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Pelvic Organ Support Study (POSST): The distribution, clinical definition, and epidemiologic condition of pelvic organ support defects

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KEY WORD
Pelvic organ prolapse

Objective: The purpose of this study was to describe the distribution of pelvic organ support in a gynecologic clinic population to define the clinical disease state of pelvic organ prolapse and to analyze its epidemiologic condition.

Study design: This was a multicenter observational study. Subjects who were seen at outpatient gynecology clinics who required an annual gynecologic examination underwent a pelvic organ prolapse quantification examination and completed a prolapse symptom questionnaire. Receiver operator characteristic curves were used to define pelvic organ prolapse with the use of symptoms and pelvic organ prolapse quantification examination measures. Standard age-adjusted univariate and multivariate logistic regression analysis were used to evaluate various relationships.

Results: The population consisted of 1004 women who were aged 18 to 83 years. The prevalence of pelvic organ prolapse quantification stages was 24% (stage 0), 38% (stage 1), 35% (stage 2), and 2% (stage 3). The definition of pelvic organ prolapse that was determined by the receiver operator characteristic curve was the leading edge of their vaginal wall that was −0.5 cm above the hymenal remnants. Multivariate analysis revealed age, Hispanic race, increasing body mass index, and the increasing weight of the vaginally delivered fetus as risk factors for pelvic organ prolapse, as defined in this population.

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Conclusion: The results from this population suggest that there is a bell-shaped distribution of pelvic organ support in a gynecologic clinic population. Advancing age, Hispanic race, increasing body mass index, and the increasing weight of the vaginally delivered fetus have the strongest correlations with prolapse.

Pelvic organ prolapse is a poorly understood condition that affects potentially millions of women worldwide. Currently, it is the most common non-cancer indication for hysterectomy in menopausal women in the United States.[1] Despite the apparent prevalence of this condition, there is little information regarding its epidemiologic mechanism and natural history. The dearth of knowledge extends to the lack of a clinically useful or scientifically validated definition of the condition, which was highlighted at a recent terminology conference assembled by the National Institutes of Health.[2]

This lack of a good definition stems in part from a poor understanding of what represents normal versus abnormal pelvic organ support in women. There have been several recent reports that described the distribution of pelvic organ support in various populations and that attempted to establish the normal distribution; however, these studies either failed to define pelvic organ support with the use of validated quantification systems or failed to evaluate diverse racial, geographic, or socioeconomic populations.[3-7] Therefore, the normal distribution of pelvic organ support in a general population still has not been described adequately. Another area of concern in the definition of pelvic organ prolapse involves the nature of the disease. Pelvic organ prolapse is a disease with little, if any, significant morbidity (except in its most severe forms) and essentially no deaths. It is a disease that primarily affects quality of life. Therefore, any attempt to define clinically significant pelvic organ prolapse should include an assessment of the subject's symptoms and their relation to various levels of support.

This study was designed to describe the distribution of pelvic organ support in a general US gynecologic clinic population and to define clinically relevant pelvic organ prolapse, with the use of a combination of physical examination findings and symptom questionnaire responses. In addition, data were collected on a variety of proposed causative factors to determine their impact on the prevalence of pelvic support defects.

Material and methods

This was a multicenter, cross-sectional, observational study. Six centers around the United States that served diverse patient populations participated. The centers included 2 centers in Texas and 1 center each in Washington, North Carolina, South Carolina, and Minnesota. These 6 centers were chosen through self-selection as part of a call for multicenter research sponsored by the American Urogynecologic Society. The study was approved by the Institutional Review Board at each center, and each subject provided written informed consent. The study population included women $\geq$18 years of age who went to 1 of the 6 outpatient gynecology clinics for routine gynecologic health care. Routine gynecologic health care was defined as patients who required a Papanicolaou test and/or their annual pelvic examination as part of their visit. Pregnant patients and patients who were seen within 6 weeks after delivery were excluded.

Subjects were recruited if they were seeking an annual gynecologic examination. They could report various gynecologic problems but had to identify the need for an annual examination as part of their reason for coming to the clinic. This requirement was established to better define our study population as a general gynecology clinic population and to remove the selection bias of subjects who were being seen for any specific gynecologic disease. After written informed consent was obtained, the subjects filled out a 17-question questionnaire (Figure 1). The questionnaire included 7 symptoms that were felt to be specific to pelvic organ prolapse at the time the study was designed. Subjects were able to respond "yes," "no," or "sometimes." "Yes" or "sometimes" responses were followed-up with an additional question that pertained to symptom bother. The patient could only answer "yes" or "no" to the follow-up bother question. There were another 4 questions about constipation, and the 4 final questions queried job description, race, household income, and smoking history. A Spanish version of the questionnaire was available for Spanish-speaking women. The Spanish questionnaire was developed and validated by experienced translators at 1 of the Texas institutions.

