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ORIGINAL ARTICLE

Birthweight and pelvic floor trauma after vaginal childbirth

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Abstract

Introduction and hypothesis Birthweight seems to be a risk factor for levator ani muscle (LAM) avulsion and a predictive factor for pelvic organ prolapse (POP). Most trauma seems due to first vaginal birth.

Methods One thousand one hundred twenty-five women with at least two vaginal deliveries underwent a physician-directed interview, followed by clinical examination (digital palpation and Pelvic Organ Prolapse Quantification-POPQ) and 4D translabial ultrasound. Ultrasound volume data were obtained at rest, on pelvic floor contraction and Valsalva. The investigator, blinded to all other data, performed offline analysis of the LAM integrity and hiatal area on Valsalva. We tested for associations between birthweight of the first and of the largest vaginally born baby on the one hand and avulsion and symptoms/signs of prolapse on the other hand.

Results Between July 2014 and July 2017, 1575 patients were seen. After exclusion of nulliparae and women with just one vaginal birth, 1202 remained. Another 77 were excluded due to missing data, leaving 1125. A significant association was found between birthweight and LAM avulsion as well as significant prolapse on POPQ. The birthweight of the first vaginally born baby was at least as predictive for avulsion as the birthweight of any subsequent births, even when adjusted for maternal age at first delivery and use of forceps.

Conclusions The birthweight of the first vaginally born baby is associated with levator avulsion and subsequent POP. Maximum weight of vaginal births does not seem to be a stronger predictor.

Keywords Birthtrauma · Birthweight · Levator ani muscle avulsion · Pelvic floor · Pelvic organ prolapse · Ultrasound

Introduction

Vaginal childbirth is the primary environmental factor in the etiology of female pelvic organ prolapse (POP), at least partly mediated by trauma to the levator ani muscle [1–4]. During the second stage of labor, the pelvic floor muscles undergo a remarkable degree of soft tissue stretch due to the pressure exerted by the passage of the fetal head, which is enhanced by maternal pushing [5, 6]. Such stretch, which is clearly more than what can be tolerated by normal skeletal muscle [5], may lead to injuries of the levator ani muscle in some women, ranging from irreversible hyperdistension of the levator hiatus (microtrauma) to avulsion (macrotrauma) [7, 8].

Levator ani muscle avulsion is characterized by a complete traumatic detachment of the puborectalis muscle from its insertion to the inferior pubic ramus [7, 8]. This trauma is associated with pelvic organ prolapse [1–4] and its recurrence after reconstructive surgery [9].

Major risk factors of levator trauma are first vaginal delivery [10, 11], advanced maternal age at first delivery (> 35 years) [12] and use of forceps [13]. It is suggested that birthweight may also be a risk factor for levator trauma [14] and a predictor for prolapse stage and symptoms [15]. It is however not clear whether it is the weight of the firstborn or the weight of the heaviest baby that is more important for the etiology of levator trauma. Thus, we tested for associations between birthweight of the first and of the largest vaginally born baby on the one hand and avulsion and symptoms/signs

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of prolapse on the other. Our study aimed to test the hypothesis: 'The birthweight of the heaviest vaginally born baby has a stronger association with LAM avulsion than the birthweight of the first vaginal birth.'

Materials and methods

Design, setting and participants

This was a retrospective study involving ultrasound data sets of 1125 vaginally parous women seen routinely at two tertiary urogynecological centers between July 2014 and July 2017. Our inclusion criteria were women who had had at least two vaginal childbirths. Women who had no information regarding their babies' birthweight were excluded. This study was approved by the local Human Research Ethics Committee (NBMLHD HREC 13–70).

