

Joint hypermobility, obstetrical outcomes, and pelvic floor disorders

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Abstract

Introduction and hypothesis Benign joint hypermobility syndrome may be a risk factor for pelvic floor disorders. It is unknown whether hypermobility impacts the progress of childbirth, a known risk factor for pelvic floor disorders. Our objective was to investigate the association between joint hypermobility syndrome, obstetrical outcomes, and pelvic floor disorders. Our hypotheses were: (1) women with joint hypermobility are less likely to experience operative delivery and prolonged second-stage labor; and (2) pelvic floor disorders are associated with benign hypermobility syndrome, controlling for obstetrical history.

Methods Joint hypermobility was measured in 587 parous women (participants in a longitudinal cohort study of pelvic floor disorders after childbirth). Their obstetrical histories were obtained from review of hospital records. Pelvic floor disorders were assessed using validated questionnaires and a

structured examination for prolapse. Joint hypermobility and pelvic floor disorders were evaluated at enrollment (5–10 years after first delivery). We compared obstetrical outcomes and pelvic floor disorders between women with and without joint hypermobility, defined as a Beighton score ≥ 4 .

Results Hypermobility was diagnosed in 46 women (7.8 %) and was associated with decreased odds of cesarean after complete cervical dilation or operative vaginal delivery [odds ratio (OR)=0.51; 95 % confidence interval (CI):0.27–0.95]. Anal sphincter laceration was unlikely to occur in women with hypermobility (OR=0.19; 95 % CI 0.04–0.80). However, hypermobility was not associated with any pelvic floor disorder considered.

Conclusions Benign joint hypermobility syndrome may facilitate spontaneous vaginal birth but does not appear to be a risk factor for pelvic floor disorders in the first decade after childbirth.

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Abbreviations

MOAD Mothers' Outcomes after Delivery
EPIQ Epidemiology of Prolapse and Incontinence
Questionnaire

Introduction

Childbirth has a very substantial impact on a woman's probability of developing pelvic floor disorders, such as urinary incontinence (UI) and pelvic organ prolapse (POP) [1]. However, childbirth is neither necessary nor sufficient for the development of these conditions: nulliparity is not completely protective against pelvic floor disorders [2], nor are pelvic floor disorders ubiquitous after childbirth [3].

Thus, other factors, independent of parity, influence the development of pelvic floor disorders.

Research on the epidemiology of pelvic floor disorders suggests that some women may be phenotypically or genotypically predisposed. For example, prevalence appears to differ across racial groups [4]. Also, family history of prolapse appears to increase the odds of prolapse among nulliparous women [5, 6], suggesting a hereditary component. Finally, local connective tissue factors might play a role in a women's likelihood to develop prolapse and other pelvic floor disorders [7]. These observations provide important clues about risk factors for these conditions.

One possible risk factor is joint hypermobility. Benign hypermobility syndrome, diagnosed using physical examination criteria, is a manifestation of generalized connective tissue laxity and is seen in approximately 10 % of adult US women [8]. Several case-control studies suggest that joint hypermobility is associated with pelvic floor disorders [9–12]. However, most of these studies have not controlled for childbirth history and other known risk factors for pelvic floor disorders. It is unknown whether joint laxity might influence obstetrical outcomes. Indeed, it has long been recognized that joint laxity increases over the course of pregnancy [13, 14], allowing the bony pelvis to adapt to accommodate vaginal birth. We are unaware of studies of the influence of benign joint hypermobility syndrome on the course of the second stage of labor. It is plausible that women with hypermobility syndrome may be at lower risk for cephalopelvic disproportion. A lower rate of cesarean deliveries could potentially be the mechanism by which women with hypermobility are exposed to a higher risk of pelvic floor disorders later in life. Thus, a critical question is whether childbirth experiences are the mechanism by which hypermobility syndrome increases the later development of pelvic floor disorders.

