Received: 29 April 2022 | Revised: 12 August 2022 | Accepted: 3 October 2022

DOI: 10.1002/ijgo.14498

CLINICAL ARTICLE

International Journal of Gynecology & Obstetrics FIGO WILEY

Prevalence and risk factor of postoperative adhesions following repeated cesarean section: A prospective cohort study

Rehab Abdelhamid Aboshama[1] | Omima T. Taha[2] | Hala Waheed Abdel Halim[3] | Eman Ibrahim Abd Elrehim[4] | Shaimaa Hanafy Moustafa Kamal[3] | Ahmed Mohamed ElSherbiny[5] | Hagar Abdelgawad Magdy[3] | Eslam Albayadi[6] | Rasha Ezzat Elsaid[3] | Amany Mohamed Abdelghany[7] | Mohamed A. Anan[8] | Laila Ezzat Abdelfattah[1]

[1]Department of Obstetrics and Gynecology, Faculty of Medicine, Fayoum University, Fayoum, Egypt

[2]Department of Obstetrics and Gynecology, Faculty of Medicine, Suez Canal University, Ismailia, Egypt

[3]Department of Obstetrics and Gynecology, Faculty of Medicine for Girls, Al-Azhar University, Cairo, Egypt

[4]Department of Obstetrics and Gynecology, Damietta Faculty of Medicine, Al-Azhar University, Damietta, Egypt

[5]Department of Obstetrics and Gynecology, Faculty of Medicine, Suez University, Suez, Egypt

[6]Department of Anesthesia, Faculty of Medicine, Suez Canal University, Ismailia, Egypt

[7]Department of Obstetrics and Gynecology, Faculty of Medicine, Zagazig University, Zagazig, Egypt

[8]Department of Obstetrics and Gynecology, Faculty of Medicine, Aswan University, Aswan, Egypt

Correspondence
Omima T. Taha, Department of Obstetrics and Gynecology, Faculty of Medicine, Suez Canal University, Ismailia, Egypt.
Email: omimatharwat@yahoo.com

Abstract

Objective: To evaluate the prevalence of intraperitoneal adhesions after repeated cesarean delivery and its associated personal and surgical risk factors.

Methods: This prospective cohort study was conducted at the delivery ward at Fayoum University Hospital from October 2020 to December 2021. Women were recruited according to predetermined inclusion and exclusion criteria. Eligible women were interviewed, and data were obtained for personal history, past surgical and obstetrical history, and data about the current delivery. Nair's scoring system was used to evaluate intraperitoneal adhesions. Postoperative data and complications were reported.

Results: Three hundred women were recruited. Moderate to severe adhesions occurred in 186 patients (62%). These patients had a significantly prolonged hospital stay and were delivered by expert surgeons ($P < 0.001$ and $P = 0.008$, respectively). The adhesion score correlated positively with patients' age ($P < 0.001$), parity ($P < 0.001$), interpregnancy interval ($P = 0.033$), duration of hospital admission either previously or in the current delivery ($P = 0.001$ and $P < 0.001$), time to ambulation ($P < 0.001$), time to intestinal movement ($P < 0.001$), operative time ($P < 0.001$), and surgeons' age and experience (both $P = 0.015$).

Conclusion: Adhesions led to increased maternal morbidity. Multiple contributing factors were significantly related to adhesions with multiple cesarean deliveries.

KEYWORDS
adhesion, cesarean section, morbidity, prevalence

1 | INTRODUCTION

Cesarean delivery is a commonly practiced obstetrical surgical intervention.[1] Its rate has risen worldwide,[1] reaching 52% in 2018 in Egypt.[2] This leads to increased repeat cesarean deliveries and related morbidity.[3] Intraperitoneal adhesions result from abdominal or pelvic surgeries. They have serious consequences such as intestinal obstruction, chronic pelvic pain, ectopic pregnancy, infertility, visceral

injury, and difficult access to the abdominal cavity.[4] This would result in hospital readmission and repeated surgeries.[5] Adhesions occurred in 24%–65% of patients after one previous cesarean delivery.[6] Adhesions can be linked to many factors such as infection, inflammation, and ischemia. The site of surgery, operative technique, surgical skills, and genetic predisposition influence their extent.[7–9] The rate of adhesions after cesarean delivery was variable between studies,[10–12] with few studies reporting its incidence in Egypt.[13] This study was conducted to study the prevalence of intraperitoneal adhesions after repeatd cesarean delivery and its associated personal and surgical risk factors.

