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COMPARATIVE ANALYSIS OF TECHNIQUES FOR OPENING THE ANTERIOR ABDOMINAL WALL IN CESAREAN SECTION:

MISGAV LADACH VS. PFANNENSTIEL

AUTHOR'S ABSTRACT

of a dissertation submitted for the award of the educational and scientific degree "Doctor"

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Prof. Emil Kovachev, MD, PhD, DMSc

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The dissertation contains a total of 110 pages and is illustrated with 21 graphs, 26 tables, and 14 figures.

The bibliography includes 204 references: 16 in Cyrillic and 188 in Latin script.

Note: The numbering of tables, graphs and figures in the author's abstract does not correspond to that in the dissertation.

The doctoral candidate works as Head of the Delivery Ward at SBAGAL "Prof. Dr. Dimitar Stamatov" – Varna and as a lecturer in the Department of Obstetrics and Gynecology, Medical University – Varna.

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The defense of the dissertation will take place on 13.03.2026 at …….. in the meeting room of SBAGAL "Prof. Dr. D. Stamatov" ……..…… at an open session of the Scientific Jury.

The defense materials are available at the Scientific Department of MU–Varna and published on the university website.

CONTENTS

LIST OF ABBREVIATIONS

ACOG	–	American College of Obstetricians and Gynecologists
APGAR	–	APGAR score – Scale for assessing neonatal condition
BMI	–	Body mass index
CBC	–	Complete blood count
CS	–	Cesarean section
ERAS	–	Enhanced Recovery After Surgery
FHR	–	Fetal heart rate
FIGO	–	International Federation of Gynecology and Obstetrics
GDM	–	Gestational diabetes mellitus
HELLP	–	Hemolysis, Elevated Liver Enzymes, Low Platelets
HIV	–	Human immunodeficiency virus
ID	–	Personal identification number
MRI	–	Magnetic resonance imaging
NHIF	–	National Health Insurance Framework
NICE	–	National Institute for Health and Care Excellence
NSI	–	National Statistical Institute
NST	–	Non-stress test
PAS	–	Placenta accreta spectrum
PPH	–	Postpartum hemorrhage
RCOG	–	Royal College of Obstetricians and Gynaecologists
RCT	–	Randomized controlled trial
SMFM	–	Society for Maternal-Fetal Medicine
SP	–	Sectio parva
USA	–	United States of America
USD	–	Ultrasound diagnostics
VTE	–	Venous thromboembolism
WHO	–	World Health Organization

INTRODUCTION

Cesarean section remains one of the most frequently performed operative interventions in modern obstetrics. Its global incidence has been steadily increasing over the past decades, reaching levels that significantly exceed the recommendations of the World Health Organization. The rising trends in maternal age, obesity, and comorbidities further contribute to the growing number of operative deliveries. This necessitates the optimization of surgical techniques with a focus on minimizing perioperative risks, reducing blood loss, shortening operative time, and improving postoperative recovery.

Two of the most widely used techniques for accessing the anterior abdominal wall during cesarean section are the Misgav Ladach technique and the Pfannenstiel–Kerr method. Each has its own advantages and limitations, related to operative duration, blood loss, postoperative discomfort, adhesion formation, and economic efficiency. In Bulgaria, despite the increasing rate of cesarean sections, there is still no standardized protocol for selecting the most appropriate operative technique based on maternal factors such as BMI, history of previous cesarean sections, or fetal parameters.

The aim of this dissertation is to conduct a comparative analysis of the two operative methods for cesarean section—Misgav Ladach and Pfannenstiel–Kerr—by evaluating key clinical indicators such as operative time, blood loss, postoperative recovery, and correlation with BMI, fetal weight, and previous uterine surgeries. The study also seeks to develop a practical protocol for selecting the optimal approach for operative delivery in specific high-risk groups of pregnant women.

OBJECTIVE

1. AIM

The objective of the present study is to perform a comparative analysis of the techniques for opening the anterior abdominal wall during cesarean section—Misgav Ladach and Pfannenstiel-Kerr—and to identify the advantages of the Misgav Ladach method over the classical Pfannenstiel technique.

2. TASKS

1. To monitor the duration of the cesarean section using both techniques.
2. To clarify the time interval from the start of the operation to the extraction of the fetus in both methods.
3. To identify intraoperative complications (blood loss, injury to other organs and tissues) associated with the studied techniques.
4. To examine the intensity of postoperative pain syndrome associated with both techniques.
5. To compare the amount of medication required for the surgical procedure itself, as well as during the postoperative period.
6. To demonstrate the economic feasibility for the hospital institution when using the two methods.

MATERIALS AND METHODS

1. CLINICAL MATERIAL

1.1. Subject of the Study

The subject of the study consists of patients who underwent operative delivery via the Misgav Ladach method and cesarean section via the Pfannenstiel technique.

1.2. Study Setting and Period

The dissertation was developed based on the results from a clinical study of 327 women who delivered in the Obstetrics Department of SBAGAL "Prof. Dr. D. Stamatov," Varna, during the period 2019–2023.

1.3. Study Design

A retrospective and prospective analysis was conducted. The patients were selected based on whether they had undergone a previous operative delivery, as well as according to the method used for performing the cesarean section—either the Misgav Ladach technique or the Pfannenstiel cesarean section. Two groups were formed:

- **Study group:** patients who underwent a modified Misgav Ladach cesarean section.
- **Control group:** patients who underwent a cesarean section via Pfannenstiel incision.

The research is based on an epidemiological approach and is experimental-theoretical in nature. Prior to data collection, direct interaction with the study subjects—women who had undergone cesarean section—was required. The investigation has a retrospective character. Sources of information included: the existing digital medical database, discharge summaries, medical histories, and operative records from the University Ob-Gyn Hospital "Prof. Dr. D. Stamatov," Varna, covering the period 2019–2023.

1.4. Inclusion and Exclusion Criteria

1.4.1. Inclusion Criteria:

- Signed informed consent;
- Completion of the "Hospitalized Patient Questionnaire" (Appendix I);
- Hospitalization for delivery in the medical institution.

1.4.2. Exclusion Criteria:

- Refusal to sign informed consent;
- Refusal to complete the patient questionnaire;
- Hospitalization for reasons other than childbirth;
- Individuals under 18 years of age.

According to the 2004 Health Act, the definition of informed consent is:

"Informed consent is voluntarily given by the patient after being presented with specific information."

Every operated patient was informed of her rights and confirmed her consent by signing the informed consent form, declaring she was aware of all possible risks and complications related to the surgical procedure.

For the clinical investigation, pregnant women were informed in advance and completed the "Hospitalized Patient Questionnaire" (Appendix I). The questionnaire does not include personal data such as: full name, personal identification number, address, or ID/passport information, ensuring confidentiality of all participants

1.5. Methodology

Given the specifics of the cesarean section, the process is divided as follows:

1.5.1. Preoperative Day:

Admission to the hospital, ordering of laboratory tests and diagnostic procedures according to the requirements of the National Health Insurance Fund: gynecological examination, ultrasound, anesthesiology consultation, complete blood count, coagulation profile, ionogram, biochemistry, urinalysis, and NST.

- Food intake up to 12 hours before the operation; fluid intake up to 4–6 hours before the operation, including clear apple juice;
- Bowel preparation with EVA Q; cleansing enema is avoided if possible;
- Establishing intravenous access.

1.5.2. Day of the Operation:

- Immediately before and during surgery: infusion of crystalloids 1000–2000 ml, urinary bladder catheterization, intraoperative antibiotic prophylaxis.

1.5.3. Preparation of the Instrument Set for Cesarean Delivery (Fig. 1):

Fig. 1. Instrument set for Pfannenstiel cesarean section (own material).

- Preparation of the instrument set for cesarean delivery using the Misgav Ladach technique requires more economical use of instruments, sutures, and consumables. This is due to the reduced need for ligation of bleeding vessels and the absence of peritonealization. (Fig. 2)

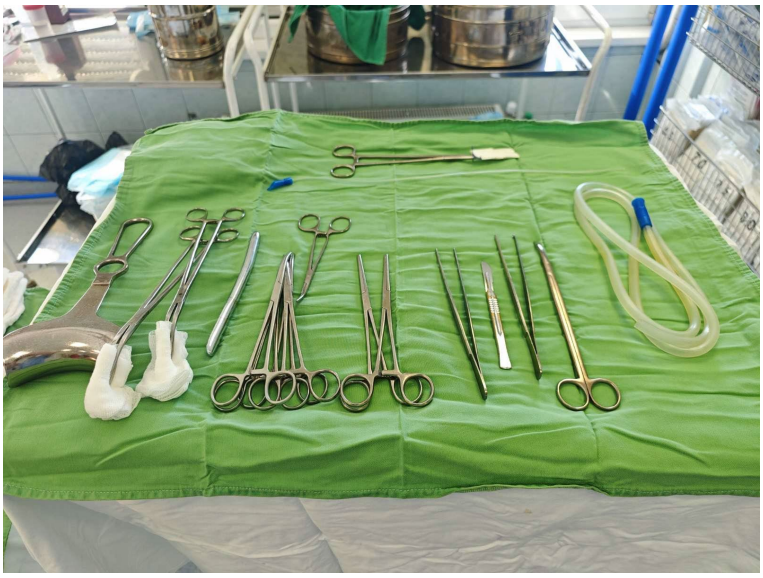


Fig. 2. Instrument set for cesarean delivery using the Misgav Ladach technique (own material).

1.5.4. Postoperative Period:

- Anticoagulant prophylaxis with Fraxiparine 0.4–0.6;
- Infusion of crystalloids;

- Follow-up blood tests within 6 hours;
- Early mobilization after 6 hours if possible;
- Removal of the urinary catheter;
- Analgesic medication;
- Uterotonics;
- Oral fluid intake 2–4 hours after surgery.

1.5.5. First to Fifth Postoperative Day:

- Early oral feeding on day 1 in the absence of signs of paralytic ileus, regardless of the presence or absence of flatulence;
- Analgesia only upon request or with Profenid suppositories;
- Anticoagulant prophylaxis until postoperative day 3;
- Removal of the IV cannula on day 3;
- Removal of the surgical dressing on day 3–4 (Fig. 3);
- Shower after dressing removal;

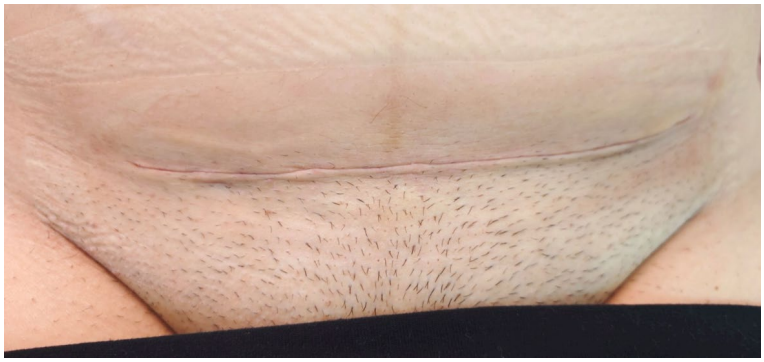


Fig. 3. Surgical wound on postoperative day 4 after Misgav Ladach cesarean section (own material).

- Wound care;
- Stimulation of defecation with lactulose on day 4;
- Stimulation of lactation and uterine involution;
- Discharge from hospital on day 5 according to NHIF regulations.

1.5.6. Follow-up Examinations:

Two examinations within the first month and one at 42 days postpartum.

2. STATISTICAL METHODS

2.1. Statistical Hypothesis Testing

- Statistical hypothesis testing for comparing two mean values based on independent samples

The verification process includes the following steps:

1. Formulation (definition) of H_0 – null hypothesis, and H_1 – alternative hypothesis:
   H_0: $\bar{X}_1 = \bar{X}_2$ (there is no statistically significant difference between the two mean values)
   H_1: $\bar{X}_1 \neq \bar{X}_2$ (there is a statistically significant difference between the two mean values)
2. Setting a significance level: $\alpha = 0.05$
3. Selection of statistical criterion: z-test (standard normal distribution)
4. Calculation of the empirical value of the chosen criterion – z_emp.
5. Determination of the theoretical value from the table of standard normal distribution quantiles – z_theor.
6. Comparison of empirical and theoretical values and decision-making:

- If z_emp < z_theor → accept H_0 (null hypothesis)
- If z_emp > z_theor → reject H_0 in favor of H_1 (alternative hypothesis)

Statistical hypothesis testing for comparing two proportions based on independent samples

The verification process includes the following steps:

1. Formulation of H_0 and H_1:
   H_0: $P_1 = P_2$ (no statistically significant difference between the two proportions)
   H_1: $P_1 \neq P_2$ (there is a statistically significant difference between the two proportions)
   Significance level: $\alpha = 0.05$
2. Selection of statistical criterion:

- z-test (standard normal distribution)

3. Calculation of z_emp.
4. Determination of z_theor from the standard normal table.
5. Decision:

- If z_emp < z_theor → accept H_0
- If z_emp > z_theor → reject H_0 in favor of H_1

2.2. Correlation Analysis

The examined variables are presented on various statistical scales (nominal, ordinal, rank, and interval). Therefore, different correlation coefficients are applied depending on the scale of each pair of correlated variables. Only statistically significant correlations with $\alpha < 0.05$ are presented.

