

Evaluation of risk factors in cesarean delivery among multiparous women with a history of vaginal delivery

Önceden vajinal doğum yapmış olan multipar kadınlarda sezaryen doğum risk faktörlerinin değerlendirilmesi

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Abstract

Objective: To predict the risk of cesarean delivery (CS) for multiparous women who have undergone previous vaginal delivery.

Material and Methods: A prospective observational study was performed, among multiparous pregnancies that were between 38 and 41 gestational weeks and had a singleton, vertex presentation fetus. Women's physical activity score, obstetric history, intrapartum and postpartum events were assessed. Multivariable logistic regression was used to explore risk factors associated with CS.

Results: Of the 245 total 83.7% had spontaneous labor and 16.3% were induced. Seventy-five percent of the induced women required CS, whereas only 19.5% of those with spontaneous labor required CS ($p < 0.001$). The logistic regression analysis model included maternal weight gain, physical activity score, cervical dilatation, and fetal weight as the predictors of CS. We detected 7 (10%) maternal complications in women who underwent intrapartum CS.

Conclusion: Labor induction is significantly associated with increased risk of cesarean delivery among previously vaginally delivered women and maternal weight gain, physical activity score, cervical dilatation, and fetal weight are most accurate parameters in the prediction of the risk of CS delivery. Intrapartum CS has an increased risk of maternal morbidity.

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Key words: Labor induction, spontaneous labor, intrapartum cesarean, vaginal delivery, multiparity

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Özet

Amaç: Çalışmamızın amacı önceden vajinal doğum yapmış olan multipar kadınlarda sezaryen doğum riskini belirlemektir.

Gereç ve Yöntemler: Tekil, 38-41 haftada, vertex geliş gebeliği olan multipar kadınlarda yapılmış prospektif gözlemsel bir çalışmadır. Kadınların fiziksel aktivite skorlaması, obstetrik öyküleri, intrapartum ve postpartum olaylar değerlendirilmiştir. Çok değişkenli lojistik regresyon analizi yapılarak sezaryen ile ilgili risk faktörleri araştırılmıştır.

Bulgular: İkiyüz kırkbeş olgunun %83.7'si spontan eylem ve %16.3'ü indüksiyondur. İndüksiyon yapılan kadınların %75'i sezaryen gerektirirken spontan eylemi olanların sadece %19.5'ine sezaryen gerekti. Lojistik regresyon için seçilen model anne kilo artışı, fiziksel aktivite skoru, servikal dilatasyon ve bebek kilosunu sezaryenin belirteçleri olarak içermektedir. İntrapartum sezaryene giden 7 (%10) kadında maternal komplikasyon saptadık.

Sonuç: Daha önce normal doğum yapmış kadınlarda doğum indüksiyonu önemli ölçüde artmış sezaryen riski ile birliktedir; gebelikte alınan kilo, fiziksel aktivite skoru, servikal açıklık ve fetal kilo sezaryen riskinin belirlenmesinde en doğru parametrelerdir. İntrapartum sezaryen maternal morbidite riskini artırmaktadır.

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Anahtar kelimeler: Doğum indüksiyonu, spontan eylem, intrapartum sezaryen, vajinal doğum, multiparite

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Introduction

High and rising rates of cesarean section delivery (CS) constitute an important health problem in Turkey. According to a report from the Turkish Ministry of Health, these operations represent 42.7% of deliveries in all hospitals nationwide in 2009 (1). Over the past two decades, a large proportion of the female population in Turkey has begun to enjoy a more urbanized lifestyle. The majority of the women we see in our daily obstetric practice are in this sedentary patient group. Advanced maternal age, decreased physical activity due to changing lifestyle, chronic health risks, such as obesity, diabetes, and

hypertension, fetal macrosomia, extensive use of continuous fetal monitoring, and changes in women's preferences are the factors responsible for the elevated CS rates (2, 3). Today, women demand more involvement and control in decisions regarding their health, and many who are advised to have induced labor will ask their obstetrician whether this increases the likelihood of CS.

Previous studies indicated that emergency or intrapartum CS is associated with higher risk of maternal and fetal complications than vaginal and elective cesarean deliveries (2, 4, 5). Maternal mortality has also been shown to be higher in emergency cesarean deliveries (6).

Early prediction of caesarean risk is important in order to decrease the maternal and fetal morbidity related to emergency CS. The objective of this study was to evaluate the risk factors for prediction of CS.

