Effect of Spinal Manipulation on Pelvic Floor Functional Changes in Pregnant and Nonpregnant Women: A Preliminary Study

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Abstract

Objective: The aim of this study was to investigate whether a single session of spinal manipulation of pregnant women can alter pelvic floor muscle function as measured using ultrasonographic imaging.

Methods: In this preliminary, prospective, comparative study, transperineal ultrasonographic imaging was used to assess pelvic floor anatomy and function in 11 primigravid women in their second trimester recruited via notice boards at obstetric caregivers, pregnancy keep-fit classes, and word of mouth and 15 nulliparous women recruited from a convenience sample of female students at the New Zealand College of Chiropractic. Following bladder voiding, 3-/4-dimensional transperineal ultrasonography was performed on all participants in the supine position. Levator hiatal area measurements at rest, on maximal pelvic floor contraction, and during maximum Valsalva maneuver were collected before and after either spinal manipulation or a control intervention.

Results: Levator hiatal area at rest increased significantly ($P < .05$) after spinal manipulation in the pregnant women, with no change postmanipulation in the nonpregnant women at rest or in any of the other measured parameters.

Conclusion: Spinal manipulation of pregnant women in their second trimester increased the levator hiatal area at rest and thus appears to relax the pelvic floor muscles. This did not occur in the nonpregnant control participants, suggesting that it may be pregnancy related. (J Manipulative Physiol Ther 2016;39:339-347)

Key Indexing Terms: *Chiropractic; Manipulation, Spinal Manipulation; Pelvic Floor Disorders; Pregnancy; Ultrasonography*

The role of the pelvic floor muscles (PFMs) in spinal stabilization has been well documented.[1,2] The PFMs are coactivated with the abdominal muscles particularly transversus abdominis during exercise and increases in intraabdominal pressure.[3] The PMFs, also known as the *levator ani muscle complex*. are intimately involved in the birth process, mainly during the second stage of labor. The consequences of a difficult vaginal delivery, particularly when intervention is required, are strongly correlated to the development of PFM dysfunction. This often manifests as stress urinary incontinence, pelvic organ prolapse, and/or fecal incontinence.[4–8] The social and economic cost of pelvic floor dysfunction is enormous.[9]

It has previously been demonstrated that sacroiliac manipulation significantly improves the feed-forward activation of the transversus abdominus.[10] Lumbar spine mobilization has been shown to change the activation of the abdominal oblique muscles.[11] Recently, real-time ultrasonographic imaging was used to demonstrate improved contraction of the transversus abdominus muscle following sacroiliac joint manipulation.[12] As the PFMs are known to be coactivated with transversus abdominis,[3] we hypothesize that sacroiliac and/or lumbar spine manipulation can affect PFM function.

Women who have increased bladder neck descent and a concomitant increase in levator hiatal area are more likely to have an uncomplicated vaginal delivery.[13] If lumbopelvic manipulations are able to alter PFM function, then this could be beneficial during the second stage of labor. The ability of the PFM to stretch during vaginal delivery is highly likely to be related to the risk of PFM damage.

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Paper submitted February 8, 2015; in revised form November 10, 2015; accepted November 10, 2015.

0161-4754

http://dx.doi.org/10.1016/j.jmpt.2016.04.004

Reduction in the incidence of PFM damage and consequent sequelae is a research priority.[14] As the use of chiropractic care during pregnancy is becoming more popular, this technique could be of benefit in the future.

Chiropractic care is often used in the care of pregnant women, particularly for low back pain. A survey of 1531 women in South Australia found that 35.5% of women experienced moderately severe low back pain during pregnancy and that two-thirds of this group had persistent back pain following pregnancy.[15] A study of obstetric caregivers and pregnant women in New Haven, CT, found that 61.7% of the pregnant women and 36.6% of the obstetric caregivers would consider chiropractic care for low back pain during pregnancy.[16] A retrospective study of 400 pregnancies and deliveries was undertaken by interview of 170 consecutive female patients presenting to 5 chiropractic offices in the Niagara Peninsula in Canada. Back pain was reported during 42.5% of the pregnancies and 44.7% of the deliveries. Those that had received manual manipulation reported significantly less pain during labor.[17] A retrospective case series studies found that chiropractic care, averaging only 1.8 visits, led to clinically important improvement in 16 of 17 cases of low back pain in pregnancy with no adverse effects.[18]

Quantitatively assessing the effect of spinal adjustment on PFM function has not previously been done. However, the use of 3-/4-dimensional (3D/4D) transperineal ultrasonography has been shown to be a reliable and effective method to assess PFM function.[19–21] A number of biometric parameters have been identified to quantify the function and morphology of the PFMs using this technique with good reproducibility.[22] The goal of this study was to use 3D/4D ultrasonography to determine if spinal manipulation alters pelvic floor function in pregnant women.