After this, the subjects underwent a pelvic organ prolapse quantification (POPQ) examination in the dorsal lithotomy position by a clinician who was familiar with the POPQ examination technique.[8] To ensure consistency about the POPQ examinations across all sites, an examination manual was created and agreed on by the local investigators. The senior author (S.E.S.) traveled to each of the sites (except the Minnesota site) and performed several POPQ examinations with the local investigators to confirm technique. After visiting several of the sites, the senior author noted excellent interexaminer reliability in the performance of the POPQ examination that was consistent with the literature.[9,10] The budget did not allow for a visit to the Minnesota

1). Do you have a sense of something falling out of your vagina?
Yes____(1) No____(2) Sometimes____(3)
1a). If yes or sometimes, does it bother you?
Yes____(1) No____(2)

2). Can you feel with your hand or see something bulging out of your vagina?
Yes____(1) No____(2) Sometimes____(3)
2a). If yes or sometimes, does it bother you?
Yes____(1) No____(2)

3). Do you have uncontrollable loss of urine?
Yes____(1) No____(2) Sometimes____(3)
3a). If yes or sometimes, does it bother you?
Yes____(1) No____(2)

4). Do you have uncontrollable loss of stool or gas from your rectum?
Yes____(1) No____(2) Sometimes____(3)
4a). If yes or sometimes, does it bother you?
Yes____(1) No____(2)

5). Do you have to put fingers in your vagina or push up on your bottom to have a bowel movement?
Yes____(1) No____(2) Sometimes____(3)
5a). If yes or sometimes, does it bother you?
Yes____(1) No____(2)

6). Do you have to put fingers in your vagina or push up on your bottom to empty your bladder?
Yes____(1) No____(2) Sometimes____(3)
6a). If yes or sometimes, does it bother you?
Yes____(1) No____(2)

7). Do you have a heaviness or fullness in the vagina, lower abdomen, or pelvis that increases as the day goes on?
Yes____(1) No____(2) Sometimes____(3)
7a). If yes or sometimes, does it bother you?
Yes____(1) No____(2)

8). Have any of these symptoms interfered with your daily activities?
Yes____(1) No____(2) Sometimes____(3)

9). Have any of these symptoms interfered with sexual activity?
Yes____(1) No____(2) Sometimes____(3)

Figure 1 The 17 questions of the symptom questionnaire that was given to all the subjects who participated in this study.

Bowel Habits
Answer each question as best you can

10). Do you have to strain to empty your bowels at least 25% of the time?
Yes____(1) No____(2)

11). Do you have lumpy or hard stools at least 25% of the time?
Yes____(1) No____(2)

12). Do you feel you do not completely empty your bowels at least 25% of the time?
Yes____(1) No____(2)

13). On average do you have less then 2 bowel movements per week?
Yes____(1) No____(2)

14).Employment
service___(1)
fabricators, laborers___(2)
housewife or homemaker___(3)
professional, managerial___(4)
technical, sales, clerical ___(5)
other ___(6)

15). Household income (per year)
0-10,000$___(1)
10,001-35,000___(2)
35,001- 60,000___(3)
60,001-120,000___(4)
more than 120,0001___(5)

16).Race
White or Caucasian___(1)
Black or African American___(2)
Asian or Pacific Islander ___(3)
Hispanic___(4)
Filipino___(5)
American Indian___(6)
Indian___(7)
Other___(8)

17). Smoking history
never___(1)
ever, but quit___(2)
currently 1/2 pack per day___(3)
currently,1 pack per day ___(4)
more than 1 pack per day ___(5)

Figure 1 (*Continued*).

site, but because of the previously mentioned findings, it was felt that this site could provide accurate data without compromising the integrity of the study.

The results of the questionnaire were withheld from the examining physician until after the examination. For this study, POPQ measures were made in 0.5-cm increments. The 9 POPQ points were recorded. Subjects were then assigned a POPQ stage, as previously described.[11] All points, except the total vaginal length, were recorded with the subject performing maximal Valsalva effort or cough.

A 1-page data collection form was completed and included the patient's demographic information, medical and surgical history, and the results of the pelvic examination. It also included data regarding obstetric history to include gravidity, parity, number of vaginal deliveries, and the weight of the largest infant delivered vaginally. The data regarding surgical history were specific to pelvic surgical procedures and included total abdominal or vaginal hysterectomy and the number of anti-incontinence and prolapse procedures. Data were entered and maintained at a central location in a write- and password-protected database with a double-entry validation.

To define the disease state of pelvic organ prolapse, we used the results of the POPQ examination and the responses to the 7 questions about symptoms of pelvic organ prolapse. Receiver operator curve (ROC) analyses were used to identify a reasonable cutoff point that was based on the subject's vaginal wall leading edge. We constructed curves for each of the 7 questions regarding symptoms of prolapse, using "yes" or "sometimes" as a positive response and evaluating the responses for each vaginal wall leading edge level value between -3 cm and $+3$ cm (no subjects in this study had prolapse beyond $+3$ cm). A second set of 7 curves was also constructed that were based on responses to "bothersome" questions. In each case, we first calculated sensitivity and specificity for all available vaginal wall leading edge values between -3 cm and $+3$ cm. Sensitivity and specificity were calculated in the following manner: sensitivity = % (no. of correctly predicted "prolapse"/no. of "true prolapse"); specificity = % (no. of correctly predicted "non-prolapse"/no. of "true non-prolapse"). We developed criterion standards for each ROC as 1-sensetivity + 1-specificity. The lowest criterion standard for any question was then used to classify subjects as having pelvic organ prolapse.