Outcome measures

Personal, clinical and obstetric data

All women underwent a standardized clinical assessment which included a physician-directed interview and patient-reported personal, clinical and obstetric data. The following characteristics were investigated: age, body mass index, parity, delivery mode, birthweight, previous surgical history and presence of urinary and POP symptoms. The average time span between the birth of the first child and the assessment was 33.4 (range, 0.7–69.7) years. We did not obtain information on the timing of subsequent births. All reported personal, clinical and obstetric data were obtained on the same day.

Pelvic floor assessment

Digital palpation was performed to assess PFM contractility, which was graded according to the Modified Oxford Grading scale (range 0 to 5) [16]. POP was quantified for each compartment separately (anterior, middle, posterior) using the Pelvic Organ Prolapse Quantification (POPQ) system (range from stage 0 to 4) [17]. POPQ stage 2 or higher for anterior and posterior vaginal wall as well as POPQ stage I or higher for the uterus were considered clinically relevant and classified as a significant prolapse on POPQ [18].

Following this, 4D translabial ultrasound (TLUS) was performed with women in the supine position, after voiding, using a GE Voluson 730 Expert system (GE Medical, Kretz, Austria) with an 8–4 MHz curved array volume transducer. Volume acquisition was performed with an acquisition angle of 85 degrees, at rest, on pelvic floor muscle (PFM) contraction and maximum Valsalva [19].

Ultrasound data analysis

Offline analysis of ultrasound volume data sets was performed using the 4D View 10.0 software (GE Medical Ultrasound, Ryde NSW, Australia) by the first author, blinded to all other data, 3 months to 3 years after the imaging volume data had been obtained and stored. A test-retest series performed prior to commencing measurements for the study yielded a coefficient of Kappa's agreement of 0.875 between the first and last author, showing good agreement for the diagnosis of avulsion.

Levator ani muscle integrity was evaluated using tomographic ultrasound imaging (TUI) of volumes obtained on maximum PFM contraction. Eight slices were obtained in the axial plane at 2.5-mm slice intervals, from 5 mm below to 12.5 mm above the plane of minimal hiatal dimensions [20]. A complete levator avulsion was diagnosed if at least the three central slices (i.e. the plane of minimal dimension plus slices 2.5 mm and 5 mm cranial to this plane—slices 3 to 5) showed an abnormal muscle insertion on the inferior pubic ramus [21], as shown in Fig. 1.

Hiatal area was measured at the plane of minimal hiatal dimensions, defined in the midsagittal plane as the minimal distance between the symphysis pubis and the anterior margin of the central aspect of the puborectalis muscle [22].

Statistical analysis

Statistical analysis was performed by the NHMRC Clinical Trials Centre of the University of Sydney using the program SPSS (Statistical Package for the Social Sciences) and adopting a significance level of 5% ($p < 0.05$). We tested for association between birthweight of the first vaginally born baby and maximum birthweight of any vaginally born baby with symptoms and signs of POP and levator avulsion, using two sample t-tests and Pearson's correlation. Univariate and multivariate logistic regressions were used to quantify the contribution of each of these birthweight variables on levator avulsion. Multivariate analyses were adjusted for maternal age at first delivery and use of forceps, with each model's performance estimated with the area under the receiver-operator characteristic (ROC) curve. The difference between two areas under the ROC curves was analyzed as described by DeLong and collaborators (1988) [23] to test the hypothesis: 'The **maximum weight of any vaginally born baby** is a stronger predictor for avulsion compared to the birthweight of the first vaginal birth.'

Results

Between July 2014 and July 2017, 1575 consecutive patients were seen at two tertiary urogynecological centers. Of those, 23 had missing ultrasound volumes, 373 were nulliparous or