Methods

Data Collection

The protocol for the acquisition of pelvic floor ultrasonography was according to previously published methodology[23] and took place before and after either a spinal manipulation session or a control session. These 2 sessions occurred on different days (in randomized order) for the nonpregnant women. For the pregnant women, to minimize their time involvement, the ultrasonographic scanning, control intervention, and spinal manipulation took place sequentially on the same day. The advantage of using 3D/4D transperineal ultrasonography[22] is that it is noninvasive, quick, easily accessible, and inexpensive. Transperineal ultrasonography has also been deemed safe for use in pregnancy.

All participants were imaged before and following the intervention or control procedure by an experienced PFM ultrasonographic operator (J.K.). The 3D/4D transperineal ultrasonography was performed using previously published methodology[23] with a Philips IU22 ultrasonographic machine (Philips Ultrasound, Bothwell, WA), and a 6-2–MHz volume curved array transducer. The probe was covered with a disposable glove or plastic wrap for hygienic purposes and orientated in the midsagittal plane on the perineum. All participants were asked to void before the imaging. Volume data sets were obtained at rest, on maximum PFM contraction (PFMC), and during maximum Valsalva using the plane of minimal dimensions as reference.[23] The most effective PFMC and Valsalva were used for measurement purposes. Postprocessing was performed using the software QLAB Version (8.1). Hiatal dimensions measured included hiatal areas and anterior-posterior and lateral diameters at rest, on maximum PFMC, and during maximum Valsalva.

Inclusion Criteria

Pregnant Women. Eleven women in their first pregnancy were recruited. They were recruited via notice boards at obstetric caregivers, pregnancy keep-fit classes, and word of mouth. The pregnant women were required to be in the second trimester of their first pregnancy with a self-referral or lead maternity caregiver referral to one of the participating chiropractic clinics. They could not have had any history of recurrent miscarriage and could not be in a high-risk pregnancy (as determined by their lead maternity caregiver).

Nonpregnant Women. Fifteen nulliparous women were recruited to act as a comparison group to the pregnant group to see whether any potential changes seen with spinal manipulation occur regardless of whether or not the women were pregnant, or whether any changes occurred only in pregnancy or nonpregnancy. They were recruited from a convenience sample by surveying female students at the New Zealand College of Chiropractic.

All women in both groups were aged between 18 and 35 years. Exclusion criteria for all women in both groups were as follows: symptoms of stress urinary incontinence, pelvic organ prolapse, or any known contraindication to receiving chiropractic adjustments, such as a recent history of trauma, or known conditions such as inflammatory or infectious arthropathies, or bone malignancies. All participants received written and verbal information about the study before inclusion, and informed consent was obtained. The study was approved by the New Zealand Northern Y Regional Ethics Committee (ref. NTY/07/08/087) and was conducted in accordance to the Declaration of Helsinki.

Experimental Process

Once eligible participants were recruited into the study, they were required to complete the eligibility questionnaire. If eligible, they were assessed in more detail for any symptoms indicative of possible pelvic floor dysfunction, pelvic surgery, or family history of pelvic floor dysfunction. Questions on symptoms of urinary stress incontinence, bowel dysfunction, and prolapse were included. Following this, they were assessed by the registered chiropractor, and a thorough health history was obtained. All eligible participants (in both groups) received both the spinal manipulation intervention and the control setup intervention. For the pregnant group, both interventions were conducted during the same session with the control setup condition first followed by the spinal manipulation intervention. The pregnant group received both interventions during the same session to minimize the effect of increasing gestation on the results. For the nonpregnant comparison group, the 2 interventions were carried out on different days in a random order.

Participant Assessment and Interventions

At the beginning of any recording session (before any data collection), the participant's spines were assessed for the presence of spinal dysfunction by a registered chiropractor (with at least 10 years of clinical experience). The clinical indicators that were used to assess the function of the spine before and after each spinal manipulation intervention included assessing for tenderness to palpation of the relevant joints, manually palpating for restricted intersegmental range of motion, assessing for palpable asymmetric intervertebral muscle tension, and any abnormal or blocked joint play and end-feel of the joints. All of these biomechanical characteristics are known clinical indicators of spinal dysfunction.[24–30] Areas of dysfunction were then manipulated as clinically indicated.