Correlation coefficients are interpreted according to the following table:

Tabl. 1. Interpretation of correlation coefficients

Value of correlation coefficient	Strength of relationship
0.0	No relationship
0.0 – 0.1	Very weak
0.1 – 0.3	Weak
0.3 – 0.5	Moderate
0.5 – 0.7	Considerable
0.7 – 0.9	Strong
0.9 – 1.0	Very strong
1.0	Functional relationship

RESULTS AND DISCUSSION

1. DEMOGRAPHIC CHARACTERISTICS

The clinical study is based on the results from 327 women who underwent operative delivery in the Obstetrics Department of the University Obstetrics and Gynecology Hospital "Prof. Dr. D. Stamatov," Varna, during the period 2019–2023.

The examined populations include:

- Patients who underwent cesarean section using the Misgav Ladach technique (study group – first group): 215 women
- Patients who underwent cesarean section via Pfannenstiel incision (control group – second group): 112 women

1.1. Age Distribution

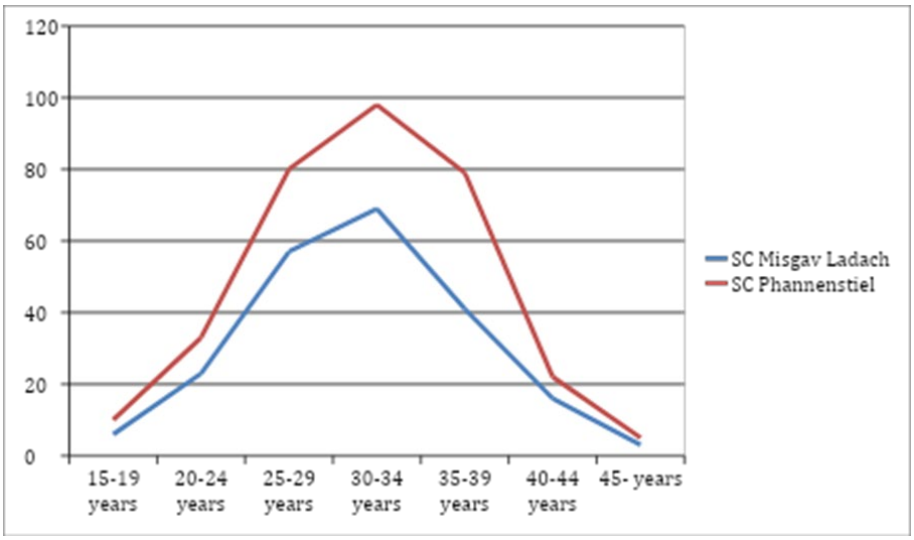
The studied patients (n = 327) had a mean age of 31.35 years.

The study group (patients undergoing cesarean section via Misgav Ladach) had a mean age of 31.2 years, while the control group (patients undergoing cesarean section via Pfannenstiel) had a mean age of 31.5 years.

Tabl. 2. Age distribution according to the method of operative delivery

Cesarean section via Misgav Ladach /women/	Cesarean section via Pfannenstiel /women/	Age	Mean number of CS/age group
6	4	15-19	5 CS/15-19
23	10	20-24	16.5 CS/20-24
57	23	25-29	40 CS/ 25-29
69	29	30-34	49 CS/ 30-34
41	38	35-39	39.5 CS/ 35-39
16	6	40-44	11 CS/ 40-44
3	2	45	2.5 / 45

According to data from the National Statistical Institute (13) for 2024, the average maternal age at first birth in Varna region is 28.7 years, and 30.1 years for the second birth. For Bulgaria overall, the average maternal age is 27.6 years at first birth and 29.1 years at second birth.The results of our study are consistent with regional and national trends, supporting their representativeness and validity. This reinforces the observation that patterns of advanced maternal age are similar both nationally and locally.



Graph 1. Age distribution according to the method of operative delivery

The graphical and tabular representations demonstrate that the highest number of operative deliveries occurred in the 30–35 age group. The highest number of cesarean sections via Misgav Ladach is found in this age group, whereas Pfannenstiel cesarean sections predominate in women aged 35–40 years.

Tabl. 3. Summary of demographic characteristics

Category	Main Finding	Study Data
Age distribution by method	Most cesarean sections occur in the 30–34 and 35–39 age ranges.	30–34 years: 69 (Misgav Ladach), 49 (total). 35–39 years: 41 (Misgav Ladach), 38 (Pfannenstiel).
Misgav Ladach method	Most frequent in the 30–34 age group.	69 in 30–34 years; 57 in 25–29 years.
Pfannenstiel method	More frequent in the 35–40 age range	38 in 35–39 years; 16 in 40–44 years..
Mean maternal age	Close to national and regional values.	31.35 overall; 31.2 (Misgav Ladach), 31.5 (Pfannenstiel).
Age differences between methods	Minimal differences in mean age between groups.	31.2 Misgav Ladach vs. 31.5 years Pfannenstiel.
Distribution trend	The majority of operative deliveries occur between ages 30–39.	30-34 .: 69 (Misgav Ladach), 49 (all 30-34 г.); 35-39: 41 (Misgav Ladach), 38 (Pfannenstiel).
Summary	Consistent with national/regional demographic data.	First birth in Varna: 28.7, second: 30.1 г.; National averages: 27.6 and 29.1

1.2. Distribution by Number of Pregnancies and Deliveries

The study group (n = 215) reported 392 total pregnancies and 273 deliveries.

Of these 273 deliveries, 246 were operative deliveries, and 35 were previous vaginal births (per vias naturales).

The control group (n = 112) had 248 total pregnancies and 148 deliveries.

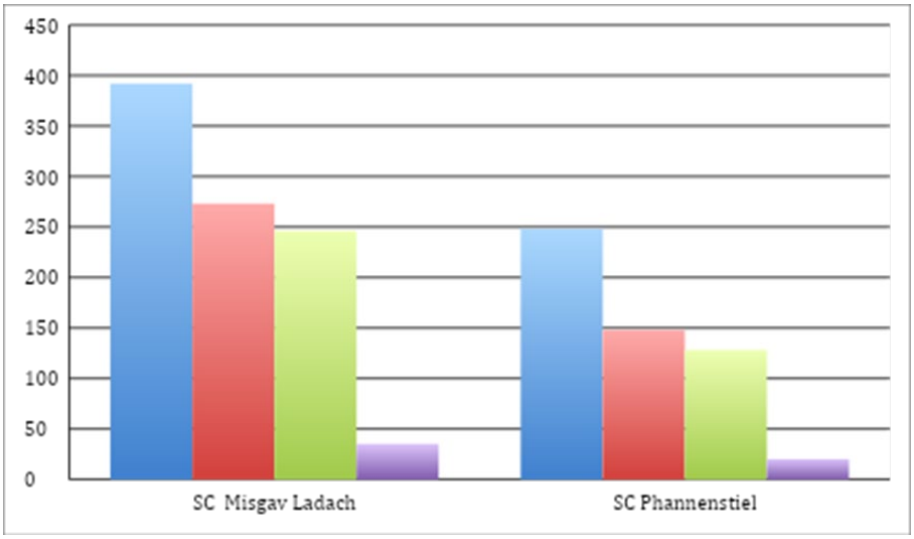
Of these, 128 were operative deliveries, and 20 were vaginal births.

Tabl. 4. Distribution by number of pregnancies and deliveries

Group	Total Pregnancies	Total Deliveries	Cesarean Deliveries	Vaginal Deliveries
Misgav Ladach	392	273	246	35
Pfannenstiel	248	148	128	20

From the presented data, it is evident that out of 640 total pregnancies, the number of deliveries was 421 (65.8%).

There were 219 abortions (34.2%), meaning that one in three pregnancies ended in abortion.



Graph 2. Distribution by number of pregnancies and deliveries

According to the National Center for Public Health and Analysis (12), 16,915 abortions (spontaneous and therapeutic) were performed in Bulgaria in 2024, consistent with our findings.

These results reflect social and healthcare challenges, including the high risk of miscarriage/abortion, preference for operative delivery, and related complications. The data

highlight the need for integrated public health strategies aimed at improving social support, education, and reproductive health prevention.

Tabl. 5. Summary of distribution by number of pregnancies and deliveries

Category	Conclusion	Data / Argument
Overall pregnancies & deliveries	High proportion of operative births in the study group.	273/392 (69.6%) operative births.
Pregnancy/delivery ratio	In the studied group of 215 parturient women, a total of 392 pregnancies and 273 births were registered, which indicates an average of about 1.83 pregnancies and 1.27 births per parturient woman.	392 pregnancies, 273 births. Total number of pregnancies (640) and births (421).
Operative vs. vaginal births	Operative births (according to Misgav Ladach) are preferred, which may point to a trend towards greater use of operative delivery.	246 out of 273 births (90.1%) in the study group were by cesarean section, with 35 natural births
Total number of pregnancies and births	In Bulgaria, according to the National Center for Public Health and Analysis, 16,915 abortions were performed in 2024, which is in line with our data (219 abortions in the study).	In our group, the abortion rate was 34.2% (219 out of 640 pregnancies).
Abortion statistics	One-third of pregnancies end in abortion.	219/640 abortions (34.2%).
National comparison	The high rate of abortions and the prevalence of operative births may signal a need for improved prevention and health services.	The high rate of abortions and operative births requires adequate support and prevention policies.

1.3. Distribution of the Studied Patients According to History of Abdominal Surgery

Among the women operated via the Misgav Ladach technique, 19 patients had a history of previous surgical intervention. One patient had undergone two abdominal surgeries—appendectomy and right adnexectomy.

The abdominal operations included: four appendectomies and one cholecystectomy.

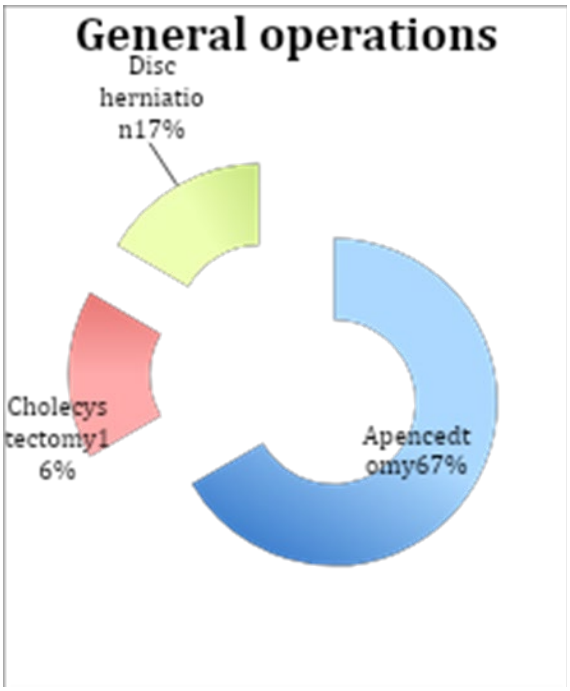
One patient had undergone surgical treatment of a disc herniation.

A total of **12 patients** had a history of gynecological operations:

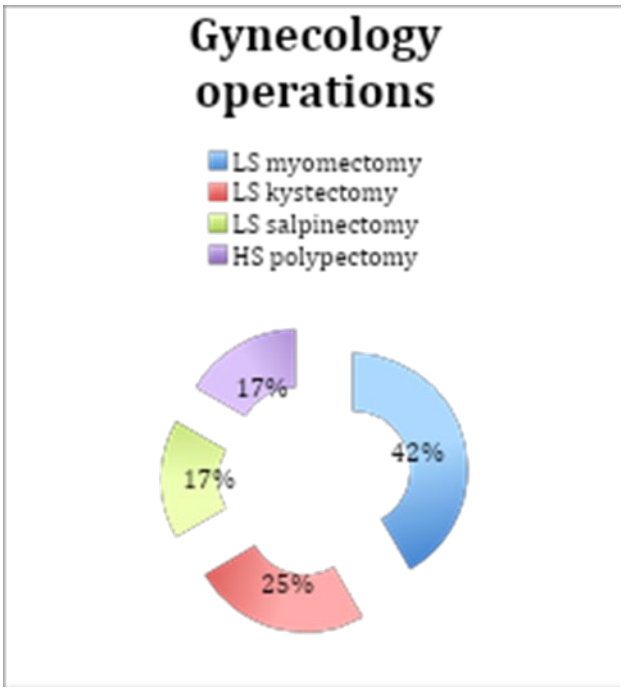
- 5 laparoscopic myomectomies
- 3 laparoscopic cystectomies
- 2 laparoscopic salpingectomies due to ectopic pregnancies
- 2 hysteroscopic polypectomies

(Graphs №3 and №4)

The women operated via Pfannenstiel reported NO previous abdominal surgical interventions.



Graph 3. General surgical interventions



Graph 4. Gynecological surgical interventions

Surgical interventions among women delivered via Misgav Ladach included both abdominal and gynecological surgeries, which may indicate a higher predisposition to (or necessity for) additional surgical procedures. Safety and risk of complications in repeat surgeries should be considered before, during, and after operative delivery.

