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GENERAL GYNECOLOGY

Recovery from pelvic floor dysfunction symptoms in the postpartum is associated with the duration of the second stage of labor

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Abstract

Purpose Pregnancy and labor are known risk factors for pelvic floor dysfunction (PFD). Yet not much is known regarding recovery from PFD. We hypothesized that the recovery from PFD during the postpartum period would be associated with the duration of the second stage of labor (SSL).

Methods We conducted a case–control study of patients who gave birth at the Soroka University Medical Center, Beer-Sheva, Israel. Those who consented completed the Pelvic Floor Distress Inventory-20 (PFDI-20), a questionnaire developed to measure the extent of injury to the pelvic floor, after delivery and 3-month postpartum. The difference between the scores was calculated, representing recovery of symptoms. The duration of the SSL, and clinical and obstetrical characteristics were retrieved from the patients' medical records. Wilcoxon rank test was used, assessing the significance of the recovery. The association between the degree of the recovery and the duration of SSL was tested using Mann–Whitney ranking.

Results A total of 92 patients completed the PFDI-20 after delivery and 3-month postpartum. We found a significant difference between PFD symptoms during pregnancy and 3-month postpartum ($P < 0.001$). This difference remained consistent in all components of the PFDI-20. In addition, a more profound recovery of colorectal and anal dysfunction (CRAD) symptoms was associated with a shorter duration of the SSL ($P = 0.03$).

Conclusions There is a statistically significant recovery of PFD symptoms in the postpartum period. Furthermore, greater recovery from CRAD symptoms is associated with a shorter duration of the SSL.

Keywords Colorectal and anal distress · Pelvic floor dysfunction · In pregnancy · Pelvic Floor Distress Inventory · Postpartum · Second stage of labor

Abbreviations

CRAD	Colorectal and anal distress
PFD	Pelvic floor dysfunction
PFDI	Pelvic Floor Dysfunction Inventory
POP	Pelvic organ prolapse
UD	Urinary distress
VD	Vaginal delivery

Introduction

Pelvic floor dysfunction (PFD) is a term used to describe a broad range of disorders including urinary and anal incontinence, overactive bladder, pelvic organ and rectal prolapse, sexual disorders as well as lower urinary tract symptoms and defecation disorders [1, 2]. Recent studies have demonstrated that approximately one-quarter of patients suffer from at least one or more symptoms of PFD [3, 4]. While the rate of PFD increases with age, it has been reported to affect reproductive age patients as well, including during pregnancy [5]. PFD may result from infection or trauma; however, it is also a common short- and long-term outcome of vaginal childbirth [1].

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Risk factors for PFD include age, race, pregnancy, mode of delivery, duration of labor and instrumental delivery [6]. Changes in collagen and elastin fibers in the pelvis that occur throughout pregnancy, specifically during the third trimester [7], also serve as a major risk factor for PFD during pregnancy [3, 7]. The ligaments and muscles supporting the urethra, recto-anus and suspended organs of the pelvic floor play a functional role in the opening and closure of the organs [8, 9]. The ligaments of the pelvic floor provide support against these muscles and rely on collagen content for strength and elastin for flexibility. Different hormones affect both the collagen and elastin [9, 10]. Estrogen plays an essential role in maintaining the strength of the ligaments, while relaxin and oxytocin receptors loosen the collagen fibers, weakening the ligaments as a preparation for labor [10].

Altered connective tissue and loosened ligaments result in weakened muscle contraction, which leads to the inability to keep the bowel and bladder emptying tubes closed or, alternatively, may not allow relaxation of these muscles, causing pain and difficulty during emptying [8, 11].

Shortly before labor, hormones from the placenta, especially relaxin, increase the softening of collagen fibers by 95%, allowing the fetus' head to stretch against the collagen fibers. The stage of the emergence of the widest part of the fetus' head, also known as "crowning", generates a great deal of pressure on the pelvic floor area [8, 10, 11]. This, in turn, causes the pelvic floor muscles, nerves and fascia to stretch, straining the ligaments as well.

