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ORIGINAL ARTICLE

Evaluation of Pelvic Floor Muscle Strength in Nulliparous, Parous and Postmenopausal Women and its Association with Various Factors

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Abstract

Objective To evaluate pelvic floor muscle strength (PFMS) in nulliparous, parous and postmenopausal women using vaginal digital palpation and perineometer.

Material and Methods It was a cross-sectional study, conducted in department of Obstetrics and Gynecology, VMMC & Safdarjung hospital. A total of 300 women were recruited from Gynaecology and Family welfare outpatient departments and divided into 3 equal groups—nulliparous women, premenopausal parous women and postmenopausal women. PFMS was measured by modified Oxford Scale with vaginal digital palpation and by perineometer. Linear regression analysis was performed to evaluate and compare mean PFMS and identify its associated factors.

Results Median age was 21 years in nulliparous, 27 years in parous and 58 years in postmenopausal group. The average body mass index was 27.45, 28.01 and 34.63 kg/m^2 in nulliparous, parous and postmenopausal group. The mean MOS by digital vaginal palpation was 4.66 in nulliparous, 3.9 in parous and 2.54 in postmenopausal women. The difference was statistically significant. The mean PFMS by perineometer was 40.04 cm H_2O, 37.69 cm H_2O and 34.93 cm H_2O in nulliparous, parous and postmenopausal group, respectively. The difference was statistically significant ($p < 0.001$). Majority (50%) of nulliparous women had PFMs between 41 and 50 cm H_2O and parous (81%) had PFMS between 21 and 30 cm H_2O. There was a statistical significance between the groups.

Conclusions The PFMS of nulliparous women was significantly higher than multiparous women, and difference was statically significant ($p < 0.001$). Age had an important influence on pelvic floor muscle before menopause, but after menopause, it is years of menopause which has significant negative impact on PFMS and not age.

Keywords Pelvic floor muscle strength · Pelvic floor dysfunction · Menopause · Normal delivery

Introduction

Pelvic floor refers to the compound structure enclosing the bony pelvic outlet and pelvic floor muscles, to the muscle layer over the pelvic floor, supporting the pelvic organs and maintaining their function with their anterior and cephalad action when contracting.

Pregnancy, vaginal delivery and menopause pose significant stress to pelvic floor muscles leading to changes in urinary and genital tract. Progesterone and relaxin increase in pregnancy, resulting in reduced tone and relaxation of pelvic floor organs and further increasing the risk of SUI, urinary urgency and frequent micturition [1]. These changes, in turn, significantly affect sexual, physical and professional activities of these women [2]. Oestrogen increases the pelvic floor strength and urethral vascularisation by increasing the number and sensitivity of alpha-adrenergic receptors, and its decline may cause changes in the muscle complex resulting in pelvic floor dysfunction, such as urinary incontinence (UI), pelvic organ prolapse (POP) and sexual problems [3].

The identification and standardisation of pelvic floor muscle strength (PFMS) can serve as reference values of

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pelvic floor muscle strength and can help predict the urinary, faecal and sexual dysfunction later in women's life. Besides that, the assessment of pelvic floor muscle strength and endurance can provide information about the severity of muscle weakness and form the basis of planning training and treatment. The evaluation is also important to provide prophylaxis for pelvic floor muscle dysfunction and improve treatment strategies.

There are several techniques for the evaluation of pelvic floor muscles which include manual digital palpation, pressure manometry, USG and MRI. Of these, manual palpation and pressure manometry are simple, well tolerated and minimally invasive methods. Evaluation of pressure manometry with perineometer is a reliable method to objectively assess the strength of pelvic floor muscles [4].

There are studies comparing the pelvic floor muscle strength between nulliparous and primiparous females, following vaginal birth and caesarean delivery [5–10] and in postmenopausal women with urinary dysfunction. But few studies have examined the effect of age on pelvic floor structure and function in the absence of disease. Similarly, there are limited studies evaluating the pelvic floor muscle strength with the aim to standardise the reference value of pelvic floor muscle strength in nulliparous, premenopausal parous and postmenopausal female.

The current study was planned to assess and compare pelvic floor muscle strength in nulliparous, parous and postmenopausal women by manual digital pressure using modified oxford scale (MOS) and pressure manometry using perineometer.