1.4. Distribution of the Studied Women by History of General and Gestational Diseases

Among the patients operated via Misgav Ladach:

- 44 had general (pre-existing) medical conditions
- 13 had gestational diseases (10 with preeclampsia, 3 with gestational diabetes)

- 3 had combined general + gestational disease (thrombophilia with preeclampsia)

Tabl. 6. Morbidity in Patients Operated via Misgav Ladach

Disease	Number of Patients
General Disease	
Anemia	2
Hypertension	4
Thyroiditis	7
Hydronephrosis	3
Thrombophilia	8
Myopia	11
Thalassemia	2
Diabetes melitus	4
Epilepsy	1
Thrombocytopenia	1
Lupus	1
Gestational Diseases	
Preeclampsia	10
Gestational diabetes	3

Among the women operated via Pfannenstiel:

- 2 had a history of varicose veins of the lower limbs,
- 2 had thrombophilia,
- 1 had hypothyroidism.

Gestational diseases were observed in 4 patients:

- 2 with preeclampsia
- 2 with gestational diabetes

One patient had combined hypothyroidism and gestational diabetes.

Tabl. 7. Morbidity in Patients Operated via Pfannenstiel

Diseases	Number
General Diseases	
Varicose veins of lower limbs	2
Thrombophilia	2
Hypothyroidism	1
Gestational diseases	
Preeclampsia	2
GDM	2
Combined disease	
Hypothyroidism and GDM	1

Gestational Diabetes Mellitus (GDM) is one of the most common pregnancy-related conditions according to the literature. Reported prevalence includes: Netherlands: 0.6%, Denmark: 3.6%, Italy: 6.3%, USA: 7%, China: ~17.5%.

GDM results from insulin resistance or reduced insulin action due to placental hormone production. Additional risk factors include advanced maternal age and obesity (201).

Women with GDM have a higher likelihood of obstetric intervention (labor induction, cesarean section).

Xiong et al. found that GDM increases the risk of cesarean section 1.13-fold (aOR = 1.13; 95% CI: 1.10–1.16; $p < 0.05$).

Fadl et al. reported a 1.46-fold increased risk (aOR = 1.46; 95% CI: 1.38–1.54; $p < 0.001$).

In our study, 6 out of 327 women (1.83%) had GDM—too small a sample for statistically reliable evaluation of GDM as a CS risk factor.

Tabl 8. Summary of Findings in Patients with GDM and Operative Delivery

Topic	Findings from Literature	Conclusions
Global prevalence of GDM	- Worldwide incidence — 0.6%-17.5%; Fadl et al. (2010, Sweden, 1991–2003): - In Bulgaria — about 7%. - Our study: 1.83% (6/327);	The incidence of GHD in our group is low compared to global data and is consistent with national indicators. International data show variations from 0.6% to 17.5%, with our level being lower.
Risk of CS in GDM	- OR = 1.13 CS GDM Xiong et al. (2001): - OR = 1.46- Fadl et al. (2010) - Our data CS (57.4%).	GDM significantly increases CS risk; trend present in our group despite small numbers.
Treatment and control	Our data: treatment type (diet/metformin/insulin) did not influence delivery mode.	Small sample prevents strong conclusions; literature shows good glucose control reduces complications.

Preeclampsia is a leading cause of maternal and perinatal morbidity and mortality worldwide. It complicates 2–8% of pregnancies.

Although preeclampsia is not in itself an absolute indication for cesarean delivery and vaginal birth is often possible, multiple studies report increased CS rates among women with preeclampsia. Katz et al. (2015): 68% of women with preeclampsia delivered by CS. Pasokruckdee & Boriboonhirunsarn: preeclampsia prevalence 9.1%, and increased risk for CS 2.2-fold.

In our cohort, preeclampsia was diagnosed in 12/327 women (3.66%).

Due to incomplete data regarding severity and causal indication for CS, no reliable statistical analysis can be performed.

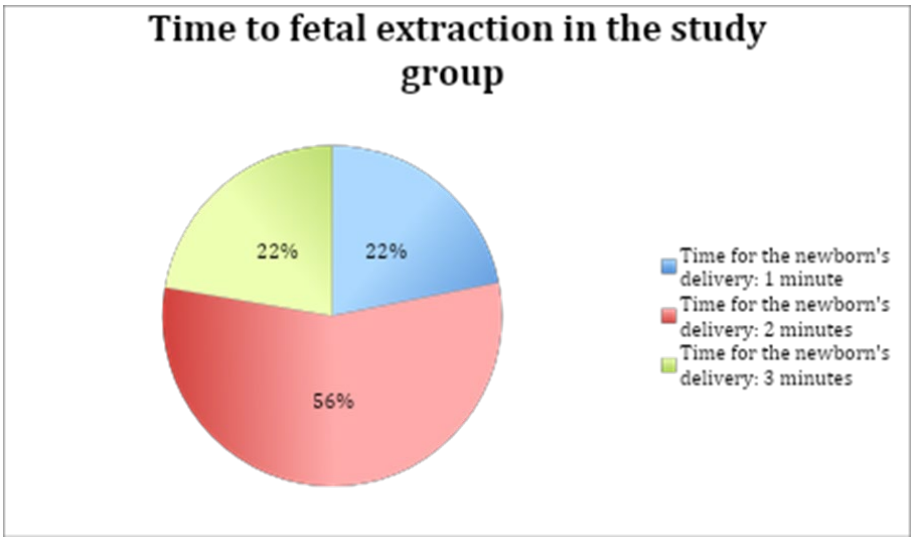
Tabl. 9. Comparison of Our Data with Global Literature on Preeclampsia and CS

Aspect	Our study Varna	Pasokpuckdee & Boriboonhirunsarn (Thailand, 2023)	Katz et al. (Brazil, 2014)	Sanchez et al. (Brazil, 2021)	Conclusion
Total number	327	670	500	3102	Smaller sample limits statistical power.
Prevalence of preeclampsia	3.66%	8.3%	~2-8%	8-9%	Comparable to global data, slightly lower
Overall CS rate	40.6%	48.9%	48-55%	50%	High CS rates consistent with global trends.
Risk for CS in preeclampsia	Not assessed	RR 2.2-2.3	RR 2.2	RR 1.8-2.0	Strong global evidence of increased CS risk.

2. STATISTICAL TESTING OF HYPOTHESES

2.1. Comparing the average time to deliver the fetus for the two groups

Time for fetal extraction in the studied group: 2.00 min. From the data obtained, we obtained the following results: time for fetal delivery in 1 min – 47 pcs (21.8%), in 2 min – 120 pcs (55.8%) and in 3 min – 48 pcs (22.3%).



Graph 5. Graphical representation of the average time to fetal extraction in the study group

Using the techniques for opening the anterior abdominal wall in cesarean section according to the Misgav Ladach method, no fetus was delivered after the 3rd minute.

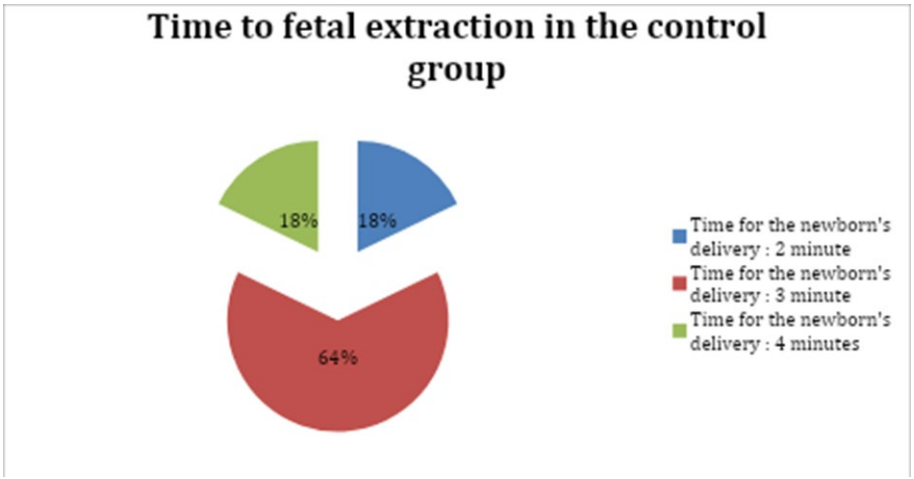
The largest number of neonates were delivered within 2 minutes from the start of the operation—55.8%.

The results for deliveries at the 1st and 3rd minute were similar—21.8% and 22.3%, respectively (Graph 5).

In the control group, the time to fetal extraction was 3.00 minutes.

Based on the obtained data, the following results were recorded:

- delivery within 2 minutes – 20 cases (17.8%)
- delivery within 3 minutes – 72 cases (64.2%)
- delivery within 4 minutes – 20 cases (17.8%)
- (Graph 6)



Graph 6. Graphical representation of the average time to fetal extraction in the control group

Using the Pfannenstiel incision for opening the anterior abdominal wall, the average time for fetal delivery is 3 minutes.

In the studied group of 112 women, there were no neonates delivered within the 1st minute; the highest percentage of newborns were delivered at the 3rd minute (Graph 7).

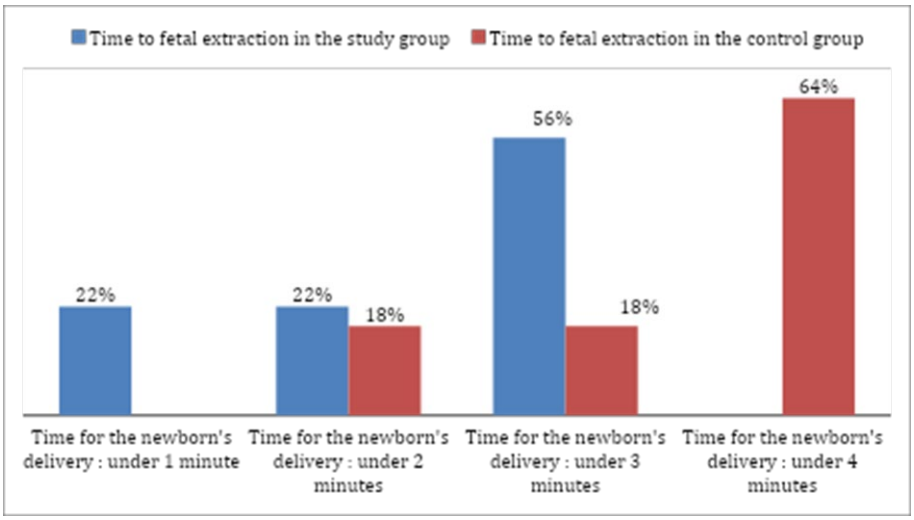


Fig. 7. Graphical representation of the average time for fetal extraction in the control group and the study group

Using statistical hypothesis testing to compare two mean times for fetal extraction, we have a statistically significant difference:

Ho: Xav.1 = Xav.2 (there is no statistically significant difference between the two means)

- H1: Xav.1 ≠ Xav.2 (there is a statistically significant difference between the two averages) α=0.05
- z-test (standard normal distribution)
- Xav.1 = 2.00 min.; Xav.2 = 3.00 min.; S1 = 0.67 min.; S2 = 0.60 min.; n1 = 215; n2 = 112
- zemp. = 17.55
- ztheor. = 1.96
- zemp. = 17.55 > ztheor. = 1.96, therefore we accept H1, i.e. there is a statistically significant difference between the average time for fetal extraction in the two groups)

According to Sarah Little et al., who examined 22,603 cesarean deliveries, the time from hysterotomy to birth ranges from 0 to 15 minutes, with a mean of 1.69 minutes and a standard deviation of 1.12 minutes. The authors also present non-parametric measures: the median time from hysterotomy to birth is 1 minute, with 84.8% of infants delivered in under 2 minutes, 94.8% in under 3 minutes, 97.9% in under 4 minutes, and 99.3% in under 6 minutes.

When performing delivery using the Misgav Ladach technique, the achieved fetal extraction time is comparable to the mean time of 1.68 minutes reported by Sarah Little et al.

In contrast, operative delivery using the Pfannenstiel approach results in a mean extraction time of around 3 minutes, which exceeds the reported standard deviation of 2.81 minutes.

2.2. Comparison of Blood Loss Between the Studied Groups

Globally, cesarean delivery is one of the most commonly performed surgical interventions in obstetrics. (178) Despite its prevalence, women undergoing cesarean section are exposed to an increased risk of surgical complications associated with abdominal surgery, such as infection, thromboembolism (VTE), injury to internal organs, hemorrhage, and the need for blood transfusions. (178)

Blood loss during operative delivery is an important indicator of surgical safety and the quality of operative care. In late pregnancy, uterine blood flow typically reaches between 500 and 750 ml/min. (18)

The average blood loss during cesarean section varies in the literature and depends on numerous factors, including the surgical technique used, the surgeon's experience, individual patient characteristics, and the presence of complications. During cesarean delivery, the average blood loss is approximately 500 ml (18), although it varies widely, ranging from under 500 ml to over 1000 ml. (92)

According to Dimitrov A., blood loss during cesarean section depends on the method of measurement. When measured using dilution methods, average blood loss is approximately 1000 ml, as this includes the amount of blood in the intervillous space released during placental separation. When using the clinical estimation method, blood loss is 550 ± 250 ml. (7)

Published data from studies on operative delivery demonstrate that the choice of surgical technique has a significant impact on the volume of blood loss. A clinical study based on 110 parturients shows that blood loss differs markedly: 336 ml with the Misgav Ladach technique versus 483 ml with the Pfannenstiel technique ($p < 0.001$). (176) Abram reports that in the Misgav Ladach group the mean blood loss is 285.2 ml, which is 122.3 ml less than the mean blood loss in the Pfannenstiel group (407.5 ml). He also finds that postoperative hemoglobin levels are higher in patients operated with the Misgav Ladach technique compared with those undergoing Pfannenstiel incisions. (17)

Seema examined 50 women operated using the Misgav Ladach method and 50 operated with the Pfannenstiel technique over a one-year period. Her published data show a mean blood loss of 294 ± 200 ml for the Misgav Ladach technique, compared to 455 ± 200 ml in the Pfannenstiel group. (168)

Lower blood loss with the Misgav Ladach technique is also demonstrated by Darj and Nordström, who in a randomized study of elective cesarean sections report mean blood losses of 448 ml for Misgav Ladach and 608 ml for Pfannenstiel. (59, 86)

Our data show that the mean blood loss among 194 women operated using the Misgav Ladach technique is 169 ml. For 21 of the women examined, blood loss data were unavailable and therefore not included in the analysis. In two patients diagnosed with placenta praevia, blood loss amounted to 1500 ml. Using the Pfannenstiel technique, the mean blood loss among 112 parturients is 219 ml (Fig. 8).

