The WHO determined that the acceptable C/S rate should not exceed 10–15% and emphasized the necessity of a classification system for cesareans to analyze and make proper comparisons between countries or even different hospitals or healthcare systems.[23]

Ulgu et al.[24] determined that the general C/S rate in our country was approximately 57% and the primary C/S rate was 28.83%. In the present study, the most common cause of C/S was determined to be fetal distress in all groups, including the male fetus group. Similarly, in the literature, fetal distress has been the most common indicator of intrapartum cesarean delivery over the last few decades.[25,26]

In the secondary evaluation criteria of our study, the outcomes of adolescent and adult pregnancies were evaluated. No difference was observed in C/S rates between the adolescent and adult groups. In the study conducted by Zeteroglu et al.,[27] which evaluated 40,391 pregnant women, no difference was observed between the cesarean delivery rates of early pregnancies and adult pregnant women. Penfield et al.[28] reported that the probability of primary C/S decreased by 20% in young women up to approximately 20 years of age.

In our study, birth weight was found to be significantly higher in the adult group compared to the adolescent group. Usta et al.[29] found that birth weight was significantly higher in their adult group compared to the adolescent group. In the study conducted by Bildircin et al.,[30] low birth weight was found to be significantly higher in adolescents. In our study, 1st and 5th-minute Apgar scores were found to be significantly higher in the adult group. By contrast, Usta et al.[29] observed no significant differences between Apgar scores in their adult and adolescent groups. In the study conducted by Bildircin et al.,[30] 5th-minute Apgar scores were found to be higher in the adult group.

CONCLUSION

There are relatively limited detailed studies in the literature on cesarean indications and fetal sex. C/S rates are becoming a public health problem in developing countries. We believe that a study conducted in a single-center hospital with such a high number of cases can be instructive regarding the number of patients who delivered by primary C/S. It should be kept in mind that fetal sex influences pregnancy outcomes and C/S rates. Additionally, C/S rates may increase in cases of suspected macrosomia and failure to progress in male fetuses. More studies are needed to determine the relationship between C/S indications and fetal sex. However, it should be remembered that the frequency of certain maternal, perinatal, and neonatal complications may be higher in adolescent mothers.

Statement

Ethics Committee Approval: The Buca Seyfi Demirsoy Training and Research Hospital Ethics Committee granted approval for this study (date: 27.09.2023, number: 2023/169).

Author Contributions: Concept – UA; Design – OY; Supervision – CA; Resource – HAA; Materials – TBB; Data Collection and/or Processing – Aİ; Analysis and/or Interpretation – AB; Literature Search – UA; Writing – CA; Critical Reviews – CA.

Conflict of Interest: The authors have no conflict of interest to declare.

