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RESEARCH ARTICLE

Childbirth at advanced reproductive age: the impact of biopsychosocial factors on the mode of delivery

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ABSTRACT

Introduction. Contemporary society reflects a clear trend towards delayed motherhood, raising significant concerns in the management of pregnancy and childbirth in women of advanced reproductive age. In this context, the mode of delivery and associated risks for this age category require increased attention. Birth methods have been thoroughly examined to identify risks and influencing factors within this specific cohort.

Material and methods. A descriptive cross-sectional study was conducted on a sample of 528 women. Data were collected using a pre-tested semi-structured questionnaire, and respondents were divided into three groups based on the mode of delivery: vaginal delivery, planned cesarean section, and emergency cesarean section. Sociodemographic, anthropometric, medical, and obstetric characteristics were analyzed using linear regression. Statistical analyses included descriptive and inferential statistics (Chi-square), with a 95.0% confidence interval.

Results. The analysis revealed statistically significant variations in the mode of delivery based on maternal age (p=0.013) and paternal age (p=0.001), with an increased rate of cesarean sections at more advanced ages. Significant variations were also found in relation to area of residence (p=0.003), education level (p=0.001), nature of work (p=0.028), GP appointments (p=0.020), number of GP appointments(p<0.001), number of obstetrician appointments (p=0.032), time of informing on risk factors (p=0.005), parity (p<0.001), multiple pregnancies (p=0.016), mode of first delivery (p<0.001), pregnancy complications (p=0.003), delivery complications (p<0.001), gestational age at birth (p=0.017), Apgar scores at 1 and 5 minutes (p<0.001).

Conclusions. Advanced reproductive age has been associated with a higher risk of cesarean section compared to vaginal delivery. The influence of age is modulated by various sociodemographic, medical, and obstetric characteristics, including area of residence, education level, history of cesarean section, parity, pregnancy and delivery complications, pre-existing chronic conditions, antenatal care and provision of information on risk factors.

Keywords: advanced reproductive age, advanced maternal age, mode of delivery, cesarean section, information, risk factors, antenatal care.

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Key messages

What is not known yet about the issue addressed in the submitted manuscript

Currently, the relationships between sociodemographic, anthropometric, medical, and obstetric characteristics influencing the mode of delivery in women of advanced reproductive age are not fully understood. Additionally, there are gaps in understanding how these interrelationships affect the increased likelihood of cesare-

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an delivery compared to vaginal delivery and influence birth outcomes in this age cohort.

The research hypothesis

Sociodemographic, anthropometric, medical, and obstetric characteristics significantly influence the mode of delivery in women of advanced reproductive age, determining a higher likelihood of cesarean delivery compared to vaginal delivery.

The novelty added to the scientific literature in the field

The scientific novelty of the article lies in the detailed analysis of how biopsychosocial factors influence the mode of delivery in women of advanced reproductive age, highlighting the specific impact of education, area of residence, medical history, and obstetric complications on mode of delivery. This research contributes to a better understanding of the factors determining the mode of delivery in this age group, providing valuable insights for optimizing antenatal care.

Introduction

Globally, the age of motherhood has increased over the previous few decades. According to the report of the Organization for Economic Co-operation and Development, between 1970 and 2021, the average age of women giving birth increased by two to five years in the majority of OECD countries [1]. In numerous high-income countries, the birth rate for women in their late 30s has increased [2].

In 2022, the average age of women at childbirth in Europe varied from 27.8 years in Bulgaria to 32.2 years in Luxembourg, while in Moldova, it was 28 years [3]. Data analysis over the last decade has shown an increase in the birth rate for women aged 35 to 39 in the United States, from 45.9 per 1 000 women in 2010 to 52.7 in 2019. Similarly, there has been an increase in the birth rate for women aged 40 to 44, from 10.2 to 12 per 1 000 [4]. A study conducted in 29 countries across Africa, Asia, the Middle East, and Latin America also revealed that 12.3% of pregnant women fall into the category of advanced maternal age [5]. There is a clear trend of an increasing average age of women at childbirth, partly due to the tendency to delay having their first child [1]. This trend can be explained by women choosing to focus on careers and financial security, thereby postponing maternal age [6]. Furthermore, advances in assisted reproductive technologies have extended the reproductive window, leading to a corresponding increase in the incidence of advanced maternal age [7].

Approximately 21% of total births worldwide, ranging from 6% in low- and middle-income countries to 27% in developed regions, are delivered by cesarean section (CS) [8]. The CS rate continues to rise globally, with reported rates (in 2016) of 24.5% in Western Europe, 32% in North America, and 41% in South America [8, 9]. The reasons for the increasing CS rate are multifactorial, but existing literature suggests that the increase is largely driven by advanced maternal age, especially among nulliparous women [10]. Statistical data indicate higher CS rates among women over 35 years old compared to younger mothers [11]. Additionally, maternal age is considered an independent risk factor for CS or unsatisfactory obstetrical outcomes. Among nulliparous women aged 35 to 39, CS rates are twice as high compared to younger ages and can triple among those over 40 [11, 12]. Consistent research findings have constantly linked increasing maternal age with higher CS rates [13].

Studies have shown that women of advanced maternal age are more likely to have pre-existing chronic diseases (such as chronic hypertension and diabetes) [14], maternal complications (gestational hypertension, gestational diabetes, preeclampsia, placenta previa, and placental abruption) [15], perinatal complications (low birth weight, prematurity, and fetal death) [15], and CS [16]. Additionally, obesity significantly increases the rate of CS, but there is limited evidence in the literature regarding whether elective CS or physiological vaginal delivery (VD) is the optimal mode of delivery for women with morbid obesity [17].

However, unjustified CS can increase short-term and long-term health risks for mothers and their children. Short-term risks include infection, hemorrhage, visceral injuries, placenta accreta, and placental abruption [18]. Long-term risks include asthma and obesity [18]. Additionally, there is a higher likelihood of spontaneous abortion, ectopic pregnancy, and stillbirth in subsequent pregnancies for mothers who have undergone CS [19].

It is important to note that for low-risk women, who typically represent a small proportion of adverse outcomes overall, recovery time after CS is longer compared to VD. Compared to VD, the risk of infection and associated morbidity during a CS can increase by up to 20 times [20]. Therefore, according to the WHO Statement in 2015 regarding CS rates, CS should be performed only when medically necessary [21]. Depending on the location, between 2.5% and 18% of CS performed worldwide are done without medical indications [22, 23].

