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Original Article

Musculoskeletal treatment of pregnant women with severe pelvic and low back pain

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ABSTRACT

INTRODUCTION. Back pain in pregnancy affects up to 90% of pregnant women, limits physical activity and mental health and has substantial socioeconomic implications. Musculoskeletal techniques (MT) are safe hands-on treatments for back pain and are easy to learn. This study evaluated the feasibility and impact of using MT on pain and function in pregnant women with back pain.

METHODS. This feasibility study included pregnant women with moderate or severe back pain who received two MT treatments at a 14-day interval and a healthy reference group. Pain intensity (numeric rating scale), functional disability (the Oswestry Disability Index) and activity limitations (the Pelvic Girdle Questionnaire) were assessed at baseline and after treatment. We performed the Mann-Whitney, marginal homogeneity and paired t-tests to investigate differences between groups.

RESULTS. The intervention group (n = 50) showed a significant reduction in pain intensity (numeric rating scale 7.2 ± 1.6 to 2.3 ± 1.4, p <0.001), Oswestry Disability Index score (50.5 ± 13.2 to 28.6 ± 14.8, p < 0.001), and Pelvic Girdle Questionnaire score (71.1 ± 11.9 to 47.7 ± 17.2, p < 0.001) after treatment. 72% of the intervention group reported severe pain, which decreased to 2% after the intervention. Post-intervention pain levels in the treatment group were similar to those of the reference group (n = 20) at baseline (p = 0.74).

CONCLUSIONS. Two MT treatments are implementable in a Danish public hospital setting and may be effective in relieving pregnant women from their severe back pain. A clinical randomised study is needed.

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TRIAL REGISTRATION. The Danish Data Protection Agency (no. P-2021-535).

Pregnancy-related back pain affects 70-90% of pregnant women, increases with gestational age and is an important public health issue that limits daily physical activities and negatively affects mental health [1-4]. The socioeconomic impact of such pain is notable; a Danish cohort study (n = 566) found sick leave rates between 18-60% at gestational week 20 and 50-75% by week 32, when severe back pain was reported [1]. In Sweden, the cost of sick leave due to pregnancy-related back pain amounted to approximately €24.6 million in 2003 [3].

Back pain is multifactorial, stemming from hormonal changes, increased pelvic mobility and altered posture [1, 3-5]. Various treatment options for back pain, including musculoskeletal techniques (MT) have been tested in

non-pregnant individuals, demonstrating positive effects on back pain [5-8]. Only a few randomised studies of low to moderate quality have investigated MT in pregnant women with back pain and are described in a Cochrane review and two systematic reviews and meta-analyses, which identify heterogeneity as a weakness [7, 9, 10]. Therefore, further high-quality studies are required. The use of painkillers is rarely recommended due to safety concerns for both the mother and foetus, emphasising the need for an effective manual therapeutic method.

The primary aim of this study was to examine whether two treatments of MT, including myofascial release (MFR), muscle energy technique (MET) and counterstrain (CST) [11], were associated with changes in patients' evaluations of severe back pain. A further aim was to explore whether MT can be feasibly implemented for women with pregnancyrelated back pain, and to prepare the ground for an RCT.

Methods

This feasibility study was conducted in an antenatal care setting at a Danish public hospital and included pregnant women experiencing back pain. The study was conducted from 1 May 2023 to 31 March 2024. The inclusion criteria were singleton pregnancy, age ≥ 18 years and back pain for at least the last three weeks, rated > 3 on an 11-item numeric rating scale (NRS). Participants were required to understand, read and speak Danish. The exclusion criteria included prior knee or hip surgery or current disc herniation. The study site, North Zealand Hospital, Copenhagen University, handles 4,000 deliveries annually.