The objective of this research was to investigate the association between joint hypermobility syndrome, childbirth outcomes, and pelvic floor disorders. Our first hypothesis was that women with joint hypermobility would experience less obstruction to childbirth in the second stage of labor, manifested by decreased rate of operative intervention and a shorter second-stage of labor. Our second hypothesis was that pelvic floor disorders would be associated with benign hypermobility syndrome, controlling for the effects of obstetrical history. The overall goal of this research was to consider whether the association between hypermobility and pelvic floor disorders might be mediated by childbirth outcomes.

Materials and methods

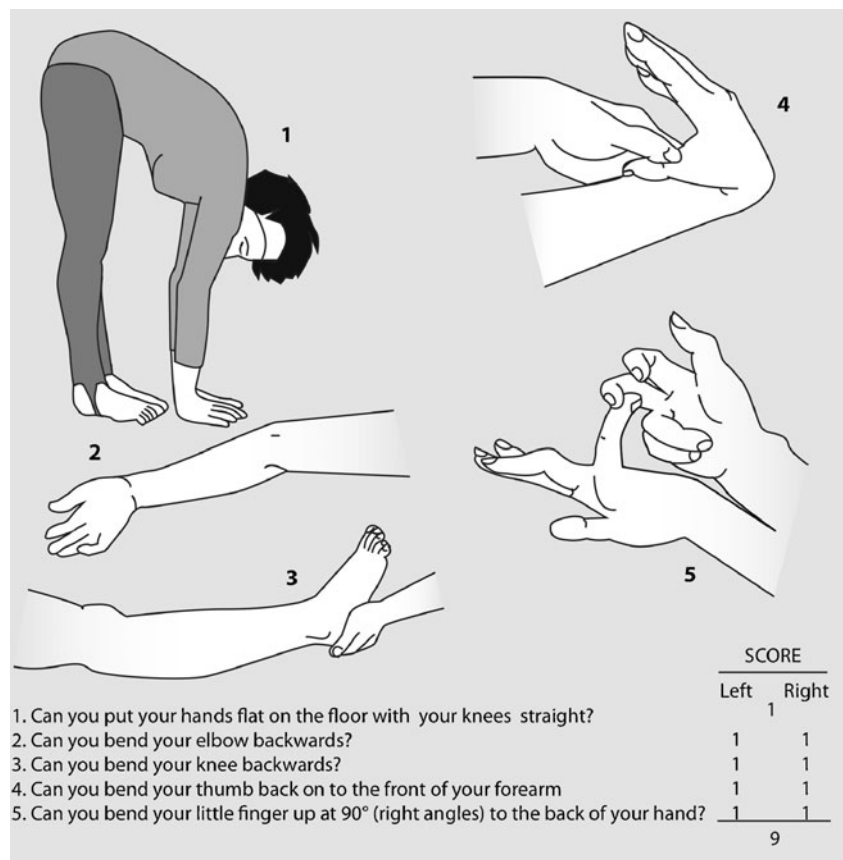
This was a supplementary analysis of the Mothers' Outcomes after Delivery (MOAD) study [1], a prospective cohort study

of pelvic floor outcomes among parous women. Participants were recruited from the obstetrical population at a large community hospital in suburban Maryland, USA. Details of study methods, eligibility criteria, and recruitment procedures have been previously described [1]. Women were eligible for the MOAD study if they had given birth to their first child 5–10 years before enrollment. Participants were recruited based on the mode of delivery of their first child (cesarean vs. vaginal), and groups were matched for age at the time of first delivery and years since that delivery. Exclusion criteria, based on the first delivery, included maternal age <15 or >50 years, delivery at <37 weeks of gestation, placenta previa, multiple gestation, known fetal congenital anomaly, stillbirth, prior myomectomy, and abruption. Eligibility was established via review of the obstetrical hospital records and confirmed with subsequent telephone interviews. This research was approved by the Institutional Review Board, and all participants provided written informed consent.

