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Distribution of pelvic organ support measures in a population-based sample of middle-aged, community-dwelling African American and white women in southeastern Michigan

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Abstract

Objective—To report the distribution of pelvic support among a population-based sample of middle-aged, community-dwelling women, as defined by pelvic organ prolapse quantification (POP-Q), and study factors that might influence POP-Q measurements.

Study Design—Secondary analysis of population-based study of community-dwelling, African American and Caucasian women aged 35 to 64 years from southeastern Michigan. 394 women consented to physical examination using the POP-Q. Statistical analysis included descriptive statistics and multivariable regression. Estimates were weighted to reflect probability and nonresponse characteristics of the sample to increase generalizability of the findings.

Results—Mean values for POP-Q points were: Aa and Ba = -1.2 cm, C = - 6.5 cm (intact uterus), C = -6.9 cm (prior hysterectomy), and Ap and Bp = -1.8 cm. The POP-Q stages: stage 0, 8.8%; stage I, 21.4%; stage II, 67.7%; stage III, 2.1%. Increasing vaginal parity was associated with increasing descent of the anterior, apical and posterior vaginal wall ($p < .001$).

Conclusion—In this population-based study of women from Southeastern Michigan, 90% of women had anterior and posterior vaginal wall support that was above or extended to the hymen. Increasing vaginal parity was associated with increasing descent of the anterior, posterior and vaginal apex.

Keywords

epidemiology; pelvic organ support; pelvic organ prolapse quantification system (POP-Q)

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Condensation In this population-based study, 90% of women had anterior and posterior vaginal wall support that was above or extended to the hymen.

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Introduction

Pelvic organ prolapse is a prevalent condition affecting 31-41%(1,2) of women resulting in over 200,000 surgical procedures annually in the United States.(3) With the goal of preventing and improving treatment of prolapse, research has increasingly focused on the natural history and epidemiology of this prevalent condition. Recent studies have benefited from the standardized and reliable description of pelvic organ support described by the International Continence Society's Pelvic Organ Prolapse Quantification system (POP-Q).(4) This system includes a standardized technique with quantitative measurements assessed at multiple vaginal sites, as well as staging system to further classify prolapse. The POP-Q system has been shown to have good intraobserver and interobserver reliability(5) and its adaptation has been important to the advancement of the specialty of female pelvic medicine.

As with all clinical staging systems, intermittent revisions are necessary to incorporate updated information and understanding of the natural history of medical conditions. When the original POP-Q staging was instituted, data concerning normative findings in the population were not available; thus, the POP-Q staging system (i.e. the assessed degree of prolapse based on quantitative measurement) was established based solely on the consensus of international experts. Therefore, it would be useful to empirically measure the distribution of POP-Q values in the general population.

Several studies have evaluated the distribution of pelvic support in specific subpopulations (2) such as women seeking routine gynecologic care.(6-8) However, there is currently a lack of population-based data of pelvic organ support to objectively define the condition of pelvic organ prolapse and/or to properly categorize this condition for clinical and research purposes.

In this study, we performed POP-Q measurements in a population-based sample of community-dwelling women, as defined by pelvic organ prolapse quantification (POP-Q). Secondly, we studied correlates that might influence POP-Q measurements in this population sample.

Materials and Methods

This is a secondary analysis of an IRB-approved population-based epidemiologic research study investigating the prevalence and structural mechanisms of urinary incontinence in African American and Caucasian women. Participants were recruited using purchased telephone records from geographic areas of known racial and geographic composition. Prior to contact, informational brochures and letters of introduction were mailed to selected households. Trained female telephone interviewers then called the households to screen for eligible participants. Women who were between the ages of 35 and 64, who self-identified as black or white race, and who had not been pregnant in the past 12 months were eligible for a 20 minute interview. The interview assessed respondents' demographic characteristics, health history, lifestyle factors, obstetric and gynecologic history.

At the completion of the telephone interview, the survey respondents were asked if they would be willing to be recontacted regarding participation in a clinical pelvic examination. At the telephone recontact, those who agreed to participate in the examination were further screened for eligibility. Women were excluded from further study participation if they had had a hysterectomy or other pelvic reconstructive surgery in the last year, were being treated for cancer, had a history of any transplants, chronically used steroids, were HIV positive, had sickle cell disease, or had neurological conditions including multiple sclerosis, uncontrolled diabetes, stroke, Alzheimer's disease or other dementias.