In low- and middle-income countries, women of advanced reproductive age significantly differ in sociodemo-

graphic characteristics [4], which is reflected in parity and mode of delivery. In this context, this study aims to describe the sociodemographic, anthropometric, obstetric, and medical characteristics of women of advanced reproductive age based on the mode of delivery, as well as to evaluate the influence of the interrelationship among these characteristics on the mode of delivery.

The objective of the study is to examine rates of VD and CS among women of advanced reproductive age based on their sociodemographic, anthropometric, medical, and obstetrical characteristics, and to evaluate the relationships among these factors.

Materials and methods

To achieve the stated objective, a selective cross-sectional observational study was conducted with a sample of 528 participants. The inclusion criteria were as follows: women aged between 35 and 49 years who gave birth during advanced reproductive age. As a research tool, a questionnaire developed by the authors was utilized. Interviews were conducted individually using a set of semi-structured questions to gather detailed information about the medical and social characteristics of the participants, in addition to available medical records. Open-ended questions were employed to capture personal experiences and individual perceptions of the participants.

We divided participants into three groups based on the mode of delivery: vaginal delivery, planned cesarean section, emergency cesarean section, and compared the influence of a series of sociodemographic, anthropometric, medical, and obstetrical characteristics using the linear regression method. Additionally, the modification of the effect was analyzed based on a series of variables whose evaluation showed statistically significant variations.

The collected data were analyzed using IBM SPSS Statistics software, version 26.0, following the documentation available at: IBM SPSS Statistics 26 Documentation. Statistical methods appropriate for the type of variables collected were employed. Tests and correlation analyses were utilized to identify potential relationships between medical and social variables. The significance of the results was assessed at a confidence interval of 95%. This methodological approach allowed for a detailed perspective on the socio-medical characteristics of women of advanced reproductive age, contributing to a deeper understanding of this evolving reality.

Results

In the study, 528 pregnant women were included, of whom 77 or 14.6% (95% CI: 12.0% - 18.0%) were aged between 35 and 39 years, and 451 or 85.4% (95% CI: 82.0% - 88.0%) were aged over 40 years. The mean age of the participants was 37.8 ± 2.5 years, with a median of 37.0 (Min=35.0, Max=49.0, IQR=3). The mean age of their partners was 41.7 ± 3.9 years, with a median of 41.0 (Min=34.0, Max=56.0, IQR=7.0) (95% CI: 41.0% – 42.0%).

Primigravidae accounted for 18.9% (95% CI: 16% - 22%), while primipara represented 25.1% (95% CI: 21% - 29%) of the participants. The mean number of pregnancies was 3.2±1.6 pregnancies, with a median of 3.0 (Min=1.0, Max=7.0, IQR=2.0) (95% CI: 3.0 – 3.3%), and the mean number of births was 1.6±1.4 births, with a median of 2.0 (Min=0.0, Max=6.0, IQR=1.3) (95% CI: 1.5% - 1.8%).

The first pregnancy resulted in birth for 66.5% (95% CI: 62% - 71%) of participants, of which 8% (95% CI: 5.6% - 10%) were via Cesarean section (CS). Complicated obstetrical history was reported in 42.0% (95% CI: 38% - 46%) of participants, and pre-existing chronic diseases in 45.3% (95% CI: 41% - 50%) of participants.

VD occurred in 59.5% (95% CI: 55% - 64%) of participants, planned cesarean section (PCS) in 15.9% (95% CI: 13% - 19%), and emergency cesarean section (ECS) in 24.6% (95% CI: 21% - 28%) of participants. Pregnancy complications were recorded in 70.8% (95% CI: 67% - 75%) of participants, and 50.6% (95% CI: 46% - 55%) developed birth complications.

For the identification and evaluation of sociodemographic, anthropometric, obstetrical, and other health-related factors associated with the mode of delivery, a bivariate analysis was conducted.

Table 1 shows the variations in the rates of VD and CS according to the sociodemographic and anthropometric characteristics of women. The mode of delivery differs significantly depending on the mother's age (p=0.013), with a mean of 38.5±2.8 years, a median of 38.0 (Min=35.0, Max=44.0, IQR=4.0) for PCS, and 37.6±2.4 years, a median of 37.0 (Min=35.0, Max=46.0, IQR=3.0) for ECS, and 37.6±2.5 years, a median of 37.0 (Min=35.0, Max=49.0, IQR=3.0) for VD. Similar differences (p=0.001) are also recorded depending on the age of the father, with a mean of 43.0±3.7 years, a median of 43.0 (Min=35.0, Max=53.0, IQR=4.5) for PCS, and 41.5±3.8 years, a median of 41.0 (Min=35.0, Max=53.0, IQR=7.0) for ECS, compared with the mean of 41.4 ±3.9 years, and the median of 41.0 (Min=34.0, Max=56.0, IQR=6.0) for VD.

Statistically significant variations are also established in the evaluation of the relationship between mode of delivery, specifically PCS and ECS, and the following characteristics: area of residence (p=0.003), education (p=0.001), and nature of work (p=0.028). Additionally, comparative evaluation between mode of delivery and workplace exposure (p=0.6), pre-pregnancy BMI (p>0.9), and recommended weight gain during pregnancy (p=0.6) did not reveal statistically significant differences. (Table 1).

The impact of antenatal care on the mode of delivery was evaluated and presented in Table 2. The study results found that participants who attended antenatal care with a GP had VD in 61.8% (95% CI: 57% - 66%), compared to 44.4% (95% CI: 33% - 56%) among participants who did not attend antenatal care with a GP. Meanwhile, 22.2% (95% CI: 13% - 32%) of participants who did not attend antenatal care with a GP gave birth by PCS, and 33.3% (95% CI: 22% - 44%) by ECS, compared to 14.9% (95% CI: 12% - 18%) of participants who attended antenatal care with a GP and gave birth by PCS, and 23.2% (95% CI: 19% - 27%) by ECS.