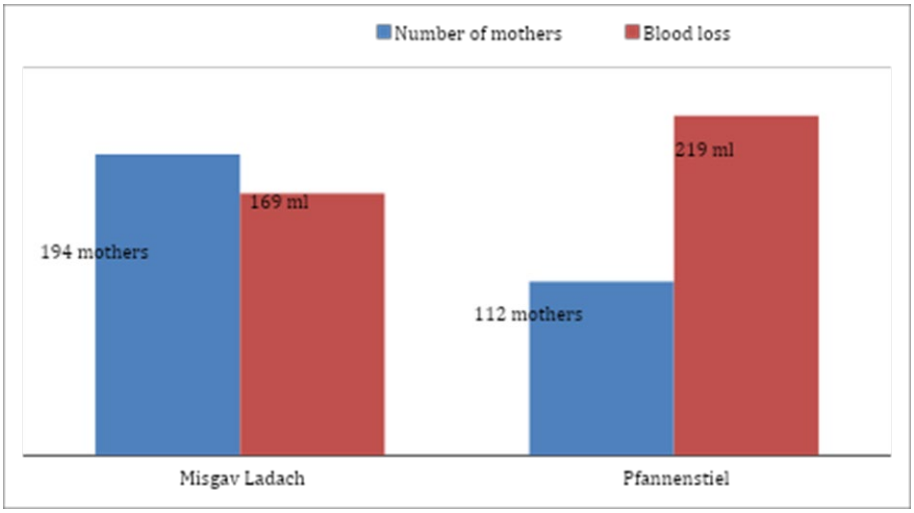


Fig. 8. Blood loss during operative delivery using the Misgav Ladach and Pfannenstiel techniques

Various research groups (128) have reported over the years a lower mean blood loss during operative delivery performed using the Misgav Ladach technique compared with the Pfannenstiel approach — as shown in Table 11.

Tabl. 10. Mean blood loss during operative delivery using the Misgav Ladach technique

Researcher / groop	Misgav Ladach mean blood loss	Pfannenstiel mean blood loss	Mean difference in blood loss
Chitra 2004	294.2 ml	455.6 ml	161.4 ml
Darj 1998	448 ml	608 ml	160 ml
Ezechi 2013	553.6 ml	734.9 ml	188.3 ml
Kabatin 2021	333 ml	470 ml	137 ml
Kanani 2017	294 ml	455.6 ml	161.6 ml
Li 2001	142 ml	212 ml	70 ml
Sharma 2019	586 ml	608 ml	22 ml
Singh 2017	294 ml	455 ml	161 ml
Our data	168.8 ml	218.9 ml	50.1 ml

The mean difference in blood loss observed in our study — 50.1 ml — is statistically significant, as demonstrated using a hypothesis test comparing blood loss between the two groups:

H_0: $\mu_1 = \mu_2$ (there is no statistically significant difference between the two means)

H_1: $\mu_1 \neq \mu_2$ (there is a statistically significant difference between the two means), $\alpha = 0.05$

We applied the z-test (standard normal distribution) using the following parameters:

$\mu_1 = 168.81$ ml; $\mu_2 = 218.93$ ml; $S_1 = 127.26$ ml; $S_2 = 83.84$ ml; $n_1 = 194$ (number of patients with available data); $n_2 = 112$.

The test results are:

- $z_{emp} = 4.22$
- $z_{theor} = 1.96$
- Since $z_{emp} = 4.22 > z_{theor} = 1.96$, we reject H_0 and accept H_1, i.e., there is a statistically significant difference in blood loss between the two groups.

Tabl. 11. Mean Intraoperative Blood Loss in Cesarean Delivery Using the Misgav Ladach and Pfannenstiel Techniques – Our Results and International Data

Aspect / Data	Our Results	International Data	Conclusions
Mean blood loss with the Misgav Ladach technique	168.8 ml (n= 194)	-294 ml (Chitra, 2004); -448 ml (Darj, 1998); -553.6 ml (Ezechi, 2013); -333 ml (Kabatin, 2021); -294 ml (Kanani, 2017); -142 ml (Li, 2001); 586 ml (Sharma, 2019); -294 ml (Singh, 2017)	Our data demonstrate considerably lower blood loss compared with published studies, confirming the efficacy of the Misgav Ladach technique.
Mean blood loss with the Pfannenstiel technique	218.9 ml (n=112)	-455.6 ml (Chitra); 608 ml (Darj); -734.9 ml (Ezechi); -470 ml (Kabatin); -455.6 ml (Kanani); -212 ml (Li); -608 ml (Sharma); -455 ml (Singh)	International data consistently show higher blood loss, supporting the notion that the Pfannenstiel technique is more traumatic.
Statistical significance of the difference	z=4.22, p<0.05	Comparable values reported in clinical studies	The difference is statistically significant, confirming that Misgav Ladach is a less hemorrhagic and safer technique.
Summary	The Misgav Ladach technique is less invasive and associated with lower blood loss.	International research supports this trend.	The method is recommended in clinical practice to minimize bleeding and complications.

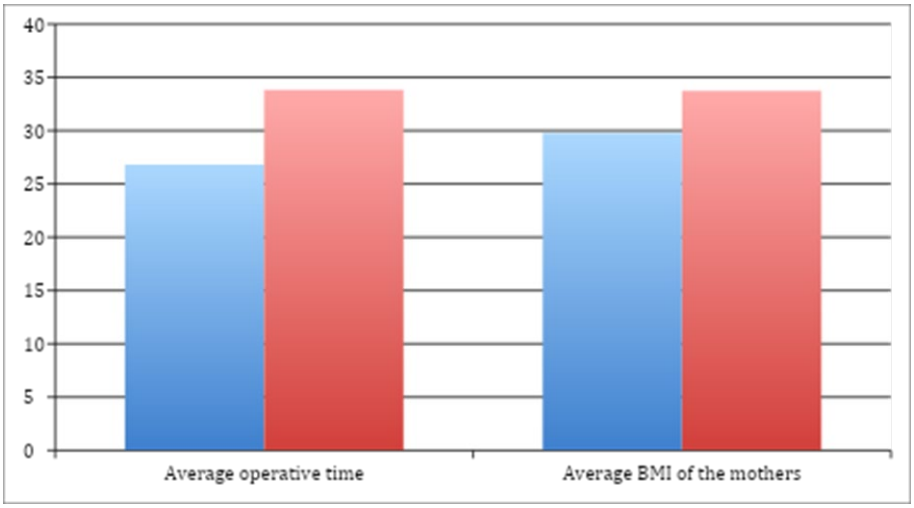
Given the published data in the international literature and the statistically confirmed results of our study, we can conclude that the Misgav Ladach technique is associated with lower blood loss compared with the Pfannenstiel technique (Table 11).

3. CORRELATION ANALYSIS – PRACTICAL APPLICATION

3.1. Relationship Between Body Mass Index (BMI), Operative Time, and Mode of Cesarean Delivery

The mean operative time for performing a cesarean section using the Misgav Ladach technique in our study is 26.83 minutes. The mean BMI of the women operated with this method is 29.8 kg/m². In comparison, performing a cesarean section using the Pfannenstiel technique requires 33.82 minutes, with a mean BMI of 33.73 kg/m² in this group.

When comparing the mean operative times between the two groups, we find that the Misgav Ladach technique is 7.8 minutes faster than the Pfannenstiel method (Fig. 9).



Graph 9. Graphical Representation of the Results for Mean Operative Time and BMI in Operated Patients

The performed correlation analysis of the data from patients operated using the Misgav Ladach technique established a strong correlation between BMI and operative time: R = 0.777, which is statistically significant.

The relationship between BMI and cesarean section is well established, with several studies demonstrating a direct linear association between the two. (29,160)

Obesity among pregnant women has increased dramatically in recent years. (155)

The increased perinatal morbidity associated with maternal obesity—such as congenital anomalies, preeclampsia, gestational diabetes, stillbirth, fetal growth abnormalities, and cesarean delivery—constitutes serious obstetric complications. (41,155)

Kominiarek et al. examined 228,668 births—women with singleton pregnancies after 37 weeks and documented BMI at hospital admission. The researchers established that the risk of cesarean delivery increases with each 1 kg/m² rise in BMI:

- by **5%** in primiparas,
- by **2%** in multiparas without a prior cesarean section, and
- by **5%** in multiparas with a prior cesarean section. (97)

According to international guidelines from the World Health Organization (WHO) and the American College of Obstetricians and Gynecologists (ACOG), the standard BMI categories before pregnancy are as follows:

- Underweight: BMI < 18.5 kg/m²
- Normal weight: BMI 18.5–24.9 kg/m²
- Overweight: BMI 25.0–29.9 kg/m²
- Obesity (Class I): BMI 30.0–34.9 kg/m²
- Obesity (Class II): BMI 35.0–39.9 kg/m²
- Severe obesity (Class III): ≥ 40.0 kg/m²

Tabl. 12. Recommended Total Gestational Weight Gain Based on Pre-Pregnancy BMI Category

BMI Category	Total Weight Gain During Pregnancy (kg)	Weekly Weight Gain in 2nd and 3rd Trimester (kg)
Underweight	12.5–18.0	0.44–0.58
Normal weight	11.5–16.0	0.35–0.50
Overweight	7.0–11.5	0.23–0.33
Obese	5.0–9.0	0.17–0.27

During the first trimester, weight gain is typically minimal—approximately 0.5–2 kg in total.

In the second and third trimester, weight gain accelerates according to the values shown above in Table 13. (154)

Tabl. 13. Tabular Presentation of the Results and Discussion from the Correlation Analysis Between Body Mass Index (BMI), Operative Time, and Mode of Delivery

	Data	**Conclusions**
Operative time for cesarean delivery	The mean operative time using the Misgav Ladach technique is 26.83 min, whereas for the Pfannenstiel technique it is 33.82 min. The difference is 7.8 minutes, which is statistically significant.	The Misgav Ladach technique enables faster completion of the operation, which significantly reduces the risk of complications associated with prolonged operative time.
Correlation between BMI and operative time	The correlation coefficient R = 0.777 demonstrates a strong positive relationship between BMI and the duration of cesarean section when using the Misgav Ladach technique.	A high BMI increases the duration of the surgical procedure, indicating that obesity complicates operative techniques and elevates the overall risk.
Mean BMI of patients in both groups	For the Misgav Ladach method, mean BMI is 29.8 kg/m^2, and for Pfannenstiel — 33.73 kg/m^2.	A high BMI in both groups, particularly in the Pfannenstiel group, is associated with more complex surgical preparation and longer operative time.
Relationship between BMI and risk of CS	International data show that the risk of cesarean section increases with rising BMI — by approximately 5% per each 1 kg/m^2 increase.	Obesity is an important risk factor for the increased rate of cesarean sections, which should be considered when developing preventive strategies.
Statistical significance	$Z_{emp} = 4.22 > Z_{theor} = 1.96$, indicating that the difference in operative time is statistically significant ($p < 0.05$).	The Misgav Ladach method is more efficient in terms of operative duration and patient safety.
Summary	The Misgav Ladach technique is faster (by approximately 7.8 min) and involves less blood loss, especially in patients with high BMI.	Emphasis should be placed on this technique, especially in obese patients, to minimize complications associated with surgical interventions.

The high mean BMI (especially in the Pfannenstiel group — 33.73 kg/m²) indicates that obesity is increasingly prevalent among pregnant women. This highlights the need for health education initiatives aimed at prevention and control of obesity even before pregnancy.

Elevated BMI and its related complications (prolonged operative time, increased risk of hemorrhage and other complications) create a significant burden on the healthcare system and society, resulting in higher costs for treatment and postpartum care.

3.2. Relationship Between BMI ≥ 30.0 kg/m², Time to Fetal Extraction, and Mode of Delivery

King et al. reported that obese mothers with high pre-pregnancy BMI are more likely to have longer incision-to-delivery intervals and a higher risk of low Apgar scores at 5 minutes. (96)

Studies in this field demonstrate a significant association between maternal obesity and prolonged incision-to-delivery times during cesarean section.

Obese mothers (BMI > 30 kg/m²) are significantly more likely to experience longer incision-to-delivery intervals compared with women with normal BMI.