The clinical phase of the study sought to recruit equal numbers of African American and Caucasian women with and without self-reported urinary incontinence. 1108 survey

respondents were recontacted regarding the examination of which 37 did not qualify and 439 were not interested in participating. A total of 632 subjects were enrolled for the clinical exam, of which 238 did not complete or qualify (87 cancelled, 133 no show, 9 urine tested positive, 5 had discomfort with testing, 4 did not qualify upon examination). A total of 222 African-American and 172 Caucasian women underwent the clinical pelvic evaluation.

The standardized exam included height, weight and pelvic organ support evaluation using the pelvic organ prolapse quantification system.⁽⁴⁾ For all subjects, the pelvic examination was performed with the subject seated in a birthing chair at a 45° angle. All points, except the total vaginal length, were recorded at maximal Valsalva strain. Examiners confirmed maximum protrusion of the vaginal walls by observing that the vaginal epithelium had become tight during straining. The measurements were taken using a large cotton swab and measurements were recorded at 1 cm intervals. All examinations were performed by trained urogynecologists.

Eight POP-Q points were measured and recorded as described by Bump et al. ⁽⁴⁾ Subjects were assigned a POP-Q system stage as defined by the POP-Q staging system.⁽⁴⁾ A positive full bladder stress test was defined as urine leakage with cough or Valsalva seen during examination after retrograde filling of the bladder with a volume of 300 mL. The power analysis was based on the number of continent and incontinent women of each racial group needed to analyze continence mechanism structure and function in the clinical phase of the study.

Data weights were constructed based on age, race, and self-reported continence status, to approximate distributions found at the population level. All analyses were performed with Stata release 9.2, which permits the incorporation of weights, and makes appropriate adjustments to the standard errors for complex sample designs. The statistical analyses proceeded from descriptive statistics to multiple regression models: First, the POP-Q points were described individually in terms of mean, range, and relevant percentiles. These points provided a basis for assigning participants to stages of prolapse. Mean levels of selected points were then compared over values of vaginal parity (coded 0, 1, 2, 3 or more). Lastly, the POP-Q points were regressed on age (coded 35 – 44 years, 45 – 54 years, 55 – 64 years), race (Caucasian=0, African American=1), vaginal parity (0, 1, 2, 3+), prior hysterectomy (no = 0, yes=1), current estrogen use (no use = 0, use = 1), obesity (BMI < 30 = 0, BMI ≥ 30 = 1), and stress urinary incontinence (no demonstrable leakage with full bladder stress test = 0, demonstrable leakage = 1) to evaluate their relationships with vaginal parity while controlling potential confounders.

Results

Study participants' demographic, health, and gynecologic characteristics are summarized in Table I. Mean age was 47.6 (CI 47.2-48.1) and mean vaginal parity was 1.8 (CI 1.6-2.0). Mean body mass index of the study sample was 30.4 (95% CI 29.5-31.4), with 46.8% of the sample having a BMI ≥ 30. 20.9% of subjects had a positive full bladder stress test. Twenty-one percent had previously undergone a hysterectomy and 12.8% were currently using estrogen (both systemic and local). Excellent or very good health was self-reported by 51.6% of the women. Medical conditions self-reported by subjects included hypertension (30.3%), diabetes (12.1%), lung disease (23.1%) and heart disease (8.9%).

Univariate statistics for the Pelvic Organ Prolapse Quantification (POP-Q) points are presented in Table II. The mean value for point Aa was -1.18 cm and the mean value for point Ba was -1.16 cm. Mean point C was — 6.5 cm for women with an intact uterus and -6.85 cm for women with a prior hysterectomy. The mean value for point Ap was -1.75 cm and the mean value for point Bp was -1.75 cm. Average total vaginal length for the sample group was 10.73 cm. Mean genital hiatus at maximum strain was 3.43 cm and mean perineal body was 3.94 cm at maximum strain. Ninety percent of the women had anterior and posterior vaginal wall support that was

above or at the level of the hymen. The distribution of pelvic organ prolapse quantification stages was: stage 0, 8.8%; stage I, 21.4%; stage II, 67.7%; stage III, 2.1% (Figure 1). No women in the sample met criteria for stage IV (Figure 1). The majority of subject with stage II prolapse had support of the anterior vaginal wall that was within a centimeter of the hymen. Stratifying for continence status (continent vs. incontinent) and body mass index (BMI <30 vs ≥ 30) there was no difference in the distribution of the POP-Q stages.