Table 1. Relationship between mode of delivery and sociodemographic and anthropometric characteristics

Mode of delivery	VD, N = 314[1]	95% CI[2]	PCS, N = 84[1]	95% CI[2]	ECS, N = 130[1]	95% CI[2]	Statistic Test	p-value[3]
Woman`s age	37.6 (2.5) 37.0 (3.0) 35.0, 49.0	37, 38	38.5 (2.8) 38.0 (4.0) 35.0, 44.0	38, 39	37.6 (2.4) 37.0 (3.0) 35.0, 46.0	37, 38	8,7	0.013
Partner`s age	41.4 (3.9) 41.0 (6.0) 34.0, 56.0	41, 42	43.0 (3.7) 43.0 (4.5) 35.0, 53.0	42, 44	41.5 (3.8) 41.0 (7.0) 35.0, 53.0	41, 42	13	0.001
Area of residence								
rural	150 (47.8%)	42%, 53%	35 (41.7%)	31%, 52%	39 (30.0%)	22%, 38%	12	0.003
urban	164 (52.2%)	47%, 58%	49 (58.3%)	48%, 69%	91 (70.0%)	62%, 78%		
Education								
secondary	154 (49.0%)	44%, 55%	24 (28.6%)	19%, 38%	43 (33.1%)	25%, 41%	18	0.001
vocational	64 (20.4%)	16%, 25%	24 (28.6%)	19%, 38%	30 (23.1%)	16%, 30%		
higher	96 (30.6%)	25%, 36%	36 (42.9%)	32%, 53%	57 (43.8%)	35%, 52%		
Nature of work								
physical	48 (15,3%)	11%, 19%	9 (10.7%)	4.1%, 17%	7 (5.4%)	1.5%, 9.3%		
intellectual	104 (33,1%)	28%, 38%	39 (46.4%)	36%, 57%	59 (45.4%)	37%, 54%	14	0.028
mixed	20 (6,4%)	3.7%, 9.1%	5 (6.0%)	0.89%, 11%	7 (5.4%)	1.5%, 9.3%		
doesn`t work	142 (45,2%)	40%, 51%	31 (36.9%)	27%, 47%	57 (43.8%)	35%, 52%		
Exposure								
yes	34 (10.8%)	7.4%, 14%	11 (13.1%)	5.9%, 20%	11 (8.5%)	3.7%, 13%	2.8	0.6
no	138 (43.9%)	38%, 49%	42 (50.0%)	39%, 61%	62 (47.7%)	39%, 56%		
Pre-pregnancy BMI	25.8 (4.3) 25.8 (6.3) 17.6 47.6	25, 26	25.9 (4.3) 24.7 (4.9) 17.6 39.6	25, 27	25.7 (3.8) 26.0 (5.7) 18.0 35.0	25, 26	0.06	>0.9
Weight gain	12.5 (4.8) 13.0 (7.0) 3.0 51.0	12, 13	12.8 (4.2) 13.0 (7.3) 1.0 21.0	12, 14	12.8 (4.6) 13.0 (7.0) 3.0 29.0	12, 14	0.95	0.6

Note: [1]n (%); Mean (SD); Median (IQR); Minimum Maximum; [2]CI = Confidence Interval; [3]Pearson's Chi-squared test; Kruskal-Wallis rank sum test

The evaluation of the relationship between the average attendance of the GP and the mode of delivery reveals statistically significant deviations (p <0.001). Among participants who had a VD, 40.1% (95% CI: 32% - 49%) had 1-3 GP`s attendances, and 46.5% (95% CI: 41% - 52%) had 4-7 attendances. In comparison, among participants with PCS, 29.8% (95% CI: 11.5% - 48.1%) had 1-3 attendances, and 47.6% (95% CI: 37% - 58%) had 4-7 attendances. For those with ECS, 23.1% (95% CI: 7.7% - 38.4%) had 1-3 attendances, and 55.4% (95% CI: 47% - 64%) had 4-7 attendances.

There is a similar trend observed in the relationship between the average attendances of the obstetrician and the mode of delivery, with statistical deviations yielding p=0.032. The rate of participants with more than 3 attendances of the obstetrician is 70,2% (95% CI: 60% - 80%) for those with PCS and 63.1% (95% CI: 55% - 71%) for those with ECS, compared to participants with up to 3 attendances, representing 29.8% (95% CI: 20% - 40%) for PCS and 36.9% (95% CI: 29% - 45%) for ECS. Simultaneously, the rate of participants with VD is approximately identical for both attendance groups, constituting 55.4% (95% CI: 50% - 61%) for those with > 3 attendances and 44.6% (95% CI: 39% - 50%) for those with 1-3 attendances.

The role of informed decision-making regarding pregnancy and childbirth in women of advanced reproductive age is underscored by statistically significant differences in CS rates based on the timing and content of information about age-related reproductive risks (p=0.005). It is noteworthy that participants who had VD were informed at similar rates either before becoming pregnant or during pregnancy, at 38.9% (95% CI: 33% - 44%) and 38.5% (95% CI: 33% - 44%), respectively. In contrast, for participants who underwent PCS or ECS, the rate of those informed before pregnancy was approximately twice as high compared to those informed during pregnancy, accounting for 59.5% (95% CI: 49% - 70%) and 28.6% (95% CI: 19% - 38%) for PCS, while it was 50.8% (95% CI: 42% - 59%) and 33.8% (95% CI: 26% - 42%) for ECS.

It is noteworthy that in this study, no statistically significant differences were identified for the relationship between the availability and utility of the perinatal book and the mode of delivery in women of advanced reproductive age (p=0.5).

The results of the evaluation of the mode of delivery based on obstetrical characteristics are presented in Table 3. Of the studied group, 59.5% (95% CI: 55% - 64%) of the participants gave birth vaginally, 15.9% (95% CI: 13% - 19%) by PCS, and 24.6% (95% CI: 21% - 28%) by ECS. It is relevant that the evaluation of the mode of delivery based on parity shows statistically significant differences (p<0.001), where, for primiparous, C-section was predominant at 57.9%, including 31.6% ECS, compared to multipara women, where VD was predominant, constituting 65.3%. In the same context, it was found that births among primipa-