For this supplementary study, the exposure of interest was benign joint hypermobility syndrome. Joint mobility was assessed on physical examination at the time of study enrollment using five standard maneuvers known as the Beighton Modification of the Carter and Wilkinson Scoring System [15]. Each participant was asked to complete the following tasks in order to calculate their flexibility score (Fig. 1): bending at the waist and placing hands flat on the floor without bending knees (1 point), hyperextension of knees (1 point for each side), hyperextension of elbows (1 point for each side), touching thumb to forearm (1 point for each side), and bending fifth finger beyond 90° (1 point for each side). Hyperextension was gauged using a goniometer. A maximum score of 9 indicates hypermobility for each maneuver. Benign joint hypermobility syndrome is diagnosed with a Beighton score of ≥ 4 . [15].

Our first hypothesis was that hypermobility decreases operative intervention during the second stage of labor. Obstetrical outcomes were defined by a review of each participant's obstetrical hospital records. Because our hypothesis is relevant only to women who had experienced the second stage of labor, we excluded those who delivered exclusively by cesarean prior to labor or in the first stage of labor. The three comparison groups of interest were: (a) cesarean after complete cervical dilation, (b) spontaneous vaginal birth, and (c) operative vaginal birth. Spontaneous vaginal birth was the reference group. We also considered whether each participant had experienced a prolonged second stage of labor (defined as >120 min) and whether she had experienced a third- or fourth-degree anal sphincter laceration. Obstetrical exposures were determined at the "woman level" by considering each participant's history across all of her deliveries [1]. Because the focus of the MOAD study is the relationship between

Fig. 1 Beighton Modification of the Carter and Wilkinson Scoring System. (Image reproduced by kind permission of Arthritis Research, UK.)



obstetrical events and pelvic floor outcomes, women were placed in the group corresponding to the delivery that was likely to be most traumatic to the pelvic floor. For instance, any woman with an operative delivery was placed in that group regardless of her other delivery types.

Standard methods for contingency tables (i.e., Fisher's exact test) were used to describe the association of hypermobility syndrome with maternal characteristics and obstetrical outcomes. Assuming that the Beighton score measured at entry into MOAD represents the score over the time span of all deliveries for each woman, we used logistic regression

methods with the obstetrical events of interest at each delivery as the outcome and hypermobility syndrome as the exposure. As each woman contributed as many records as deliveries, we used robust methods to calculate the standard errors (SE) of the regression coefficients.

Our second hypothesis was that benign hypermobility syndrome is associated with pelvic floor disorders. Each participant was evaluated for the presence or absence of pelvic floor disorders at enrollment (e.g., 5–10 years after first delivery) using two validated measures. First, symptoms of stress urinary incontinence (SUI), overactive

Table 1 Maternal characteristics of the 587 women with a history of reaching the second stage of labor by Beighton flexibility scores at enrollment (e.g., 5–10 years from first delivery)

Characteristic	Beighton score		P value
	<4 N=541	≥4 N=46	
Age at enrollment, median (IQR), in years	40.0 (36.4, 43.2)	37.7 (35.3, 40.8)	0.047
Race			
Caucasian	469 (87 %)	39 (85 %)	0.582
African American	53 (10 %)	4 (9 %)	
Other	19 (4 %)	3 (7 %)	
Maternal age >35 at 1st delivery	158 (29 %)	8 (17 %)	0.091
Multiparous (at enrollment)	402 (74 %)	33 (72 %)	0.727
Body mass index ≥30 kg/m ² (at enrollment)	101 (19 %)	7 (15 %)	0.693

IQR Interquartile range

Table 2 Obstetrical outcomes of the 587 study participants, by Beighton flexibility scores at enrollment. Data are presented as *N* (%)

	Characteristic	Beighton score		<i>P</i> value
		<4 (<i>N</i> =541)	≥ 4 (<i>N</i> =46)	
	Delivery group ^a			0.049
	Cesarean ^b	132 (24 %)	8 (17 %)	
	Spontaneous vaginal birth ^c	288 (53 %)	33 (72 %)	
	≥1 Operative vaginal birth	121 (22 %)	5 (11 %)	
	Prolonged second stage >120 min ^d	237 (44 %)	15 (33 %)	0.164
	Anal sphincter laceration ^d	93 (17 %)	2 (4 %)	0.021