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REFERENCES

1. Sheiner E. The relationship between fetal gender and pregnancy outcome. Arch Gynecol Obstet 2007;275:317–9.
2. Di Renzo GC, Rosati A, Sarti RD, Cruciani L, Cutuli AM. Does fetal sex affect pregnancy outcome? Gend Med 2007;4:19–30.
3. Aibar L, Puertas A, Valverde M, Carrillo MP, Montoya F. Fetal sex and perinatal outcomes. J Perinat Med 2012;40:271–6.
4. Naeye RL, Demers LM. Differing effects of fetal sex on pregnancy and its outcome. Am J Med Genet Suppl 1987;3:67–74.
5. Liu Y, Li G, Zhang W. Effect of fetal gender on pregnancy outcomes in northern China. J Matern Fetal Neonatal Med 2017;30:858–63.
6. Peelen MJ, Kazemier BM, Ravelli AC, De Groot CJ, Van Der Post JA, Mol BW, et al. Impact of fetal gender on the risk of preterm birth, a national cohort study. Acta Obstet Gynecol Scand 2016;95:1034–41.
7. Feinstein U, Sheiner E, Levy A, Hallak M, Mazor M. Risk factors for arrest of descent during the second stage of labor. Int J Gynaecol Obstet 2002;77:7–14.
8. Hershkovitz R, Silberstein T, Sheiner E, Shoham-Vardi I, Holcberg G, Katz M, et al. Risk factors associated with true knots of the umbilical cord. Eur J Obstet Gynecol Reprod Biol 2001;98:36–9.
9. Sheiner E, Hadar A, Hallak M, Katz M, Mazor M, Shoham-Vardi I. Clinical significance of fetal heart rate tracings during the second stage of labor. Obstet Gynecol 2001;97:747–52.
10. Teoh PJ, Ridout A, Seed P, Tribe RM, Shennan AH. Gender and preterm birth: Is male fetal gender a clinically important risk factor for preterm birth in high-risk women? Eur J Obstet Gynecol Reprod Biol 2018;225:155–9.
11. Lieberman E, Lang JM, Cohen AP, Frigoletto FD Jr, Acker D, Rao R. The association of fetal sex with the rate of cesarean section. Am J Obstet Gynecol 1997;176:667–71.
12. Antonakou A, Papoutsis D. The effect of fetal gender on the delivery outcome in primigravidae women with induced labours for all indications. J Clin Diagn Res 2016;10:QC22–5.
13. Yohai D, Baumfeld Y, Zilberstein T, Yaniv Salem S, Elharar D, Idan I, et al. Does gender of the fetus have any relation with fetal heart monitoring during the first and second stage of labor? J Matern Fetal Neonatal Med 2017;30:150–4.
14. Melamed N, Yogev Y, Glezerman M. Fetal gender and pregnancy outcome. J Matern Fetal Neonatal Med 2010;23:338–44.
15. Koyanagi A, Zhang J, Dagvadorj A, Hirayama F, Shibuya K, Souza JP, et al. Macrosomia in 23 developing countries: An analysis of a multicountry, facility-based, cross-sectional survey. Lancet 2013;381:476–83.
16. Nkwabong E, Nzalli Tangho GR. Risk factors for macrosomia. J Obstet Gynaecol India 2015;65:226–9.
17. de Jong CL, Gardosi J, Baldwin C, Francis A, Dekker GA, van Geijn HP. Fetal weight gain in a serially scanned high-risk population. Ultrasound Obstet Gynecol 1998;11:39–43.
18. de Zegher F, Devlieger H, Eeckels R. Fetal growth: Boys before girls. Horm Res 1999;51:258–9.
19. Herman, CJ. Changes in the male to female ratio at different stages of life. Br J Obstet Gynaecol 1996;103:391–2.
20. Kolås T, Hofoss D, Daltveit AK, Nilsen ST, Henriksen T, Häger R, et al. Indications for cesarean deliveries in Norway. Am J Obstet Gynecol 2003;188:864–70.
21. Al Rowaily MA, Alsalem FA, Abolfotouh MA. Cesarean section in a high-parity community in Saudi Arabia: Clinical indications and obstetric outcomes. BMC Pregnancy Childbirth 2014;14:92.
22. Ashwal E, Hadar E, Chen R, Aviram A, Hiersch L, Gabbay-Benziv R. Effect of fetal gender on induction of labor failure rates. J Matern Fetal Neonatal Med 2017;30:3009–13.
23. World Health Organization. WHO statement on caesarean section rates. Available at: https://iris.who.int/bitstream/handle/10665/161442/WHO_RHR_15.02_eng.pdf. Accessed Jan 20, 2025.
24. Ulgu MM, Birinci S, Altun Ensari T, Gözükara MG. Cesarean section rates in Turkey 2018-2023: Overview of national data by using robson ten group classification system. Turk J Obstet Gynecol 2023;20:191–8.
25. MacKenzie IZ, Cooke I. Prospective 12 month study of 30 minute decision to delivery intervals for “emergency” caesarean section. BMJ 2001;322:1334–5.
26. Tuffnell DJ, Wilkinson K, Beresford N. Interval between decision and delivery by caesarean section-are current standards achievable? Observational case series. BMJ 2001;322:1330–3.
27. Zeteroglu S, Sahin I, Gol K. Cesarean delivery rates in adolescent pregnancy. Eur J Contracept Reprod Health Care 2005;10:119–22.
28. Penfield CA, Yvonne WC, Aaron BC. 547: Adolescents have lower primary cesarean delivery rates than young adults. Am J Obstet Gynecol 2011;204:S219.
29. Usta IM, Zoorob D, Abu-Musa A, Naassan G, Nassar AH. Obstetric outcome of teenage pregnancies compared with adult pregnancies. Acta Obstet Gynecol Scand 2008;87:178–83.
30. Bildircin FD, Kurtoglu E, Kokcu A, Işik Y, Ozkarci M, Kuruoglu S. Comparison of perinatal outcome between adolescent and adult pregnancies. J Matern Fetal Neonatal Med 2014;27:829–32.