Table 2. Relationship between mode of delivery and antenatal care

Mode of delivery	VD, N = 314[1]	95% CI[2]	PCS, N = 84[1]	95% CI[2]	ECS, N = 130[1]	95% CI[2]	Statistic test	p-value[3]
GP attendance								
yes	282 (89.8%)	86%, 93%	68 (81.0%)	73%, 89%	106 (81.5%)	75%, 88%	7.8	0.020
no	32 (10.2%)	6.8%, 14%	16 (19.0%)	11%, 27%	24 (18.5%)	12%, 25%		
Timing of initiation of antenatal care								
first trimester	226 (72.0%)	67%, 77%	55 (65.5%)	55%, 76%	90 (69,2%)	61%, 77%	1.4	0.5
second/third trimester	88 (28.0%)	23%, 33%	29 (34.5%)	24%, 45%	40 (30.8%)	23%, 39%		
GP attendances								
1-3	126 (40.1%)	32%, 49%	25 (29.8%)	11,5%, 48,1%	30 (23.1%)	7.7%, 38.4%		
4-7	146 (46.5%)	41%, 52%	40 (47.6%)	37%, 58%	72 (55.4%)	47%, 64%	34	<0.001
>7	10 (3.2%)	1.2%, 5.1%	3 (3.6%)	-0.40%, 7.5%	3 (2.3%)	-0.27%, 4.9%		
0	32 (10.2%)	6.8%, 14%	16 (19.0%)	11%, 27%	24 (18.5%)	12%, 25%		
Number of USG exams								
<=2	56 (17.8%)	14%, 22%	8 (9.5%)	3.2%, 16%	16 (12.3%)	6.7%, 18%	5.6	0.2
>2	255 (81.2%)	77%, 86%	76 (90.5%)	84%, 97%	113 (86.9%)	81%, 93%		
0	3 (1.0%)	-0.12%, 2.0%	0 (0.0%)	0.0%, 0.0%	1 (0.8%)	-0.73%, 2.3%		
Obstetrician attendances								
1-3	140 (44.6%)	39%, 50%	25 (29.8%)	20%, 40%	48 (36.9%)	29%, 45%	6.9	0.032
> 3	174 (55.4%)	50%, 61%	59 (70.2%)	60%, 80%	82 (63.1%)	55%, 71%		
Risk factors information								
before pregnancy	122 (38.9%)	33%, 44%	50 (59.5%)	49%, 70%	66 (50.8%)	42%, 59%		
after pregnancy	121 (38.5%)	33%, 44%	24 (28.6%)	19%, 38%	44 (33.8%)	26%, 42%	15	0.005
uninformed	71 (22.6%)	18%, 27%	10 (11.9%)	5.0%, 19%	20 (15.4%)	9.2%, 22%		
Pregnancy book								
Useful	262 (83.4%)	79%, 88%	71 (84.5%)	77%, 92%	104 (80.0%)	73%, 87%		
Useless	31 (9.9%)	6.6%, 13%	10 (11.9%)	5.0%, 19%	13 (10.0%)	4.8%, 15%	3.6	0.5
Not available	21 (6.7%)	3.9%, 9.5%	3 (3.6%)	-0.40%, 7.5%	13 (10.0%)	4.8%, 15%		

Note: *[1]n (%); [2]CI - Confidence Interval; [3]Pearson's Chi-squared test; Kruskal-Wallis rank sum test; GP – General practitioner.*

rous constituted 17.8% (95% CI: 14% - 22%) of VD, 41.7% (95% CI: 31% - 52%) of PCS, and 32.3% (95% CI: 24% - 40%) of ECS compared to 82.2% (95% CI: 78% - 86%) of VD, 58.3% (95% CI: 48% - 69%) of PCS, and 67.7% (95% CI: 60% - 76%) of ECS in multipara women, representing statistically significant differences (p=0.001).

In the conducted study, the mean number of previous births among participants who delivered via PCS was 1.2±1.3 births, with a median of 1.0 (Min=0.0, Max=5.0, IQR=2.0), 1.3±1.2 births, median 1.0 (Min=0.0, Max=5.0, IQR=2.0) for those with ECS, and 1.9±1.4 births, median 2.0 (Min=0.0, Max=6.0, IQR=2.0) for those who had VD. These differences are statistically significant (p<0.001). The same trend is observed when comparing the number of pregnancies in medical history (p<0.001). Correlation with other variables such as pre-existing chronic diseases (p=0.2), complicated obstetrical history (p=0.13), history of medical abortion (p=0.9), history of spontaneous abortion (p=0.7), and mode of conception (p=0.4) did not reveal statistically significant differences.

Meanwhile, the proportion of primigravidae who delivered via PCS and ECS is approximately twice as high compared to those who had VD, comprising 29.8% (95% CI: 20% - 40%) and 23.1% (95% CI: 16% - 30%) respectively, compared to 14.3% (95% CI: 10% - 18%). Additionally, the rate of multigravidas who delivered vaginally is about 6 times higher compared to primigravidae, 3.3 times higher for those via ECS, and 2.3 times higher via PCS, constituting 85.7% (95% CI: 82% - 90%) for VD, 70.2% (95% CI: 60% - 80%) for PCS, and 76.9% (95% CI: 70% - 84%) for ECS. These differences reach statistical significance with p=0.002.

According to the results of the present study, among participants who had ECS, 81.5% (95% CI: 75% - 88%) had pregnancy complications, and among those who had PCS, 73.8% (95% CI: 64% - 83%) had pregnancy complications, compared to 65.6% (95% CI: 60% - 71%) among participants with VD (p=0.003).

Of particular interest is the finding that the proportion of women who experienced birth complications is significantly lower among participants who had PCS compared to those who had VD or ECS, comprising 25% (95% CI: 16% - 34%) of OCS, compared to 53.8% (95% CI: 48% - 59%) and 59.2% (95% CI: 51% - 68%) of participants who had VD or ECS, respectively, showing statistically significant differences (p < 0.001).

There are significant variations in the mode of delivery based on the outcomes of the first pregnancy (p=0.0001), which show that participants whose first pregnancy ended in delivery had a VD rate of 66.7% (95% CI: 61.5% - 71.6%)

Table 3. Relationship between the mode of delivery and medical and obstetrical characteristics