Difficult or prolonged duration of the second stage of labor (SSL) may exceed the stretch limits of the soft tissue causing imbalance in the reparative and degradative processes. When applied for a long period, the pressure can cause temporary or permanent physical and/or functional damage through hypoxia, ischemia and other deleterious processes [12, 13]. In addition, operative VD by forceps or vacuum extraction as well as prolonged SSL increases the risk for perineal tears and pelvic floor injury [2, 7].

The collagen rods re-strengthen after delivery, but may do so poorly resulting in loosened ligaments. As a result, the muscles are not able to resume their full prelabor function causing a wide range of PFD symptoms. Therefore, many studies have placed VD and prolonged SSL as major risk factors for PFD [6]. The purpose of this study is to investigate whether there is an association between the duration of the SSL and postpartum PFD symptoms recovery.

Materials and methods

A case–control study was conducted between February 2017 and July 2017 at the Soroka University Medical Center (SUMC), a 1000-bed tertiary teaching hospital. SUMC is the sole tertiary medical center serving a population of over 700,000 residing in southern Israel with an annual average of 15,000 deliveries in recent years.

Patients who underwent delivery (vaginal or cesarean section during second stage of labor) were approached and offered to participate in the study. After receiving an explanation about the study, those who agreed and gave their informed consent completed the PFDI-20 questionnaire, representing their state during the third trimester of pregnancy. All participants agreed to a telephone follow-up questionnaire at 3-month postpartum. In addition, patients were given the option to complete a computerized questionnaire recording their answers. Questionnaires completed at 3-month postpartum represent the puerperium.

The PFDI-20, validated in the Hebrew language, is a condition-specific questionnaire developed to measure quality-of-life and the extent of injury to the pelvic floor in patients with all forms of PFD. The PFDI-20 is a short version of the PFD-I composed of 20 questions. The questionnaire is divided into three subscales which evaluate the following symptoms: UD (6 questions), CRAD (8 questions) and pPOP (6 questions). The PFDI-20 was shown to be psychometrically valid and reliable in non-pregnant as well as in pregnant patients [14–16]. Participants can answer either yes or no to questionnaire items. "No" is given a value of "0" whereas "yes" will be followed by a ranking of the level of bother on a scale between 1 and 4 (1 = "not at all" 2 = "somewhat" 3 = "moderately" and 4 = "quite a bit"). For each patient, there is an option to calculate a Scale Score and a Summary Score. The Scale Score is the mean value of all questions answered per scale multiplied by 25, meaning that each scale (urinary distress, colorectal anal distress and pelvic organ prolapse) may receive a maximum score of 100. The Summary Score is the sum of all three Scale Scores (range 0–300). The study received the approval of the Soroka University Medical Center's institutional ethical review board (0199-16-SOR).

Eligibility criteria included patients who speak Hebrew or English fluently with access to a cellular phone or computer, age ≥ 18, absence of serious medical problems and delivery at a gestational age ≥ 36 weeks. Patients with connective tissue disease, previous pelvic floor surgery, preterm delivery, delivery of a stillbirth, birth by cesarean section (electively or during first stage of labor), non-fluency in Hebrew or English or age < 18 were excluded from the study. In addition to recording the duration of SSL, demographical, clinical and obstetrical information were retrieved from the patients' medical records and analyzed. This information included: maternal age and weight, gestational age, gravidity, parity, mode of delivery for current and previous pregnancies, and neonatal information including gender, weight and APGAR scores.

Differences between the scores were calculated by subtracting the score representing the third trimester from the

score representing the puerperium—creating a delta score; delta score = 0 indicates of no recovery of symptoms, higher delta scores indicate a better recovery (as the number scored in the third trimester is higher than that scored in the puerperium). Complete recovery is achieved when the peripartum score is zero. Two groups were created and compared: patients with full recovery and patients with partial or no recovery.

Statistical analysis was performed, using the SPSS software, version 21. Initial analysis was performed using descriptive statistics. Normally distributed parameters were evaluated using mean and standard deviation, while parameters that did not distribute normally were evaluated using median and mode. The scores given by each woman in the two periods were compared using the Wilcoxon *U* test. The association between SSL and the different scores was tested using the Mann–Whitney coefficient. To further investigate the association between the two, we divided the delta scores into two groups, below and above the median delta score, representing worse and better recovery, respectively. All analyses with two-sided *P* value of < 0.05 were considered significant.