Materials and Methods

We conducted a prospective observational study between July 2010 and October 2010 at Fatih University Hospital, Ankara and at the State Hospital in Denizli, Turkey. The study protocol was approved by the review boards of both institutions. Each participant gave written informed consent before she was enrolled. A health professional at each institution (an obstetric resident at Fatih University Hospital and a trained nurse at Denizli State Hospital) identified women who were admitted for delivery and who had a history of term vaginal delivery (VD). Multiparous pregnant women in this group who were between 38 and 41 gestational weeks and had a singleton, vertex presentation fetus were recruited for the study. Women with scheduled CS and those who had undergone CS in a previous pregnancy were excluded. Women who were induced because of pregnancy complications (such as pregnancy-induced hypertension, pre-gestational or gestational diabetes mellitus, intra-uterine growth restriction oligohydramnios, polyhydramnios) and those who underwent elective induction between 38 and 41 gestational weeks were included.

Information regarding gestational age, maternal demographic characteristics, obstetric history, and intrapartum and postpartum events were obtained during interviews with the mothers. Gestational age was determined based on the last menstrual period and ultrasound findings in the first trimester. A total of 245 subjects were enrolled. Sixty-eight percent of the deliveries took place at Denizli State Hospital and 32% took place at Fatih University Hospital.

We assessed the women's physical activity using the Modified Grimby Scale (7). The categories were (1) moving only for necessary chores; (2) walking or other outdoor activities 1-2 times a week; (3) walking or other outdoor activities several times a week; (4) exercising 1-2 times a week to the point of perspiring and heavy breathing; (5) exercising more than 1-2 times a week to the point of perspiring and heavy breathing; (6) exercising for fitness several times a week to the point of perspiring and heavy breathing. Women in categories 1 and 2 were classified as sedentary and those in categories 3 and higher were classified as active. There is no Turkish validation of the Grimby scale. Labor was diagnosed as regular uterine contractions combined with effacement of the cervix and dilatation of 2 cm or more and/or spontaneous rupture of the membranes. Induction was defined as initiation of uterine contractions to promote delivery before spontaneous onset of labor. Women who presented with contractions and required augmentation were not included in the induction group. Induction was carried out using oxytocin infusion and examinations were performed every 0.5 to 1 hours. Preinduction cervical ripening was not used at either hospital during the study period.

In our study, the term CS was used to refer to intrapartum CS. Indications of CS delivery were; failure to progress in labor, fetal

distress, and failed induction. Failed induction was defined as CS performed before the cervix was dilated to 4 cm and the absence of non-reassuring fetal status. A patient was considered to have exhibited failure to progress if arrest of dilatation occurred after 4 cm or if arrest of descent was recorded in her medical record. Caesarean deliveries performed on maternal request during labor were excluded from the study.

The primary outcome was mode of delivery. We also examined the distribution of reasons for CS, and maternal and fetal complications arising from the type of the birth.

Statistical analyses were performed using SPSS software, version 17.0 (SPSS, Chicago, IL, USA). A power calculation was made using a computer program to determine the minimum sample size assuming alpha 0.05 and 95% power (G*Power Ver. 3.1.2, Franz FAUL, Universität Kiel, Germany, <http://www.psychology.uni-duesseldorf.de/aap/projects/gpower/>). A retrospective pilot study we conducted on 50 pregnancies in women with history of vaginal delivery revealed that 11% of these women had undergone CS in their most recent pregnancy. For the current study, we identified a sample size of 240 as sufficiently large to detect differences between vaginally delivered and CS required group in women with history of vaginal delivery.

The Shapiro-Wilk test was used to evaluate the distribution of variables. Because the data were not normally distributed, non-parametric tests were used for analyses. Categorical variables were compared using the chi-square test or Fisher's exact test. The Mann-Whitney U test was used to compare continuous variables. A p value of less than 0.05 was regarded as significant. A multiple logistic regression model (backward: likelihood ratio binary logistic regression) was used to assess independent risk factors for mode of delivery while controlling for potential confounders. Maternal age and gestational age were used as independent scale variables. Body mass index (BMI), weight gain during pregnancy, physical activity score, cervical dilatation upon admission, fetal weight at delivery, and type of labor (spontaneous or induced) were used as independent categorical variables. The probabilities of entry and removal were regarded as 0.05 and 0.10, respectively. All variables were included in stepwise multivariate logistic regression analysis using a backward elimination procedure. At each stage, the variable with the largest p value was eliminated and the procedure was then repeated until all remaining variables were statistically significant ($p < 0.05$). Odds ratios (OR) and 95% confidence intervals (CI) were also calculated using multivariate logistic regression analysis.