To determine the contribution of the various proposed causes, for pelvic organ prolapse, age-adjusted univariate logistic regression analysis was used to calculate relative risks as odds ratios with 95% CIs. We used a vaginal wall leading edge value of ≥ -0.5 cm as the definition of pelvic organ prolapse (this was determined after analysis of the ROCs). The risk factors that were evaluated included age, body mass index, gravidity, parity, number of vaginal deliveries, weight of largest vaginally delivered infant, previous hysterectomy (total abdominal hysterectomy or total vaginal hysterectomy vs no hysterectomy), previous prolapse surgery (ever vs never), constipation (reported as a positive response to any of the constipation question), menopausal status (before vs after), hormone replacement therapy (ever vs never), any chronic illness (hypertension, diabetes mellitus, asthma, or emphysema vs none), employment (laborer/housewife vs technical/service/professional), household income ($\leq$35K vs 35-120K vs $>$120K), race (white vs black vs Hispanic vs others), and smoking history (ever vs currently vs never). A stepwise multivariate regression analysis was then used with the variables detected by univariate analysis as possibly having an influence on the prevalence of pelvic organ prolapse. Statistical significance was considered if the probability value was $<.05$.

Data analysis was performed with SAS statistical software (version 8.2; SAS Institute Inc, Cary, NC). Statistical analyses involved summary and descriptive statistics. Continuous demographic variables were summarized by either medians or means, standard deviations, or minimum and maximum. Qualitative demographic and other patient characteristics were summarized by counts and percentages. Paired *t*-test was used to compare the difference between the anterior the posterior vaginal segments and the anterior and apical vaginal segments.

Results

One thousand four women participated in the study over an 18-month period from September 1999 through March 2002. The centers served various populations: 2 centers served a primarily private gynecologic practice; 1 center combined private practice and house-staff resident clinic populations; 1 center served mainly resident house-staff clinic populations; 1 center served a military population (which included active duty and military dependents), and 1 center served as a gynecology clinic for indigent Hispanic patients. All of the centers contributed significant numbers of subjects that ranged from 110 to 220 subjects enrolled.

The mean age of the population was 42.7 $\pm$ 13.9 ($\pm$ SD) years (range, 18-83 years). The median gravidity was 3 (range, 0-16), and the median parity was 2 (range, 0-13). Seventeen percent of subjects had undergone an abdominal or vaginal hysterectomy. Fifty-eight percent of subjects were premenopausal; 40% of subjects were postmenopausal, and the menopausal status of 2% of subjects was unknown. Racial distribution, as self-reported, was 43% white, 24% black, 29% Hispanic, 2% Asian, and 2% other. The following distribution of household income was self-reported: 37.6%, 0 to

$10,000 per year; 31.6%, $10,001 to $35,000 per year; 15.5%, $35,001 to $60,000 per year; 13.0%, $600,001 to $120,000 per year; and 2.4%, >$120,001 per year.

The following data represents the distribution of pelvic organ support by POPQ stages for the population: stage 0, 24%; stage 1, 38%; stage 2, 35%; and stage 3, 2%. There were no subjects in our population with POPQ stage 4 pelvic organ prolapse. In addition to the POPQ stage, the distribution of the leading edge of the vaginal walls was documented (Figure 2). The structure or POPQ point that made up the leading edge was determined by taking the greatest value between points Aa, Ba, C, D, Ap, and Bp within each subject.

To evaluate which vaginal segments had the greatest degree of relaxation, we determined the mean value for each of the nine POPQ measurements (Table I). We took the greatest value between Aa and Ba (−1.7 cm) to represent the anterior vaginal wall and did a similar calculation with points Ap and Bp (−2.2 cm) to represent the posterior vaginal wall and with points C and D (−6.0 cm) to represent the vaginal apex. Paired *t*-test analysis revealed that the anterior vaginal segment was statistically significantly greater then the posterior vaginal segment ($P < .001$) or apical segment ($P < .001$).

Ninety-eight percent of the subjects completed the questionnaire regarding symptoms of pelvic organ prolapse. The number of positive responses per subject and number of positive bothersome responses per subject was determined by the POPQ stage. There was a trend of increasing number of positive responses per subject and positive bothersome responses per subject with increasing stage (Figure 3). However, a clear cut-off point, to allow for a definition of the disease state of pelvic organ prolapse, with the stage was not apparent with this evaluation. Therefore, we developed ROCs for each of the 7 symptoms and their follow-up bother questions. The criterion standard to select a cut-off for pelvic organ prolapse was evaluated. This ROC analysis revealed that all of the symptom and bothersome questions had ideal criterion standards for the various leading edge values of between −2.5cm and +3.0 cm (Table II). The reason involved very poor and discordant sensitivities. In addition, when we evaluated the c value for each of the ROCs, the values remained between 0.51 and 0.64, which suggested poor ability of the question to properly classify the subjects as having prolapse. This was true for all of the questions, except for the question regarding a vaginal bulge and the follow-up bothersome question that had c values of 0.72 and 0.75, respectively (Table II). This suggests that the question regarding a bothersome vaginal bulge had a 75% chance of correctly classifying a subject with prolapse. The lowest criterion standard for both the symptom of a bulge question and the follow-up bothersome question was −0.5 cm. Therefore, we defined the disease state of pelvic organ prolapse as the leading edge of the prolapse being at −0.5 cm for the rest of our evaluation. This meant that 218 subjects (22%) were defined as having pelvic organ prolapse.