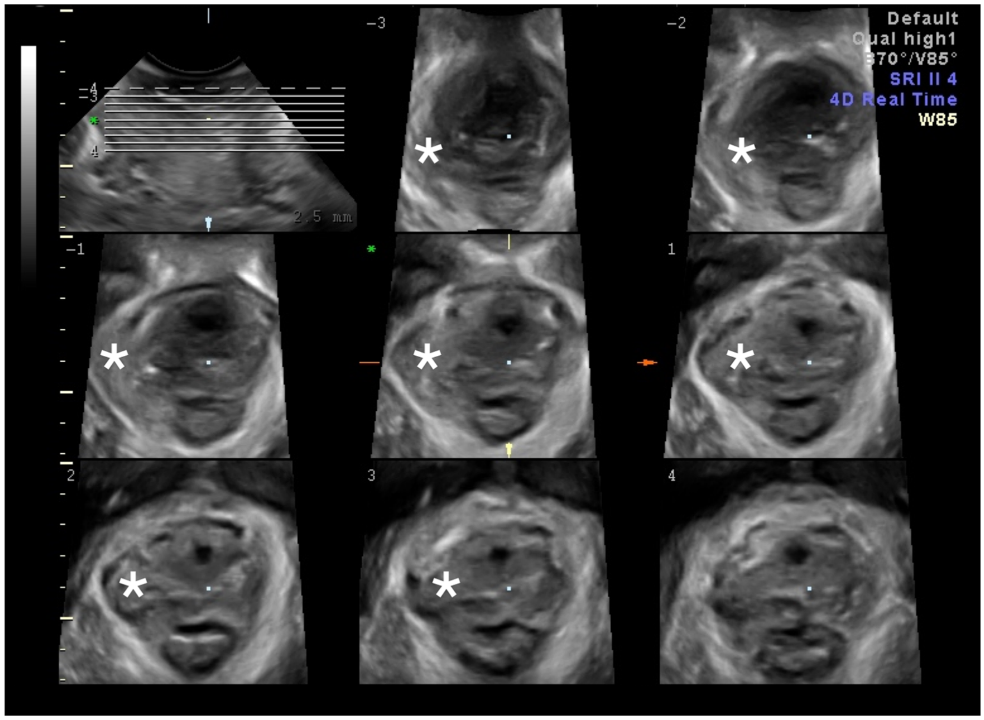

Fig. 1 Right-sided complete avulsion, indicated by an asterisk (*). A complete levator avulsion is diagnosed if at least the three central slices (slices 3 to 5) show an abnormal muscle insertion on the inferior pubic ramus

had just one vaginal delivery, and 54 did not have data regarding their babies' birthweights and were excluded from the study. Therefore, the final sample was composed of 1125 parous women, and all reported data pertain to this population unless otherwise indicated.

Mean age was 57.1 ± 12.5 years old (range 24.2 to 89.7), and mean body mass index was 29.5 ± 6.3 kg/m^2 (range 15.7 to 58.8). All patients were parous women who had had at least two vaginal births and 371 (33%) at least one forceps delivery. The mean birthweight of the first vaginally born baby was 3362 g (range, 459–5000 g); the average weight of the heaviest vaginally born child was 3775 g (range, 1786–5900 g). Three hundred ninety-four (35%) had had a hysterectomy since their last birth, 144 (12.8%) incontinence surgery and 236 (21%) prolapse surgery. Eight hundred eighteen (72.7%) reported symptoms of stress incontinence, 842 (74.8%) of urge incontinence, 289 (25.7%) of increased urinary frequency, 433 (38.5%) of nocturia and 374 (33.2%) of voiding dysfunction.

Clinical examination was possible in 1124 women. On POPQ examination (Table 1), 693 (61.6%) had a significant cystocele, 220 (37.5%) significant uterine prolapse and 646 (52.8%) significant descent of the posterior vaginal wall. The Gh + Pb measure was abnormal (≥ 7 cm) [24] in 905 women (80%). The Modified Oxford Scale was used to grade the pelvic floor muscle contractility, resulting in a mean grading of 2.1 (range 0–5) on the right and 2.3 (range 0–5) on the left. On digital palpation, a unilateral avulsion was found in 170 women (15.1%) while bilateral avulsion was found in 128 women (11.4%).