Several researchers have shown that obese mothers have an average incision-to-delivery time of 12.0 minutes. (75,96,200)

Maternal obesity is also associated with an increased risk of low Apgar score (< 7) at 5 minutes after delivery. (200,202)

- Women with BMI 30–34.9 kg/m² have a 1.57-fold higher risk of low Apgar score.
- Women with BMI ≥ 40 kg/m² have a 3.41-fold higher risk compared with women of normal weight. (202)

In the studied group, among 215 women who underwent cesarean delivery using the Misgav Ladach technique, the mean BMI was 29.8 kg/m².

Of these, 64 women had BMI ≥ 30.0 kg/m².

In this subgroup of obese patients, we established longer operative time and longer skin-incision-to-delivery interval (Table 14).

Tabl. 14. Results in Patients with BMI ≥ 30.0 kg/m² Delivered via Misgav Ladach Cesarean Section

Misgav Ladach Cesarean Section	Values
Mean BMI (all patients)	29.83 kg/m²
Mean operative time (all)	26.83 min
Mean time to fetal extraction (all)	2.00 min
Mean neonatal weight (all)	3126 g
Mean BMI ≥ 30.0 kg/m² (64 patients)	33.6 kg/m²
Mean operative time (BMI ≥ 30.0)	26.95 min
Mean extraction time (BMI ≥ 30.0)	2.17 min
Mean neonatal weight (BMI ≥ 30.0)	3191 g

The correlation analysis demonstrates a relationship between BMI and the time to fetal extraction: R = 0.324 (moderate correlation) in patients delivered via Misgav Ladach technique.

The mean operative time in obese patients was 0.12 sec longer, consistent with scientific literature indicating that BMI is a determining factor during operative delivery.

In the group delivered via Pfannenstiel incision, there were 112 patients with a mean BMI of 33.8 kg/m².

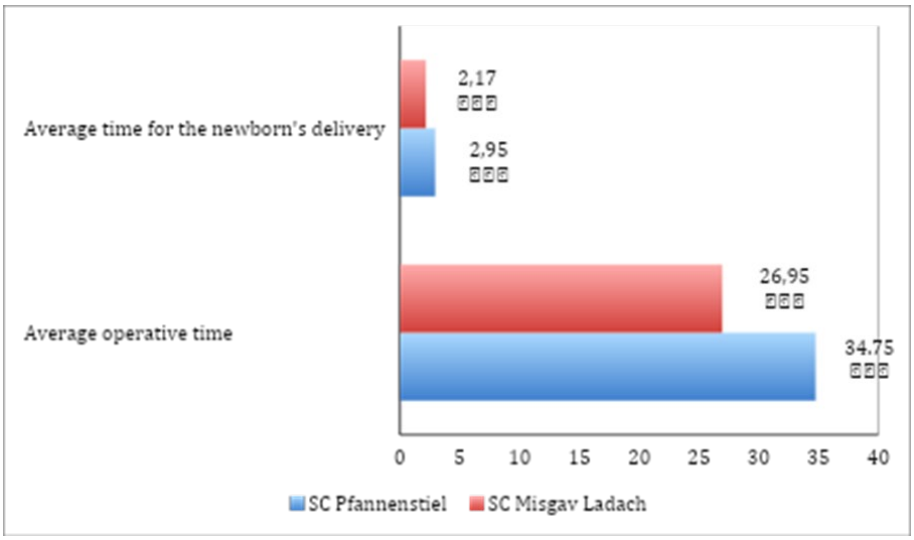
Among them, 49 women (BMI ≥ 30.0 kg/m²) were classified as obese.

The mean BMI in this subgroup was 39.03 kg/m².

Tabl. 15. Results in Patients with BMI ≥ 30.0 kg/m² Delivered via Pfannenstiel Cesarean Section

Pfannenstiel Cesarean Section	
Mean BMI (kg/m²)	33.8 kg/м²
Mean operative time (min)	33.82 min
Mean time to fetal extraction (min)	3.00 min
Mean neonatal birth weight (g)	3029 g
Mean BMI ≥ 30,0 kg/м² 49 patients	39.03 kg/м²
Mean operative time BMI ≥ 30,0 kg/м²	34.75 min
Mean time to fetal extraction BMI ≥ 30,0 kg/м²	2.95 min
Mean neonatal birth weight (g) BMI ≥ 30,0 kg/м²	3057 g

The duration of cesarean delivery using the Pfannenstiel technique is 34.75 minutes and is longer compared to women with a normal BMI. The mean time to fetal extraction in both groups—those with normal BMI and those with BMI ≥ 30.0 kg/m²—shows comparable values (Table 15).



Graph 10. Comparison of Mean Operative Time and Fetal Extraction Time in Patients with BMI ≥ 30.0 kg/m²

When comparing the mean operative times required to perform cesarean delivery in patients with BMI ≥ 30.0 kg/m² in both study groups, it is evident that the Misgav Ladach method is 7.8 minutes faster than the Pfannenstiel method.

The faster technique for fetal extraction in obese women is also the Misgav Ladach method, in which the fetus is delivered in 2.17 minutes, compared to 2.95 minutes using the Pfannenstiel technique (Graph 10).

3.3. Correlation Between BMI ≥ 30.0 kg/m² and Blood Loss During Cesarean Delivery via Misgav Ladach and Pfannenstiel Techniques

Blood loss is an important criterion when choosing the operative technique in obstetrics, especially in obese patients.

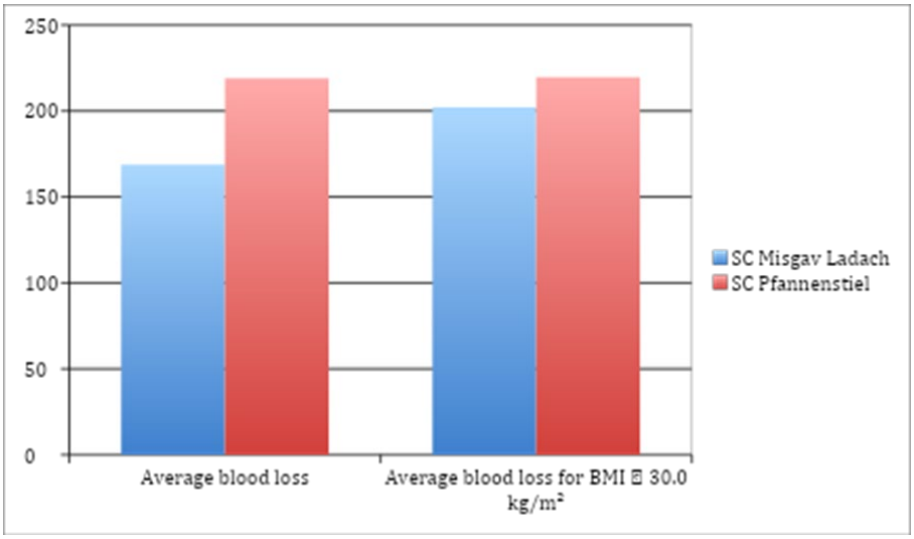
This criterion is of major significance, as excessive blood loss may increase the risk of adverse outcomes for both the mother and the fetus.

A systematic review and meta-analysis including more than 1 million pregnant women found that 47% had gestational weight gain above the recommendations of the Institute of Medicine (IOM), which is associated with higher risk of adverse maternal and neonatal outcomes. (76)

Tabl. 16. Blood Loss in Patients with BMI ≥ 30.0 kg/m²

	Misgav Ladach CS	**Pfannenstiel CS**
Mean blood loss	168.8 ml	218.9 ml
Mean blood loss in BMI ≥ 30.0 kg/m²	202.13 ml	219.79 ml

The clinical study showed that blood loss in women with BMI ≥ 30.0 kg/m² who underwent cesarean delivery using the Misgav Ladach technique averaged 202.13 ml, which is 17.66 ml less compared with women delivered using the Pfannenstiel technique.



Graph 11. Graphical Representation of Blood Loss in Patients with BMI ≥ 30.0 kg/m²

The statistical correlation between BMI and blood loss in both groups is significant:

- R = 0.362 for Misgav-Ladach
- R = 0.342 for Pfannenstiel

Higher BMI is associated with greater blood loss (Graph 11).

Tabl. 17. Correlation Between BMI ≥ 30.0 kg/m² and Blood Loss in Misgav Ladach and Pfannenstiel CS Compared to International Literature

	Our Results	**International Data**	**Conclusions**
Mean blood loss in BMI ≥ 30.0 kg/m^2	202.13 ml (Misgav-Ladach) 219.79 ml (Pfannenstiel)	Studies show that average blood loss in such patients ranges from 285 ml to over 600 ml, with higher losses observed with the Pfannenstiel technique	High BMI increases blood loss regardless of technique; however, Misgav Ladach significantly reduces bleeding compared with Pfannenstiel.
Correlation coefficient R	R = 0.362 (Misgav-Ladach) R=0.342 (Pfannenstiel)	International studies confirm that increasing BMI is associated with increased risk of significant hemorrhage	Positive and statistically significant correlation between BMI and blood loss. Higher BMI increases the probability of greater intraoperative bleeding.
Statistical significance	$z=4.22$, $p<0.05$ difference between techniques and relationship with BMI)	Global literature emphasizes that Misgav Ladach leads to less blood loss and fewer complications in high-BMI patients	Positive and statistically significant correlation between BMI and blood loss. Higher BMI increases the probability of greater intraoperative bleeding.
Summary	High BMI (≥ 30.0 kg/m^2) is associated with increased blood loss, and Misgav Ladach results in significantly less bleeding		Technique choice is crucial in reducing complications in obese patients

The obtained results correspond to various studies showing that obese pregnant women are at increased risk of greater blood loss. (196)

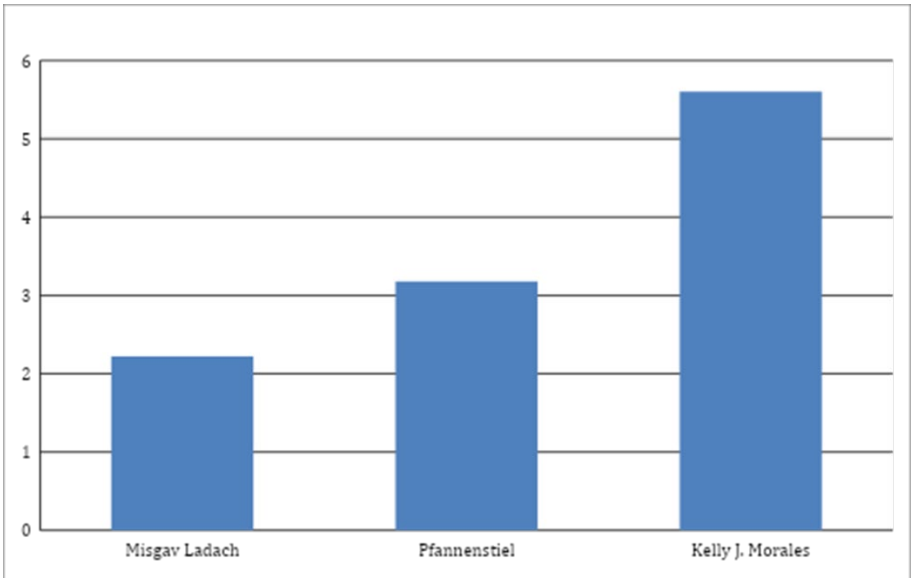
Reduced bleeding associated with the Misgav Ladach technique may be particularly beneficial in obese patients undergoing cesarean section, decreasing the risks related to hemorrhage. (179,183,184)

Additionally, the Misgav Ladach technique is associated with shorter operative time, faster mobilization, and reduced hospital stay. (85) (see Table 17)

3.4. Correlation Between Prior Cesarean Section and Fetal Extraction Time

In the Misgav Ladach group, 32 women had one previous CS, and 1 woman had two previous CS.

The mean fetal extraction time in women with one previous CS was 2.22 minutes.



Graph 12. Average time to delivery of the fetus in repeated CS

The group delivered using the Pfannenstiel technique included 11 women with one previous CS.

Their calculated mean fetal extraction time was 3.18 minutes.

There were no patients in the study delivered via Pfannenstiel who had two or more previous cesarean sections.

According to the literature, during repeat cesarean section, the time from skin incision to fetal delivery varies between 2 and 5 minutes. (58,197,200)

Other authors report average fetal extraction times ranging between 10–15 minutes.