Materials and Methods

The current study was a cross-sectional study conducted in tertiary care institute in India over a period of 18 months. A total of 300 women were recruited from Gynaecology and Family welfare outpatient departments and divided into 3 equal groups—nulliparous women, premenopausal parous women and postmenopausal women. Detailed obstetrical history, examination and pelvic floor muscle strength assessment was done in eligible women willing to participate in the study by modified oxford scale (MOS) and squeeze pressure checked by peritron perineometer (Fig. 1). Women with urinary/bowel/sexual dysfunction, cognitive/physical disability or history of previous pelvic surgery were excluded.

For digital vaginal palpation, women were laid in supine position after passing urine. Distal phalanx of index and middle finger was placed in distal vagina, and subjects were asked to squeeze and lift the pelvic floor. Process was repeated three times, and contraction of pelvic floor muscle was graded according to modified oxford grade.

To assess PFMS using peritron perineometer (Fig. 1), women were laid in supine position after passing urine. A balloon catheter covered with a pair of condoms and filled with 10 ml of air, which will permit contact with the vaginal wall, was introduced in the vagina. Equipment was zeroed immediately, and she was asked to hold three pelvic floor muscle contractions as long as possible with approximately 30 s rest intervals between them.

The maximum peak of each contraction was registered as cm H_2O, and the average of the measurements were used to avoid biased results. The outer condom was removed after each vaginal examination and was replaced by a fresh one.

Statistical analysis done using SPSS version 21. Categorical variables were presented in number and percentage (%), and continuous variables were presented as mean ± SD and median. Normality of data was tested by Kolmogorov–Smirnov test. Quantitative variables were compared using Independent T test/Mann–Whitney Test (when the data sets were not normally distributed) between the two groups and ANOVA/Kruskal–Wallis test was used to compare between three groups. Qualitative variables were correlated using Chi-Square test/Fisher exact test. p value of < 0.05 was considered statistically significant.

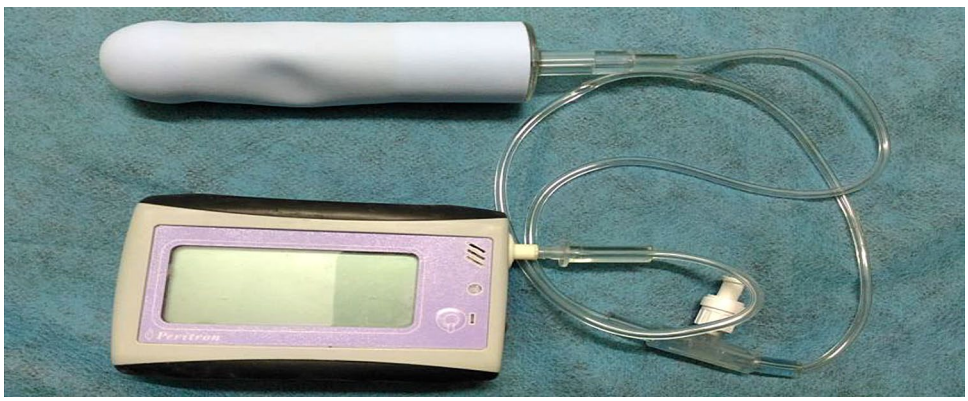

Fig. 1 The "peritron perineometer" with vaginal probe (PRN09302 PRTN-1-13111221)

Table 1 Socio-demographic factors

	Nulliparous ($n=100$) mean	Premenopausal parous ($n=100$) mean	Menopausal ($n=100$) mean	*P* value
Age (years)	21.7 + 2.71	27.6 + 5.6	58.9 + 3.56	–
BMI (kg/m^2)	27.45 + 6.84	28.01 + 5.06	34.63 + 5.35	< 0.0001
Parity	–	1	4	< 0.0001
Years since menopause	–	–	5	
Vaginal delivery	–	74	97	< 0.0001
Caesarean delivery	–	26	3	< 0.0001
Prolonged labour	–	11	3	0.049
Instrumental delivery	–	4	3	1.000
MOS	4.66 + 0.48	3.9 + 0.87	2.54 + 0.56	< 0.0001
Squeeze pressure (cm H_2O)	40.04 + 2.33	37.69 + 3.23	34.93 + 3.51	< 0.0001