During Valsalva, the mean hiatal area was 29.8 cm^2 (SD 9.7). Complete levator avulsion was found in 293 women (26%), and it was bilateral in 134 (11.9%). Table 2 shows the association between the birthweight of the first vaginally born baby and the maximum weight of any vaginally born baby with levator avulsion and symptoms and signs of prolapse. There was no significant difference in birthweight regarding the type of avulsion (uni- or bilateral) on subgroup analysis.

Subsequent births were heavier than the first in 456/1125 (40.5%). These women did not have a higher risk of avulsion than those with smaller subsequent births. The odds for levator ani muscle avulsion are 1.36 times greater for those women in whom the first baby was the heaviest compared with those who had a heavier baby in a subsequent delivery, even when adjusted for maternal age at first delivery and use of forceps ($p = 0.03$) (Table 3).

The birthweight of the first vaginally born baby is a better univariate predictor for levator avulsion (AUC = 0.574) compared with the maximum weight of any vaginally born baby (AUC = 0.540). We created two models for the prediction of avulsion, containing known predictors such as forceps and age at first birth, and then added either the birthweight of the firstborn or the birthweight of the heaviest baby. When adjusted for maternal age at first delivery and use of forceps, the area under the curve (AUC) for the birthweight of the first vaginally born baby was 0.634 (model 1) and the AUC for the maximum weight of any vaginally born baby was 0.628 (model 2). This difference was not significant ($p = 0.473$). Hence, we were

Table 1 Clinical examination of pelvic organs descent

		Mean ± SD (range) *(in centimeters)*
Pelvic Organ Prolapse Quantification-POPQ $n = 1124$	Ba	−0.6 ± 1.6 (−3 to 7.5)
	C	−4.2 ± 2.9 (−11 to 8)
	Bp	−0.9 ± 1.3 (−3 to 8)
	Gh	4.5 ± 1.2 (1.5 to 10)
	Pb	3.4 ± 0.8 (1 to 7)

Data are presented as mean and standard deviation (SD)

not able to prove our hypothesis ('the birthweight of any vaginally born baby is a stronger predictor for avulsion compared to the birthweight of the first vaginal birth').

Discussion

This study has demonstrated a significant relationship between birthweight and major levator trauma (levator avulsion) as well as significant prolapse on POPQ in women presenting for treatment of pelvic floor dysfunction over 30 years after a first vaginal birth. The birthweight of the first vaginally born baby was at least as predictive for levator avulsion as the maximum weight of any subsequent vaginally born baby, refuting our hypothesis.

The first vaginal delivery seems to be the crucial moment for levator trauma [10, 11], which occurs in approximately 10–35% of women giving birth vaginally in the developed world [8], although trauma rates may be substantially lower in populations with traditional reproductive behavior [25]. Additional pregnancies and vaginal births do not seem to be associated with a significant increase in the odds of levator avulsion [10].

The baby's birthweight is strongly associated with head circumference (r = 0,749; $p < 0.001$) [26] and therefore is closely linked to the degree of stretching of the puborectalis muscle during vaginal delivery [27]. It is not surprising therefore that larger head circumference seems to be associated with increased length of the second stage of labor [26].

In this study, if the first vaginally born baby was also the heaviest one, this was found to be a significant risk factor for levator avulsion with an odds ratio of 1.36 ($p = 0.03$). Even when adjusted for maternal age at first delivery and use of forceps, the association between first birthweight and avulsion remained significant (AUC = 0.634) although not significantly stronger than the maximum weight of any vaginally born baby (AUC = 0.628).

It is plausible that tissues that are unable to stretch with a given distension because of the individual biomechanical properties of the mother will rupture at the time of a first birth. Biomechanical properties clearly vary enormously. [27]. The second birth will be easier because the rupture has already occurred with the first, and further trauma may then be unlikely. On the other hand, if tissues survived intact the first time, they probably will not rupture at the time of a second birth. This is consistent with evidence from observational studies [10, 11].