The spinal manipulation intervention consisted of spinal manipulation of the participants' dysfunctional spinal segments. All of the spinal manipulations carried out in this study were high-velocity, low-amplitude thrusts to the spine or pelvic joints. This is a standard manipulation technique used by chiropractors. The mechanical properties of this type of CNS perturbation have been investigated; and although the actual force applied to the participant's spine depends on the therapist, the patient, and the spinal location of the manipulation, the general shape of the force-time history of spinal manipulations is very consistent,[31] and the duration of the thrust is always less than 200 milliseconds (for review, see Herzog[32]). The high-velocity type of manipulation was chosen specifically because previous research[33] has shown that reflex electromyographic activation observed after manipulations only occurred after high-velocity, low-amplitude manipulations (as compared with lower-velocity mobilizations). This manipulation technique has also been previously used in studies that have investigated neurophysiological effects of spinal manipulation (for review, see Haavik and Murphy[34]).

The control intervention consisted of passive and active movements of the participant's head, spine, and body that were carried out by the same chiropractor who prechecked the participants for spinal dysfunction and who performed the spinal manipulations in the experimental intervention session. This control intervention involved the participants being moved into the manipulation setup positions where the chiropractor would normally apply a thrust to the spine to achieve the manipulations. However, the experimenter was particularly careful not to put pressure on any individual spinal segments. No spinal manipulation was performed during any control intervention. This control intervention was not intended to act as a sham manipulation but to act as a physiological control for possible changes occurring due to the cutaneous, muscular, or vestibular input that occurs with the type of passive and active movements involved in preparing a participant/patient for a manipulation. It also acted as a control for the effects of the stimulation necessary to collect the dependent measures of the study and acted as a control for the time required to carry out the manipulation intervention.

Data Analysis

The experimental measure (levator hiatus area) was assessed and found to be of normal Gaussian distribution. All statistical analyses were performed using SPSS v12 for Windows (SPSS Inc, Chicago, IL) by running 3-way repeated-measures analyses of variance separately for each measure (ie, area at rest, on Valsalva, and during maximum PFMCs with factors "Intervention" [control vs spinal manipulation], "Time" [pre vs post], and "Group" [pregnant vs nonpregnant chiropractic students]). Post hoc paired t tests were conducted as needed. Significance was set at $P = .05$.

Results

For the control group, the women were aged from 19 to 32 years (mean age, 22.9 years), ranged from 160 to 181 cm tall (mean height, 168 cm), and weighed from 55 to 85 kg (mean weight, 66.5 kg). They were mostly of European descent except for 2 that were from Indian decent, 1 Samoan, and 1 of Asian descent. They were all chiropractic students, except for 1 who was a chiropractor, and all reported receiving regular chiropractic adjustments.

For the pregnant group, the women were aged from 18 to 38 (mean age, 30.1 years), ranged from 155 to 167 cm tall (mean height, 160.3 cm), and weighed from 61 to 81 kg (mean weight, 65.6 kg). Their gestational age ranged from 16 to 25 of 40 weeks (mean gestational age, 22.1/40 weeks). Additional participant demographics can be seen in Tables 1 and 2.

There was an interactive effect for Group vs Intervention vs Time ($F_{1,10} = 7.65$, $P = .02$) for levator hiatal area at rest. There were no interactive effects for hiatal area during Valsalva or during voluntary contraction. The pregnant group had an Intervention vs Time interactive effect ($F_{1,10} = 15.0$, $P = .003$). Paired t tests revealed that spinal manipulation of the pregnant women increased levator hiatal area at rest

Table 1. *Demographics and General Characteristics of the Nonpregnant Control Participants*