2 | MATERIALS AND METHODS

This was a prospective cohort study conducted at the labor and delivery ward at Fayoum University Hospital from October 2020 to December 2021 after receiving the approval of the research ethics committee of the Faculty of Medicine, Fayoum University. Written informed consent was obtained from all participants before enrollment in the study. Women were recruited according to the following inclusion and exclusion criteria. Inclusion criteria were age ranged from 18 to 45 years, women with previous cesarean delivery, and women undergoing an elective repeat cesarean section and cesarean delivery after labor pains. Exclusion criteria were: women who refused to participate in the study, history of chemotherapy or radiotherapy, history of midline skin incisions (either upper or lower), history of chronic steroid use, or history of pelvic inflammatory disease.

Eligible women were interviewed, and data were obtained about age, weight, parity, gestational age calculated from the date of the last menstrual period and an early ultrasound, interval from the last pregnancy (in months), number of previous cesarean deliveries, and history of infertility.

Data about surgical history included previous abdominal surgeries, previous laparoscopic surgery, history of wound infection, history of puerperal sepsis, history of intestinal obstruction, duration of previous hospital stay (in hours), history of chronic pelvic pain—defined as persistent non-cyclic pain related to the pelvis for at least 6 months,[14] need for blood transfusion, site of previous delivery (private/governmental hospital), the shape of the scar (thin, raised, or keloid), and color of the scar (dark, red, or white).

Data about the current delivery included preoperative hemoglobin level, type of the cesarean delivery (emergency / elective repeat), type of anesthesia (general / spinal), duration of hospital admission (in hours), operative time (in minutes), intraoperative blood transfusion, and intraoperative complications (visceral injury). Data about the operating surgeon included gender, age, and years of experience. An expert obstetrician was defined as a currently practicing doctor in the emergency and delivery ward with at least 10 years of experience.[15]

Nair's scoring system was used to estimate intra-abdominal adhesions. This system classified adhesions into no adhesions (scored 0), single band of adhesions between viscera or from viscera to the abdominal wall (scored 1), two bands of adhesions between viscera or from viscera to the abdominal wall (scored 2), more than two bands of adhesions as described above or intestinal adhesions forming a mass (scored 3), and viscera directly adherent to the abdominal wall, regardless of the number or extent of the bands (scored 4).[16] For statistical purposes, scores (0) and (1) were considered as one group (no or minimal adhesions), and scores from 2 to 4 were considered as one group (moderate to severe adhesions).

Postoperative follow up included time to patient ambulation (in hours), time to audible intestinal movement (in hours) (defined as the time from the end of the operation to the time of detection of active intestinal sounds),[17] and postoperative hemoglobin level measured at 6 hours after delivery. Postoperative pain was measured according to the need for analgesia. Mild pain was controlled by ketoprofen 100 mg rectal suppository every 8 hours (Profenid suppository, Gardenia Pharmacy, Giza, Egypt). Moderate pain needed the addition of paracetamol 1 g intravenous drip every 6 h (Perfalgan 1 g infusion, Bristol Mayers Squibb, New York, NY, USA). Severe pain needed opioid analgesics such as pethidine 50 mg (Martindale Pharmaceuticals, Romford, UK). Postoperative complications were reported. These included wound seroma, hematoma, wound infection, and postpartum hemorrhage. This last was classified as primary postpartum hemorrhage when blood loss was 1000 ml or more in women undergoing cesarean delivery in the first 24 h after delivery and secondary postpartum hemorrhage when blood loss occurred between 24 h and 6 weeks after delivery.[18]

The sample size was calculated at a level of significance of 95%. The prevalence of adhesions was 45.1%.[19] At a level of error of 6% and a dropout proportion of 10%, the sample size was 300 participants.

