The impact of parity on pelvic floor morphology and function: a retrospective study

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February 22, 2024

Abstract

Objective: To analyse the impact of parity on pelvic floor morphology and function in postpartum period. Design: Retrospective study Setting: single-country . Population: This study included 1076 participants who visited Fujian Maternity and Child Health Hospital from December 2019 to August 2022. Methods: One-way ANOVA and covariance analysis were used between groups. Pearson correlation analysis and partial correlation analysis were used to assess the relationship between variables. Main outcome measures: Modified Oxford scale, surface electromyography, and pelvic floor three dimensions ultrasound. Results: Both one-way ANOVA analysis and covariance analysis indicated that the differences between primipara, deuteripara, and tertipara in bladder neck presentation, urethral rotation angle, bladder neck descent, and hiatal area were statistically significant. Pearson and partial correlation analysis all showed the positive correlations between rapid contraction, tonic contraction, endurance contraction and the grade of modified Oxford scale. Unlike pearson correlation analysis, most correlations subsided in the further partial correlation analysis except pretest resting baseline with urethral rotation angle. Conclusion: The grade of modified Oxford scale exhibited a positively correlation with the contractions of surface electromyography which reflected the reliability of pelvic floor surface electromyography. The impact of parity on not only the grade of modified Oxford scale but also surface electromyography was not statistically significant, but the descent of pelvic organ increased as parity increased. Except pretest resting baseline, any other factors of modified Oxford scale and surface electromyography had no correlation with pelvic organ displacement.

Introduction

Pelvic floor dysfunction (PFD) has became an increasing concern in recent years, with the incidence being much higher in women than in men due to the impact of pregnancy and childbirth (1-5). PFDs, including pelvic organ prolapse, urine incontinence, and sexual dysfunction, may lead to limited exercise participation, reduced self-image, significant economic burden, and poor quality of life (6-8). The occurrence and development of PFDs are closely related to the changes of pelvic floor structure and function (9, 10). Although it does not dilate and squeeze the vagina, cesarean section (CS) as well as vaginal delivery (VD) has a negative effect on the pelvic floor, which mainly occurred in pregnancy (11, 12). With the implementation of Chinese three-child policy, more and more women choose to have their third child, which result in rising concerns about pelvic floor injury caused by their more times of delivery (13). Will parity has an impact on pelvic floor morphology and function? Completely opposite outcomes were found in different studies. Previous studies reported that parity had no association with the incidence of PFDs, however, some studies reported that parity had an impact on the development of PFDs and also affected pelvic floor muscle strength (PFMS) (14-19). Further study is needed for the research of the association between parity and pelvic floor injury.

Therefore, the aim of this study was to evaluate the impact of parity on pelvic floor morphology and function, and the relationship between the parameters of modified Oxford scale (MOS), surface electromyography (sEMG), and pelvic floor three dimensions (3D) ultrasound in postpartum period.

Materials and methods

Participants

This retrospective study included 1076 participants who visited Fujian Maternity and Child Health Hospital from December 2019 to August 2022. And the study was approved by the Ethics Committee of Fujian Maternity and Child Health Hospital (No. 2021YJ032). All patients had undergone a standardized interview to assess medical history, and clinical examination which included modified Oxford scale (MOS), surface electromyography (sEMG), pelvic floor three dimensions (3D) ultrasound. The inclusion criteria were as follows: participants who were 40 days to 12 months postpartum and who could tolerate a gynecological examination. The exclusion criteria were: participants with gynecologic bleeding, those suspected of being pregnant, those cannot conduct Valsalva maneuver, and those who had severe medical or surgical diseases.

Assessment of PFMS

The PFMS of the participants was evaluated by a physician using the MOS. Participant who underwent examinations of MOS, sEMG, and pelvic floor 3D ultrasound was all placed in the lithotomy position, and pelvic floor muscle contractions were asked to perform without abdominal, gluteal, or hip adductor muscle during corresponding contractions' period to ensure that the participants had mastered the test correctly. The PFMS was evaluated according to the following scale: 0, no contraction; 1 (very weak pressure), a barely perceptible contraction lasting <1 second; 2 (weak pressure), a faint contraction persisting for 1 to 3 seconds; 3 (moderate pressure), a contraction that resulted in resistance to the elevation of the examiner's finger within the vaginal vault and a duration of 4 to 6 seconds; 4 (good pressure), perceptible resistance to the elevation of the finger for a period of 7 to 9 seconds; and 5 (strong pressure), a strong contraction with a duration of [?]9 seconds (20).