Chiro Students									
Participant	Age (y)	Weight (kg)	Stress Incontinent	Urge Incontinent	Frequency	Nocturia	Voiding	Symptoms of Prolapse	Bowel Symptoms
C 1	22	57	None	None	Normal	No	Normal	None	None
C 2	19	85	None	None	Normal	No	Normal	None	None
C 3	20	62	None	None	Normal	No	Normal	None	None
C 4	22	80	None	None	Normal	No	Normal	None	None
C 5	28	69	None	Weekly	6/d	No	Normal	None	None
C 6	20	57	Occasionally	None	Normal	Occasionally	Normal	None	None
C 7	20	59	None	None	Normal	No	Normal	None	None
C 8	20	69	None	None	Normal	No	Normal	None	None
C 9	25	62	None	None	Normal	No	Normal	None	None
C 10	23	55	None	None	Normal	1/night	Normal	None	None
C 11	22	65	None	None	Normal	No	Normal	None	None
C 12	32	57	None	None	8-12/d	1/night	Normal	None	None
C 13	23	70	None	None	Normal	No	Normal	None	Incomplete emptying
C 14	20	71	None	None	Normal	2/night	Normal	None	None
C 15	27	80	None	None	Normal	No	Normal	None	None

Table 2. *Demographics and General Characteristics of the Pregnant Participants*

Participant	Age (y)	Weight (kg)	Stress Incontinent	Urge Incontinent	Urine Frequency	Nocturia	Voiding	Prolapse Symptoms	Bowel Symptoms
P 1	33	60	None	None	Normal	None	Normal	None	None
P 2	34	61	None	None	Normal	1/night	Normal	Lump	None
P 3	25	63	None	None	Normal	None	Normal	None	None
P 4	30	58	None	Monthly	6-8/d	2/night	Normal	None	Constipation, not frequent
P 5	32	65	None	None	Normal	None	Normal	None	None
P 6	18	69	Occasionally	None	5/d	None	Normal	None	None
P 7	30	81	None	None	8-12/d	1/night	Normal	None	None
P 8	38	63	None	None	8-12/d	None	Normal	None	None
P 9	31	64	None	None	>17/d	None	Normal	None	None
P 10	33	73	None	None	Normal	None	Normal	None	None
P 11	34	61	None	None	Normal	1/night	Normal	Lump	None

significantly, with an average increase of 2.3 cm^2 ($P = .003$). No significant change was found postmanipulation with the nonpregnant women. Figure 1 shows the hiatal area of 1 pregnant woman at rest pre– and post–spinal manipulation, and Figure 2 shows a scatter plot of the participants before and after manipulation.

Biometric indices of the levator hiatus area at rest, during PFM contraction, and during Valsalva maneuver for both the pregnant and nonpregnant group can be seen in Table 3. Interestingly, the nonpregnant chiropractic students' levator hiatal area during the voluntary Valsalva maneuver was 20 ± 4.0 cm^2. This is larger than has been seen previously reported for "normal" control participants in published studies.[35,36] In fact, this area measurement on Valsalva has only previously been seen in elite nulliparous athletes,[35] during third trimester of pregnancy,[36] or during second trimester of pregnantcy as shown in this study. The chiropractic students' levator hiatus areas at rest and during maximal voluntary pelvic floor contractions on the other hand are comparable with what has previously been reported in the literature for "normal" control participants.[35,36] Figure 3 represents a nonpregnant chiropractic student hiatal area at rest and during Valsalva. Note the large increase in hiatal area during Valsalva.

Discussion

This study is the first to show that spinal manipulation of pregnant women in their second trimester appears to relax the PFMs at rest as reflected by an increase in levator hiatus area measured with translabial 3D ultrasonography. No changes occurred postmanipulation in the nonpregnant control group; thus, the changes seen in the pregnant group may be unique to pregnancy. A second novel finding is that the nonpregnant control group that consisted of a convenience sample of local chiropractic students appears to be able to elicit an effective voluntary Valsalva maneuver to a similar degree only previously seen in elite nulliparous women[35] or in pregnant women.[36]

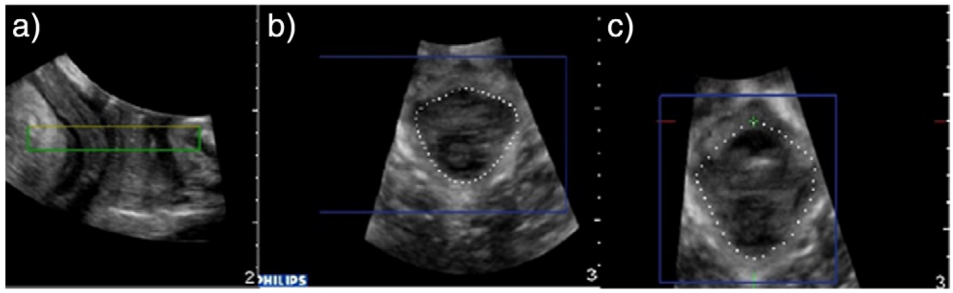

Fig 1. *Representative transperineal ultrasonographic image of 1 pregnant participant. a, The diagonal line indicates identification of the plane of minimal dimensions in the midsagittal plane. b, The dotted line indicates the area measurement of the hiatus at rest before spinal manipulation. c, The dotted line indicates the area measurement of the hiatus at rest following spinal manipulation. Note the increase in levator hiatus area at rest postmanipulation compared with baseline.*