Current literature is contradictory regarding the association between birthweight and obstetric trauma and the predisposition to POP occurrence [28, 29]. Delivery of infants over 4000 g seems associated with Obstetric Anal Sphincter Injury (OASIS) [30] and pelvic floor dysfunction [31]. Valsky and collaborators (2009) [26] showed that, for birthweight > 3400 g, the odds of levator avulsion increased by a factor of 1.094 ($p = 0.028$) for every 100 g increase.

Table 2 Association between birthweight and levator avulsion and signs and symptoms of prolapse

		Birthweight of the first vaginally born baby (g)		Maximum weight of any vaginally born baby (g)	
Symptoms of prolapse (mean ± SD)[1]	Yes ($n = 619$) No ($n = 506$)	3377 (± 0.563) vs 3343 (± 0.578)	$p = 0.33$	3693 (± 0.557) vs 3696 (± 0.562)	$p = 0.91$
Significant prolapse on POPQ (M ± SD)[1]	Yes ($n = 919$) No ($n = 205$)	3377 (± 0.568) vs 3292 (± 0.573)	$p = 0.05$	3711 (± 0.571) vs 3618 (± 0.495)	$p = 0.03$
Levator ani muscle avulsion[1§]	Yes ($n = 293$) No ($n = 832$)	3467 (± 0.553) vs 3324 (± 0.571)	$p < 0.001$	3755 (± 0.536) vs 3673 (± 0.565)	$p = 0.03$
Hiatal area on Valsalva ($n = 1124$)[2]		$p < 0.001$; r = 0.13		$p < 0.001$; r = 0.15	

Data are presented as mean and standard deviation (SD)

[§] Considering complete unilateral (right or left) or bilateral avulsion

POPQ = Pelvic Organ Prolapse Quantification

[1] *t*-test was used. [2] Pearson's correlation test was used

Table 3 Birthweight and risk of levator ani muscle avulsion

		First baby heaviest $n = 669$	Any other subsequent birth heaviest $n = 456$	p value[1]	OR	95% CI
Avulsion	No	511 (76.4%)	321 (70.4%)	0.03	1.36	1.04–1.78
	Yes	158 (23.6%)	135 (29.6%)			

[1] Chi-square test; OR: odds ratio; 95% CI: 95% confidence interval. $n = 1125$

Several limitations of our study need to be mentioned. Obstetric data, including birthweight, were patient-reported, and this may have led to recall bias. This is particularly true in view of the fact that the average time span between the birth of the first child and the assessment was 33.4 (range, 0.7–69.7) years.

In addition, we did not have information on some characteristics of labor that may also influence the likelihood of levator ani trauma and act as confounders, such as length of the second stage of labor, fetal head circumference, malposition or the occurrence of obstructed labor. Moreover, due to the above-mentioned long latency of 33.4 years, our findings clearly represent past rather than present obstetric practice, which may also have influenced results. Due to this long latency, other factors such as chronic constipation, smoking, asthma and menopause may have influenced our findings. However, menopausal status seems unlikely to impact pelvic floor functional biometry [32], and the same seems true for asthma and smoking (unpublished own data).

Finally, it needs to be mentioned that the majority of our patients were Caucasian and symptomatic of pelvic floor dysfunction, limiting the validity of our findings for other populations.

In conclusion, birthweight is significantly associated with levator avulsion and subsequent pelvic organ prolapse, especially the birthweight of the first vaginally born baby. Maximum birthweight is also predictive, but clearly not more so than the weight of the first vaginally born child.

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Compliance with ethical standards

Conflicts of interest HP Dietz has received paid travel expenses and honoraria from GE Medical.