Table 2 Factors affecting PFMS

Factors	Nulliparous mean		Premenopausal parous mean		Menopausal mean	
	Squeeze pressure (cm H_2O)	MOS	Squeeze pressure (cm H_2O)	MOS	Squeeze pressure (cm H_2O)	MOS
Age (years)						
< 20	39.88	4.65	39.06	4.12	–	–
21–30	40.17	4.67	38.22	3.97	–	–
31–40	–	–	36.30	3.59	–	–
41–50	–	–	32.46	3.54	35.20	3.01
51–60	–	–	–	–	34.96	2.95
> 60	–	–	–	–	34.86	2.67
BMI (kg/m^2)						
< 18.5	41.04	4.5	41.71	4.0	Age (years)	Age (years)
18.5–24.9	39.48	4.64	38.18	4.03	36.56	2.34
> 25	40.28	4.68	37.4	3.84	34.85	2.98
Mode of delivery						
Vaginal	–	–	37.34	3.81	34.95	3.41
Caesarean	–	–	38.68	4.15	34.45	3.27
Prolonged labour						
Absent	–	–	37.69	3.83	34.92	3.76
Present	–	–	37.70	4.46	35.39	3.62

Results

In this study, the strength was maximum in nulliparous followed by premenopausal and postmenopausal had least strength (Table 1) The age in premenopausal women affected the PFMS with women more than 40 having lower strength (Table 2). Both vaginal squeeze pressure and oxford scale were found to be decreasing significantly with increasing age after 40 years. In menopausal women, it was the years since menopause which had an association, more the years lesser was the strength. The only obstetric factor which was associated with lower strength was parity. Higher the parity, the strength decreased. Duration of

Table 3 Association of demographic and obstetric characteristics with PFMS

Characteristic	*P* value (PFMS)		
	Nulliparous	Parous	Postmenopausal
Age	0.884	0.009	0.53
Years after menopause	–	–	0.007
Parity	–	0.007	0.007
Mode of delivery	–	0.337	0.906
Prolonged labour	–	0.664	0.102

labour or mode of delivery did not affect strength of pelvic floor muscles (Table 3).

Mean vaginal squeeze pressure in nulliparous, parous and postmenopausal women was 40.04, 37.69 and 34.93 cm H_2O, respectively, with the median of 40.15, 38.45 and 35.6 cm H_2O (Fig. 2). Mean MOS in nulliparous, premenopausal parous and postmenopausal women was 4.66, 3.9 and 2.6, respectively (Fig. 2).

Discussion

The present study was aimed to establish the normal reference values of pelvic floor muscle strength in nulliparous, parous and postmenopausal women which is important as any deviation from normal can result in pelvic floor dysfunction (Fig. 3).

The mean age of women in nulliparous, parous and postmenopausal women was 21.7, 27.6 and 58.9 years with BMI being 27.45, 28.01and 34.6 kg/m^2, respectively.

95.4% of nulliparous women had PFMS between 31.3 and 48.7 vmH2O with mean being 40.04 cm H_2O. Similar results were obtained in a study conducted by Palmezoni VP et al. [11] in Brazil, where mean value of maximum vaginal squeeze pressure assessed by perineometer in 36 nulliparous women was 45.6 cm H_2O. Afshari et al. [12] from Iran, who studied 96 nulliparous women using Peritron 9300 V perineometer, found PFMS ± SD to be 55.62 ± 15.86 cm H_2O, which is higher than the present study, which could be attributed to the built and stature of Iranian women.

Age was found to have an impact on muscle strength, which was found to be decreasing with increase in age. Mean PFMS was found to be 39.06 ± 3.94 cm H_2O in age group < 20yrears, 38.22 ± 2.96 cm H_2O between 21 and 30 years, 36.3 ± 2.83 cm H_2O between 31 and 40 years and 32.46 ± 2.14 cm H_2O above 40 years ($p = 0.009$). Quiron et al. [13] found that women with age > 25 years were twice as likely to have reduction in PFMS during the postpartum period (RR of 2.8 and 2.53 for women in the age group 25–29 years and > 30 years, respectively) as compared to those younger than 25 years. Ilic et al. [14] also found that increasing age was in positive correlation with declining values of pelvic floor muscle strength ($p = 0.07$).

Increasing parity was found to have significant negative impact on pelvic floor strength ($p = 0.007$ for vaginal squeeze pressure and $p = 0.021$ for oxford scale score). This was in correlation with a previous study. Ozdemir et al. [15] found that pelvic floor strength weakens after delivery and as the number of deliveries increase, quality of life decreases. In a study involving 241 women who gave birth vaginally and experienced urinary incontinence, pelvic floor strength was 25.5 cm H_2O in women with 1–3 children, 19.1 cm H_2O with 4–6 children and 19.6 cm H_2O in those with more than 6 children.