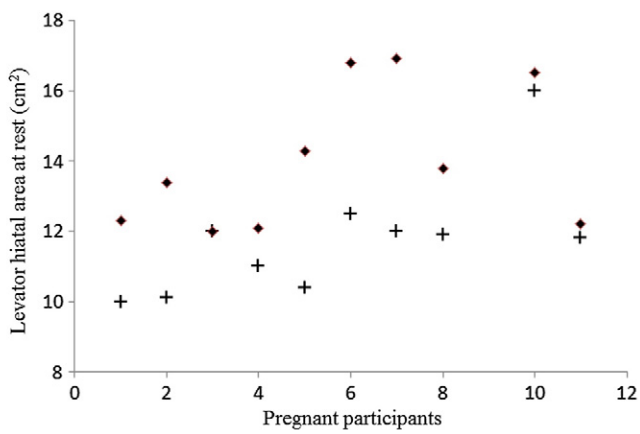

Fig 2. *Scatter plot of the levator hiatus area (cm^2) of the pregnant participants at rest before (crosses) and after (diamonds) spinal manipulation. Note that each participant's hiatal area increases postmanipulation aside from 1 that did not change. The average premanipulation area was 11.8 ±1.7 cm^2, and the average postmanipulation area was 14.0 ± 2.0 cm^2, an average increase of 2.3 cm^2 (P = .003).*

The Levator Hiatus and Pregnancy

The other levator hiatal dimensions in the pregnant group are similar to what has been shown previously for pregnant women in their third[36] and second trimester.[37] It has been postulated that the mechanical and hormonal effects of pregnancy can lead to biomechanical, neurological, or neuromuscular changes to the pelvic floor and pelvic organ supports[38,39] that may contribute to pelvic floor dysfunction, independent of delivery mode. A previous study found that both hiatal dimensions and urethral mobility were markedly higher in women in late pregnancy and at 4 months after giving birth,[36] suggesting a very substantial mechanical and/or hormonal effect of pregnancy on the pelvic floor. Our study did not find any differences between the hiatal dimensions at baseline between the group of women in their second trimester and our nonpregnant control group. The hiatal areas for both groups at rest are similar to what has been shown previously for nonpregnant women.[36,40] After spinal manipulation, the hiatal area of the pregnant women at rest was on average 14.0 ± 2.0 cm^2. This is similar to what has been previously shown for women in late pregnancy (average of 15.1 ± 3.2 cm^2). This increase in hiatal area at rest for the pregnant group following spinal manipulation may be a result of the manipulation itself, as this was not present following a "sham" (control) maneuver. This relaxation of the levator ani muscles is likely to be beneficial for a vaginal delivery, suggesting that spinal manipulation may be of benefit to pregnant women to relax their PFMs if this does not occur naturally for them. However, this would need to be explored further to see if chiropractic care improves labor outcomes. In this regard, it should be highlighted that the pregnant women were manipulated where clinically indicated as assessed by the chiropractor, and this varied from woman to woman. It is unknown whether specific segments need to be manipulated to induce the observed effects in this study or whether it is improving the function of dysfunctional segments that

Table 3. *Biometric Indices of the Levator Hiatus at Rest, During PFMC, and During Valsalva Maneuver (Units in cm²) for Both the Pregnant and Nonpregnant Groups*