Mode of delivery	VD, N = 314[1]	95% CI[2]	PCS, N = 84[1]	95% CI[2]	ECS, N = 130[1]	95% CI[2]	Statistic Test	p-value[3]
Preexisting chronic conditions								
yes	133 (42.4%)	37%, 48%	44 (52.4%)	42%, 63%	62 (47.7%)	39%, 56%	3.1	0.2
no	181 (57.6%)	52%, 63%	40 (47.6%)	37%, 58%	68 (52.3%)	44%, 61%		
Gravidity	3.4 (1.6) 3.0 (2.8) 1.0, 7.0	3.3, 3.6	2.8 (1.6) 3.0 (3.0) 1.0, 7.0	2.4, 3.1	2.9 (1.5) 3.0 (2.0) 1.0, 7.0	2.6, 3.1	20	<0.001
Parity	1.9 (1.4) 2.0 (2.0) 0.0, 6.0	1.8, 2.1	1.2 (1.3) 1.0 (2.0) 0.0, 5.0	0.89, 1.5	1.3 (1.2) 1.0 (2.0) 0.0, 5.0	1.1, 1.5	31	<0.001
Abortion history	0.4 (0.8) 0.0 (0.0) 0.0, 4.0	0.27, 0.43	0.3 (0.7) 0.0 (0.0) 0.0, 3.0	0.15, 0.45	0.3 (0.7) 0.0 (0.0) 0.0, 4.0	0.19, 0.42	0.23	0.9
Spontaneous abortion history	0.2 (0.6) 0.0 (0.0) 0.0, 3.0	0.17, 0.30	0.3 (0.7) 0.0 (0.0) 0.0, 4.0	0.15, 0.47	0.3 (0.7) 0.0 (0.0) 0.0, 4.0	0.18, 0.43	0.78	0.7
Ectopic pregnancy history	0.0 (0.1) 0.0 (0.0) 0.0, 1.0	0.00, 0.03	0.1 (0.3) 0.0 (0.0) 0.0, 2.0	0.01, 0.14	0.0 (0.2) 0.0 (0.0) 0.0, 2.0	0.00, 0.09	6.6	0.037
Parity								
primipara	56 (17.8%)	14%, 22%	35 (41.7%)	31%, 52%	42 (32.3%)	24%, 40%	25	<0.001
multipara	258 (82.2%)	78%, 86%	49 (58.3%)	48%, 69%	88 (67.7%)	60%, 76%		
Mode de conception								
Natural	306 (97.5%)	96%, 99%	80 (95.2%)	91%, 100%	124 (95.4%)	92%, 99%	1.7	0.4
IVF	8 (2.5%)	0.80%, 4.3%	4 (4.8%)	0.21%, 9.3%	6 (4.6%)	1.0%, 8.2%		
Complicated obstetric history								
yes	121 (38.5%)	33%, 44%	41 (48.8%)	38%, 59%	60 (46.2%)	38%, 55%	4.1	0.13
no	193 (61.5%)	56%, 67%	43 (51.2%)	41%, 62%	70 (53.8%)	45%, 62%		
Mode of first pregnancy delivery								
VD	227 (72.3%)	67%, 77%	26 (31.0%)	21%, 41%	56 (43.1%)	35%, 52%	75	<0.001
CS	7 (2.2%)	0.60%, 3.9%	15 (17.9%)	9.7%, 26%	20 (15.4%)	9.2%, 22%		
Nulliparae	80 (25.5%)	21%, 30%	43 (51.2%)	41%, 62%	54 (41.5%)	33%, 50%		
Pregnancy complications								
yes	206 (65.6%)	60%, 71%	62 (73.8%)	64%, 83%	106 (81.5%)	75%, 88%	12	0.003
no	108 (34.4%)	29%, 40%	22 (26.2%)	17%, 36%	24 (18.5%)	12%, 25%		
Delivery complications								
yes	169 (53.8%)	48%, 59%	21 (25.0%)	16%, 34%	77 (59.2%)	51%, 68%	27	<0.001
no	145 (46.2%)	41%, 52%	63 (75.0%)	66%, 84%	53 (40.8%)	32%, 49%		
Gestational age								
22-28 weeks	14 (4.5%)	2.2%, 6.7%	0 (0.0%)	0.00%, 0.00%	2 (1.5%)	-0.58%, 3.7%	12	0.017
29-35 weeks	31 (9.9%)	6.6%, 13%	5 (6.0%)	0.89%, 11%	21 (16.2%)	9.8%, 22%		
36-40 weeks	269 (85.7%)	82%, 90%	79 (94.0%)	89%, 99%	107 (82.3%)	76%, 89%		
Apgar score at 1 min	7.0 (1.1) 7.0 (2.0) 3.0, 9.0	6.9, 7.2	7.6 (0.9) 8.0 (1.0) 5.0, 9.0	7.4, 7.8	7.2 (1.1) 8.0 (1.8) 3.0, 9.0	7.0, 7.4	19	<0.001
Apgar score at 5 min	7.8 (1.0) 8.0 (1.0) 5.0, 9.0	7.7, 7.9	8.3 (0.8) 8.0 (1.0) 6.0, 10.0	8.1, 8.5	7.9 (1.0) 8.0 (2.0) 4.0, 10.0	7.7, 8.1	19	<0.001
Multiple pregnancy								
yes	3 (1.0%)	-0.12%, 2.0%	5 (6.0%)	0.89%, 11%	5 (3.8%)	0.54%, 7.2%	8.3	0.016
no	311 (99.0%)	98%, 100%	79 (94.0%)	89%, 99%	125 (96.2%)	93%, 99%		
Inpatient days	2.6 (1.2) 2.0 (1.0) 1.0, 7.0	2.4, 2.7	3.7 (1.4) 3.0 (1.0) 2.0, 7.0	3.4, 4.0	3.6 (1.4) 3.0 (1.0) 1.0, 7.0	3.4, 3.9	98	<0.001

***Note*:** *[1]n (%); Mean (SD); Median (IQR); Minimum Maximum; [2]CI - Confidence Interval; [3]Pearson's Chi-squared test; Kruskal-Wallis rank sum test; IVF – in vitro fertilization; VD – vaginal delivery; CS – cesarean section.*

and an ECS rate of 21.7% (95% CI: 17.5% - 26.3%), compared to participants whose first pregnancy ended in miscarriage, where 51.5% (95% CI: 33.5% - 69.2%) had a VD and 36.4% (95% CI: 20.4% - 54.9%) had an ECS. This highlights the higher rate of VD among participants whose first birth ended in delivery compared to primipara and primigravidae, emphasizing the role of first pregnancy outcomes on the mode of delivery in subsequent pregnancies (Figure 1).