Using the definition of pelvic organ prolapse noted earlier, we performed age-adjusted univariate logistic regression analysis on various factors to define odd ratios for the development of this disease (Table III). Multivariate analysis was performed on those factors that were identified in univariate analysis as potentially affecting pelvic organ prolapse (Table IV).

Comment

The current state of research regarding pelvic support defects has been hampered by the lack of a sound definition of the disease of pelvic organ prolapse. Until the disease can be defined, it cannot be recognized; until it can be recognized, little progress can made into describing its epidemiologic condition. This study was designed to document the distribution of pelvic organ support in a geographically and racially diverse group of women, to develop a meaningful definition of pelvic organ prolapse with the use of physical findings in combination with common symptoms, and once a definition of prolapse was established, to evaluate several proposed etiologic factors.

The data generated from this study on the distribution of pelvic organ support in women are consistent with previously published reports. The distribution follows a bell-shaped curve with most subjects having POPQ stage 1 and 2 pelvic organ support and only 7% of the subjects having the leading edge of the prolapse at or beyond the hymenal remnants (Figures 2). The previous reports regarding the distribution of pelvic organ support demonstrated that between 1% and 3 % of subjects had pelvic organ support defects, with the vagina prolapsing to or beyond the vagina opening.[3,5-7] This population that shows slightly more prolapse beyond the hymen. This may stem from the lack of racial or geographic diversity in previous reports. In particular, most of these reports had an overwhelming predominance of white subjects. The strength of the data that were generated in this report involves the inclusion of large numbers of minority women, the wide geographic distribution of the data collection centers, and the use of a well-studied POPQ.[9-11]

One aim of this study was to describe a population that accurately reflects the general US population. However, despite efforts to recruit a representative population, this report still does not accurately reflect the US population. According to the census bureau, the distribution of race across the United States for the year 2000 was 71.2% white, 12.3% black, 12.5% Hispanic, 3.8% Asian or Pacific Islander, and 0.9% Native American.[12] Our study population was more heavily