Eligible women were invited to join the intervention group during pregnancy after assessment by their midwife or obstetrician. Participants received two treatments with MT at a 14-day interval.MT were performed by two chief physicians (an anaesthesiologist and an obstetrician) which had achieved a master's degree in MT. The MFR technique targets fascial tension through pressure and stretching [11]. In pregnant women, the most frequently used points for performing MFR are at the gluteal muscles and the quadratus lumborum muscle. MET involves the contraction of muscles against therapist-provided resistance to enhance joint mobility and muscle flexibility [11]. The most frequent points used in this type of treatment are at the muscles surrounding the hip in all directions and the small muscles along the spinal column. CST is a pain-relief method that involves passive positioning to promote muscle relaxation and is well tolerated in patients with severe back pain, as it is not painful [12]. All three techniques are well described and well known in the MT field. All women were examined using a standardised protocol, testing muscles from the neck to the feet. Each intervention treatment session lasted approximately 30 minutes.

A reference group of healthy pregnant women was randomly recruited during routine antenatal visits at the midwife's office.

Baseline and post-treatment data were collected from validated self-report questionnaires before and just after the second treatment. The questionnaires focused on pain intensity and daily activities, utilising the NRS (0-10). Pain levels were categorised as: mild (0-3), moderate (4-6) or severe (7-10). Two validated questionnaires were used; the Pelvic Girdle Questionnaire (PGQ) [13] and the Oswestry Disability Index (ODI) (version 2.0) [14]. The PGQ evaluates activity limitations and symptoms from back pain using 25 items scored from 0 to 3. The scores were summarised, divided by the maximum score and converted into a percentage (from no disability (0%) to severe disability (100%)) [13]. The ODI assesses how low back pain affects daily life and comprises ten sections, each with six response options. The total points were divided by the maximum score and expressed as a percentage, indicating varying disability levels from mild (0-20%) to bed-bound or functional impairment (81-100%) [14]. Baseline and post-treatment questionnaires were distributed and answered electronically.

Data distributions were assessed using visual inspection of QQ plots and histograms. Data were calculated as

percentages, means and standard deviations for normally distributed data, or as medians and interquartile ranges for skewed data, and are presented as numbers (%) and means (± SD). Mann-Whitney tests assessed baseline differences in pain intensity between the post-treatment and reference groups using the NRS, ODI and PGQ outcomes. The marginal homogeneity test and the paired t-test were used to evaluate within-group differences in pain from baseline to post-treatment for ODI and PGQ outcomes, respectively. Statistical significance was set at 5%. Statistical analyses were performed using SPSS version 29 and R version 2024.04.2.

All participants received verbal and written information about the project and provided written informed consent prior to participation.

Ethics statement

This study was approved on 8 April 2021 by the Danish Data Protection Agency (no. P-2021-535) and the obstetric department at the study site.

Ethical approval was not required from the Danish Research Ethics Committees owing to its noninvasive nature. All participants received verbal and written information about the project and provided written informed consent prior to participation.

The online questionnaire responses were anonymised and blinded using REDCap, a secure web platform for building and managing online databases and surveys [15].

Data sharing statement

In accordance with Danish legislation, the dataset generated and analysed in the present study is not publicly available due to confidentiality requirements. However, the dataset may be made available from the corresponding author upon reasonable request. Transfer of individual participant data is permissible under the Danish Data Protection Act if approval from the Danish Data Protection Agency has been obtained and a Standard Contractual Clause has been completed to establish the legal basis for data transfer.

Trail registration: The Danish Data Protection Agency (no. P-2021-535).

Results

The analysis included 50 pregnant women in the intervention group and 20 healthy pregnant women in the reference group. However, only 44 participants contributed to the data in the post-intervention analyses as post-intervention data were missing for six participants; four who delivered at term before the second intervention could be administered, and two who did not complete the questionnaires.

The intervention and reference groups were similar in age, BMI and gestational age at inclusion (**Table 1**), with most participants having two or more years of higher education. Prior to pregnancy, 72% of the intervention group and 80% of the reference group reported pain such as lower back pain, gluteal pain and/or pubic bone pain. However, there were considerable differences in full-time sick leave rates (60% versus 25%, p = 0.001) and pain experienced in a previous pregnancy (34% versus 20%, p = 0.04) (Table 1).