Shown in Table III are the mean values and 95% confidence intervals for the anterior (Aa, Ba), apical (C) and the posterior points (Ap, Bp) over the number of vaginal births. A test of the equality of the means for the POP-Q points across levels of vaginal parity showed statistically significant differences between the means for the majority of the points.

Multiple regression analysis was performed to further investigate the relationship between POP-Q points and vaginal parity, by controlling likely correlates (Table IV). The factors chosen for the model have been observed in prior epidemiologic studies to be associated with pelvic support. Specifically, age, race, vaginal parity, prior hysterectomy, estrogen use, continence status (as defined by full bladder stress test) and obesity were included. The models explained approximately 7-16% of the variance in POP-Q points. Vaginal parity was the only factor that consistently related all POP-Q points evaluated. Increasing vaginal parity was associated with increasing descent of the anterior, apical (cervix or vaginal cuff) and posterior vaginal wall.

Comment

In this population-based cross-sectional study, we found that 90% of community-dwelling women had anterior and posterior vaginal wall support that was above or at the level of the hymen. This is generally considered normal pelvic anatomy. However, according to the POP-Q system the majority (67.7%) of our study population met criteria for stage II pelvic organ prolapse.

These findings are significant in that stage II “prolapse” might be considered by some as an indication for operative repair. Our results suggest that some component of stage II support (-1) as defined by POP-Q measurement are normal while others fall outside of the normal range (+1). This potential misclassification of a women’s exam/condition could lead to unnecessary concern for the patient or worse unwarranted medical interventions that can carry long-term complications. Subsequent population-based studies that include assessment of women’s prolapse symptoms will be necessary to precisely delineate normal pelvic support versus pelvic organ prolapse by correlating objective physical findings with subjective feelings of pelvic prolapse.

We found similar rates of stage 0 (8.8%) and stage III (2.1%) as compared to prior studies(6, 9) which reported rates of 2.3-6.4% and 1.9% accordingly. However, we had approximately 2-6 times as many women with stage II support (67.7%) as compared to prior studies (11.2-47.7%).(6-8) It is possible that this difference in the distribution of pelvic organ prolapse staging may have resulted from the position in which these women were examined. All women in our study were examined in a birthing chair at 45 degrees versus in a supine position.

Similar to the majority of current studies, the number of vaginal deliveries was a factor that was significantly associated with greater descent of all the vaginal walls in our sample. In contrast, we did not observe significant associations of age(1,2,6-8,10), race(2,6), hysterectomy(6), estrogen use(2), and body mass index(2,7,8), with pelvic organ descent. It is possible that factors not measured in the study or factors beyond those currently identified (e.g. biochemical, histologic, or genetic) might better explain differences in pelvic support in a general population. This is highlighted by the fact that despite our relatively large sample size

and inclusion of widely accepted covariates, our final regression models only explained between 7 and 16% of POP-Q variability.

Several important factors must be considered when interpreting the findings from this study. Because women were recruited from Southeastern Michigan, our findings may not generalize to women of European or African descent in other parts of the United States. Moreover, we did not recruit Latinas or Asian American women, although these groups are a rapidly growing part of the U.S. population. Our results also may not be applicable to younger or older populations. It is also possible that women who agreed to clinical exam were more likely to have prolapse, thus skewing the distribution of the POP-Q values. Finally, we did not include questions regarding symptoms attributable to pelvic organ prolapse. It is possible that the inclusion of women with symptomatic prolapse might have systematically biased our study results. Since the study was initially designed to evaluate racial differences in women with urinary incontinence it is also possible that our POP-Q measurements are not representative of general population. However, when we compared individual POP-Q measurements and stage of prolapse we found no significant differences between continent and incontinent women.

In conclusion, in this population-based study of middle-aged, community-dwelling women, 90% had anterior and posterior vaginal support measurements that were above or extending to the hymen. Despite this finding, the majority of our population met criteria for stage II pelvic organ prolapse according to POP-Q staging. These findings suggest a need to potentially revisit the current POP-Q staging system since most women with stage II support likely have a variant of normal vaginal support that does not require surgical intervention. Future population-based studies should include symptoms of pelvic organ prolapse to further delineate normal pelvic support from the condition of pelvic organ prolapse.