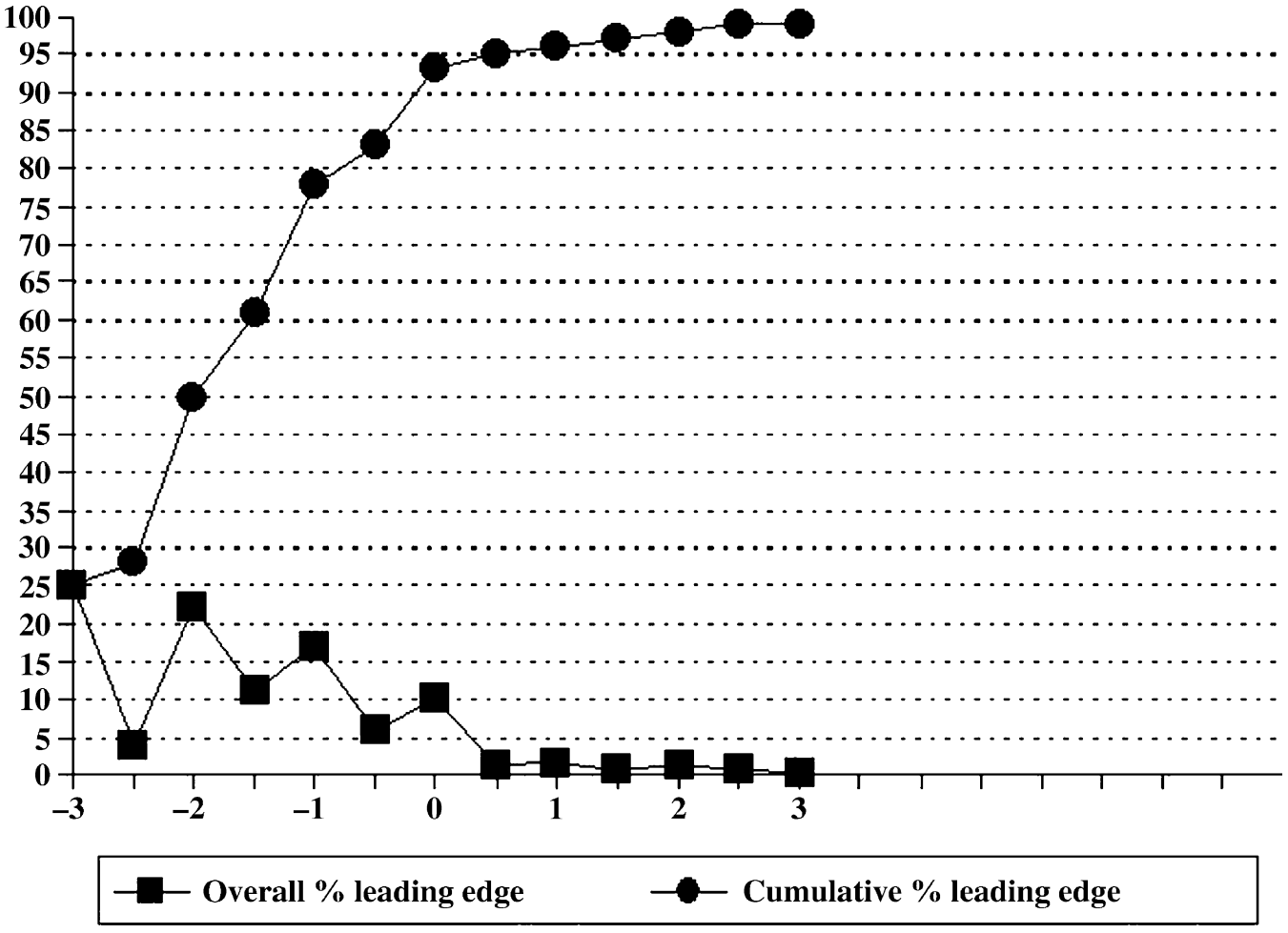

Figure 2 The cumulative percent of subjects. The percentage of individuals; the leading edge at any of the points is listed. Note that 95% of subjects have the leading edge of their prolapse at or above 0 cm (or the hymenal remnants).

weighted toward Hispanic (29%) and black (24%) patients, with only 43% white and 2% Asian patients. In addition, according to the 2000 census, 12.4% of families in the United States live below the poverty line, somewhere between $10,000 and $13,000 per year. This study population had >35% earning <$10,000 per year. It can be seen that, in our study population, minorities and patients who are living in poverty are over represented. In addition, only subjects who were being seen for gynecologic health care examinations were selected for participation, which is not necessarily representative of the general population. Therefore, it is difficult to state that our study population accurately reflects the general population of women in the United States. Obtaining data from a truly random population that represents the US population would be difficult, if not impossible. Randomly selecting subjects from the various population centers and requesting that they receive a gynecologic examination would be fraught with disappointing results. In planning this project, the selection bias in examining subjects who were attending gynecologic visits was discussed, but no viable alternative could be found to approximate the general population. This group was chosen as a population that reflects those subjects who come into contact with the gynecologic health care providers and would be the population being screened for pelvic support disorders. Also, these subjects were already undergoing a pelvic examination, so there would be very little additional discomfort involved in their office visit. This group likely

Table I The mean values (±SD) of the 9 POPQ points

POPQ point	Mean value (cm)
Aa	−1.7 ± 1.1
Ba	−1.7 ± 1.1
C	−6.0 ± 1.8
D	−8.6 ± 1.8
Ap	−2.3 ± 1.0
Bp	−2.2 ± 1.1
Gh	2.9 ± 0.9
Pb	−2.2 ± 0.9
Tvl	9.6 ± 1.5