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References

1. Dietz HP, Franco AV, Shek KL, Kirby A. Avulsion injury and levator hiatal ballooning: two independent risk factors for prolapse? An observational study. Acta Obstet Gynecol Scand. 2012;91(2):211–4. https://doi.org/10.1111/j.1600-0412.2011.01315.x.
2. Van Delft K, Sultan AH, Thakar R, Schwertner-Tiepelmann N, Kluivers K. The relationship between postpartum levator ani muscle avulsion and signs and symptoms of pelvic floor disorders. BJOG. 2014;121(9):1164–71. https://doi.org/10.1111/1471-0528.12666.
3. Volløyhaug I, Mørkved S, Salvessen KA. Association between pelvic floor muscle trauma and pelvic organ prolapse 20 years after delivery. Int Urogynecol J. 2016;27(1):39–45. https://doi.org/10.1007/s00192-015-2784-8.
4. Abdool Z, Dietz HP, Lindeque BG. Prolapse symptoms are associated with abnormal functional anatomy of the pelvic floor. Int Urogynecol J. 2017;28(9):1387–91. https://doi.org/10.1007/s00192-017-3280-0.
5. Lien KC, Mooney B, DeLancey JO, Ashton-Miller JA. Levator ani muscle stretch induced by simulated vaginal birth. Obstet Gynecol. 2004;103(1):31–40. https://doi.org/10.1097/01.AOG.0000109207.22354.65.
6. Svabik K, Shek KL, Dietz HP. How much does the puborectalis muscle have to stretch during childbirth? BJOG. 2009;116(12):1657–62. https://doi.org/10.1111/j.1471-0528.2009.02321.x.
7. Shek KL, Dietz HP. The effect of childbirth on hiatal dimensions. Obstet Gynecol. 2009;113(6):1272–8. https://doi.org/10.1097/AOG.0b013e3181a5ef23.
8. Dietz HP. Pelvic floor trauma in childbirth. Aust N Z J Obstet Gynaecol. 2013;53(3):220–30. https://doi.org/10.1111/ajo.12059.
9. Friedman T, Eslick G, Dietz HP. Risk factors for prolapse recurrence—systematic review and meta-analysis. Int Urogynecol J. 2018;29(1):13–21. https://doi.org/10.1007/s00192-017-3475-4.
10. Horak TA, Guzman-Rojas R, Shek KL, Dietz HP. Pelvic floor trauma: does the second baby matter? Ultrasound Obstet Gynecol. 2014;44(1):90–4. https://doi.org/10.1002/uog.13252.
11. Kamisan Atan I, Lin S, Herbison P, Dietz HP. Wilson PD for the PROLONG study group: it is the first birth that does the damage: a cross-sectional study 20 years after delivery. Int Urogynecol J. 2018;29:1637–43. https://doi.org/10.1007/s00192-018-3616-4.
12. Rahmanou P, Caudwell-Hall J, Kamisan Atan I, Dietz HP. The association between maternal age at first delivery and risk of obstetric trauma. Am J Obstet Gynecol. 2016;215(4):451.e1–7. https://doi.org/10.1016/j.ajog.2016.04.032.
13. Dietz HP. Forceps: towards obsolescence or revival? Acta Obstet Gynecol Scand. 2015;94(4):347–51. https://doi.org/10.1111/aogs.12592.
14. Garcia-Mejido JA, Gutierrez-Palomino L, Borrero C, Valdivieso P, Fernandez-Palacin A, Sainz-Bueno JA. Factors that influence the development of avulsion of the levator ani muscle in eutocic deliveries: 3-4D transperineal ultrasound study. J Matern Fetal Neonatal Med. 2016;29(19):3183–6. https://doi.org/10.3109/14767058.2015.1118041.
15. Rodriguez-Mias NL, Martinez-Franco E, Aguado J, Sanchez E, Amat-Tardiu L. Pelvic organ prolapse and stress urinary incontinence: do they share the same risk factors? Eur J Obstet Gynecol Reprod Biol. 2015;190:52–7. https://doi.org/10.1016/j.ejogrb.2015.04.015.
16. Laycock J, Jerwood D. Pelvic floor muscle assessment: the PERFECT scheme. Physiotherapy. 2001;87(12):631–42. https://doi.org/10.1016/S0031-9406(05)61108-X.