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Figure 1.
Distribution of pelvic organ prolapse quantification stages

Table I

Study Sample Demographic, Gynecologic, and Health Characteristics from the overall sample who completed telephone questionnaire (*) and the subsample that had clinical examination (†)

Characteristic	Percentage	95% CI
Age *		
35 – 44	41.1	[39.0, 43.2]
45 – 54	37.6	[35.9, 39.4]
55 – 64	21.3	[19.8, 22.8]
Race *		
White	65.1	[63.7, 66.5]
African American	34.9	[33.5, 36.3]
Education (years completed) *		
< 12	6.4	[3.5, 11.5]
12	22.2	[17.2, 28.2]
13 – 15	34.3	[28.6, 40.4]
16+	37.1	[31.0, 43.5]
Household Income *		
< \$35,000	48.4	[41.6, 55.2]
\$35,000 - \$69,999	24.0	[19.0, 29.8]
\$70,000+	27.7	[22.0, 34.1]
Vaginal Parity *		
0	31.8	[26.1, 38.2]
1	17.8	[13.3, 23.5]
2	18.7	[14.6, 23.7]
3+	31.6	[26.3, 37.6]
Currently Smokes	27.7	[22.2, 34.0]
Prior Hysterectomy *	21.1	[16.5, 26.4]
Estrogen use *	12.8	[9.4, 17.3]
Body Mass Index (kg/m ²) [†]		
< 30	53.2	[46.9, 59.5]
≥ 30	46.8	[40.5, 53.1]
Full Bladder Stress Test [†]		
Positive (Wet)	20.9	[16.6, 26.0]
Negative (Dry)	79.1	[74.0, 83.4]
Self-Rated Health *		
Excellent/ Very Good	51.6	[45.4, 57.7]
Good/ Fair/ Poor	48.4	[42.3, 54.6]
Hypertension *	30.3	[24.9, 36.4]
Diabetes *	12.1	[8.9, 16.1]
Heart Disease *	8.9	[5.9, 13.1]
Lung Disease *	23.1	[17.8, 29.4]

* Self-reported

[†] Measured at clinical exam N = 394

Table II

Distribution of Pelvic Organ Support Measures in a Population-based Sample of Middle-aged, Community-dwelling, African American and Caucasian Women in Southeastern Michigan

	Mean	95%CI	Range	Percentiles								
				1 st	5 th	10 th	25 th	50 th	75 th	90 th	95 th	99 th
Aa	-1.18	[-1.31, -1.04]	-3, 1	-3	-3	-3	-2	-1	0	0	1	1
Ba	-1.16	[-1.30, -1.02]	-3, 2	-3	-3	-3	-2	-1	0	0	1	1
C _{cervix}	-6.50	[-6.73, -6.28]	-12, 4	-11	-9	-8	-8	-6	-5	-5	-4	-2
C _{cuff}	-6.85	[-7.35, -6.34]	-12, 5	-11	-10	-9	-8	-7	-5	-5	-4	1
Ap	-1.75	[-1.90, -1.60]	-3, 3	-3	-3	-3	-3	-2	-1	0	0	1
Bp	-1.75	[-1.90, -1.60]	-3, 5	-3	-3	-3	-3	-2	-1	0	0	2
GH	3.43	[3.29, 3.57]	1, 8	1	2	2	3	3	4	5	5	7
PB	3.94	[3.80, 4.08]	1, 8	2	2	3	3	4	5	5	6	7
TVL	10.73	[10.56,10.89]	7, 15	7	8	9	10	11	12	12	13	15

Anterior vaginal wall points: Aa (fixed point) and Ba (most dependent); Ccervix (most dependent edge of the cervix); Ccuff (leading edge of the vaginal cuff scar in a woman with prior hysterectomy);

Posterior vaginal wall points: Ap (fixed point) and Bp (most dependent); GH, Genital Hiatus; PB, Perineal body; TVL, Total Vaginal Length

For Aa, Ba, Ap, Bp, TVL: N = 394

For Ccervix: N = 289; For Ccuff: N = 105

For GH: N = 393

For PB: N = 392

Table III
Unadjusted Means [and 95% CIs] for Selected POP-Q Points, by Number of Vaginal Deliveries