^aAcross all delivery types (see “Methods”)

^bAfter complete cervical dilation

^cNon-operative (reference group)

^dEver present, across all deliveries before enrollment

bladder (OAB), anal incontinence (AI), and prolapse were assessed using the validated Epidemiology of Prolapse and Incontinence Questionnaire (EPIQ) [16]. We used validated thresholds [16] for each EPIQ score to distinguish between women with and without bothersome symptoms of SUI, OAB, AI, and prolapse. In addition, objective evidence of pelvic organ support was assessed during a gynecologic exam using the Pelvic Organ Prolapse Quantification (POP-Q) examination [17]. Based on examination results, prolapse was defined as any descent of the cervix or vaginal walls to or beyond the hymen. Each pelvic floor disorder was considered separately. The primary exposure of interest was hypermobility syndrome, and univariate OR (OR) were calculated using standard methods for 2 × 2 tables. Logistic regression was used to provide OR for the association between pelvic floor disorders and hypermobility syndrome. This was accomplished through analysis of five logistic models, with one of five pelvic floor disorders as the outcome of interest for each model. The presence of hypermobility syndrome was the exposure of interest in each model. Adjusted OR were obtained by including the delivery group in each of the five models (with spontaneous vaginal delivery as the reference).

Results

Of 1,011 in the MOAD enrollment cohort [1], we excluded 420 women who had never experienced the second stage of labor, leaving 591 for analysis. Four additional women were excluded due to missing Beighton score, leaving a sample of 587 for this analysis. Forty-six of 587 (7.8 %) women met the criterion for benign joint hypermobility syndrome (Beighton score ≥4). The characteristics of women with and without hypermobility are shown in Table 1. As noted, women with hypermobility were somewhat younger at the time of enrollment and were somewhat less likely to have delivered their first child after age 35. There were no differences between groups with respect to race, multiparity, or obesity [body mass index (BMI) ≥30 kg/m²].

Obstetrical outcomes are described in Table 2. Women with hypermobility experienced less operative intervention in the second stage of labor. Specifically, women with hypermobility were significantly less likely to experience cesarean or operative vaginal birth (*p*=0.049). Women with hypermobility were less likely to have experienced prolonged second-stage labor, although the difference was not significant (*p*=0.164). Finally, women with hypermobility were significantly less likely to have experienced an anal

Table 3 Pelvic floor disorders and Beighton flexibility scores at enrollment (e.g., 5–10 years after first delivery) among the 587 women with a history of reaching the second stage of labor

Pelvic Floor Disorder	Beighton score		Unadjusted OR (95 % CI) ^a	Adjusted OR ^b (95 % CI) ^a
	<4 <i>N</i> =541	≥4 <i>N</i> =46		
Stress urinary incontinence, <i>n</i> =82 (14 %)	73 (13 %)	9 (20 %)	1.56 (0.72, 3.37)	1.62 (0.74, 3.52)
Overactive bladder, <i>n</i> =54 (9 %)	51 (9 %)	3 (7 %)	0.67 (0.20, 2.24)	0.77 (0.23, 2.60)
Anal incontinence, <i>n</i> =72 (12 %)	66 (12 %)	6 (13 %)	1.08 (0.44, 2.64)	1.14 (0.46, 2.80)
Prolapse symptoms, <i>n</i> =21 (4 %)	21 (4 %)	0 (0 %)	- ^c	- ^c
Prolapse on examination, <i>n</i> =65 (11 %)	60 (11 %)	5 (11 %)	0.98 (0.37, 2.57)	0.95 (0.36, 2.53)

^a95% Confidence interval

^bOdds ratio (OR) adjusted by delivery group: either cesarean, spontaneous vaginal, or operative vaginal birth

^cUndefined due to no symptoms among those with Beighton score ≥4

sphincter laceration ($p=0.021$). In an analysis at the delivery-level, adjusting for African American race, maternal age >35 at first delivery, multiparity, and obesity, we found that hypermobility was inversely associated with cesarean after complete cervical dilation or operative vaginal delivery [OR=0.51; 95 % confidence interval (CI): 0.27–0.95] and anal sphincter laceration (OR=0.19; 95 % CI 0.04–0.80) but not prolonged second stage of labor (OR=0.63; 95 % CI:0.35–1.13).