Table 1 Demographic, clinical and obstetrical characteristics of the study group

$N = 92$	
Characteristic	
Maternal age (years; mean ± SD)	30.58 ± 4.67
Gravity (median; mode)	3 (1)
Parity (median; mode)	1 (0)
Maternal BMI (mean ± SD)	29.58 ± 5.18
Birth weight (grams; mean ± SD)	3274.58 ± 491.71
Gestational age at delivery (weeks; mean ± SD)	39.28 ± 1.89
Second stage labor (min; mean ± SD)	57.18 ± 87.58
Frequency	
Vaginal delivery (*N*, %)	80 (87)
Vacuum (*N*, %)	5 (5.4)
Caesarian delivery (*N*, %)	7 (7.6)
Episiotomy (*N*, %)	6 (6.5)
Epidural (*N*, %)	54 (58.7)
Grade 1 perineal tear (*N*, %)	12 (13)
Grade 2 perineal tear (*N*, %)	24 (26.1)
Grade 3 perineal tear (*N*, %)	1 (1.1)
Grade 4 perineal tear (*N*, %)	1 (1.1)

BMI body mass index, *SD* standard deviation

Results

Of 159 patients recruited, 92 (57.8%) were found eligible and completed the questionnaire at 3-month postpartum. Of those, 85 (92.4%) underwent VD and 7 (7.6%) had a cesarean section during SSL. The demographic and clinical characteristics of the study groups are presented in Table 1. Percentage of perineal tears varied between 26.1 and 1.1%, with most of the tears being grade 2 tears. The patients were mostly multiparous (median parity prior to participation in the study of 1) with an epidural rate of 58%, and 5.4% of study population underwent delivery by vacuum extraction vaginal delivery.

Results of the third trimester PFDI-20 questionnaire are presented in Table 2. The questionnaire items were divided by scores of the different components evaluating Pelvic Organ Prolapse Distress (POPDI-6), Colorectal and Anal Distress (CRADI-8) and Urinary Distress (UDI-6), as well as summary scores for PFD symptoms representing the third trimester and puerperium periods. While symptoms from all components were prevalent, we found UD symptoms to be the most prevalent and severe during both periods. A significant difference was noted between the two periods with regard to all items (Fig. 1). All components (CRADI, POPDI, UDI) as well as the summary scores of the PFDI-20 representing pelvic floor dysfunction showed improvement between late pregnancy and the puerperium ($PV < 0.001$).

Assessment of the delta scores between the PFDI-20 results in third trimester and the puerperium, representing the recovery, reveals that the most significant recovery is seen in CRAD symptoms. When assessing the association between the duration of the SSL and the median CARDI score (set at 12.5), we found that among patients with a CRADI score above the median, SSL was significantly longer (98.11 vs. 62.99 min, $P = 0.03$) (Fig. 2). UD remained the most severe item that was reported in the postpartum period (42.4%, 13.04 ± 18.45), although symptoms from all PFDI-20 components were prevalent (31.1–57.6%). As displayed in Table 3, 42.4% of patients experienced complete recovery of CRAD symptoms during the postpartum. The remaining 57.6% experienced none or partial recovery.

The association between SSL and the recovery as reflected by the subtraction of scores given at delivery and 3-month postpartum as presented in Table 3. One must notice that two different comparisons were made: between patients with full versus partial/no recovery and between patients with better and worse recovery (scores above and below median, respectively). No association was found between duration of SSL and POPD, UD, as well as the PFDI-20 scores in general ($PV = 0.845$, 0.325 and 0.45, respectively). An association between recovery of CRAD symptoms and the duration of the SSL was demonstrated. We found that patients who showed a profound recovery from CRAD symptoms experienced a shorter duration of the SSL (33.44 ± 62.19 vs. 71.10 ± 97.33, $PV = 0.03$) as opposed to the other components of the PFDI-20 (Table 4).