Assessment of pelvic floor sEMG

A human biostimulation feedback instrument (MLD B2T, Medlander, Najing, Jiangsu, China) was used to evaluate the sEMG of the participants, including pretest resting, rapid contractions, tonic contractions, endurance contractions, and posttest resting, following the Glazer protocols (21). The participants who underwent the test was placed a vaginal probe into the vagina, and electrode configurations were positioned on abdominal muscles to monitor unwanted muscle activation. Then, the automated protocol software instructed the participants with text hints on a screen and voice prompts. In addition, our staff also supervised participants to correctly perform contractions.

Assessment of pelvic floor 3D ultrasound

Transperineal ultrasound with a Mindray Reson8s 3D ultrasound system (Mindray Reson8s (11), Shenzhen, Guangdong, China) was used to evaluate the pelvic floor morphology of participants. A transducer was placed on the perineum in a mid-sagittal plane, with a sweep angle of 85 degrees were obtained at rest, at Valsalva and at pelvic floor muscle contraction (PFMC). At most three Valsalva and PFMC were required, with the most effective contraction being used for evaluation.

Statistical analysis

All statistical analyses were performed using SPSS software version 26.0. Counting data and measurement data were expressed as (n%) and () respectively. Results were compared and analyzed with the one-way ANOVA and covariance analysis between groups. Moreover, pearson correlation analysis and partial correlation analysis were used to assess the relationship between variables. Possible confounding factors such as neonatal weight (NW), gestational weight gain (GWG), body mass index (BMI), CS, VD, forceps delivery (FD), number of fetus (NOF) were included as covariates. For all tests, a two-tailed P value < 0.05 was considered statistically significant.

Results

A total of 1076 participants were included in this analysis. The population age ranged from 19 to 44 years, with a mean of 30.85 years (SD 3.93 years). NW ranged from 0.77 to 5.95 kg, with a mean of 3.3 kg (SD 0.45 kg). GWG ranged from 0 to 30, with a mean of 12.56 kg (SD 4.69 kg). BMI ranged from 17 to 56 kg/m^2, with a mean of 29 kg/m2 (SD 6 kg/m^2). A total of 141 (13.1%) women received less than 12 years of education, 935 (86.9%) women received more than 12 years of education. A total of 144 (13.4%) participants had a CS, 882 (82.0%) had a VD, 50 (4.6%) had a forceps FD. A total of 1068 (99.3%) participants had single births and 8 (0.7%) had twin or triplet births. The baseline demographic features are summarized in Table 1.

One-way ANOVA analysis indicated that the differences between primipara, deuteripara, and tertipara in bladder neck presentation (BNP), urethral rotation angle (URA), bladder neck descent (BND), and hiatal area (HA) were statistically significant (P <0.001,P =0.006, P <0.001, and P <0.001, respectively), with an increasing trend in higher parity group. And these results in covariance analysis were consistent to covariance analysis (P <0.001, P =0.023,P <0.001, and P= 0.001, respectively) (table 2).

As shown in table 3, there were positive correlations between Rapid contraction (RC), tonic contraction (TC), endurance contraction (EC) and MOS both in pearson correlation analysis (P <0.001,P <0.001, and P <0.001, respectively) and partial correlation analysis (P <0.001,P <0.001, and P =0.001, respectively). MOS showed a positive correlation with BND (P= 0.045) in pearson correlation analysis, but no correlation with all other factors in partial correlation analysis (table 4). Table 5 revealed that both pretest resting baseline (PreRB) and posttest resting baseline (PostRB) had a positive correlation with BNP (P <0.001, and$P$ <0.001, respectively). In contrast, they had a negative correlation with URA, BND, and HA (P <0.001,P <0.001, and P <0.001, respectively;P <0.001, P <0.001, and$P$ <0.001, respectively). And the correlation between EC and HA was also significant (P =0.009). In contrast to above results, only PreRB was found to be corrected with URA (P =0.041) in further partial correlation analysis.