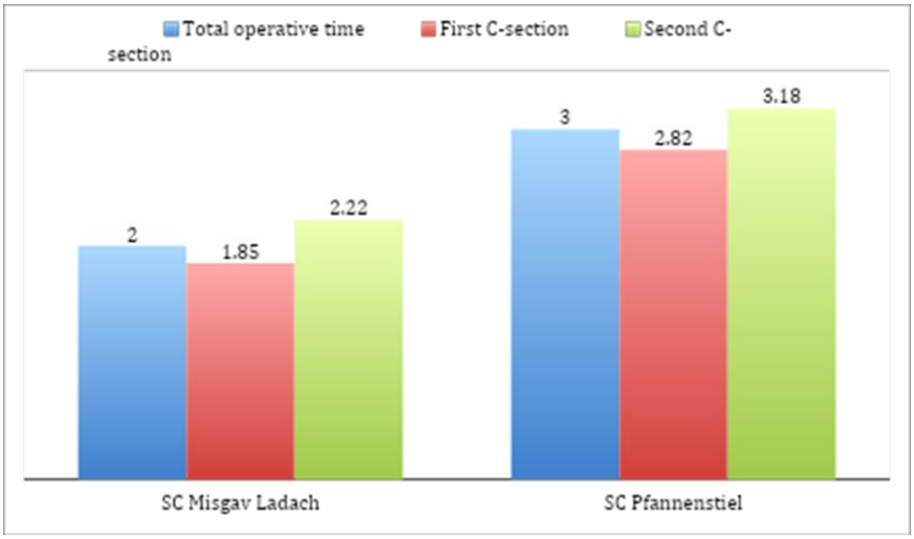
This interval may be influenced by factors such as: the type of incision, the anesthesia used, the urgency of the procedure, the surgeon's experience, and other clinical conditions. (104,109) (see Graph 12)

Adhesions are a common complication following cesarean delivery, occurring in 55% of operated women. (147)

In women with a previous cesarean section, the average time from incision to delivery is approximately 10–15 minutes. Compared with the first cesarean, subsequent procedures tend to be longer due to altered anatomy and the presence of adhesions. (193)

A study by Morales et al. demonstrated the relationship between prior cesarean section and fetal extraction time:

- Repeat CS: adhesions in 46% of cases; fetal extraction time 5.6 min
- Third CS: adhesions in 75%; fetal extraction time 8.5 min
- Fourth CS: adhesions in 83%; fetal extraction time 18.1 min (94)



Graph 13. Fetal extraction time according to the delivery method and the number of previous cesarean sections

From the data presented in Graph 13, we establish that during repeat CS, the fetal extraction time is prolonged in both operative techniques compared with the time required for fetal extraction during the first CS.

The mean extraction time for repeat CS using the Misgav Ladach technique is 2.22 minutes, which is 0.37 minutes slower than fetal extraction in women undergoing their first CS.

The correlation between the number of previous CS and fetal extraction time for the Misgav Ladach technique is R = 0.491, which is statistically significant.

The time required for fetal extraction during a second CS using the Pfannenstiel method is on average 3.18 minutes, which is 0.36 minutes slower compared with the first CS.

The statistical analysis reveals a correlation between the number of previous cesarean sections and fetal extraction time with R = 0.452.

This correlation indicates a proportional relationship between fetal extraction time and the number of prior CS.

Tabl. 18. Comparison between our correlation analysis (previous CS vs. fetal extraction time) and international data

	Our results	**International data**	**Conclusions**
Mean fetal extraction time at first CS (Misgav Ladach)	1.85 min (in 32 women with one prior CS, avg. 2.22 min in women with one previous CS)	~1–2 min in some studies (Sarah Little et al., 2013), 2–5 min in others	Misgav Ladach enables fast fetal extraction, aligned with global standards
Mean time at repeat CS (Misgav Ladach)	2.22 min (in women with one previous CS)	2–5 min internationally (Wylie et al., 2010; Morales et al., 2007)	Time increases during repeat CS; our values correspond to 2–3 min reported globally
Mean extraction time at first CS (Pfannenstiel)	2.82 min	10–15 min (older data and classical techniques)	Pfannenstiel is slower, consistent with literature, affecting operative safety
Mean time at repeat CS (Pfannenstiel)	3.18 min	Higher values reported—over 10 min in emergencies; average 10–15 min	Extraction time is prolonged during repeat operations
Correlation	R=0.491 (Misgav Ladach); R=0.452 (Pfannenstiel)	Strong positive correlations globally	More previous CS → longer extraction time; statistically confirmed

We observe consistency between our findings and international publications showing that the interval from skin incision to fetal delivery is longer in repeat CS compared with primary CS.

The prolongation in both methods is similar:

- Misgav Ladach – 0.37 min
- Pfannenstiel – 0.36 min
- Comparing the two techniques, Misgav Ladach is faster for fetal extraction in both primary and repeat CS.
- Mean times:
- First CS: Misgav Ladach 1.85 min vs. Pfannenstiel 2.82 min

- Repeat CS: Misgav Ladach 2.22 min vs. Pfannenstiel 3.18 min
- (see Table 18)

3.5. Correlation between fetal weight and fetal extraction time

In Bulgaria, the diagnosis of fetal macrosomia ranks 11th among the indications for cesarean delivery and accounts for 5.54% of all indications. (6) According to national standards, fetal macrosomia is defined as a birth weight above 4000 g.

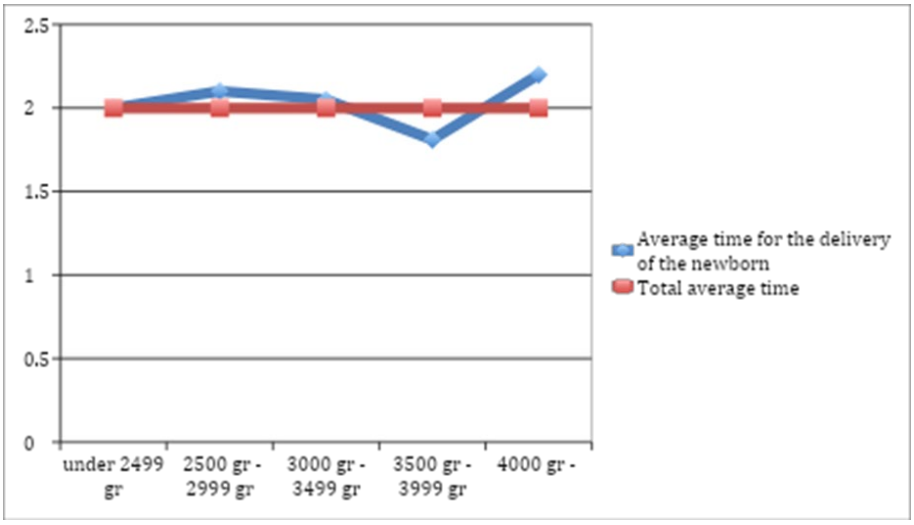
The incidence of macrosomia has increased in recent years, mainly due to the growing proportion of newborns weighing 4000–4500 g. (5)

Women operated using the Misgav Ladach method were divided into several groups according to neonatal weight, as presented in Table 19.

Multiple pregnancies were excluded from the correlation analysis between fetal weight and extraction time.

Tabl. 19. Distribution of fetal weight and extraction time in Misgav Ladach CS

Misgav Ladach CS			
Neonatal weight	**Number of newborns**	**Mean neonatal weight**	**Mean extraction time**
Up to 2499 g	15	2157 g	2 min
2500 - 2999 g	40	2746 g	2.1 min
3000 - 3499 g	92	3210 g	2.05 min
3500 - 3999 g	38	3686 g	1.81 min
Over 4000 g	10	4159 g	2.2 min



Graph 14. Distribution by fetal weight and extraction time (Misgav Ladach)

The summarized data show that using the Misgav Ladach technique, the longest extraction time occurs in newborns weighing above 4000 g (mean 2.2 min), while the fastest extractions are in the 3500–3999 g group.

Preterm infants require an average of 2 minutes, which is also the general mean extraction time for Misgav Ladach CS (Graph 14).

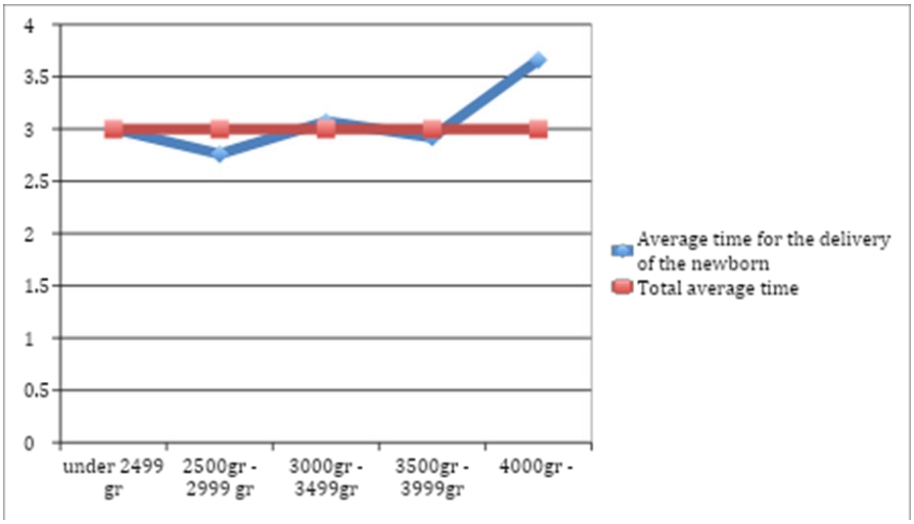
Women operated via Pfannenstiel were similarly divided into weight groups:

up to 2499 g; 2500–2999 g; 3000–3499 g; 3500–3999 g; and over 4000 g.

Newborns from multiple pregnancies were excluded (Table 20).

Tabl. 20. Distribution of fetal weight and extraction time in Pfannenstiel CS

Pfannenstiel CS			
Neonatal weight	**Number of newborns**	**Mean neonatal weight**	**Mean extraction time**
Up to 2499 g	17	2187 g	3 min
2500 - 2999 g	25	2803 g	2.76 min
3000 - 3499 g	50	3248 g	3.07 min
3500 - 3999 g	13	3597 g	2.92 min
Over 4000 g	3	4143 g	3.66 min



Graph 15. Distribution by fetal weight and extraction time (Pfannenstiel)

The mean extraction time for macrosomic newborns (>4000 g) delivered via Pfannenstiel is 3.66 min, representing the longest extraction interval recorded in our study.

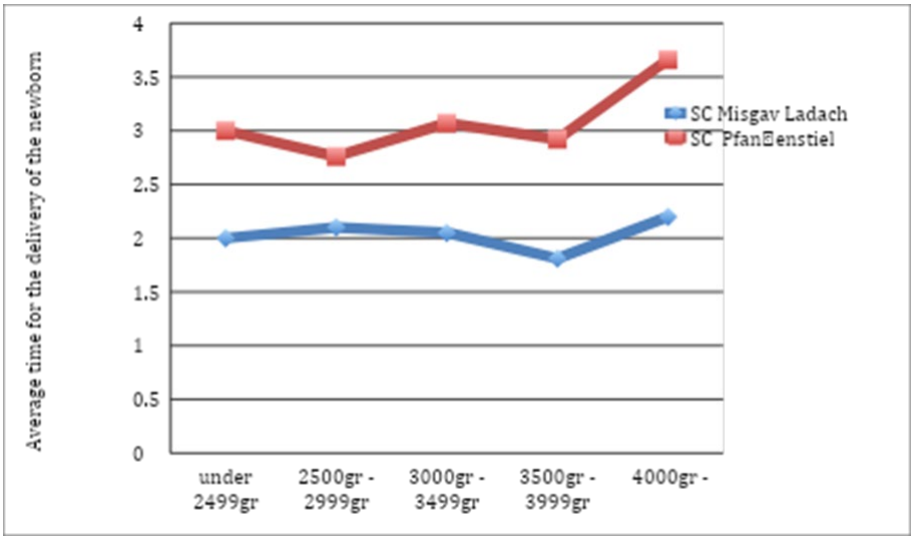
The fastest extractions via Pfannenstiel occur in newborns weighing 2500–2999 g (Graph 15).

The correlation coefficients between fetal weight and extraction time are:

- Misgav Ladach: R = 0.362
- Pfannenstiel: R = 0.372

This indicates a moderate statistical correlation, meaning that higher fetal weight is associated with longer extraction time.

When comparing the two techniques, Misgav Ladach is faster for extracting newborns over 4000 g than Pfannenstiel (Graph 16).



Graph 16. Mean extraction time by neonatal weight

The data demonstrate that the longest extraction time occurs in newborns weighing more than 4000 g.

A study analyzing nearly 10,000 cesarean sections confirms that fetal weight above 4000 g significantly prolongs operative time.

Macrosomic fetuses are associated with an increased median extraction time (skin incision to delivery) of 4–6 minutes compared with infants weighing less than 3500 g. (48)

According to the Society for Maternal–Fetal Medicine (SMFM), in cases of macrosomia (>4000 g), the operative time—from incision to delivery—is usually prolonged by 3–5 minutes compared with newborns weighing 3000–3999 g. (56)

Our data correspond with these findings, confirming that fetal extraction time depends directly on fetal weight

3.6. Correlation between fetal weight and blood loss

Operative delivery in cases of fetal macrosomia is technically more challenging compared with fetuses of normal weight.

Complications occur more frequently, including: difficulties during fetal extraction, increased risk of uterine tears, greater intraoperative blood loss, higher incidence of peripartum uterine atony. (5)

Macrosomia is associated with nearly **twice the risk** of emergency cesarean section, longer maternal hospitalization, and increased risk of adverse outcomes for both mother and newborn. (90)

In our study, the average estimated blood loss in cesarean sections performed using the Misgav Ladach method was **168.8 ml**.

The distribution by fetal weight demonstrated varying mean values, shown in Table 21.

Women with multiple pregnancies were excluded from this analysis.

Tabl. 21. Mean blood loss by fetal weight in Misgav Ladach CS

Misgav Ladach CS			
Mean neonatal weight	**Number of newborns**	**Mean neonatal weight**	**Mean blood loss**
Up to 2499 g	15	2157 g	138.4 ml
2500 - 2999 g	40	2746 g	190.4 ml
3000 - 3499 g	92	3210 g	151.8 ml
3500 - 3999 g	38	3686 g	185.2 ml
Over 4000 g	10	4159 g	200 ml

The lowest blood loss was observed in newborns weighing up to 2499 g (138.4 ml).