17. Bump RC, Mattiasson A, Bø K, et al. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. Am J Obstet Gynecol. 1996;175(1):10–7.
18. Dietz HP. Pelvic organ prolapse—a review. Aust Fam Physician. 2015;44(7):446–52.
19. Dietz HP. Pelvic floor ultrasound: a review. Clin Obstet Gynecol. 2017;60(1):58–81. https://doi.org/10.1097/GRF.0000000000000264.
20. Dietz HP, Shek KL. Tomographic ultrasound imaging of the pelvic floor: which levels matter most? Ultrasound Obstet Gynecol. 2009;33(6):698–703. https://doi.org/10.1002/uog.6403.
21. Dietz HP, Bernardo MJ, Kirby A, Shek KL. Minimal criteria for the diagnosis of avulsion of the puborectalis muscle by tomographic ultrasound. Int Urogynecol J. 2011;22(6):699–704. https://doi.org/10.1007/s00192-010-1329-4.
22. Dietz HP, Wong V, Shek KL. A simplified method for determining hiatal biometry. Aust N Z J Obstet Gynaecol. 2011;51(6):540–3. https://doi.org/10.1111/j.1479-828X.2011.01352.x.
23. DeLong ER, DeLong DM, Clarke-Pearson DL. Comparing the areas under two or more correlated receiver operating characteristic curves: a nonparametric approach. Biometrics. 1988;44(3):837–45.
24. Girgis B, Kamisan Atan I, Shek KL, Dietz HP. How to determine "ballooning" of the levator hiatus on clinical examination: a retrospective observational study. Int Urogynecol J. 2013;24(11):1933–7. https://doi.org/10.1007/s00192-013-2119-6.
25. Turel F, Caagbay D, Dietz HP. The prevalence of major birth trauma in Nepali women. J Ultrasound Med. 2018; Accepted 27.2.18.
26. Valsky DV, Lipschuetz M, Bord A, et al. Fetal head circumference and length of second stage of labor are risk factors for levator ani muscle injury, diagnosed by 3-dimensional transperineal ultrasound in primiparous women. Am J Obstet Gynecol. 2009;201(1):91.e1–7. https://doi.org/10.1016/j.ajog.2009.03.028.
27. Svabik K, Shek KL, Dietz HP. How much does the puborectalis muscle have to stretch during childbirth? BJOG. 2009;116:1657–62.
28. Tegerstedt G, Miedel A, Mæhle-Schmidt M, Nyrén O, Hammarstrom M. Obstetric risk factors for symptomatic prolapse: a population-based approach. Am J Obstet Gynecol. 2006;194(1):75–81. https://doi.org/10.1016/j.ajog.2005.06.086.
29. Swift SE, Pound T, Dias JK. Case-control study of etiologic factors in the development of severe pelvic organ prolapse. Int Urogynecol J Pelvic Floor Dysfunct. 2001;12(3):187–92.
30. Kapaya H, Hashim S, Jha S. OASI: a preventable injury? Eur J Obstet Gynecol Reprod Biol. 2015;185:9–12. https://doi.org/10.1016/j.ejogrb.2014.11.023.
31. Wilson D, Dornan J, Milsom I, Freeman R. UR-CHOICE: can we provide mothers-to-be with information about the risk of future pelvic floor dysfunction? Int Urogynecol J. 2014;25(11):1449–52. https://doi.org/10.1007/s00192-014-2376-z.
32. Trutnowski G, Guzman Rojas R, Martin A, Dietz HP. Pelvic floor dysfunction—the role of menopause. Maturitas. 2013 Oct;76(2):134–8.