Table 2 Differences in Pelvic Floor Distress 20 scores between pregnancy and the postpartum

N = 92	Third trimester scores (mean ± SD)	Postpartum scores (mean ± SD)	*P* value	Delta (mean ± SD)
POPDI	22.62 ± 17.59	6.15 ± 11.98	< 0.001	14.78 ± 15.60
CRADI	16.78 ± 16.86	10.30 ± 15.84	< 0.001	17.50 ± 19.54
UDI	32.69 ± 23.08	13.04 ± 18.45	< 0.001	4.43 ± 14.50
PFDI	72.09 ± 48.08	29.39 ± 39.70	< 0.001	36.45 ± 36.50

PFDI Pelvic Floor Distress Inventory, *CRADI* Colorectal Anal Distress Inventory, *POPDI* Pelvic Organ Prolapse Inventory, *SD* standard deviation, *UDI* Urinary Distress Inventory

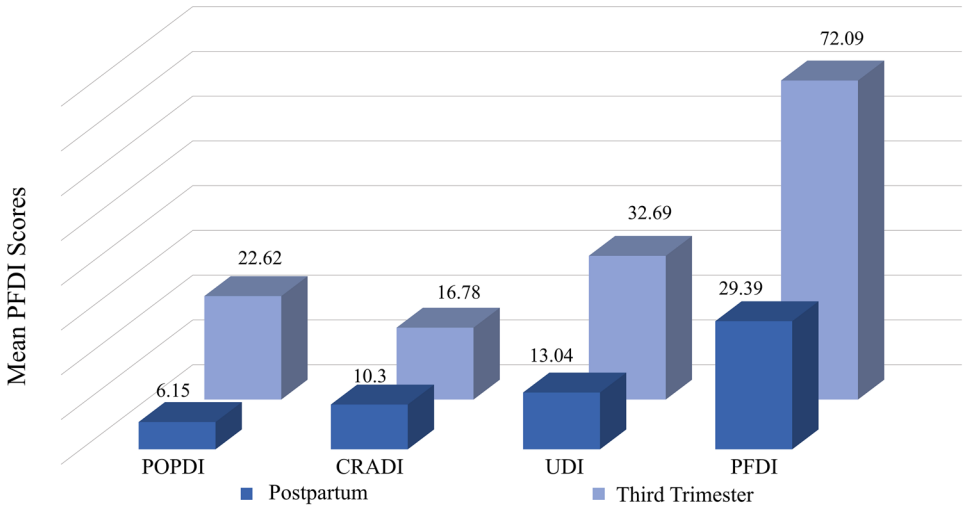

Fig. 1 Pelvic Floor Distress Inventory 20 scores during the third trimester and the postpartum. This figure displays the mean Pelvic Floor Distress Inventory 20 results, divided into domains, both during the third trimester and the postpartum. This figure emphasizes the difference in the scores, representing a recovery in each domain. *CRADI* Colorectal Anal Dysfunction Inventory, *PFDI* Pelvic Floor Dysfunction Inventory, *POPDI* Pelvic Organ Prolapse Distress Inventory, *UDI* Urinary Distress Inventory

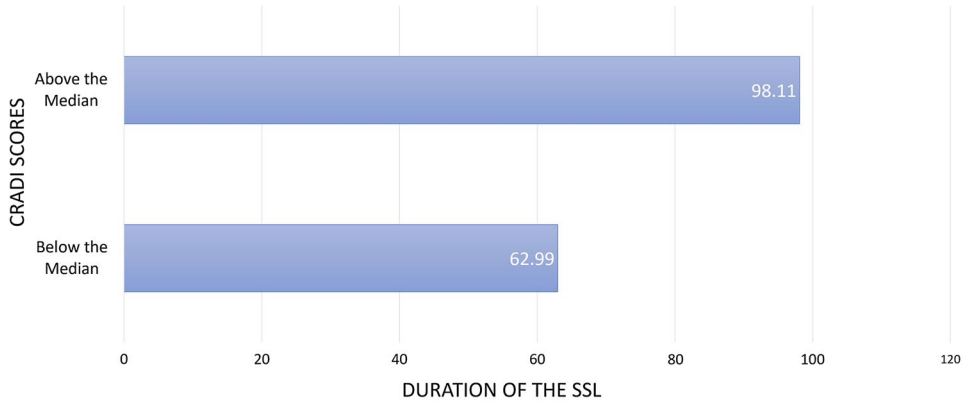

Fig. 2 Association between the duration of the second stage of labor and the median of the colorectal anal distress inventory. This figure displays the association between the median Colorectal Distress Inventory results with the duration of the second stage of labor, portraying that a higher score is associated with a longer duration of the second stage of labor. *CRADI* Colorectal Anal Dysfunction Inventory, *SSL* second stage of labor