Results

Two hundred and forty-five multiparous women with singleton, vertex pregnancies at 38-41 gestational weeks' were recruited to the study. Seventy (28.6%) of the 245 women underwent CS and 175 (71.4%) underwent VD. Of the 245 total, 205 (83.7%) had spontaneous labor and 40 (16.3%) were induced. Of the study population, 94.3% of vaginally delivered (VD) patients, and 57.1% of patients undergoing CS were admitted hospital with spontaneous labour, whereas 5.7% in the VD group and 42.9% in the CS group were admitted for induction of labor

($p < 0.001$). Thirty (75%) of the 40 women who were induced required CS, whereas only 19.5% (40) of those with spontaneous labor required CS ($p < 0.001$).

Table 1 presents baseline characteristics, with the subjects grouped according to mode of delivery. There were no significant differences between the VD and CS groups with respect to maternal age, gravida, parity, maternal height or gestational age at delivery ($p > 0.05$ for all). There was also no significant difference between these groups' median physical activity scores. Of the 245 pregnant women, 88.6% were sedentary and only 28 women were active. All the active women were in category 3 or 4; that is, none had a score above 4. Larger proportions of the sedentary women underwent induced labor and CS, respectively, compared to the active group; however, these differences were not statistically significant (Tables 1 and 2). The sedentary subgroup had a higher median pre-pregnancy BMI than the active subgroup (22.1 vs. 20.2, respectively; $p > 0.05$) and also exhibited heavier fetal weights at delivery (3560 g vs.

3390, respectively; $p > 0.05$), these differences also were not significant. Sedentary group gained more weight during pregnancy (13 kg vs. 11 kg, respectively; $p = 0.015$).

Comparisons of the VD and CS groups showed that the median interval from most recent delivery to the index delivery was significantly shorter in the VD group than in the CS group (5 years vs. 7 years, respectively; $p = 0.023$). Women in the VD group were, on average, of lighter weight than those in the CS group (BMI: 23.7 vs. 25.1, respectively; $p = 0.006$), and gained less weight during pregnancy than the CS group (11.0 kg vs. 12.0 kg, respectively; $p = 0.037$). Cervical dilatation on initial examination was significantly greater in the VD group than in the CS group (3.8 cm vs. 1.8 cm, respectively; $p < 0.001$). The VD group had a lower median estimated fetal weight at the last examination, lighter fetal weight at delivery than in the CS group ($p < 0.05$ for both).

Compared with the 165 women who had spontaneous labor and VD, the 40 who underwent spontaneous labor but ulti-

Table 1. Characteristics of women grouped by mode of delivery

	Vaginal deliveries (n=175)	Cesarean deliveries (n=70)	*p
Mean age (yrs)±SD	29.7±4.6	30.7±5.0	0.217
Gravida	2 (1)	3 (1)	0.655
Parity	2 (1)	2 (1)	0.808
Maternal height (cm)	160 (7)	162 (7)	0.250
BMI kg/m ²	23.7 (4)	25.1 (8)	0.006
Weight gain (kg)	11.0 (6)	12.0 (6)	0.037
Occupation (%)			0.223
Housewife	111 (63.4)	50 (71.4)	
Working women	64 (36.6)	20 (28.6)	
Physical activity score	1 (1)	1 (1)	
Sedentary	154 (88.0)	63 (90.0)	
Active	21 (12.0)	7 (10.0)	0.657
EFW (g)	3300 (600)	3500 (700)	0.020
Interval	5 (4)	7 (5)	0.023
1-5 years	117 (66.9)	31 (44.2)	
6-10 years	58 (33.1)	39 (55.8)	
Week of delivery	39.3 (2.0)	39.2 (2.1)	0.894
Cx dilatation (cm)	3.8 (2.0)	1.8 (1.9)	<0.001
Cx effacement (%)	40 (50)	30 (40)	0.113
Labor type (%)			<0.001
Spontaneous	165 (94.3)	40 (57.1)	
Induction	10 (5.7)	30 (42.9)	
Birth weight (g)	3300 (578)	3440 (660)	0.025
Values are noted as median (IQR: interquartile range), or mean±SD (standard deviation), *p<0.05 is significant, BMI: Body mass index at first prenatal visit, Weight gain: Weight gain during pregnancy, EFW: Estimated weight of fetus at the last perinatal sonography, Interval: time from previous delivery to index delivery, CX: cervix			