	Chiro Students		Pregnant	
A	Pre-Control	Post-Control	Pre-Control	Post-Control
Levator hiatal area at rest (cm^2)	12.3 ± 2.8	13.2 ± 2.7	12.2 ± 2.1	12.8 ± 1.9
Levator hiatal area on PFMC (cm^2)	9.0 ± 2.1	8.8 ± 1.6	9.1 ± 1.0	9.4 ± 1.1
Levator hiatal area on Valsalva (cm^2)	18.9 ± 6.3	18.2 ± 5.1	18.3 ± 2.9	18.4 ± 3.3
AP dimension at rest (cm)	4.9 ± 0.7	5.0 ± 0.7	4.8 ± 0.4	4.9 ± 0.6
AP dimension on PRFC (cm)	3.9 ± 0.8	4.1 ± 1.4	3.7 ± 0.5	3.8 ± 0.4
AP dimension on Valsalva (cm)	5.8 ± 1.1	5.5 ± 1.1	5.6 ± 0.4	5.8 ± 0.6
Transverse dimension at rest (cm)	3.6 ± 0.4	3.9 ± 0.3	3.7 ±0.3	3.8 ± 0.4
Transverse dimension on PRFC (cm)	3.2 ± 0.4	3.7 ± 1.7	3.4 ±0.2	3.5 ± 0.3
Transverse dimension on Valsalva (cm)	4.3 ± 0.6	4.23 ± 0.7	4.2 ± 0.3	4.3 ± 0.3
B	**Pre-SM**	**Post-SM**	**Pre-SM**	**Post-SM**
Levator hiatal area at rest (cm^2)	12.8 ± 2.1	12.6 ± 2.4	12.2 ± 2.1	14.0 ± 2.0 *
Levator hiatal area on PFMC (cm^2)	10.1 ± 1.8	10.6 ± 1.7	9.1 ± 1.0	9.8 ± 1.2
Levator hiatal area on Valsalva (cm^2)	19.9 ± 7.4	20.6 ± 7.0	18.3 ± 2.9	20.0 ± 4.0
AP dimension at rest (cm)	5.1 ± 0.6	5.0 ± 0.8	4.8 ± 0.4	5.1 ± 0.4
AP dimension on PRFC (cm)	4.2 ± 0.7	4.3 ± 0.5	3.7 ± 0.5	4.0 ± 0.4
AP dimension on Valsalva (cm)	5.8 ± 1.1	6.2 ± 1.6	5.6 ± 0.4	5.9 ± 0.8
Transverse dimension at rest (cm)	3.6 ± 0.3	3.6 ± 0.4	3.7 ±0.3	4.0 ± 0.4
Transverse dimension on PRFC (cm)	3.4 ± 0.4	3.3 ± 0.4	3.4 ±0.2	3.4 ± 0.4
Transverse dimension on Valsalva (cm)	4.4 ± 0.7	4.6 ± 0.8	4.2 ± 0.3	4.5 ± 0.6

AP, anterior-posterior; PFMC, pelvic floor muscle contraction; PRFC, pelvic rest floor contraction; SM, spinal manipulation.
* $P < .01$ compared to preintervention data.

produces the relaxation of levator hiatus as observed in this study.

Nonpregnant Changes With Spinal Manipulation

Our study also found that both groups were able to produce hiatal areas of at least 20 cm^2 on the voluntary Valsalva maneuver. This is similar to what is seen in women in late pregnancy.[36] However, it was an interesting and unexpected finding to discover the large levator hiatus areas that the nonpregnant control group was able to produce during the voluntary Valsalva maneuver. This may be due to the fact the control group consisted of chiropractic students who may have received chiropractic care more regularly because a previous study has shown that sacrum manipulation increased phasic perineal contraction and basal perineal tonus in young healthy nulliparous women.[41] Previous studies have also shown that spinal manipulation can alter motor control in a variety of ways in asymptomatic persons.[10,42–44] The timing of core muscle contractions,[10] muscle-specific changes in intracortical facilitatory and inhibitory processing, and control has been observed,[43,44] as have changes in cortical drive,[42] lowered recruitment threshold of motor neurons to Ia afferent input,[42] prevention of fatigue,[42] and an increase in maximal voluntary muscle contractions of a lower limb muscle.[42] It has been hypothesized that spinal manipulation of dysfunctional spinal and/or pelvic segments improves somatosensory processing and sensorimotor and mulitimodal integration,[34,45–47] thus producing improved motor control. As the control participants had received more frequent chiropractic care, they may be more kinesthetically aware[48] and did not have the same degree of co-contraction during a voluntary Valsalva as is often seen in nulliparous women. This was also observed previously in a cohort of elite athletes.[35] There was no difference between the chiropractic students' levator hiatal area values at rest and during contractions as compared with other "normal" control participants in previously published studies.[35,36]