Table 3 Association between the recovery from pelvic floor dysfunction and the duration of the second stage of labor

Scale	Complete recovery postpartum (*N*, %)	No/partial recovery postpartum (*N*, %)	*P* value[a]	Median delta score	*P* value[b]
POPDI	56 (60.9)	36 (31.1)	0.68	16.67	0.85
CRADI	39 (42.4)	53 (57.6)	0.04	12.50	0.03
UDI	41 (44.6)	51 (55.4)	0.10	6.25	0.35
PFDI	24 (26.1)	68 (73.9)	0.07	36.46	0.45

CRADI Colorectal Anal Distress Inventory, *POPDI* Pelvic Organ Prolapse Inventory, *PFDI* Pelvic Floor Distress Inventory, *UDI* Urinary Distress Inventory

[a]Comparison was made between patients above and below median score, representing better and worse recovery, respectively

[b]Comparison was made between patients with complete recovery and patients with no/partial recovery

Table 4 The association between the duration of the second stage of labor and the recovery from symptoms of colorectal and anal dysfunction

N = 92	Number of patients (%)	SSL (mins) (mean ± SD)	*P* value
Delta CRADI score below median	58 (63)	71.10 ± 97.33	< 0.001
Delta CRADI score above median[a]	34 (37)	33.44 ± 62.19	

Mins minutes, *CRADI* Colorectal Anal Distress Inventory, *SSL* second stage of labor

[a]Delta above median represents a better recovery

Discussion

Our main assumption conducting this study was that the duration of SSL is associated with on the recovery of PFD symptoms as reflected by the different scores given at third trimester and the puerperium. In our study, UD was the most prevalent and most severe in both the third trimester and the puerperium. In addition, we found that a significant physiological recovery of PFD symptoms exists from the third trimester to the puerperium with a consistent trend of improvement in all components of PFD including UD, CRAD, POPD as well as for the general score of the PFDI-20. In the present study, we have found that greater recovery from CRAD was associated with a shorter duration of the SSL (PV = 0.03).

Many clinical factors affect the duration of the SSL. The duration the SSL as found in our cohort (57.18 ± 87.58 min) corresponds with that described by The American College of Obstetricians Gynecologists (ACOG). ACOG states that the mean duration of the SSL is 54 and 19 min in nulliparous and multiparous patients, respectively [17, 18]. Prolonged SSL is defined as more than 2–3 h or 1–2 h in nulliparous and multiparous patients, respectively. Epidural has a prolongation effect of approximately 25 min in both cases [17, 18].

There is a great amount of literature supporting the association between pregnancy, labor and delivery, and the prevalence of PFD [1–3, 6, 19]. While most literature places vaginal delivery as the major contributor to PFD, some note that pregnancy itself is associated with a certain degree of injury. This is supported by the integral theory suggested by Petros [10]. During pregnancy, collagen rods begin to loosen in a response to hormones from the placenta, specifically relaxin. The loosening of the collagen fibers results in weakened ligaments, allowing the fetus' head to stretch against the pelvic floor during delivery, and contributes to the prevalence of PFD [10].

Our finding, regarding a significant association between recovery from CRAD symptoms and the duration of SSL, is supported by Yohay et al. [12]. In their study, they found a mild but significant decrease in the CRADI items 7 and 8 (Do you feel the need to strain hard to have bowel movement?; Do you feel you have not completely emptied your bowels at the end of a bowel movement?) between the third trimester and puerperium. Rogers et al. [1] found that the duration of the SSL has an effect on postpartum PFD symptoms.