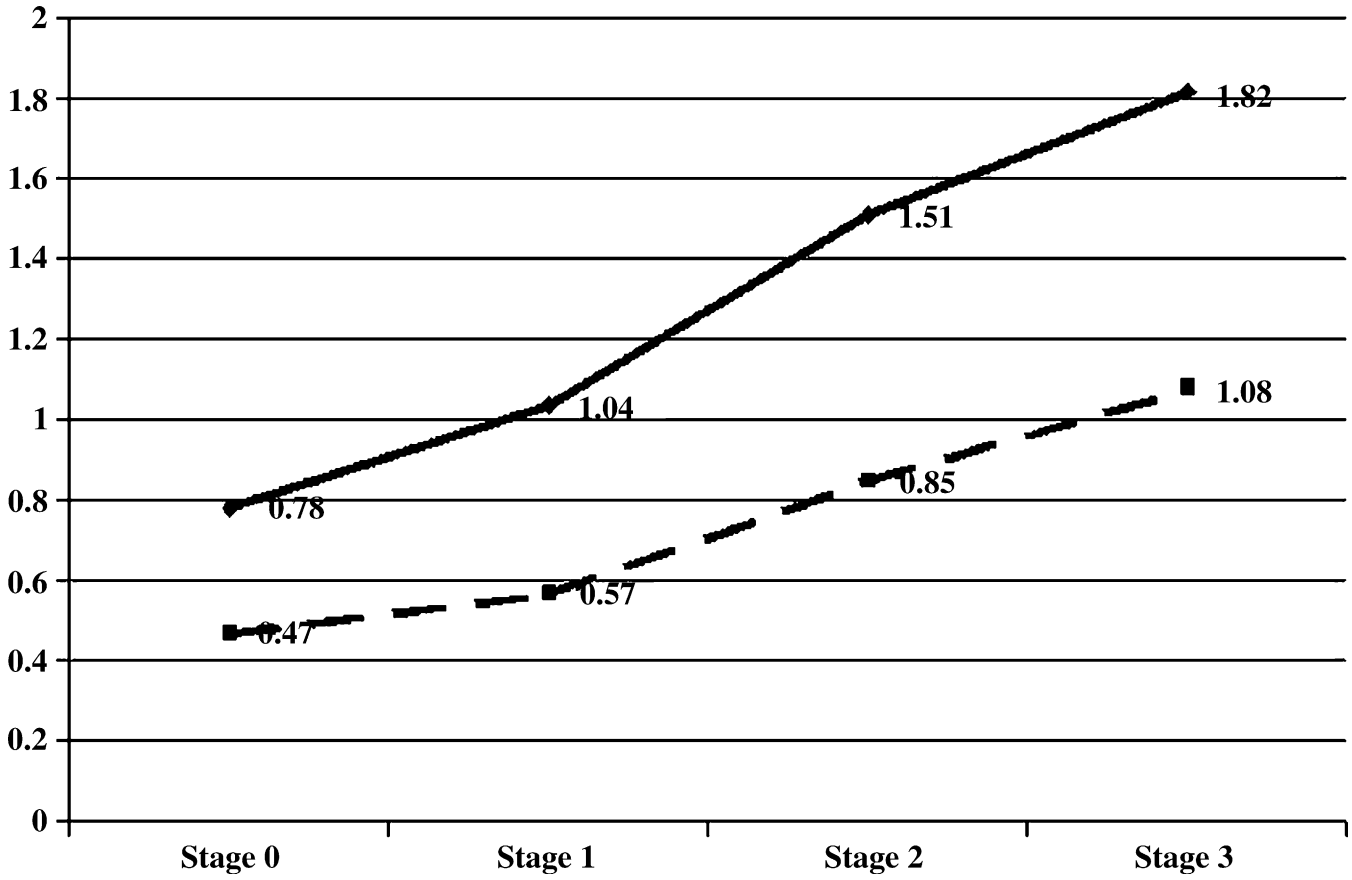

Figure 3 The *solid line* represents the number of positive responses per subject to the 7 questions about pelvic organ prolapse symptoms within each POPQ stage. The *dashed line* represents the number of positive responses per subject about the bothersome nature of the symptom. Note that subjects with POPQ stage 3 prolapse had, on average, almost 2 symptoms that were associated with pelvic organ prolapse and at least 1 bothersome symptom.

under represents the true prevalence of more severe forms of pelvic organ prolapse but is probably an accurate reflection of the relative distribution of POPQ stage 0, 1, and 2 pelvic organ support.

Understanding the variation in pelvic organ support and how the degree of support relates to symptoms is crucial for defining the condition or disease state of pelvic organ prolapse. The current definitions of pelvic organ prolapse are based more on expert opinion then on data and are often vague or too inclusive. The American College of Obstetrics and Gynecology defines it as the protrusions of the pelvic organs into or out of the vaginal canal.[13] This could be interpreted to include all patients with POPQ stage 1 or greater prolapse. Another recent attempt to define pelvic organ prolapse occurred at a terminology conference for researchers in the study of pelvic floor disorders that was convened by the National Institutes of Health. They acknowledged that there was not enough current information to properly define pelvic organ prolapse, but they proposed a definition for pelvic organ prolapse as the decent of any vaginal segment to within 1 cm of the hymen or lower.[2] Although this is a very specific definition that includes all patients with POPQ stage 2 or greater prolapse, it may be too inclusive and would encompass almost 40% of the subjects in this report. The members of the National Institutes of Health conference also pointed out that, because pelvic organ prolapse is a condition that primarily affects quality of life, any definition of the disease should include some evaluation of symptoms.

The problem with our current definitions of pelvic organ prolapse is that they do not properly reflect the nature of the disease of pelvic organ prolapse. In a recent article that compared various techniques for the correction of anterior vaginal wall defects, the authors used POPQ stage 0 or 1 as a definition of anatomic cure and a questionnaire to determine the subjective improvement.[14] The anatomic cure rates ranged from 30% to 46% for the various procedures that were studied; despite this, according to the questionnaires, almost all of the subjects were satisfied with the results. The authors concluded that their anatomic definition of cure may have been too stringent; the data from this study agree with this with this conclusion. Almost 40% of routine gynecology patients have POPQ stage 2 pelvic

Table II The results of the ROC analysis for each of the 7 symptom questions and the follow-up bothersome question (c values and criterion standards)

Symptom question/ follow-up question	C-value for question	Criterion standard for question (cm)
Sense of something falling out/does it bother	0.59/0.61	−1.0/−1.0
Feel or see something bulging out/does it bother	0.72/0.75	−0.5/−0.5
Uncontrollable loss of urine/does it bother	0.60 /0.60	−1.0/−1.0
Uncontrollable loss of gas or stool/does it bother	0.52/0.51	+3/0
Splint or digitate to have a bowel movement/does it bother	0.57/0.57	−1.0/−1.5
Splint or digitate to empty bladder/does it bother	0.56/0.64	−0.5/0
Heaviness or fullness in the vagina, lower abdomen, or pelvis/does it bother	0.58/0.60	−1.0/−2.5

organ support, and in this report many subjects with stage 2 examinations were considered "normal," so it is not surprising that some subjects who attained this level after operation were satisfied with their outcome.