Table 2. Characteristics of women grouped by type of labor

	Spontaneous labor group (n=205)	Induction group (n=40)	*p
Mean age (yrs)±SD	29.6±4.7	30.4±5.6	0.634
Week of delivery	38.5 (2)	39.2 (2)	0.169
Dilatation (cm)	4.0 (2.0)	2.0 (0.2)	0.029
EFW (g)	3350 (600)	3400 (937)	0.915
Interval (yrs)	5.0 (4.0)	5.5 (4.0)	0.231
Weight gain (kg)	12.0 (5.0)	11.0 (8.0)	0.711
Physical activity:			0.230
Sedentary	183 (87.6)	34 (94.4)	
Active	26 (12.4)	2 (5.6)	
Perinatal problem (%)	20 (9.7)	10 (25)	0.022
Birth weight (g)	3365 (595)	3400 (690)	0.558
CS (%)	40 (19.5)	30 (75.0)	<0.001
			OR=12.3;95%CI 5.5-27.3
Indications for CS			
Failure to progress	22 (55)	7 (23.3)	0.007
Fetal distress	8 (20)	6 (20.0)	0.987
Failed induction	-	12(40.0)	
Prolonged 2 nd stage	10 (25)	5 (16.6)	0.620
Complications of CS	6 (15)	1 (3.3)	0.096
Complications of VD	14 (8.2)	2 (33.3)	0.082
Admission to NICU	3 (1.4)	3 (8.3)	0.018
Values are noted as medians (IQR: interquartile range) or mean±SD (standard deviation), *p<0.05 is significant, EFW: Estimated weight of fetus at the last perinatal sonography, CS: Cesarean delivery, VD: Vaginal delivery, NICU: Neonatal intensive care unit			

mately delivered via CS had a longer interval from prior delivery to index delivery (Z=1743; p=0.081) and delivered heavier infants (Z=2853; p=0.004). The subgroup that was induced but required CS had a similar rate of CS-related complications than the subgroup with spontaneous labor that required CS (3.3% and 15% respectively, p=0.096). Seven of the 70 pregnant women that required intrapartum CS, developed complications: ureter injury (n=1), bladder injury (n=1), uterine artery rupture (n=1), uterine atony (n=4).

Table 3 shows the results of the logistic regression modeling. Maternal BMI was not significantly correlated with mode of delivery (p>0.05). In the initial χ^2 analysis, labor induction was associated with twelve-fold greater risk of CS delivery compared to spontaneous labor (OR 12.37, 95% CI 5.59-27.39; p<0.001); however, this risk was attenuated after adjustment for confounders (OR 3.32, 95% CI 1.44-10.44; p=0.007), (Table 3). The model identified maternal weight gain (OR 1.51, 95% CI 1.01-1.98, p=0.042), physical activity score (OR 0.12, 95% CI 0.10-0.72, p=0.028), cervical dilatation upon admission (OR 0.22, 95% CI 0.07-0.64, p=0.005), and fetal weight at delivery (OR 0.99, 95% CI 0.99-1.00, p=0.033) as predictors of CS.

Discussion

This study evaluated the factors for the prediction of cesarean delivery and the effect of physical activity on the ease of labor in multiparous women. We found that, of 245 women with a history of vaginal birth, 84% experienced spontaneous labor and 16% required labor induction. The induced multiparous women had a three-fold greater risk of CS than those who experienced spontaneous labor. This finding is consistent with reports of several authors (3, 8, 9) that showed a two- to threefold higher risk of CS among women who received labor induction. However, there are some important differences between previous studies and ours. First, most prior investigations have focused on nulliparous women, thus the rates of labor induction for this patient group were higher than the rate we observed. Second, most previous investigators applied cervical ripening methods before oxytocin infusion, whereas we did not. The proportion of women requiring labor induction in our study was small, but a much larger proportion of these women had pregnancy complications and than the group with spontaneous labor. Also, they had less favorable cervix and their infants were much more likely to require admission to the neonatal intensive care unit.