Association between hypermobility and pelvic floor disorders is shown in Table 3. Hypermobility did not increase the relative odds for any pelvic floor disorder considered. This observation was not affected in a multivariable logistic model controlling for delivery group.

Discussion

Our results suggest that women with benign joint hypermobility syndrome are significantly more likely to deliver by spontaneous vaginal birth than women without hypermobility. More specifically, they were less likely to deliver by cesarean after complete cervical dilation and less likely to deliver by operative vaginal birth than women without hypermobility. This finding is consistent with our hypothesis. Joint laxity may allow for more easy passage of the fetal head through the pelvis. Thus, from an obstetrical perspective, joint hypermobility may be advantageous to facilitate spontaneous vaginal birth.

We were surprised to find no evidence of an association between joint hypermobility syndrome and any of the pelvic floor disorders considered. Prior research suggested an association, especially for hypermobility and prolapse. Prior studies compared women seeking treatment for prolapse with controls seeking gynecologic care, and therefore, unmeasured differences between cases and controls may have influenced results. Also, the prevalence of hypermobility reported in these prior studies is much higher than would be expected. For example, among healthy female blood donors, benign joint hypermobility syndrome was identified in 10 % [8]. The prevalence of joint hypermobility in our study population was 7.8 %, which is similar to the reported rate. In contrast, Al-Rawi [9] identified hypermobility among 66 % of 76 consecutive women with prolapse versus 18 % of 76 age- and parity-matched controls. In 1995, Norton [10] found that women 50 % of 36 women with stage 2–3 cystocele had hypermobility, in contrast to 27 % of 70 women with grade 0–1 cystocele. Finally, in 2010, Aydeniz [11] noted hypermobility in 54 % of 75 women presenting for treatment of prolapse versus 10 % in 52 volunteers. Thus, the prevalence of benign hypermobility syndrome among both cases and controls is unexpectedly high in these published studies.

A limitation of our research is that we assume that hypermobility identified at the time of MOAD study enrollment played a role in obstetrical events 5–10 years prior. It is uncertain whether hypermobility changes over a lifespan, although the prevalence of hypermobility appears to decrease with age. For example, hypermobility syndrome has been diagnosed among <1 % of postmenopausal women [18] versus 7.5 % of younger women [19] versus 13 % of school children [20]. Therefore, we cannot with certainty conclude that the hypermobility observed at the time of study enrollment was present prior to childbearing. A prospective study would be necessary to confirm our observations. Additionally, our exclusion of women who never experienced the second stage of labor may have contributed to selection bias, especially with regard to women who elected to deliver via cesarean without obvious medical indication.

This study investigates associations at a single point in time (e.g., 5–10 years from first delivery). The median age of this population was close to 40 years, and it is plausible that the impact of hypermobility syndrome on pelvic floor disorders is not seen until later in life. Longitudinal follow-up of this cohort will establish whether women with hypermobility syndrome will experience a higher incidence of pelvic floor disorders over time. In addition, as this population ages and pelvic floor disorders become more prevalent, we anticipate greater statistical power to investigate less common outcomes (such as bothersome symptoms of prolapse).

In summary, our results suggest that joint hypermobility may facilitate spontaneous vaginal birth but is not a risk factor for pelvic floor disorders 5–10 years after delivery. Other local or systemic connective tissue factors may play a role in the genesis of pelvic floor disorders. Additional research is needed to identify at-risk phenotypes for the development of pelvic floor disorders so that prevention efforts can be targeted appropriately.

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Conflicts of interest None.

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