3 | RESULTS

Of the 300 included women, 6 (2%) did not have adhesions, 108 (36%) had score (+1), 80 (26.7%) had score (+2), 63 (21%) had score (+3), and 43 (14.3%) had score (+4).

The mean age of the studied population was 28.25 ± 5.12 years, and women with moderate to severe adhesions had advanced age (29.55 ± 4.91 versus 26.14 ± 4.76 years, $P < 0.001$). They also had increased parity, increased number of repeat cesarean sections, and longer duration of hospital admission in the last delivery than those with mild adhesions (Table 1).

Women with moderate to severe adhesions had significantly increased rates of abdominal surgeries other than cesarean delivery, laparoscopic surgeries, wound infection, chronic pelvic pain, and keloid scars ($P = 0.013$, $P = 0.002$, $P = 0.001$, $P < 0.001$, and $P < 0.001$, respectively) (Table 2).

During the current delivery, women with moderate to severe adhesions had a significantly prolonged hospital stay and were delivered by expert surgeons ($P < 0.001$ and $P = 0.008$, respectively) (Table 3).

TABLE 1 Maternal risk factors for the development of adhesions[a]

		Prevalence of adhesions			
		No or minimal ($n = 114$)	Moderate to severe ($n = 186$)	All cases ($n = 300$)	*P* value
Age, y		26.14 ± 4.76	29.55 ± 4.91	28.25 ± 5.12	<0.001
Weight, k		85.64 ± 15.84	91.58 ± 15.39	89.32 ± 15.80	0.001
Gestation, wk		38.28 ± 0.92	37.12 ± 1.26	37.56 ± 1.27	<0.001
Gravidity		3.11 ± 1.27	3.88 ± 1.43	3.59 ± 1.42	<0.001
Parity		1.76 ± 0.89	2.63 ± 1.19	2.30 ± 1.16	<0.001
Interpregnancy interval, mo		24.04 ± 10.30	26.15 ± 13.04	25.34 ± 12.09	0.145
Hemoglobin, mg/dl		11.16 ± 1.05	10.61 ± 1.18	10.82 ± 1.16	<0.001
Number of CS		1.38 ± 0.66	2.33 ± 1.09	1.97 ± 1.05	<0.001
Previous hospital stay, h		16.67 ± 6.44	20.31 ± 15.74	18.92 ± 13.12	0.019
Infertility	No	109 (95.6%)	166 (89.2%)	275 (91.7%)	0.039
	Positive history	5 (4.4%)	20 (10.8%)	25 (8.3%)	

Abbreviation: CS, cesarean section.

[a]Data are presented as mean ± standard deviation or as number (percentage).

Women with moderate to severe adhesion had prolonged surgery, delayed ambulation, delayed audible intestinal movement, and increased postoperative pain and bowel injury (Table 4).

The adhesion score correlated positively with patients' age ($P < 0.001$), parity ($P < 0.001$), interpregnancy interval ($P = 0.033$), duration of hospital admission either previously or in the current delivery ($P = 0.001$ and $P < 0.001$, respectively), time to ambulation ($P < 0.001$), time to intestinal movement ($P < 0.001$), operative time ($P < 0.001$), and surgeons' age and experience (both $P = 0.015$) (Table 5).

4 | DISCUSSION

About two-thirds of the studied population had moderate to severe adhesions. Dense adhesions occurred in 2.94%, as reported by an earlier study.[20] Another study showed that 53% of its participants had moderate to severe adhesions.[21] The incidence of intraperitoneal adhesions differs between studies, with high rates reaching 93%.[22] Intraperitoneal adhesion formation was related to multiple factors like closure or non-closure of the peritoneum and others, with variable results about its contributing role.[23–25] However, these data would be difficult to obtain because about two-thirds of the participants had their previous delivery in private hospitals. Additionally, we recruited women with previous abdominal surgeries other than cesarean delivery and chronic pelvic pain, which might influence the role of repeat cesarean delivery on peritoneal adhesions. Accordingly, the rate of peritoneal adhesions is variable between studies because of variable grading of the adhesions between studies, and the inability to exclude women with other abdominal surgeries and inflammatory diseases,[26] and different presentations (infertility).[13]