The same situation is observed in the comparative evaluation of the mode of delivery for the first and present pregnancy delivery, revealing that 73.5% (95% CI: 68.2% - 78.3%) of participants whose first pregnancy ended in VD subsequently had a VD, compared to 16.7% (95% CI: 7.0% - 31.4%) for those whose first pregnancy ended in CS. Conversely, among participants who had a CS, 8.4% (95% CI: 5.6% - 12.1%) had a PCS and 18.1% (95% CI: 14.0% - 22.9%) had an ECS among those whose first pregnancy ended in VD, compared to 35.7% (95% CI: 21.6% - 52.0%) by PCS and 47.6% (95% CI: 32.0% - 63.2%) by ECS among those whose first pregnancy ended in CS. Of interest is that 45.2% (95% CI: 37.7% - 52.8%) of nulliparae had VD, 24.3% (95% CI: 18.2% - 31.3%) by PCS, and 30.5% (95% CI: 23.8% - 37.9%) by ECS (Fig. 2). These results show significant statistical variations (p=0.0000), demonstrating the importance of obstetrical history on the mode of delivery. It is evident that these data could potentially be influenced by elective CS.

The evaluation of the relationship between mode of delivery and a series of parameters revealed significant statistical differences for pregnancy complications (p=0.003), delivery complications (p<0.001), gestational age (p=0.017), Apgar score at 1 minute (p<0.001), Apgar score at 5 minutes (p<0.001), multiple pregnancy (p=0.016), and length of hospital stay (p<0.001) (Table 3).

Further exploration through multivariate analysis based on multiple parameters such as mode of delivery, obstetrical history, and pregnancy complications found significant statistical deviations (p=0.004, Chi^2=11.06049) among par-

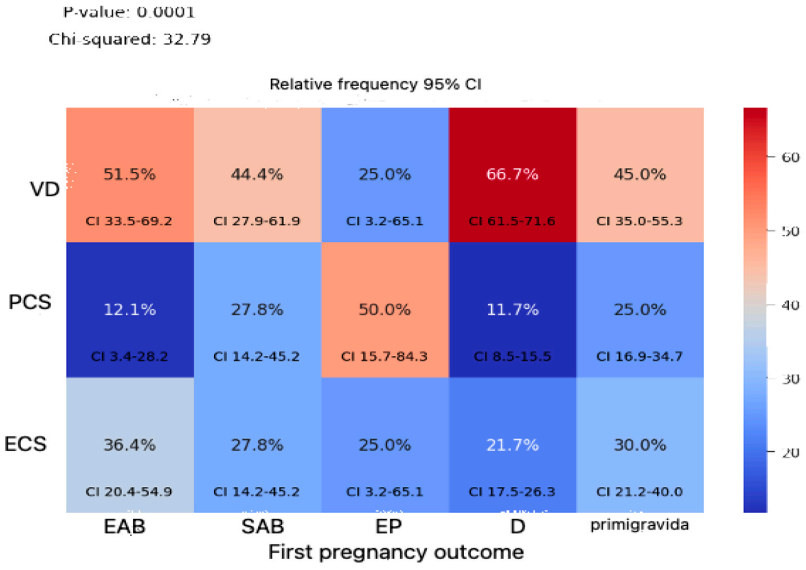

Fig. 1 Relationship between the mode of delivery and the results of the first pregnancy.

Note: *VD – vaginal delivery, PCS – planned cesarean section, ECS – emergency cesarean section, EAB – elective abortion, SAB – spontaneous abortion, EP – ectopic pregnancy*

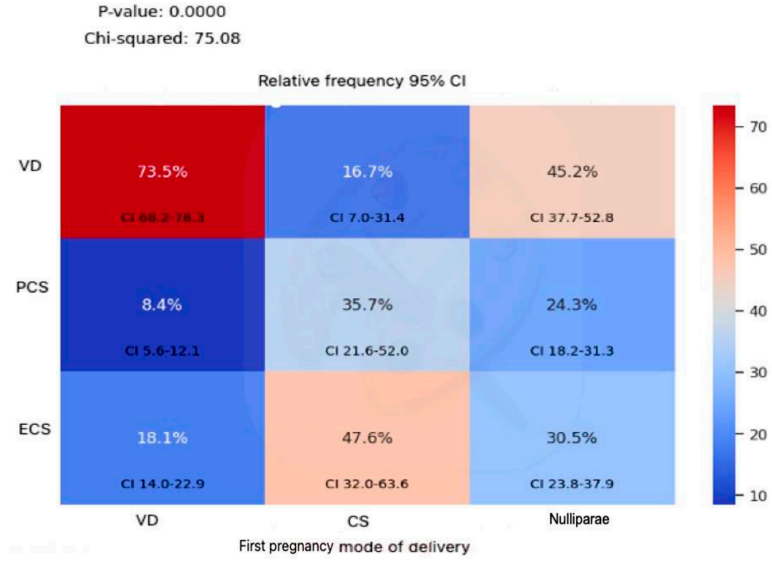

Fig. 2 Relationship between mode of first and present pregnancy delivery

Note: *VD – vaginal delivery, CS – cesarean section, PCS – planned cesarean section, ECS – emergency cesarean section.*

ticipants with complicated obstetric history and pregnancy complications, who had PCS in 85.4% (95% CI: 74.5% - 96.2%) and ECS in 86.7% (95% CI: 78.1% - 95.3%), compared to participants without complicated obstetric history and pregnancy complications, who delivered via PCS in 62.8% (95% CI: 48.3% - 77.2%) and ECS in 77.1% (95% CI: 67.3% - 87%), highlighting the role of complicated obstetric history in the rate of CS (Table 4).

Table 4. Relationship between mode of delivery and obstetrical history and pregnancy complications

Pregnancy complications		%	95% CI[2]	Statistic Test	p-value[3]
Complicated obstetric history	Mode of delivery				
Yes	VD	64.5	55.9%, 73.0%	M^2 = 11.06049, dof = 2	0.004
	PCS	85.4	74.5%, 96.2%		
	ECS	86.7	78.1%, 95.3%		
No	VD	66.3	59.7%, 73.0%		
	PCS	62.8	48.3%, 77.2%		
	ECS	77.1	67.3%, 87.0%		

Note: *[2]CI - Confidence Interval; [3]Pearson's Chi-squared test; Kruskal-Wallis rank sum test; VD – vaginal delivery, PCS – planned cesarean section, ECS – emergency cesarean section.*

Results of the evaluation of the relationship between mode of delivery, pre-existing chronic conditions, and pregnancy complications reveal significant statistical deviations (p=0.0042, Chi^2 test=10.9559). Among participants with pregnancy complications and pre-existing chronic conditions, 72.2% (95% CI: 64.6% - 79.8%) had VD, compared to 60.8% (95% CI: 53.7% - 67.9%) of participants without pre-existing chronic conditions. Additionally, participants with pregnancy complications and pre-existing chronic conditions delivered via PCS in 77.3% (95% CI: 64.9% - 89.7%), compared to 70% (95% CI: 55.8% - 84.2%) of those without pre-existing chronic conditions. Furthermore, participants with pregnancy complications and pre-existing chronic conditions who had ECS constituted 83.9% (95% CI: 74.7% - 93.0%), compared to 79.4% (95% CI: 69.8% - 89.0%) of participants without pre-existing chronic conditions (Fig. 3).