Discussion

In present study, we found that the differences of parity groups in both the parameters of sEMG and MOS were not statistically significant. Similar to our findings, studies from Brazil and Netherlands also found no differences between parity groups (22-24). However, the results of Hwang JY et al and Özdemır Ö et al revealed that there was a negative relationship between parity and PFMS (16, 25). The reasons for that might be the differences in participants' times of delivery and age groups respectively.

In contrast to the results of sEMG and MOS, BNP, URA, BNP, and HA were all increased as parity increased. Previous studies reported that parity was condemned for the development of urethral mobility, hiatal dimensions, rectal prolapse, cardinal ligament lengthening (26-29). The structural deformation of the pelvic floor occurred during pregnancy, some women recovered after delivery, while others did not, which might be the reason for the pelvic floor relaxation caused by increased parity (30, 31).

Correlation analysis indicated that RC, TC, and EC were moderately related with MOS, which was similar to zhang et al's findings (32). Slightly different, Navarro et al and Botelho et al demonstrated that sEMG had a weakly and strongly relationship with MOS, based on women with PFDs and normal women respectively (33, 34). In addition, sEMG is reliable and consistently predictive of several important clinical status variables (35, 36). when contrast to MOS, sEMG seems to be a more comprehensive and objective method to assess pelvic floor function of contraction and relaxation.

Surprisingly, almost all of contraction parameters were found no correlation with the displacement of pelvic floor structure. And the protective effects of PreRB and PostRB were mostly subsided in the further partial correlation analysis except PreRB with URA. All these findings were consistent to the differences of contractions and pelvic organ displacement in three parity groups. Previous study has reported higher resting baseline in CS women, we hence concluded that CS rather than higher resting baseline provided protection for pelvic organ displacement (37-39). In the cross-sectional study of Caagbay D et al, PFMS and thickness are not associated with pelvic organ prolapse (40). Likewise, the association between MOS and translabial ultrasound measurements of tissue displacement was also not significant (41). Parity might result in increased fiber length and levator relaxation while PFMS increased over time after childbirth, which might account for our outcomes of the correlation between PFMS and pelvic organ displacement (42-44).

Conclusion

The grade of MOS exhibited a positively correlation with the contractions of sEMG which reflected the reliability of pelvic floor sEMG. The impact of parity on not only MOS but also sEMG was not statistically significant, but the descent of pelvic organ increased as parity increased. Except PreRB, any other factors of MOS and sEMG had no correlation with pelvic organ displacement.

Limitations

This was a retrospective study, which meant that we could only include existing factors for analysis and cannot include more potential factors as in a prospective study. The number of multiparas (>3) was too small to observe the changes of PFMS and pelvic organ descent when parity continued to grow. Since only data below the pubic symphysis were reported, we only included 164 RAP and 878 BND data, which might affect the accuracy of the results.

Funding: This was not a funded project.

Disclosure of interests : The authors declare that there is no conflict of interest regarding the publication of this article.

Authors' contributions

JF: Conceptualization, Formal analysis, Writing - original draft, RZ: Data curation, Resources, SL: Data curation, Resources, YC: Resources, YL: Resources, MW: Resources, YL: Resources, YW: Resources, JL: Methodology, Project administration, Supervision, JS: Project administration; Supervision; Writing - review & editing

Acknowledgements

Not applicable.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Details of ethics approval

The study was approved by the Ethics Committee of Fujian Maternity and Child Health Hospital (No. 2021YJ032) and was conducted in accordance with Chinese law and the Guidelines of the National Human Biomedical Research Policies . No informed consent was obtained from the patients because the study was retrospective because the Ethics Committee of Fujian Maternity and Child Health Hospital has waived the informed consent procedure for the study. Administrative permissions for the data were acquired by the authors for research purposes.

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