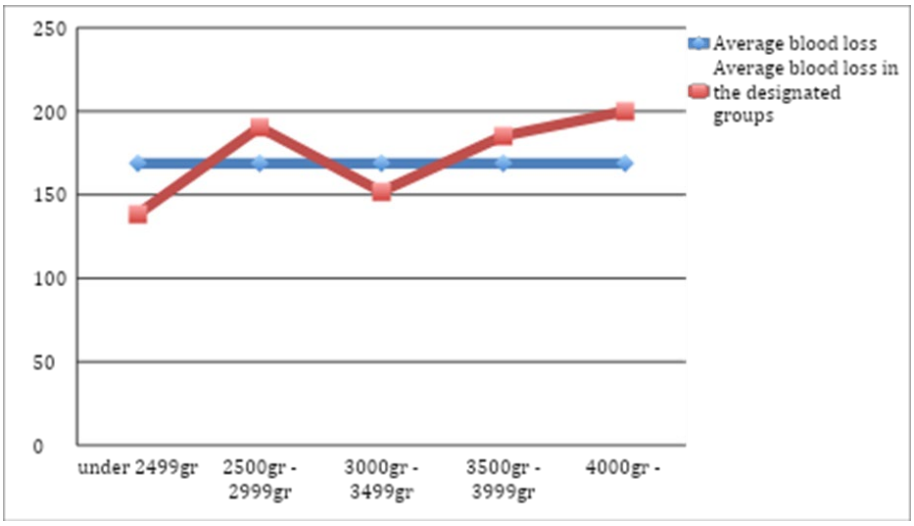
The highest blood loss during Misgav Ladach CS occurred in macrosomic fetuses, with a mean of 200 ml.

The correlation coefficient between fetal weight and blood loss was:

- $R = 0.328$

indicating a moderate positive correlation.

Statistically, higher fetal weight is associated with greater intraoperative blood loss (Graph 17).



Graph 17. Mean blood loss by fetal weight in Misgav Ladach CS

For Pfannenstiel CS, the mean blood loss was 218.9 ml, with values in different weight groups ranging from 190 ml to 230.7 ml (Table 22).

Women with multiple pregnancies were excluded from this analysis.

Tabl. 22. Mean blood loss by fetal weight in Pfannenstiel CS

Pfannenstiel CS			
Neonatal weight	**Number of newborns**	**Mean neonatal weight**	**Mean blood loss**
Up to 2499 g	17	2187 g	214.7 ml
2500 - 2999 g	25	2803 g	230 ml
3000 - 3499 g	50	3248 g	209.8 ml
3500 - 3999 g	13	3597 g	230.7 ml
Over 4000 g	3	4143 g	190 ml

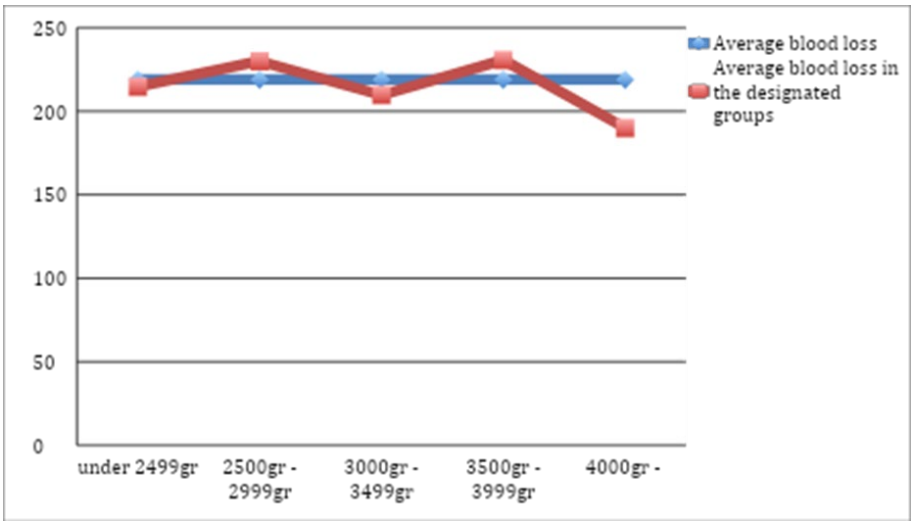
In the macrosomic group delivered via Pfannenstiel, we observed a mean blood loss of 190 ml, which is unexpectedly low and likely due to the small sample size (n = 3).

The highest mean blood loss (230.7 ml) was found in the 3500–3999 g group.

After excluding macrosomic fetuses from the analysis due to insufficient sample size, the correlation coefficient between fetal weight and blood loss for Pfannenstiel CS was:

- R = 0.426

This confirms a moderate correlation.



Graph 18. Mean blood loss by fetal weight in Pfannenstiel CS

Our findings are consistent with other studies showing that as fetal weight increases, so does the risk of complications during delivery.

Tables №22 and 23 and Graphs №18 and 19 clearly illustrate that blood loss is directly influenced by neonatal weight.

The frequency of cesarean section increases significantly in macrosomic infants. (43,120,194)

Overall CS rates for newborns weighing >4000 g vary widely between 14% and 44%. (107)

Hemorrhage is more common during delivery of macrosomic babies (42,43), and the risk increases proportionally with neonatal weight (194).

This may result from a combination of factors such as fetal size, operative delivery itself, and uterine atony. (48)

3.7. Correlation Between Total Operative Time and Fetal Extraction Time

Clinical protocols and guidelines from international organizations such as the Royal College of Obstetricians and Gynaecologists (RCOG) and the American College of Obstetricians and Gynecologists (ACOG) state that fetal delivery should be performed as quickly as possible when there is an urgent threat to the life or health of the mother or fetus.

The interval between skin incision and fetal delivery is typically below 2–4 minutes.

The recommended target is under 3 minutes, in order to minimize neonatal risks. (20,156,172)

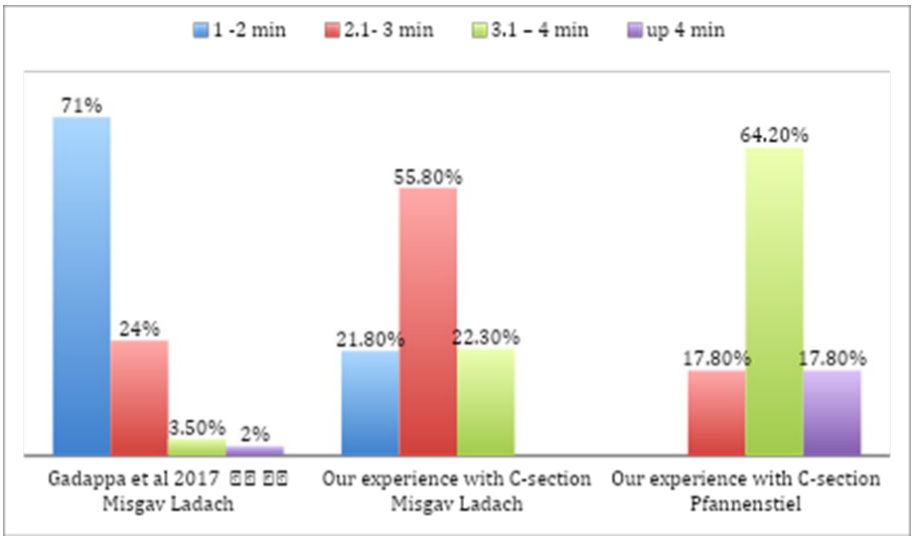
Gadappa et al. report that in most cases, the time from skin incision to fetal birth is 1–2 minutes.

In their study:

- 70.5% of newborns were delivered within 1–2 minutes,
- 2% required more than 4.1 minutes. (72)

Tabl. 23. Comparison of fetal extraction times between Gadappa et al. and our data

Gadappa et al. 2017 – Misgav Ladach CS	Extraction time	Number of patients	Number of patients %
	1 -2 min	141	70.5
	2.1- 3 min	45	24
	3.1 – 4 min	7	3.5
	Over 4 min	4	2
Our data – Misgav Ladach CS			
	1 -2 min	47	21.8
	2.1- 3 min	120	55.8
	3.1 – 4 min	48	22.3
	Over 4 min	No cases	
Our data – Pfannenstiel CS			
	1 -2 min	No cases	
	2.1- 3 min	20	17.8
	3.1 – 4 min	72	64.2
	Over 4 min	20	17.8



Graph 19. Comparison of extraction times: Gadappa et al. vs. our results

When comparing our study with the findings of Gadappa et al., we observe that no newborn delivered via Misgav Ladach in our study was born after 4 minutes. (72) Gadappa et al. report their highest proportion of births within 1–2 minutes. This corresponds with the findings of Kshirsagar N. et al., who report a mean extraction time of 1.4 minutes for Misgav Ladach versus 2.4 minutes for the traditional Pfannenstiel method. (72,98)

In contrast: Our most frequent interval for Misgav Ladach was 2.1–3 minutes, while for Pfannenstiel, 64.2% fell within 3.1–4 minutes (Graph 19).

Corosu R. et al. used a Pfannenstiel incision instead of Joel-Cohen and reported a mean skin-incision-to-delivery time of 4.8 minutes. (52)

Fatusic et al. reported a mean extraction time via Misgav Ladach of 1.25 minutes, while Elnaggar et al. reported the longest times, around 4 minutes.

All research groups consistently reported longer extraction times for Pfannenstiel compared with Misgav Ladach:

The longest time (8.1 min) was published by Elnaggar et al., while the shortest (2.4 min) by Kshirsagar et al.

Our results show a mean fetal extraction time of: 2 minutes for Misgav Ladach, 3 minutes for Pfannenstiel.

These values are in line with international standards and published literature (Table 24). (65,68,98,157)

The mean time to fetal extraction using the Misgav Ladach technique ranges from 1.25 minutes in Fatusić et al. to 4 minutes in Elnaggar et al., with most reported values around 2 minutes. Our observations confirm that this technique successfully allows fetal extraction within approximately 2 minutes, in line with international data.

For the Pfannenstiel technique, reported mean extraction times vary from about 2.4 minutes in Kshirsagar et al. to 8 minutes in Elnaggar et al., with most studies showing values closer to 3–4 minutes. Our data, showing an average extraction time of 3 minutes, correspond well with this trend.

Importantly, both techniques achieve results within the internationally recommended time frames, aiming for fetal extraction in under 4 minutes. Specifically, the Misgav Ladach method, based on our findings, demonstrates excellent efficiency for rapid delivery, which is particularly critical in emergency situations or in high-risk neonates.

Tabl. 24. Comparison of extraction times: Misgav Ladach vs. Pfannenstiel — International and our data

Research group	Misgav Ladach (min)	Pfannenstiel (min)	Difference (min)
Fatusic 2003	1.25	4.10	2.45
Kshirsagar 2016	1.4	2.4	1.0
Elnaggar 2016	4.0	8.1	4.1
Sahin 2018	1.42	3.16	1.34
Our data	2.0	3.0	1.0

Research evaluating total operative time for Misgav Ladach and Pfannenstiel reports significant differences.

- According to Gadappa et al., mean operative duration was 26 min 12 sec.
    - 52.5% of CS required 20–25 minutes,
    - 37% required 25–30 minutes. (72)

Kshirsagar et al. found:

- Misgav Ladach: 31–35 minutes
- Traditional method: 36–40 minutes

Hudic I. et al. reported:

- Joel-Cohen incision: 13.3 ± 7.4 min
- Pfannenstiel: 19.1 ± 6.8 min ($p < 0.05$). (88)

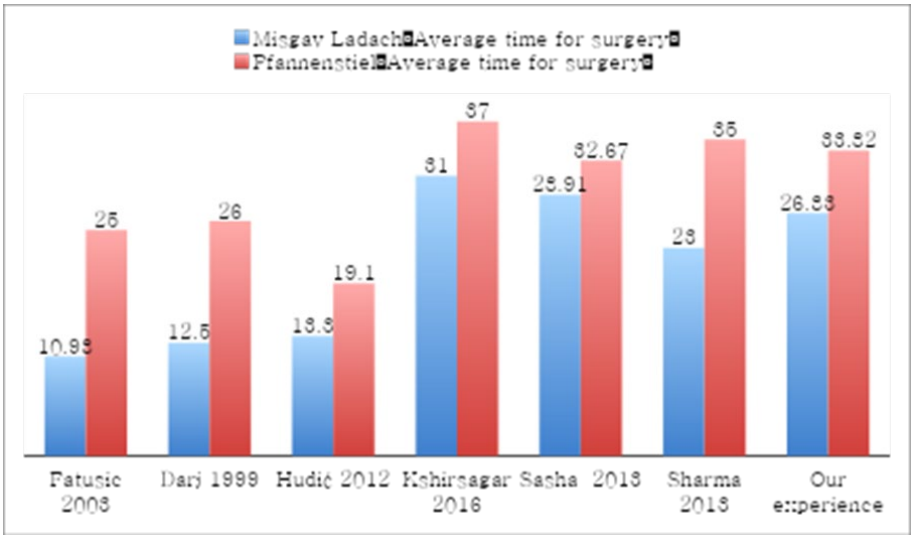
Sharma et al.:

- Misgav Ladach: 23 minutes
- Pfannenstiel: 35 minutes (164)

Tabl. 25. Comparison of mean operative time — International and our data

Research group	Misgav Ladach (min)	Pfannenstiel (min)	Difference (min)
Fatusic 2003	10.98	25	14.02
Darj 1999	12.5	26	13.5
Hudić 2012	13.3	19.1	5.8
Kshirsagar 2016	31	37	6
Sasha 2013	29.81	32.67	2.86
Sharma 2013	23	35	12
Our data	26.83	33.82	6.99

Based on the conducted studies and collected data, it is evident that the Misgav Ladach cesarean section technique significantly reduces operative time compared to the traditional Pfannenstiel technique. The mean difference in duration between the two procedures ranges from 2.86 to 14.02 minutes in favor of the Misgav Ladach method (Table 25).