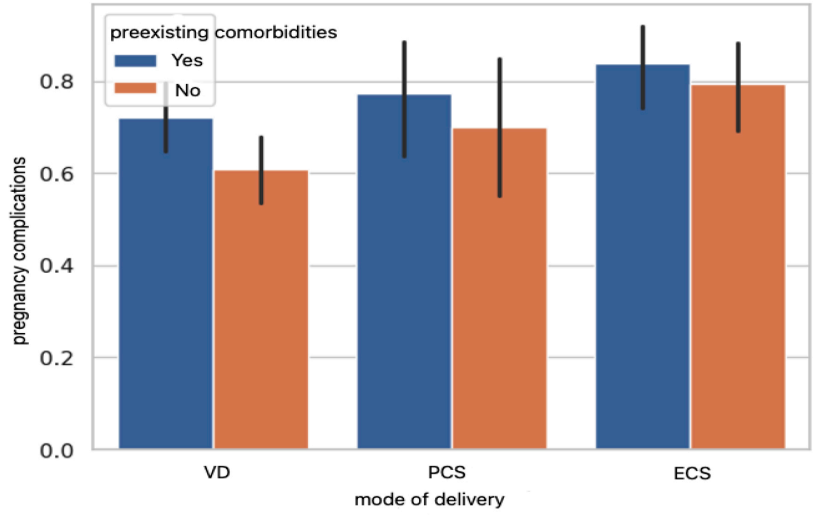

Fig. 3 Relationship between mode of delivery and pre-existing chronic conditions and delivery complications

Note: *VD – vaginal delivery, PCS – planned cesarean section, ECS – emergency cesarean section.*

Discussions

This study aimed to analyze the rates of vaginal and cesarean deliveries among women of advanced reproductive age based on sociodemographic, anthropometric, medical, and obstetrical characteristics and to assess their relationship. The study evaluated the effects of age on the mode of delivery in women of advanced reproductive age, with results showing an increased rate of CS based on several determinant factors. These findings are consistent with recent studies suggesting that advanced reproductive age is a potential risk factor for higher rates of CS and a higher incidence of obstetrical complications. [11, 12].

Results found increased rates of CS, specifically 15,9% (95% CI: 13% - 19%) of participants delivered via PCS and 24.6% (95% CI: 21% - 28%) via ECS. These findings are supported by research indicating that the mean maternal age tends to correlate with higher rates of CS, with older women being more likely to deliver via CS [24]. According to an American study, the incidence of CS increased with maternal age (under 25 years, 11.6%; over 40 years, 43.1%) [24]. Women aged over 25 had a 3.6% chance of CS, while those over 40 had a 21.1% chance. In a German study, 77.1% of women over 22 years old and 53.1% of those over 32 years old delivered spontaneously, whereas

14.5% of women under 22 and 32.3% of those over 32 underwent CS [25].

The evaluation of the relationship between mode of delivery and pregnancy complications (p=0.003) and delivery complications (p<0.001) reveals statistically significant differences. The lowest rate of pregnancy complications is observed in participants who had VD, constituting 65.6% (95% CI: 60% - 71%), compared to the highest rate of 81.5% (95% CI: 75% - 88%) observed in participants who had ECS. Additionally, the association with pre-existing chronic conditions in the multivariate analysis shows the highest rate of ECS at 83.9% (95% CI: 74.7% - 93.0%) in participants with pre-existing chronic conditions, compared to 79,4% (95% CI: 69.8% - 89.0%) in participants without pre-existing chronic conditions, and 77.3% (95% CI: 64.9% - 89.7%) in participants with pre-existing chronic conditions via PCS, compared to 70% (95% CI: 55.8% - 84.2%) in participants without pre-existing chronic conditions.

Complications during pregnancy and pre-existing chronic conditions are potential indicators for cesarean section among women of advanced reproductive age. Recent studies have indicated that pregnant women with medical conditions such as hypertensive disorders, diabetes mellitus, mild renal insufficiency, and multiple sclerosis tend to opt for repeat CS, suggesting that pregnancy complications influence the choice of mode of delivery [26]. All this evidence underscores the importance of managing pre-existing chronic conditions during family planning and antenatal care to reduce the rate of CS among women of advanced reproductive age. It highlights the significance of antenatal care and consultations with obstetricians in determining the appropriate delivery approach, aiming to lower the rate of ECS among participants with pregnancy complications.

Supporting this finding are the results of the evaluation of the mode of delivery based on delivery complications, which indicate that the rate of women who experienced birth complications is twice as low in participants who had PCS compared to those who had VD or ECS. This rate is 25% (95% CI: 16% - 34%) for participants who had PCS, compared to 53.8% (95% CI: 48% - 59%) and 59.2% (95% CI: 51% - 68%) for participants who had VD or ECS, respectively.

Even though there are recognized clinical indicators for opting for CS, non-clinical factors often play a significant role in the decision-making process. It is important to consider the risks associated with subsequent pregnancies and deliveries due to the decision to undergo CS in the absence of medical indications. Pregnant women with a history of CS are at higher risk of developing various complications such as placenta previa, uterine rupture, postpartum hemorrhage, hysterectomy, preterm birth before 37 weeks of gestation, fetal distress, hypertension, and gestational diabetes [27]. The basis of the decision about the mode of delivery often lies in the interaction between the woman and the healthcare provider, and there is a probability that the woman's preferences and beliefs about childbirth, as well as the clinician's subjective assessment of her obstetric risks and perception of the preferred mode of delivery, influence the choice to give birth by CS [28].