In the population that was studied, 7% of the subjects had the leading edge of the vaginal wall at or beyond the hymenal remnants (some POPQ stage 2 and all stage 3; Figure 2). Previous research would suggest that, once the leading edge of the vaginal wall extends beyond the introitus or region of the hymenal remnants, a subject is more likely to experience symptoms that are attributed to their prolapsing pelvic organs.[15,16] Those subjects with POPQ stage 3 prolapse have obvious prolapse and would expect to be symptomatic. However, the graph in Figure 3 does not demonstrate an obvious cut-off point beyond which subjects can be described clearly as having the disease of symptomatic pelvic organ prolapse. Therefore, to further evaluate the relationship between symptoms and leading edge of vaginal support, we developed ROCs for each of the 14 questions regarding either symptoms or bothersome symptoms that are attributed commonly to pelvic support defects. This was done to determine whether there was a best-fit model for defining pelvic organ prolapse with the symptoms in combination with physical examination findings. Using the criterion standards for both the symptom and bothersome questions (lowest sum of 1-sensetivity + 1-specificity), we came up with various cut-off values in defining pelvic organ prolapse for each question (Table I). When this project was initiated, there were very little data on what symptoms were related to pelvic organ support defects. The authors developed the questionnaire that was used

Table III Univariate logistic regression analysis for the various risk factors for pelvic organ prolapse, with risk factors that are adjusted for age

Risk factor	Total (n)*	Prolapse (n)†	Odds ratio (95% CI)
Age (y)			
1	998	217	1.04 (1.03-1.05)
10			1.46 (1.30-1.64)
Body mass index (kg/m^2)			
<25	283	25	1.00
25-30	286	73	3.13 (1.91-5.15)
>30	374	105	3.52 (2.19-5.66)
Race			
White	424	41	1.00
Black	242	47	2.64 (1.66-4.20)
Hispanic	289	124	6.29 (4.20– 9.41)
Other	31	2	0.77 (0.17-3.36)
Gravidity	988	217	1.26 (1.17-1.35)
Parity	989	216	1.39 (1.27-1.52)
Vaginal delivery	977	213	1.39 (1.27-1.51)
Weight of vaginally delivered infant (oz)			
10	937	198	1.12 (1.08-1.17)
20			1.26 (1.17-1.36)
30			1.42 (1.27-1.59)
Hysterectomy			
No total abdominal or total vaginal	825	166	1.00
Prolapse surgical procedure	173	51	1.10 (0.74-1.62)
Never	966	203	1.00
Ever	32	14	1.81 (0.86-3.78)
Menopausal status			
After	399	123	1.00
Before	573	80	0.62 (0.36-1.07)
Hormone replacement therapy			
Never	463	97	1.00
Ever	229	53	0.59 (0.39-0.90)
Constipation			
No	46	14	1.00
Yes	942	201	0.73 (0.38-1.42)
Chronic illness			
None	727	139	1.00
Any	267	77	1.18 (0.65-2.13)
Constipation			
No	46	6	1.00
Yes	948	49	0.47 (0.18-1.22)
Employment			
Nonlabor	440	49	1.00
Labor	526	161	3.01 (2.10-4.30)
Income			
High (>120K)	21	5	1.00
Medium (35-120K)	263	19	0.26 (0.08-0.79)
Low (<35K)	641	182	1.39 (0.49-3.93)
Smoking history			
Never	651	161	1.00
Ever	187	29	0.50 (0.32-0.78)
Currently	143	23	0.71 (0.43-1.15)

* N = 1004.
† N = 218.

Table IV A multivariate logistic regression analysis of those factors that had a significant relationship by univariate analysis

Factor	Odds ratio (95% CI)
Age (per 10-y)	1.38 (1.09-1.75)
Body mass index (kg/m^2)	
<25	1.00
25-30	2.51 (1.18-5.35)
>30	2.56 (1.23-5.35)
Race	
White	1.00
Black	1.20 (0.44-3.26)
Hispanic	4.29 (1.80-10.2)
Other	2.40 (0.47-12.1)
Parity (per 1 unit)	1.11 (0.71-1.73)
Gravidity (per 1 unit)	0.93 (0.74-1.16)
NVD (per 1 unit)	1.13 (0.89-1.44)
Weight of vaginally delivered infant (per 10 oz)	1.11 (1.04-1.19)
Hormone replacement therapy ever	0.98 (0.57-1.69)
Employment labor related income	1.19 (0.63-2.26)
High (<120K)	1.00
Medium (35-120K)	0.21 (0.06-0.74)
Low (<35K)	0.24 (0.06-0.93)
Smoking history	
Never	1.00
Ever	1.20 (0.60-2.41)
Currently	0.90 (0.33-2.46)
Chronic illness (any)	1.05 (0.53-2.09)