Vaginal Parity	Aa	Ba	C _{cervix}	C _{cuff}	Ap	Bp	GH	PB
0	-1.69 [-1.92, -1.46]	-1.68 [-1.91, -1.45]	-7.27 [-7.63, -6.91]	-7.04 [-8.04, -6.05]	-2.24 [-2.47, -2.02]	-2.30 [-2.50, -2.11]	3.15 [2.93, 3.36]	4.13 [3.85, 4.41]
1	-1.06 [-1.43, -0.70]	-1.06 [-1.42, -0.69]	-5.84 [-6.38, -5.31]	-7.52 [-8.12, -6.92]	-1.70 [-2.02, -1.38]	-1.70 [-2.02, -1.38]	3.29 [2.91, 3.66]	4.02 [3.74, 4.29]
2	-1.13 [-1.38, -0.89]	-1.12 [-1.37, -0.87]	-6.41 [-6.90, -5.93]	-6.82 [-7.60, -6.03]	-1.46 [-1.80, -1.13]	-1.45 [-1.78, -1.12]	3.39 [3.16, 3.62]	3.96 [3.65, 4.28]
3+	-0.76 [-0.97, -0.55]	-0.74 [-0.94, -0.53]	-6.05 [-6.43, -5.67]	-6.46 [-7.48, -5.45]	-1.43 [-1.68, -1.17]	-1.37 [-1.64, -1.11]	3.83 [3.53, 4.12]	3.70 [3.48, 3.92]
* p	< .001	< .001	< .001	.27	< .001	< .001	< .01	.08

Anterior vaginal wall points: Aa (fixed point) and Ba (most dependent); C_{cervix} (most dependent edge of the cervix); C_{cuff} (leading edge of the vaginal cuff scar in a woman with prior hysterectomy);

Posterior vaginal wall points: Ap (fixed point) and Bp (most dependent); GH, Genital Hiatus; PB, Perineal body; TVL, Total Vaginal Length

For Aa, Ba, Ap, Bp: N = 392

For C_{cervix}: N = 287; For C_{cuff}: N = 105

For GH: N = 391

For PB: N = 390

* From the adjusted Wald test for the equality of the means over the number of vaginal deliveries.

Table IV
Multiple Regression Models for Selected POP-Q Points

Characteristic	Aa	Ba	C _{cervix}	C _{cuff}	Ap	Bp	GH	PB
Age: 45 – 54	-.37 [*]	-.34 [*]	.03	-.09	-.00	-.02	-.15	-.10
Age: 55 - 64	-.33	-.32	.32	-.24	-.14	-.17	-.79 [†]	.12
African American	-.10	-.14	-.05	-.98	-.23	-.26	-.07	-.17
Vaginal Parity: 1	.69 [†]	.69 [†]	1.30 [†]	-.35	.71 [†]	.71 [†]	.27	-.07
Vaginal Parity: 2	.64 [†]	.65 [†]	.83 [†]	-.01	.81 [†]	.85 [†]	.32	-.06
Vaginal Parity: 3+	.96 [†]	.98 [†]	1.16 [†]	.47	.94 [†]	1.00 [†]	.84 [†]	-.40 [*]
Hysterectomy	-.17	-.18	NA	NA	.27	.25	-.24	.14
Estrogen Use	.16	.17	-.06	.10	.03	.04	.33	-.14
Full Bladder Stress Test	.17	.16	-.28	-1.10 [*]	-.26	-.24	.36 [*]	-.06
Obese (BMI ≥ 30)	.02	.01	-.41	-.84	.13	.13	.23	.38 [†]
R ²	.16	.16	.13	.12	.13	.13	.16	.07
N	382	382	280	102	382	382	381	380

Anterior vaginal wall points: Aa (fixed point) and Ba (most dependent); C_{cervix} (most dependent edge of the cervix); C_{cuff} (leading edge of the vaginal cuff scar in a woman with prior hysterectomy);

Posterior vaginal wall points: Ap (fixed point) and Bp (most dependent); GH, Genital Hiatus; PB, Perineal body; TVL, Total Vaginal Length

The reference categories are: age 35 – 44, Caucasian, no vaginal delivery, no prior hysterectomy, not currently using estrogen, negative full bladder stress test, body mass index < 30. NA, Not ascertained; hysterectomy was not included in the models for C_{cervix} and C_{cuff}.

* p < .05

† p < .01

‡ p < .001