Emergency cesarean delivery was performed in 21.7% of the studied population, although another study reported higher rates (63.7%).[20] This difference would be linked to the high rates of irregular prenatal care visits (57.8%). The mean operative time was 71.96 ± 19.48 min in moderate to severe adhesions. This agreed with the results reported previously, where the mean operative time was 70 min, which was the result of the presence of significant adhesions.[27] Another study reported a mean time of 75 min among women with four or more cesarean deliveries.[28]

Bladder injury occurred in 5.3% of the population with moderate to severe adhesions. Blood transfusion was required in 9% of cases reporting moderate to severe adhesions. A previous study reported lower bladder injury and blood transfusion rates (1.96% and 5.88%, respectively), which might be related to the fewer cases with dense adhesions.[19] Other studies reported that blood transfusion was required in 13.5% of their participants despite less blood loss. This was explained by documented preoperative anemia, which made the patients vulnerable to minor blood loss.[29] Adhesiolysis would be the cause of bladder injury. Also, adhesions lead to difficult access to the abdominal cavity and the lower segment. This leads to increased surgical duration and blood loss.[20]

The most common postoperative complication was wound-related (hematoma, seroma, or infection). Wound infection occurred in 11.76% in a previous study.[20] Patients were discharged within 24 hours after delivery. Women with dense adhesions reported prolonged hospital admission (3–4 days). This agreed with previous results where prolonged hospital admission was related to postoperative complications (wound infection and postpartum hemorrhage).[20] Bowel injury is a rare complication in women with repeated cesarean delivery. The current study reported one woman (0.5%) with bowel injury. An earlier study reported an incidence of 0.04% (1/2713) for bowel injury among women undergoing Pfannenstiel incision.[30] Another study reported no bowel injury among 250 women undergoing three or more cesarean deliveries.[31] The association between repeated cesarean delivery and bowel injury was documented in the

TABLE 2 Surgical history risk factors for the development of adhesions[a]

		Prevalence of adhesions			
		No or minimal ($n = 114$)	Moderate to severe ($n = 186$)	All cases ($n = 300$)	*P* value
History of intestinal obstruction	No	114 (100.0%)	183 (98.4%)	297 (99.0%)	0.237
	Positive history	0 (0.0%)	3 (1.6%)	3 (1.0%)	
History of abdominal surgery	No	110 (96.5%)	165 (88.7%)	275 (91.7%)	0.013
	Positive history	4 (3.5%)	21 (11.3%)	25 (8.3%)	
History of laparoscopy	No	112 (98.2%)	168 (90.3%)	280 (93.3%)	0.002
	Positive history	2 (1.8%)	18 (9.7%)	20 (6.7%)	
History of wound infection	No	109 (95.6%)	147 (79.0%)	256 (85.3%)	0.001
	Positive history	5 (4.4%)	39 (21.0%)	44 (147%)	
History of puerperal sepsis	No	113 (99.1%)	153 (82.3%)	266 (88.7%)	0.001
	Positive history	1 (0.9%)	33 (17.7%)	34 (11.3%)	
History of chronic pelvic pain	−ve	107 (93.9%)	139 (74.7%)	246 (82.0%)	<0.001
	+ve	7 (6.1%)	47 (25.3%)	54 (18.0%)	
History of blood transfusion	No	112 (98.2%)	165 (88.7%)	277 (92.3%)	0.004
	1 unit	2 (1.8%)	21 (11.3%)	23 (7.70%)	
Place of birth	Private	79 (69.3%)	121 (65.1%)	200 (66.7%)	0.265
	Tertiary center	35 (30.7%)	65 (34.9%)	100 (33.3%)	
Shape of scar	Thin	101 (88.6%)	89 (47.8%)	190 (63.3%)	<0.001
	Raised	12 (10.5%)	68 (36.6%)	80 (26.7%)	
	Keloid	1 (0.9%)	29 (15.6%)	30 (10.0%)	
Color of scar	Dark	14 (12.3%)	86 (46.2%)	100 (33.3%)	<0.001
	Red	3 (2.6%)	20 (10.8%)	23 (7.7%)	
	White	97 (85.1%)	80 (43.0%)	177 (59.0%)	

[a]Data are presented as number (percentage).