Limitations

Because of the small sample size, the results in this study need to be interpreted with caution. Future research should follow up these findings both to investigate the effect of spinal manipulation during pregnancy and the potential effects on birth outcomes, and to explore why chiropractic students can contract their PFMs to the degree that they could in this study. Limitations of this study include that the time frame for the interventions in the pregnant cohort was not exactly the same as in the nonpregnant cohort, which may have influenced the comparisons between the groups. Another consideration to be noted is that some of the pregnant women were naive to chiropractic care, whereas those in the nonpregnant group were all familiar with chiropractic. It is therefore possible that the effect seen in the pregnant group may be a consequence of first exposure to chiropractic, although for those pregnant women familiar with chiropractic care, the effect was still present, suggesting that the postmanipulation changes in pelvic floor function were a genuine clinical outcome. Future work could

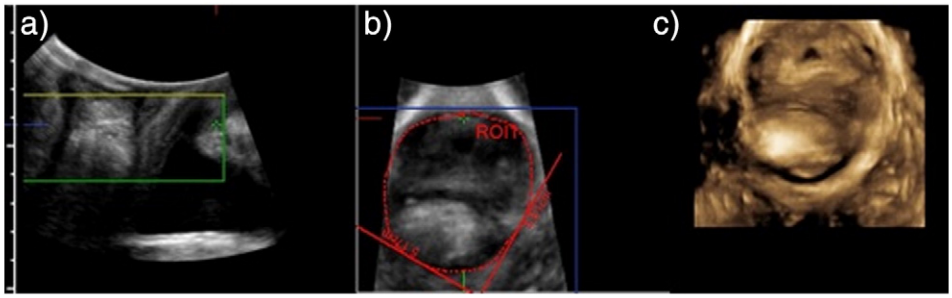

Fig 3. *Representative transperineal ultrasonographic image of 1 nonpregnant chiropractic student. a, The diagonal line indicates identification of the plane of minimal dimensions in the midsagittal plane. b, The dotted line indicates the area measurement of the hiatus during voluntary Valsalva maneuver. c, The volume image of the area measurement of the hiatus during voluntary Valsalva maneuver. Note the unusually large levator hiatus area during Valsalva in a nonpregnant control participant.*

include larger cohorts of pregnant women who have or have not had chiropractic care in the past. It should also be noted, in light of the current findings, that pregnant women who have perineal hypotonia may not be suitable to receive spinal manipulation.

Conclusion

This study showed that spinal manipulation of pregnant women in their second trimester appears to relax the PFMs at rest, as reflected by an increase in levator hiatus area measured with translabial 3D ultrasonography. No changes occurred postmanipulation in the nonpregnant control group; thus, the changes seen in the pregnant group may be due to the hormonal changes of pregnancy. This relaxation of the levator ani muscles seen with spinal manipulation may mean that spinal manipulation could be of benefit to pregnant women's vaginal delivery by aiding the relaxation of their PFMs if this does not occur naturally for them. A second novel finding is that the nonpregnant control group, which consisted of a convenience sample of local chiropractic students, appears to be able to perform a voluntary Valsalva maneuver to a similar degree only previously seen in elite athletic[35] or pregnant women.[36]

Funding Sources and Conflicts of Interest

The authors acknowledge the following organizations for support and funding: Australian Spinal Research Foundation, Hamblin Chiropractic Research Fund Trust, and the New Zealand College of Chiropractic. No conflicts of interest were reported for this study.

Contributorship Information

Concept development (provided idea for the research): B.M., H.H., J.K.
Design (planned the methods to generate the results): B.M., H.H., J.K.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): H.H., J.K.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): H.H., J.K.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): H.H., J.K.
Literature search (performed the literature search): B.M., H.H., J.K.
Writing (responsible for writing a substantive part of the manuscript): B.M., H.H., J.K.
Critical review (revised manuscript for intellectual content; this does not relate to spelling and grammar checking): B.M., H.H., J.K.

Practical Applications

- This study shows that spinal manipulation of pregnant women in their second trimester appears to relax the PFMs at rest, as reflected by an increase in levator hiatus area measured with transperineal 3D ultrasonography.
- No changes occurred postmanipulation in the nonpregnant control group; thus, the changes seen in the pregnant group may be unique to pregnancy.
- This relaxation of the levator ani muscles seen with spinal manipulation suggests that spinal manipulation could be of benefit to pregnant women's vaginal delivery by aiding the relaxation of their PFMs if this does not occur naturally for them.

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