by reviewing textbooks that uniformly listed the symptoms that were queried in our questionnaire. Multiple subsequent studies have demonstrated that the symptoms of urinary and fecal incontinence, splinting or reducing the bulge to void or evacuate, and the sense of pelvic pain are not correlated with increasing pelvic organ prolapse.[17,18] The only bothersome symptom that appears to be related consistently to worsening pelvic organ prolapse is a vaginal bulge that can be seen or felt.[19,20] Therefore, it is not surprising that this was the only symptom that demonstrated any ability to classify pelvic organ prolapse and was the symptom on which we relied to distinguish pelvic organ prolapse from normal in this study. The leading edge of the vagina at or beyond −0.5 cm may not be the most clinically useful definition of pelvic organ prolapse, but it is consistent with other reports that demonstrate that, as the vaginal wall approaches the hymen, subjects tend to report more bothersome symptoms. The original POPQ document describes measuring the various points at 1-cm intervals; if you round up the results of this study, then 0 cm would be the most clinically useful cut-off for the definition of pelvic organ prolapse that may be more clinically useful.[11]

After a definition of pelvic organ prolapse was established, an age-adjusted univariate analysis was performed on various suspected causes to determine their relative contribution (Table III). The causes, which were identified by univariate analysis as risk factors, largely agree with several previous publications and included increasing age, body mass index, gravidity, parity, number of vaginal deliveries, and weight of vaginally delivered infants. In addition, Hispanic and black race and employment that involved manual labor appeared to increase the risk of prolapse. Increasing age as a risk factor for pelvic organ prolapse is intuitive and is identified consistently as a cause, regardless of the definition that is used to define pelvic organ prolapse, and explains our decision for an age-adjusted analysis.[3,6,8,19-21] Pregnancy is another commonly cited risk factor, and the data in this report, again, are consistent with the literature, which shows a 20% to 40% increase with either gravidity, parity, vaginal delivery, and increasing weight of a vaginally delivered infant.[3,8,18,22,23] Interestingly, vaginal delivery did not increase the odds ratio over parity alone, which would suggest that it is the term pregnancy that increases the risk of pelvic organ prolapse and not the delivery method. It does appear that the increasing weight of the vaginally delivered infant is associated with pelvic organ prolapse. We did not record the weight of the largest infant who was carried by the subject; therefore, we cannot state whether large infants are associated with prolapse or only large infants who are delivered vaginally.

There is very little literature on the impact of job description and the risk of prolapse. One previous report on nursing assistants found that women who functioned in an employment that was associated with a lot of lifting were more likely to undergo surgical procedures to correct prolapse. These data would confirm that report, subjects who self-reported themselves as housewife/laborers had a significantly increased risk of prolapse over nonlaborers. However, this did not remain statistically significant in the multivariate analysis.[24]

Another area that was analyzed in this study involved the effect of race on pelvic organ prolapse. There are only 2 previous reports on race: 1 report noted an increased risk for Hispanic women, and both reports noted a decreased risk for black women over white women.[25,26] In the univariate analysis, black race appeared to have an influence on pelvic organ prolapse, but this apparent relationship disappeared on multivariate analysis. Therefore, black race may not increase the risk of pelvic organ prolapse over white race but, in this population, did not appear to be protective.

Constipation, previous prolapse surgery, and hysterectomy in our population did not increase the risk of pelvic organ prolapse, which is in contradistinction to previous studies.[7,19] Finally, 3 areas that were deemed protective were medium and lower socioeconomic status,

cigarette smokers, and hormone replacement therapy users. These data are difficult to comment on because there is very little in the literature; however, in other studies, it was noted that cigarette smoking was protective against the development of prolapse.[26] This protective effect disappeared in the multivariate analysis; it remains questionable whether smoking should be considered in a strategy to prevent the development of pelvic organ prolapse. Like smoking history, the effects of hormone replacement therapy disappeared in the multivariate analysis, and likewise it would be difficult to recommend hormone replacement therapy to prevent prolapse.

To date, this report represents a description of the most geographically and racially diverse population of women studied for pelvic organ support. It used 6 centers from around the country that examined women from various geographic, racial, and socioeconomic backgrounds with a validated POPQ system. The most interesting finding in these data is the suggestion that POPQ stages 0, 1, and some stage 2 are "normal" degrees of support. Our data suggest that subjects with POPQ stage 2 support (particularly those subjects with the leading edge at −1 cm) represent a variant of normal. The questionnaire that was used to define symptomatic pelvic organ prolapse in this study was not a validated tool (at the initiation of this study and throughout the data collection, no validated pelvic organ prolapse quality-of-life tool was available); therefore, these data on defining clinically significant pelvic organ prolapse can be questioned. However, the relationship between symptoms and physical examination findings suggests that the hymen is an appropriate dividing line in the definition of pelvic organ prolapse. Whether this point should be just proximal to the hymen or at the hymen is still a subject that is open to debate. This definition deserves more study and confirmation in various populations with a validated quality of life questionnaire before it can be advocated as a definition of pelvic organ prolapse.

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