TABLE 3 Risk factors related to current delivery[a]

		Prevalence of adhesions			
		No or minimal ($n = 114$)	Moderate to severe ($n = 186$)	All cases ($n = 300$)	*P* value
Type of CS delivery	Emergency	14 (12.3%)	51 (27.6%)	65 (21.7%)	0.001
	Elective	100 (87.7%)	134 (72.4%)	234 (78.3%)	
Type of anesthesia	Spinal	112 (98.2%)	174 (93.5%)	286 (95.3%)	0.055
	General	2 (1.8%)	12 (6.5%)	14 (4.7%)	
Duration of hospital stay, h		25.11 ± 4.04	34.49 ± 16.72	30.91 ± 14.13	<0.001
Surgeon's gender	Male	57 (50.0%)	123 (66.1%)	180 (60.0%)	0.004
	Female	57 (50.0%)	63 (33.9%)	120 (40.0%)	
Surgeon's age, y		41.93 ± 10.62	45.02 ± 9.65	43.85 ± 10.12	<0.001
Years of experience		16.80 ± 10.43	19.92 ± 9.53	18.74 ± 9.98	0.008

Abbreviation: CS, cesarean section.

[a]Data are presented as mean ± standard deviation or as number (percentage).

literature.[32] This low incidence would be attributed to the presence of consultants during the delivery of women with increased cesarean deliveries. Additionally, residents call senior obstetricians/ consultants when difficulties arise.[30]

Multiple factors correlated significantly with the severity of adhesions as patients' age, parity, weight, gestational age at delivery, duration of hospital admission during this delivery, time to intestinal movement, and patient ambulation. Other studies reported that

TABLE 4 Maternal outcomes in women by adhesion status[a]

		Prevalence of adhesions			
		No or minimal ($n = 114$)	Moderate to severe ($n = 186$)	All cases ($n = 300$)	*P value*
Operative time, min		50.45 ± 5.94	71.96 ± 19.48	63.78 ± 18.91	<0.001
Intraoperative blood transfusion	No	114 (100%)	158 (85.4%)	272 (91.0%)	<0.001
	Yes	0 (0.00%)	27 (14.59%)	27 (9.00%)	
Postoperative movement, h		8.46 ± 2.09	11.49 ± 3.88	10.34 ± 3.62	0.001
Bowel open, h		13.91 ± 5.55	18.67 ± 7.78	16.86 ± 7.38	<0.001
Postoperative hemoglobin, mg/dL		10.14 ± 0.77	11.39 ± 12.30	10.92 ± 9.71	0.277
Postoperative pain	Mild	98 (86.0%)	78 (41.9%)	176 (58.7%)	0.001
	Moderate	16 (14.0%)	108 (58.1%)	124 (41.3%)	
Bladder injury	No	114 (100.0%)	170 (91.4%)	284 (94.7%)	0.001
	Yes	0 (0.0%)	16 (8.6%)	16 (5.3%)	
Bladder dissection	Blunt	107 (93.9%)	10 (5.4%)	117 (39.0%)	<0.001
	Surgical	7 (6.1%)	176 (94.6%)	183 (61.0%)	
Postoperative complications	No	102 (89.5%)	135 (73.0%)	237 (79.3%)	0.022
	Seroma	3 (2.6%)	14 (7.6%)	17 (5.7%)	
	Hematoma	7 (6.1%)	19 (10.3%)	26 (8.7%)	
	Septic wound	2 (1.8%)	14 (7.6%)	16 (5.4%)	
	Intestinal injury	0 (0.0%)	1 (0.5%)	1 (0.3%)	
	PPH	0 (0.0%)	2 (1.1%)	2 (0.7%)	

Abbreviation: PPH, postpartum hemorrhage.

[a]Data are presented as mean ± standard deviation or as number (percentage).