Respecting human rights by ensuring each woman's right to complete and accurate information about the risks associated with pregnancy and childbirth at advanced reproductive age empowers women to make informed decisions and actively participate in their health decision-making process. The study's results found that the rate of participants who were informed before becoming pregnant is approximately twice as high as those who were informed during pregnancy, comprising 59.5% (95% CI: 49% - 70%) and 28.6% (95% CI: 19% - 38%) for PCS, and 50.8% (95% CI: 42% - 59%) and 33.8% (95% CI: 26% - 42%) for ECS. In comparison, participants who had VD had similar rates of being informed either before becoming pregnant or during pregnancy, 38.9% (95% CI: 33% - 44%) and 38.5% (95% CI: 33% - 44%). These data demonstrate the impact of information about the risks associated with advanced reproductive age on the decision to give birth in this category of women.

Of course, particular attention is given to understanding and interpreting the information received, as well as the method of information delivery, since risks are often perceived differently by women and healthcare providers. The doubled rate of antenatal information among women who gave birth via CS may result from a high level of responsibility and pregnancy planning among women at increased risk, or an exaggerated interpretation of risk information leading to elective CS. In this regard, an evidence-based tool called the Safe Motherhood Initiative has been implemented by most World Health Organization-associated countries for nearly 30 years [29, 30]. According to WHO recommendations, pregnant women should have at least four antenatal attendances, as the use of antenatal care plays a significant role in the decision-making process regarding the mode of delivery. Women who underwent more than 4 antenatal attendances more often undergo CS, though the exact cause of this phenomenon remains unknown. Additionally, there is a probability that a cautious approach to women with pregnancy difficulties contributed to the preference for CS. The goal of antenatal care is to reduce health risks, identify anomalies early in pregnancy, and, if necessary, take corrective measures to prepare both mother and fetus, ensuring a healthy start in life for every newborn [31]. In 2016, the World Health Organization (WHO) suggested that antenatal care be increased from four to eight consultations with medical professionals during pregnancy. Compared to the previous four attendances, the aim of increasing the number of antenatal attendances is to reduce perinatal deaths by 8 per 1000 live births [32].

The study results also found that women who had regular GP attendances had a significantly higher likelihood – by 50% – of giving birth vaginally compared to those who did not have such attendances (p=0,02). At the same time, there were no statistically significant differences in evaluating the impact of GP attendances in the first trimester or later on the mode of delivery (p=0.5). A different situation was observed in the evaluation of the relationship between

the number of GP attendances (p<0.001) or the number obstetrician's attendances (p=0.032) and the mode of delivery, which showed statistically significant deviations. The ratio between the rate of women who had 4-7 GP attendances compared to 1-3 varied between 1.16 attendances for participants with VD and 2.4 for those with ECS, constituting 1.6 for participants with PCS.

A similar trend was observed in the evaluation of services provided by the obstetrician, which found that the proportion of participants who had more than 3 obstetrician attendances was approximately twice as high among participants with PCS and ECS compared to those who had up to 3 attendances and was approximately identical among participants who gave birth vaginally.

In the absence of other evidence and analyses of associated characteristics, this finding can be interpreted ambiguously. One viable interpretation is that higher attendance at antenatal care services by women with high-risk pregnancies influences the increase in the rate of CS. Additionally, without evaluating the reasons for this high GP and obstetrician attendance, there is a possibility that the increased rate of CS is due to voluntary attendance of participants without medical indications, leading to elective cesareans. Furthermore, consideration must be given to the possibility of overdiagnosis caused by medical staff's desire to prevent pregnancy and delivery complications, given that advanced reproductive age is a risk factor.

The evaluation of the impact of the mode of first delivery on subsequent deliveries identified statistically significant differences (p<0.001), indicating a probability approximately 2 times higher for VD among women whose first delivery ended vaginally, compared to a probability approximately 8 times higher for cesarean delivery among women whose first delivery ended in a CS. This demonstrates the impact of a CS history on subsequent pregnancies.

As reported in several studies, a previous CS has been predictably associated with a subsequent CS. According to a study from Brazil, a previous CS was linked to cesarean delivery in the current pregnancy [33]. Published research also indicates that women who have previously undergone a CS are more likely to experience placenta previa, placental abruption, and uterine rupture in subsequent pregnancies [34].

A significant aspect is the interrelation between the mode of delivery and parity, noting statistically significant differences (p<0.001) and revealing that every 6th woman who delivers vaginally is primipara, compared to every 3rd woman who delivers by ECS, and every 2 out of 5 who deliver by PCS. Supporting these findings, several studies highlight that the risk of CS, including ECS, in women of advanced reproductive age is considerably higher in primipara women, whereas the risk of preeclampsia is significantly higher in multipara women [35]. Like other studies, we found that the effects of increasing age were significantly more pronounced among primipara women than among multipara women [36]. This difference could be influenced by the higher likelihood of older primipara women opting for elective CS [37]. Some studies indicate that the risk of CS increases with age among both nulliparous and multipara women [38]. These findings may result from the higher probability of younger women being healthier and not suffering from preexisting chronic conditions that pose potential risks for pregnancy and delivery. Additionally, the influence of institutional culture and the expertise level of the healthcare provider could potentially affect women's decision-making processes regarding the mode of delivery [39].

Furthermore, in accordance with a previous study, our research demonstrated a positive correlation between maternal age and the likelihood of preterm birth (p=0.007) [40].

Conclusions

Our study identified the influence of biopsychosocial factors on the mode of delivery. Pregnancy at advanced reproductive age is associated with an increased rate of CS. Factors such as area of residence and education were found to have a significant impact on the mode of delivery. Women with higher levels of education are more likely to opt for CS. Previous CS, parity, pregnancy and delivery complications, and preexisting chronic conditions were also identified as contributing factors to CS. Proper information about pregnancy risks and the importance of antenatal care, including managing preexisting chronic conditions, plays a significant role in preventing adverse pregnancy and birth outcomes in this age group. These results highlight that advanced reproductive age can be an individual risk factor, emphasizing that providing detailed information to mothers over 35 about factors affecting pregnancy outcome improves them, particularly for primipara women.

Competing interests

None declared.

Authors' contributions

RS conceptualized the project, drafted the first manuscript and interpreted the data. LS added some conceptual ideas and critically revised the manuscript. Both authors revised and approved the final version of the manuscript.

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Patient consent

Obtained.

Ethics approval

The study protocol was approved by the Research Ethics Committee of *Nicolae Testemițanu* State University of Medicine and Pharmacy, minutes No.16, from 13th of February 2012.

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