Moreover, we found that there is a significant difference between PFD symptoms during the third trimester and PFD in the puerperium with a consistent trend of improvement in all components of the PFDI-20. Many studies are aligned with our findings and report that PFD, specifically urinary incontinence, is most prevalent during the second half of pregnancy, as opposed to the postpartum [4, 5, 20]. Mason et al. [21] found a profound decrease in the prevalence of UI from 34 to 36 weeks gestation to 8–10 weeks postpartum. Likewise, Yohay et al. [12] found a 26% decrease in UDI items between late pregnancy and the puerperium. Additional studies report that prolonged SSL increases the odds of postpartum urinary insufficiency [22–24]. Van Kessel et al. [25] found stress urinary incontinence to be prevalent in both periods. This is in line with our finding that UD was the most prevalent and most severe among the PFD symptoms both in the third trimester and in the puerperium.

Petros' integral theory supports these findings as well. After the third stage of labor, the delivery of the placenta, there is a major decrease in the secretion of relaxin. As a result, the collagen rods re-strengthen, allowing the recovery process of PFD symptoms to commence [9, 10]. This is a likely explanation for the lesser degree of PFD symptoms noticed in the puerperium. The degree of recovery is determined by the amount of injury caused to the ligaments both during pregnancy and during VD, the shorter the SSL, the lesser the injury to the ligaments.

Our study holds several advantages. First and foremost, to the best of our knowledge this is the first study assessing the association between recovery from PFD symptoms in general and the duration of the SSL. To date, our study holds the largest sample size on the topic.

In addition, the study took place at the Soroka University Medical Center which is the sole tertiary center for the population of Southern Israel. This allowed us to avoid selection bias and to recruit a heterogeneous population and increase the generalizability of our findings. All data were recorded directly from each patients' file and updated online, double checked by multiple staff members, allowing very little room for mistakes and missing data. We used the PFDI-20, a validated questionnaire (available and validated in Hebrew as well) to measure not only the degree of PFD symptoms but also their effect on quality of life.

Another advantage that our study holds is the high rate of compliance at the 3-month postpartum follow-up. Over 60% of the participants who met the inclusion criteria were reached for a second interview. Most of the patients who were lost to follow-up were due to technical reasons including incorrect phone numbers or disconnected phone number with no following number. Very few declined to further participate. This makes selection due to loss to follow-up bias less.

Nonetheless, the study had some limitations. The PFDI-20 was the sole tool used to measure pelvic function. In this study, we did not use sonography or other objective tools to measure PFD. The sonographic measurement of the pelvic floor is not only less available, but would also be intrusive in this study, and require patients to actively arrive to the clinic, which would likely impede follow-up. Another limitation lies with the use of the PFDI-20 that requires patients to remember their pelvic floor function during the previous 3 months; this is subject to recall bias. However, the PFDI-20 is a validated, commonly used study tool, for both pregnant and non-pregnant patients [14, 16].

Cesarean delivery (CD), VD and third/fourth degree lacerations were not exclusion criteria and may have confounded our findings. However, we found a heterogeneous population including multiparous patients and patients with and without epidural anesthesia to better reflect reality and enable generalization of our results to the entire population. Further studies with a larger sample size may include multivariate analysis controlling for these potential confounders. For this reason, we also choose to include patients who underwent CD due to a prolonged duration of the SSL and arrest. This is in the assumption that despite the head and body not being delivered vaginally, maternal forces during the SSL had a great impact on the pelvic floor and, hence, relevant when examining pelvic floor recovery. In addition, it is possible that the 3-month difference may be clinically insignificant (e.g., longer duration should be examined). However, van Brumen et al. [26] found that symptoms presented at 3-month postpartum and symptoms presented at 12 months postpartum are quite similar. Finally, patients were surveyed up to 48 h after delivery about their symptoms during the third trimester. It may have been more valid to interview patients immediately prior to delivery. However, an emphasis was made to recall symptoms from the third trimester exclusively, without taking into consideration the onset of symptoms postpartum. Only after ensuring this point was understood did the patients complete the PFDI-20.

Conclusion

In conclusion, UD is the most prevalent and severe PFD symptom in the pre- and postpartum period. All patients who suffer from PFD symptoms during the third trimester experience a certain level of recovery during the puerperium. Specifically, patients with a shorter duration of the SSL are more likely to experience a significant recovery of symptoms of CRAD.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the institutional review board (0199-16-SOR).

Human and animal rights statement This article does not contain any studies with animals performed by any of the authors.

Informed consent Informed consent was obtained from all individual participants included in the study.

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