TABLE 5 Correlation between adhesion score and patients' history and operative data

Variable	Correlation coefficient	*P* value
Age	0.30	<0.001
Weight	0.26	<0.001
Gestational age	−0.47	<0.001
Gravidity	0.26	<0.001
Parity	0.33	<0.001
Interpregnancy interval	0.12	0.033
Hemoglobin	−0.33	<0.001
Previous hospital admission time	0.19	0.001
Duration of hospital admission in this cs	0.51	<0.001
Time to movement	0.56	<0.001
Time to open bowel	0.52	<0.001
Surgeon's age	0.14	0.015
Surgeon's experience	0.14	0.015
Intraoperative time	0.81	<0.001

patients' age, repeated cesarean delivery, and postpartum infection were significantly associated with adhesions.[26] The current study reported that women with dense adhesions had higher numbers of previous cesarean deliveries and a history of abdominal surgery; however, a significant correlation was not reported. This agreed with the results of earlier studies, where repeat cesarean deliveries were associated with increased intraperitoneal adhesions.[33,34] Additionally, raised, keloid, and dark red scars were associated with dense intraperitoneal adhesions; however, a significant correlation was lacking. Conflicting results are present regarding this issue. Some studies declared that hypopigmented and depressed scars were associated with dense intraperitoneal adhesions,[35,36] while others reported the contrary.[37,38]

The effect of age on adhesion formation was unclear. Intestinal obstruction occurred after an appendectomy at age 20–39 and less than 60 years.[39] Obesity plays a significant role in adhesion formation, leading to increased surgical morbidity, infection, improper wound healing, and defective fibrinolysis.[5] Preterm delivery was associated significantly with adhesion formation as it is commonly associated with infection and inflammation.[40]

Further research considering the effect of repeated cesarean section is recommended. The development of predictive models for adhesions combining ultrasound markers, skin markers, and patient characteristics is warranted.

The present study's strengths include that it was the first study conducted in Egypt to discuss the rate of adhesion formation and its associated risk factors. We recruited a large number of participants. Operative data concerning previous deliveries were not available.

We recruited women with previous surgeries, inflammatory bowel disease, and chronic pelvic pain. However, a limitation was that the present study did not report neonatal outcomes related to prolonged delivery time in women with adhesions.

In conclusion, adhesions are fibrous bands between intraperitoneal structures, leading to increased maternal morbidity after cesarean delivery. Multiple contributing factors were significantly related to adhesion formation in women undergoing repeated cesarean delivery.

AUTHOR CONTRIBUTIONS

RAA and LEA contributed to protocol/project development, data collection and management, and manuscript writing and editing. OTT, EA, and REE contributed to data analysis and manuscript writing and editing. HWAH, SHMK, and AME contributed to data management and to manuscript writing and editing. EAE and HAM contributed to protocol/project development, data analysis, and manuscript writing and editing. AMA and MMA contributed to data management, manuscript writing and editing, and manuscript revision. All authors have read and approved the manuscript.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

FUNDING INFORMATION

This was self-funded research.

CONFLICT OF INTEREST

The authors have declared that there are no conflicts of interest.