Graph 20. Comparison between the average time for CS according to Misgav Ladach and Pfannenstiel, international and our experience

Research worldwide reports average operative durations for Misgav Ladach: 23–31 minutes (Gadappa et al. 26 min > 12 sec, Kshirsagar et al. 31-35 min).Pfannenstiel: 33–40 minutes (Kshirsagar et al. 36-40 min, Sharma et al. 35 min). Our findings align with these ranges, confirming the reliability of our data. The results clearly show that the Misgav Ladach technique significantly reduces operative duration compared with the traditional Pfannenstiel method.

A significant positive correlation was found between total operative time and fetal extraction time:

- Misgav Ladach: R = 0.521
- Pfannenstiel: R = 0.532

Both techniques demonstrate a similar strong positive relationship. This confirms that methods enabling faster fetal extraction also reduce total operative time — an essential clinical advantage associated with lower complication rates and quicker maternal recovery

VI. CONCLUSION

In Bulgaria, the rate of cesarean sections is approximately 30–35% of all births, reaching over 40% in some regions—values higher than the global average. National obstetric and gynecological guidelines emphasize the importance of modern and less invasive surgical techniques, as well as the need for an individualized approach for each pregnant woman. Currently, no national protocol exists to guide the choice of operative technique for cesarean section. Given the increasing cesarean rate, the rising prevalence of obesity, and the trend toward childbearing at an advanced maternal age, establishing a protocol for safe operative delivery is crucial for the daily practice of obstetricians and gynecologists.

Blood loss during cesarean section is an important indicator of surgical quality. The volume of blood loss is used as a criterion for assessing surgical performance and assists in determining the safer and more effective technique that minimizes complications.

Our study found:

- mean blood loss for Misgav Ladach: 168.8 ml
- mean blood loss for Pfannenstiel: 218.9 ml

This difference is statistically significant and supports the conclusion that the Misgav Ladach technique is associated with greater safety, lower risk of hemorrhage, and fewer complications. This is particularly important in high-risk patients such as women with severe obesity or prior cesarean sections.

Choosing the appropriate operative technique for women with high BMI is essential to minimize complications, blood loss, and recovery time. A high body mass index (BMI $\geq$ 30 kg/m^2) is associated with:

- prolonged operative time,
- longer fetal extraction time,
- and increased blood loss.

In clinical practice, specialists typically prefer a method that enables less trauma, quicker fetal delivery, and better control of intraoperative bleeding.

This comparative study with detailed correlation analyses demonstrates that the Misgav Ladach technique offers significant advantages over the Pfannenstiel–Kerr method in women with BMI $\geq$ 30 kg/m^2.

When comparing mean operative times in women with BMI $\geq$ 30 kg/m^2:

- Misgav Ladach was 7.8 minutes faster

Mean fetal extraction time was 2.17 minutes vs. 2.5 minutes with Pfannenstiel

Additionally, the faster technique was associated with less blood loss, which is especially important in obese patients.

Our data confirm that fetal extraction time is longer in repeat cesarean sections compared with the first CS.

The Misgav Ladach method provides faster fetal delivery both at first and repeat cesarean sections compared with the Pfannenstiel technique.

Faster extraction is statistically associated with a higher APGAR score at 1 and 5 minutes, reducing neonatal risks.

The analysis shows that Misgav Ladach allows the operation to be completed in less time:

- mean operative duration: 26.83 minutes vs. 33.82 minutes for Pfannenstiel
- shortening the procedure by approximately 7.8 minutes

This is clinically significant in emergency situations and high-risk pregnancies.

Mean fetal extraction time:

- Misgav Ladach: 2 minutes
- Pfannenstiel: 3 minutes

These results align with international standards and confirm the high efficiency of the technique for rapid and safe delivery.

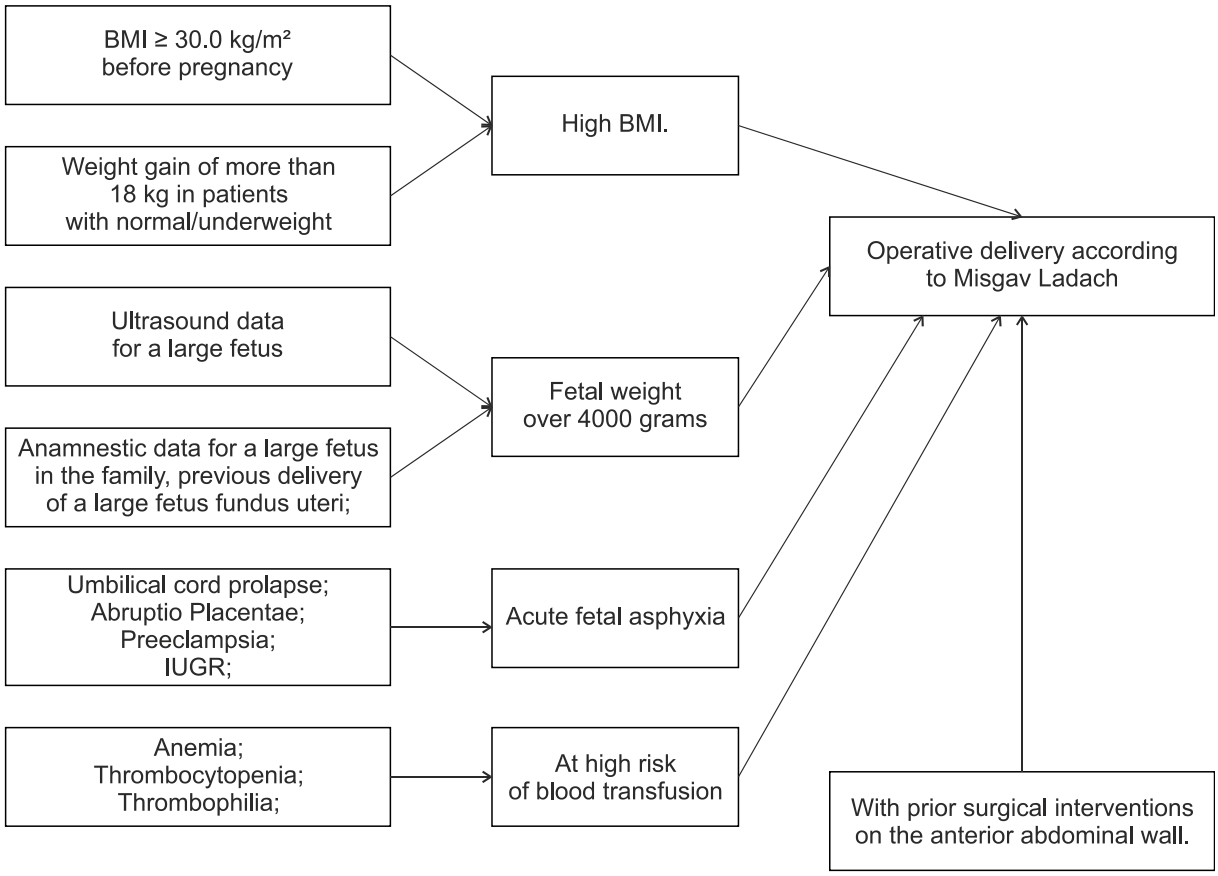
Choosing the appropriate operative method when delivering a fetus > 4000 g reduces maternal and neonatal morbidity. Although "large fetus" is an established indication for CS in Bulgaria, no specific operative technique is recommended.

Our study showed that for fetuses > 4000 g:

- Misgav Ladach extraction time: 2.2 minutes
- Pfannenstiel extraction time: 3.66 minutes

Overall, the results clearly demonstrate that Misgav Ladach is the preferred technique—more efficient, faster, and less traumatic for both the mother and fetus, especially in cases of obesity and macrosomia. This method minimizes operative time, blood loss, and complications associated with cesarean delivery.

Based on the collected data, we propose the following operative delivery selection algorithm(Scheme No. 1) (Scheme No. 1)



(Scheme No. 1) Protocol for the selection of operative delivery

CONCLUSIONS

1. From the correlation analysis performed, we established a strong correlation between BMI and operative time:

   R = 0.777, which is statistically significant.

   A higher maternal BMI corresponds to a longer operative duration.
2. We established the mean fetal extraction time for the study group:

   2.0 minutes for Misgav Ladach.

   The time required for fetal extraction with the Pfannenstiel technique is 3.0 minutes.
3. When comparing the mean operative duration in patients with BMI ≥ 30.0 kg/m² between the two study groups, we found that the Misgav Ladach method is 7.5 minutes faster than the Pfannenstiel technique.
4. Our results show that the faster method of fetal delivery in obese women is Misgav Ladach, with fetal extraction in 2.17 minutes, compared with 2.5 minutes using Pfannenstiel.
5. From the conducted clinical study, we established that blood loss in women with BMI ≥ 30.0 kg/m² is lower when CS is performed via the Misgav Ladach technique compared with women operated via Pfannenstiel.
6. The time from skin incision to fetal delivery is longer in repeat cesarean sections compared with the first CS.
7. When comparing the two methods, we found that Misgav Ladach is faster for fetal delivery both in first and repeat cesarean sections.
8. Misgav Ladach (2.2 minutes) is a faster method for delivering fetuses weighing over 4000 g than Pfannenstiel (3.66 minutes)

CONTRIBUTIONS OF THE DISSERTATION WORK

1. ORIGINAL SCIENTIFIC AND APPLIED CONTRIBUTIONS

- An original sample Protocol for selecting a method of operative delivery has been developed.
- For the first time in Bulgaria, a detailed comparative analysis was performed of the advantages and disadvantages of the operative techniques for opening the anterior abdominal wall during cesarean section: Misgav Ladach and Pfannenstiel-Kerr.
- For the first time in the country, a study and analysis were conducted regarding operative delivery techniques in specific groups of patients:
    - – BMI ≥ 30.0 kg/m²
    - – previous cesarean section(s)
    - – pregnancies complicated by fetal macrosomia.
- As a result of the implemented protocol for selecting the method of cesarean section and the demonstrated advantages—such as reduction in operative duration, shortened anesthesia time, reduced blood loss, etc.—the economic effectiveness for the medical institution is clearly visualized.

2. CONFIRMATORY CONTRIBUTIONS

- Our results show that the mean fetal extraction time via Misgav Ladach is 2 minutes, and 3 minutes via Pfannenstiel. The data obtained from our scientific study confirm international findings that the Misgav Ladach CS method is faster for fetal delivery.
- The results obtained support the conclusion that the Misgav Ladach method is a more efficient technique with respect to total operative time.
- The results of our study regarding average blood loss in the Misgav Ladach and Pfannenstiel-Kerr techniques confirm the conclusion that Misgav Ladach is associated with lower blood loss.
- We confirm the statement that in women with high BMI, performing CS via Misgav Ladach results in lower blood loss compared with women operated via Pfannenstiel

PUBLICATIONS RELATED TO THE DISSERTATION WORK

- Georgiev B., Kachovski Ts., Ivanova V., Kovachev E. Selection of operative delivery method in patients with BMI ≥ 30 kg/m². Journal "Reproductive Health," Issue 41/25, pp. 24–29, ISSN 1312-6180.
- Georgiev B., Dimitrova Z., Kachovski Ts. Torsion of a healthy adnexa in the presence of a dermoid cyst in the contralateral ovary in a pregnant woman at 12 gestational weeks and subsequent cesarean section at term. Journal "Reproductive Health," Issue 41/25, pp. 29–34, ISSN 1312-6180.
- Kovachev E., S. Angel, B. Georgiev. *Gastroschisis – contribution with a clinical case.* 2021, Obstetrics and Gynecology, Vol. 60, Issue 1, pp. 39–44.

APPENDICES

**Appendix No. 1

Questionnaire for the examination of hospitalized patients:**

- Age of the mother: .....
- Number of pregnancies: .....
- Number of deliveries – total: .....
- Number of cesarean deliveries: .....
- Number of vaginal deliveries: .....
- BMI: .....
- Date of the previous cesarean section: .....
- Birth weight of the newborn: .....
- Problems during pregnancy: .....
- Use of medications for pregnancy maintenance: .....
- Concomitant diseases: .....
- Presence of another abdominal surgery: .....
- Type of cesarean section: .....
- Duration of the operation: .....
- Blood loss in ml: .....
- Injury to other organs and tissues: .....
- Other complications during the cesarean section: .....
- Pain assessment scale (from 1 – mild pain to 10 – severe pain):

  .....
- Medications during the cesarean section: .....
- Medications in the postoperative period: .....
- Duration of the recovery period: .....
- Frequency of postoperative adhesive syndrome: .....

Date: .....

Researcher: .....

Signature: .....

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