Table 3. Results for variables in logistic regression step 4*

Parameters	Wald	p	OR	95% CI for OR	
				Lower	Upper
BMI	3.194	0.059	1.307	1.079	1.589
Weight gain	4.205	0.042	1.512	1.010	1.981
Activity	4.857	0.028	0.127	0.104	0.726
Dilatation	7.255	0.005	0.225	0.079	0.643
Type of labor	6.037	0.007	3.320	1.447	10.440
Fetal weight	4.569	0.033	1.004	1.000	1.016

*Variables entered in step 1: Maternal age, gestational age at delivery, BMI, weight gain during pregnancy, physical activity score, type of labor, cervical dilatation upon admission, estimated fetal weight, and fetal weight at delivery, CI: confidence interval, OR: odds ratio, BMI: body mass index at the beginning of pregnancy

We prospectively studied clinical parameters to identify strong predictors of mode of delivery in women with a history of VD. Several authors (9-11) have reported, the risk of CS was influenced by labor induction, maternal weight gain during pregnancy, cervical dilatation at enrollment, and physical activity score of women. Results of our study showed that greater maternal BMI was statistically associated with CS delivery in the bivariate correlation analysis, but this correlation was not significant after adjustment for confounders. A new study has also identified excessive weight gain during pregnancy and medically induced labor as independent risk factors for intrapartum CS (12). Another study by Uyar et al. (13) showed that the BMI of women at the end of pregnancy and transvaginal cervical length were better predictors in determining the success of labor. However, our parameters were; BMI at the beginning of pregnancy and weight gain during pregnancy. Weight gain during pregnancy is an important determinant of the BMI at the end of pregnancy. We consider that this methodological difference leads to various results in this issue.

Regular physical activity has been proven to result in marked benefits for mother and fetus (14). Few studies that have directly examined the effects of physical activity on labour and delivery indicate that, for women with normal pregnancies, physical activity is accompanied with shorter labour and decreased incidence of operative delivery (15). We prospectively administered a modified version of the Grimby scale (which is extremely easy to use and interpret) to the patients in our study. After adjusting for maternal demographic factors, we also found that decreased physical activity of pregnant multiparous women was associated with increased risk of CS. The sedentary women in our sample were more likely to require labor induction than the active women, and pre-pregnancy BMI and fetal weight at delivery were also greater in the sedentary subgroup, but none of these differences was statistically significant. Many women in Turkey tend to live in city high-rises and have minimal physical activity. Our earlier observations led us to believe that women with low levels of physical activity would experience more problems at initiation of labor and throughout the labor process. Our initial expectation from this study was to find supporting evidence for this. Nearly 90% of the 245 subjects were sedentary and only 28 women were active with

scores of 3 or 4, none higher. Melzer et al. (14) reported that the prevalence of a sedentary life style in the Swiss population is lower than 39%. We believe that the reason we did not find a significant statistically relationship between physical activity and type of labor was an insufficient number of physically active patients in the sample, which may led to Type II error. Further studies enrolling more women with higher levels of physical activity are required to confirm the association between physical activity and labor.

Intrapartum CS carries a higher risk of maternal morbidity than elective CS, hence, prediction of the former is important for optimal patient management (8). In our sample, we observed 10% morbidity in the subgroup that required intrapartum CS. The complication rate for intrapartum CS in multiparous women who had induced labor was not significantly different from the rate among those with spontaneous labor.

Nonetheless, the findings of this study must be interpreted together with recognition of its limitations. First, we were unable to record Bishops scores. Second, our study group was mostly composed of women with a sedentary life style, as well as the borderline statistical significance regarding the difference in incidence of labor induction and CS between active and sedentary women, which does not allow us to draw firm conclusions as to the effects of the recommended level of physical activity on the type of delivery.

This study prospectively evaluated the risk of CS in multiparous women with a history of VD. In conclusion, cervical dilatation at enrollment and labor induction are important predictors of CS. Increased weight gain during pregnancy, and decreased physical activity score are statistically associated with increased risk of CS. Roughly 10% of women who undergo intrapartum CS develop serious complications. In order to optimally manage labor, it is important to be able to predict which women are more likely to require CS. Accurate information should be provided to expectant mothers regarding their risk of CS and the higher risk of maternal morbidity after intrapartum CS. These are important elements in the decision-making process regarding type of delivery.

Conflict of interest

No conflict of interest was declared by the authors.

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