ORCID

Omima T. Taha https://orcid.org/0000-0001-8743-5434

REFERENCES

1. Sanjivani A. Wanjari, rising caesarean section rate: a matter of concern? *IJRCOG*. 2014;3:728-731.
2. Abdel-Tawab N, Oraby D, Hassanein N, El-Nakib S. *Cesarean Section Deliveries IN Egypt: Trends, Practices, Perceptions, and Cost*. The Population Council, Inc; 2018.
3. Orazulike NC, Alegbeleye JO. Pattern, and outcome of higher-order caesarean section in a tertiary health institution in Nigeria. *SCIENCEDOMAIN Int*. 2016;17(4):1-6.
4. Dogan A, Ertas IE, Uyar I, et al. Preoperative Association of Abdominal Striae Gravidarum with intraabdominal adhesions in pregnant women with a history of previous cesarean section: a cross-sectional study. *Geburtshilfe Frauenheilkd*. 2016;76(3):268-272. doi:10.1055/s-0042-101545
5. Fortin CN, Saed GM, Diamond MP. Predisposing factors to postoperative adhesion development. *Hum Reprod Update*. 2015;21:536-551. doi:10.1093/humupd/dmv021
6. Rossouw JN, Hall D, Harvey J. Time between skin incision and delivery during cesarean. *Int J Gynaecol Obstet*. 2013;121:82-85.
7. O'Neill SM, Khashan AS, Henriksen TB, et al. Does a cesarean section increase the time to a second live birth? A register-based cohort study. *Hum Reprod*. 2014;29:2560-2568.
8. Vrijland WW, Jeekel J, van Geldorp HJ, Swank DJ, Bonjer HJ. Abdominal adhesions: intestinal obstruction, pain, and infertility. *Surg Endosc*. 2003;17:1017-1022.
9. Awonuga AO, Belotte J, Abuanzeh S, Fletcher NM, Diamond MP, Saed GM. Advances in the pathogenesis of adhesion development: the role of oxidative stress. *Reprod Sci (Thousand Oaks, CA)*. 2014;21:823-836.
10. Al-Asmari N, Tulandi T. The relevance of post-cesarean adhesions. *Surg Technol Int*. 2012;22:177-181.
11. Hamel KJ. Incidence of adhesions at repeat cesarean delivery. *Am J Obstet Gynecol*. 2007;196:e31-e32.
12. Earlier S, Seyfettinoglu S, Yilmaz E, et al. Incidence of adhesions and maternal and neonatal morbidity after repeat cesarean section. *Arch Gynecol Obstet*. 2017;295:303-311.
13. Dawood AS, Elgergawy AE. Incidence and sites of pelvic adhesions in women with post-cesarean infertility. *J Obstet Gynaecol*. 2018;38(8):1158-1163. doi:10.1080/01443615.2018.1460583
14. Engeler D, Baranowski AP, Borovicka J, et al.; European Association of Urology. Guidelines on chronic pelvic pain. http://uroweb.org/wp-content/uploads/EAU-Guidelines-Chronic-Pelvic-Pain-2015.pdf. Accessed May 29, 2015.
15. Hruban L, Spilka J, Chudáček V, et al. Obstetrician agreement on CTG records. *J Eval Clin Pract*. 2015;21:694-702. doi:10.1111/jep.12368
16. Nair SK, Bhat IK, Aurora AL. Role of proteolytic enzyme in the prevention of postoperative intraperitoneal adhesions. *Arch Surg*. 1974;108(6):849-853.
17. Altraigey A, Ellaithy M, Atia H, Abdelrehim W, Abbas AM, Asiri M. The effect of gum chewing on the return of bowel motility after planned cesarean delivery: a randomized controlled trial. *J Matern Fetal Neonatal Med*. 2020;33(10):1670-1677. doi:10.1080/14767058.2018.1526913
18. World Health Organization (WHO). Springer Reference. DOI: 10.1007/springerreference_70205
19. Moro F, Mavrelos D, Pateman K, Holland T, Hoo WL, Jurkovic D. Prevalence of pelvic adhesions on ultrasound examination in women with a history of cesarean section. *Ultrasound Obstet Gynecol*. 2015;45:223-228. doi:10.1002/uog.14628
20. Ghani A, Ferdouse JA, Sultana N, Sultana J. Repeat caesarean sections: complications and outcomes. *J Shaheed Suhrawardy Med Coll*. 2019;10(2):74-79. doi:10.3329/jssmc.v10i2.41161
21. Jaafar Z, Obeid RZ, Salman DA. Skin markers and the prediction of intraabdominal adhesion during second cesarean delivery. *Ginekol pol*. 2019;90(6):325-330. doi:10.5603/GP.2019.0059
22. Okabayashi K, Ashrafian H, Zacharakis E, et al. Adhesions after abdominal surgery: a systematic review of the incidence, distribution and severity. *Surg Today*. 2014;44(3):405-420. doi:10.1007/s00595-013-0591-8
23. Lyell D, Caughey A, Hu E, et al. Rectus muscle and visceral peritoneum closure at cesarean delivery and intraabdominal adhesions. *Am J Obstet Gynecol*. 2012;206(6):515.e1-515.e5. doi:10.1016/j.ajog.2012.02.033
24. Schiliro A, Muscat J, Calixte R, et al. 515: factors influencing adhesion formation after primary cesarean delivery. *Am J Obstet Gynecol*. 2016;214(1):S279-S280. doi:10.1016/j.ajog.2015.10.559
25. Bamigboye AA, Hofmeyr GJ. Closure versus non-closure of the peritoneum at caesarean section: short- and long-term outcomes. *Cochrane Database Syst Rev*. 2014;(8):CD000163. doi:10.1002/14651858
26. Hesselman S, Hogberg U, Rassjo E-B, Schytt E, Lofgren M, Jonsson M. Abdominal adhesions in gynecologic surgery after caesarean section: a longitudinal population-based register study. *BJOG*. 2018;125:597-603.
27. Alshehri KA, Ammar AA, Aldhubabian MA, et al. Outcomes and complications after repeat cesarean sections among king