Mode of delivery, in our study, did not show any influence on pelvic floor strength in premenopausal parous women. Mean vaginal squeeze pressure ± SD in women delivered vaginally was 37.34 ± 3.52 cm H_2O and those who underwent caesarean section was 38.68 ± 1.97 cm H_2O ($p = 0.337$). This is in contrast to many previous studies which have found decline in pelvic floor strength following vaginal delivery, although several studies also report that type of delivery has no influence on muscle function. Mendes EPB et al. (2016) in their study did not find any

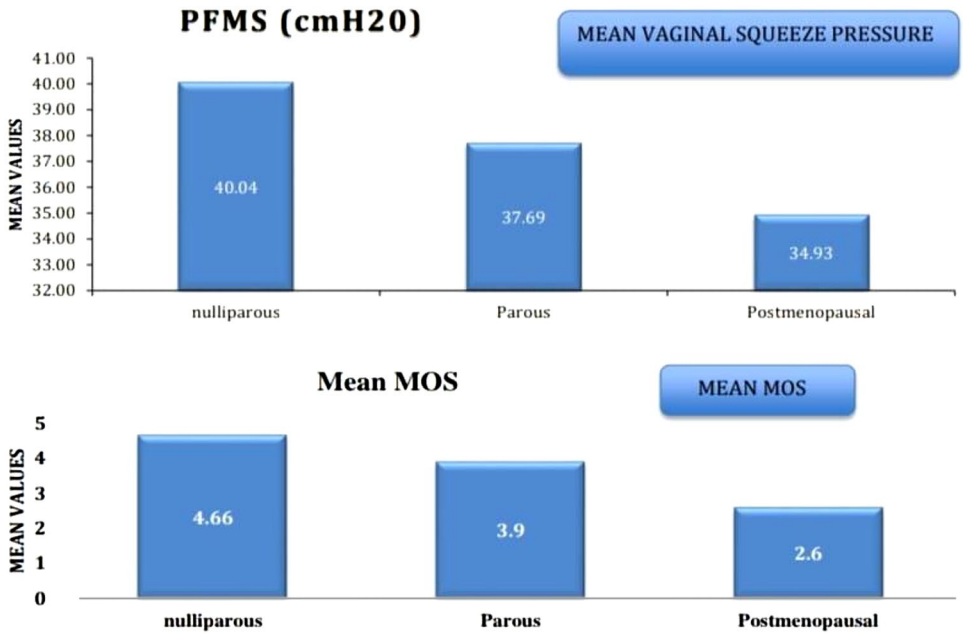

Fig. 2 Mean MOS and vaginal squeeze pressure

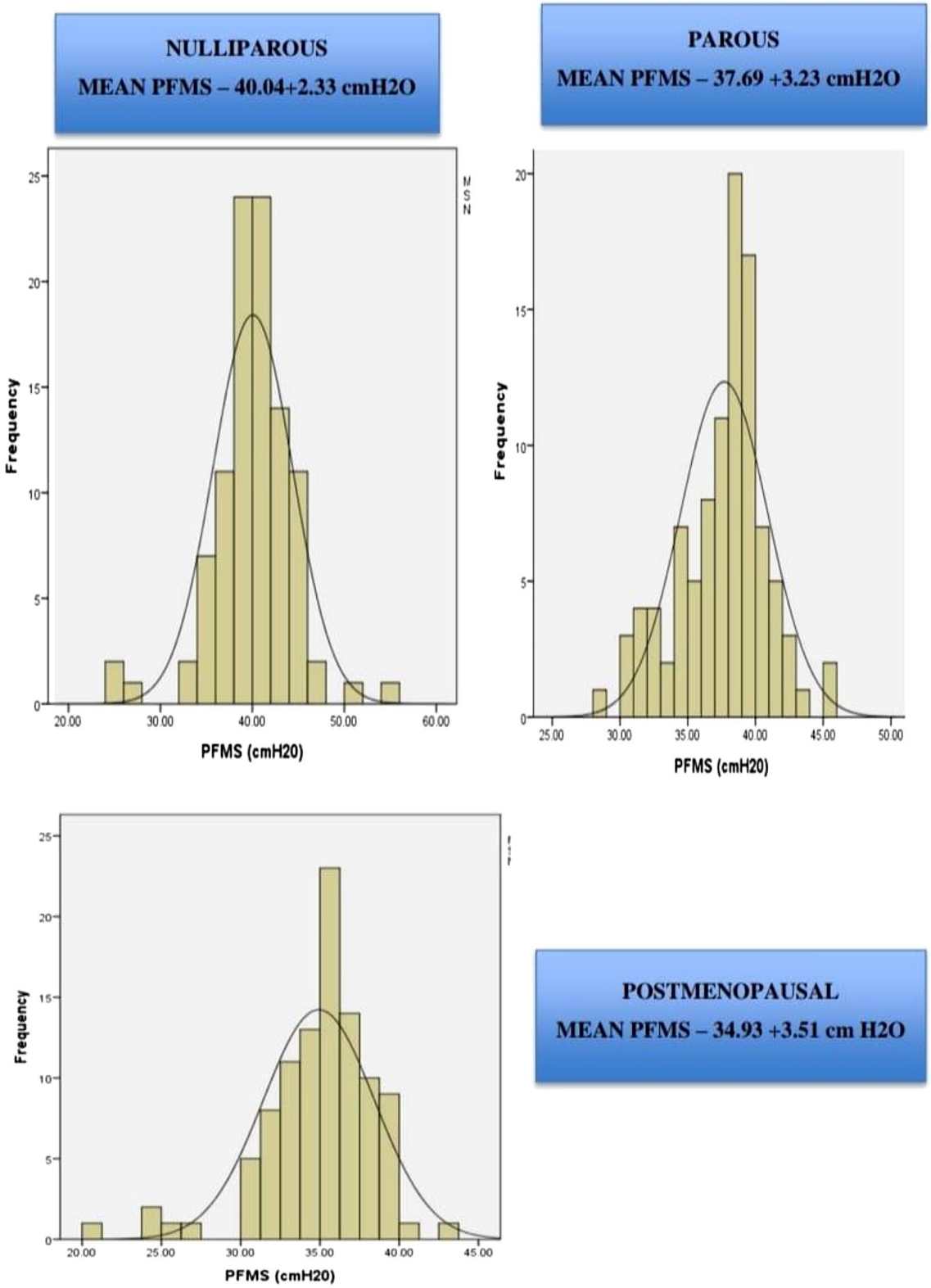

Fig. 3 Nomograms for PFMS of Nulliparous, premenopausal parous and postmenopausal parous women

significant impact of type of delivery on muscle strength which could be attributed to variability in the assessment periods of PFMS. The literature suggests that mean PFMS, independent of the type of birth, increases overtime [16]. It was found that mean PFMS increased from 8.3 cm H_2O in women normal vaginal delivery and 13.7 cm H_2O in caesarean birth to 54.1 cm H_2O and 59.9 cm H_2O at 98 days and 12 months postpartum, respectively. This similar variation can be seen even with devices that use different units of measurement [17–19].

In the menopausal women, the years since menopause greatly reduced muscle strength. This was in correlation with study by Trowbridge et al. [20] who found that that increasing age was associated with decreasing maximal urethral closure pressure ($r = -0.758$, $p < 0.001$) with a 15 cm H_2O decrease in pressure per decade. Maximal urethral closure pressure in the senescent urethra was 40% of that in the young urethra.

In the current study, the PFMS assessment was done objectively by a single operator using perineometer, and hence, the values were more reproducible. Small sample size was found to be the main limitation of our study. In order to establish the normal values of pelvic floor muscle strength in women with different groups, further studies involving larger sample size are needed.

Conclusions

Pelvic floor muscle strength decreases after child birth and is further decreased after menopause. Age had an important influence on pelvic floor muscle before menopause, but after menopause, it is years of menopause which has significant negative impact on PFMS and not age. BMI influence on pelvic floor muscle in nulliparous, premenopausal parous and postmenopausal women could not be established as none of women were very obese. In parous women, both premenopausal and menopausal, Mode of delivery, history of prolonged labour had no impact on PFMS. Increasing parity was significantly associated with reduction in pelvic floor muscle strength.

Funding Not applicable.

Declarations

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

Ethical Approval The study is 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. This article does not contain any studies with animals performed by any of the authors. Informed Consent was obtained from the participant. It is a non-funded study.

Human or Animal Rights The study is done keeping in mind the ethical standards of the responsible committee on human experimentation (Institutional and National) and with the Helsinki Declaration of 1975, as revised in 2008 (5).

Informed Consent Written informed consent of all study subjects was taken.

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