Abdulaziz university hospital patients. *Mater Sociomed*. 2019 Jun;31(2):119-124.
28. Shanmugham D et al. Intraoperative difficulties encountered in women undergoing repeat caesarean section. *East African Scholars J Med Sci*. 2018;1(3):77-82.
29. Gupta N, Sinha R. Intra-operative uterine scar condition and feto-maternal outcome in patients of previous lower segment caesarean section (LSCS) with scar tenderness. *Int J Res Med Sciences*. 2017;5(11):4911-4914.
30. Makoha FW, Fathuddien MA, Felimban HM. Choice of abdominal incision and risk of trauma to the urinary bladder and bowel in multiple cesarean sections. *Eur J Obstet Gynecol Gynecol Reprod Biol*. 2006;125(1):50-53.
31. Lynch CM, Kearney R, Turner MJ. Maternal morbidity after elective repeat caesarean section after two or more previous procedures. *Eur J Obstet Gynecol Reprod Biol*. 2003;106:10-13.
32. Makoha FW, Felimban HM, Fathuddien MA, Roomi F, Ghabrah T. Multiple cesarean section morbidity. *Int J Gynecol Obstet*. 2004;87(3):227-232.
33. Lakshmi JV, Anuradha C, Rishitha M. Intra-operative complications in repeat cesarean sections. *Int J Clin Obstet Gynecol*. 2020;4(2):144-149.
34. Bano A, Srikavya A. The study of intra-operative difficulties in one repeat caesarean section compared with two or more caesarean sections. *J Evol Med Dent Sci*. 2021;10(33):2745-2749.
35. Salim RY, Kadan Z, Nachum Edelstein S, Shalev E. Abdominal scar characteristics as a predictor of intra-abdominal adhesions at repeat cesarean delivery. *Fertil Steril*. 2008;90(6):2324-2327. doi:10.1016/j.fertnstert.2007.10.037
36. Cim N, Elci E, Guneş Elci G, et al. Are the skin scar characteristics and closure of the parietal peritoneum associated with pelvic adhesions? *Turk J Obstet Gynecol*. 2018;15(1):28-32. doi:10.4274/tjod.55491
37. Pergialiotis V, Frountzas M, Siotos C, et al. Cesarean wound scar characteristics for the prediction of pelvic adhesions: a meta-analysis of observational studies. *J Matern Fetal Neonatal Med*. 2017;30(4):486-491. doi:10.1080/14767058.2016.1176135
38. Elprince M, Taha OT, Ibrahim ZM, et al. Prediction of intraperitoneal adhesions using striae gravidarum and scar characteristics in women undergoing repeated cesarean sections. *BMC Pregnancy Childbirth*. 2021;21(1):1-7. doi:10.1186/s12884-021-03763-z
39. Andersson RE. Small bowel obstruction after appendectomy. *Br J Surg*. 2001;88:1387-1391.
40. Reddy UM, Rice MM, Grobman WA, et al. Serious maternal complications after early preterm delivery (24–33 weeks' gestation). *Am J Obstet Gynecol*. 2015;213(538):e1-e9.

How to cite this article: Aboshama RA, Taha OT, Abdel Halim HW, et al. Prevalence and risk factor of postoperative adhesions following repeated cesarean section: A prospective cohort study. *Int J Gynecol Obstet*. 2022;00:1-7. doi: 10.1002/ijgo.14498