TABLE 1 Baseline characteristics of the intervention and the reference groups.

	Intervention group (N_i = 50)	Reference group (N_r = 20)
Age[a], mean (± SD), yrs	33.20 (± 5.07)	31.95 (± 4.58)
BMI, pre-pregnancya, mean (± SD), kg/m²	26.18 (± 5.12)	25.26 (± 5.90)
Gestational age at inclusion[a], mean (± SD), wks	28.88 (± 5.12)	30.65 (± 3.15)
Parity[a], n (%)		
Nulliparous	12 (24)	9 (45)
1 previous delivery	31 (62)	7 (35)
2 previous deliveries	6 (12)	4 (20)
Educational level[a], n (%)		
Primary school	1 (2)	2 (10)
Vocational education	4 (8)	0
High school	6 (12)	0
Shorter higher education: < 2 yrs	2 (4)	1 (5)
Intermediate or higher education: ≥ 2 yrs	37 (74)	17 (85)
Employment before sick/maternity leave[a], n (%)		
Full-time	35 (70)	15 (75)
Part-time	7 (14)	1 (5)
Unemployed	4 (8)	2 (10)
Student	3 (6)	1 (5)
Stay-at-home	0	1 (5)
Other	1 (2)	0
Work status at inclusion[b], n (%)		
At work	10 (20)	14 (70)
Sick leave:		
Full-time	30 (60)	5 (25)
Part-time	7 (14)	0
Maternity leave	3 (6)	0
Pain prior to pregnancy?[b], n (%)		
Yes	36 (72)	16 (80)
None	11 (22)	2 (10)
Do not know/remember	3 (6)	1 (5)
Pain in previous pregnancies?[b], n (%)		
Yes	17 (34)	4 (20)
None	21 (48)	6 (30)
Nulliparous pregnancy	12 (18)	9 (45)

a) Data from 1 participant was missing in the intervention group.
b) Data from 1 participant was missing in the reference group.

Pain intensity in the intervention group decreased significantly ($p < 0.001$) from baseline to post-intervention, with the mean NRS score decreasing from 7.2 ± 1.6 to 2.3 ± 1.4 after the two intervention treatments (**Table 2**). At baseline, the majority of the intervention group (72%) reported severe pain (NRS 7-10), whereas only 2% reported severe pain post-intervention (**Table 3**). Instead, after treatment, the majority (89%) reported mild back pain (NRS 1-3) Table 3). The healthy reference group had a mean NRS score of 2.2 ± 2.3, and the difference in NRS scores between the groups at baseline ($p < 0.001$) (**Figure 1**) was no longer significant when comparing the intervention group after treatment with the reference group at baseline ($p = 0.74$) (Figure 1 B).

TABLE 2 Total scores from the numeric rating scale (NRS), the Oswestry Disability Index (ODI) and the Pelvic Girdle Questionnaire (PGQ) at baseline and post-treatment of the intervention group and the baseline scores of the reference group.

	Intervention group				
	baseline (N_{ib} = 50)	post-intervention[a] (N_{ip} = 44)	p value	Reference group baseline (N_{rb} = 20)	p value[b]
NRS score[d], mean (± SD)	7.2 (± 1.6)	2.3 (± 1.4)	< 0.001	2.2 (± 2.3)[c]	0.735
Total ODI score[e], mean (± SD), %	50.5 (± 13.2)	28.6 (± 14.8)	< 0.001	10.7 (± 13.1)	0.017
Total PGQ score[f], mean (± SD), %	71.1 (± 11.9)	47.7 (± 17.2)	< 0.001	19.4 (± 23.4)	< 0.001
Use of pain-relieving medication, n (%)	12 (24)	7 (14)	0.2096	2 (10)	0.536

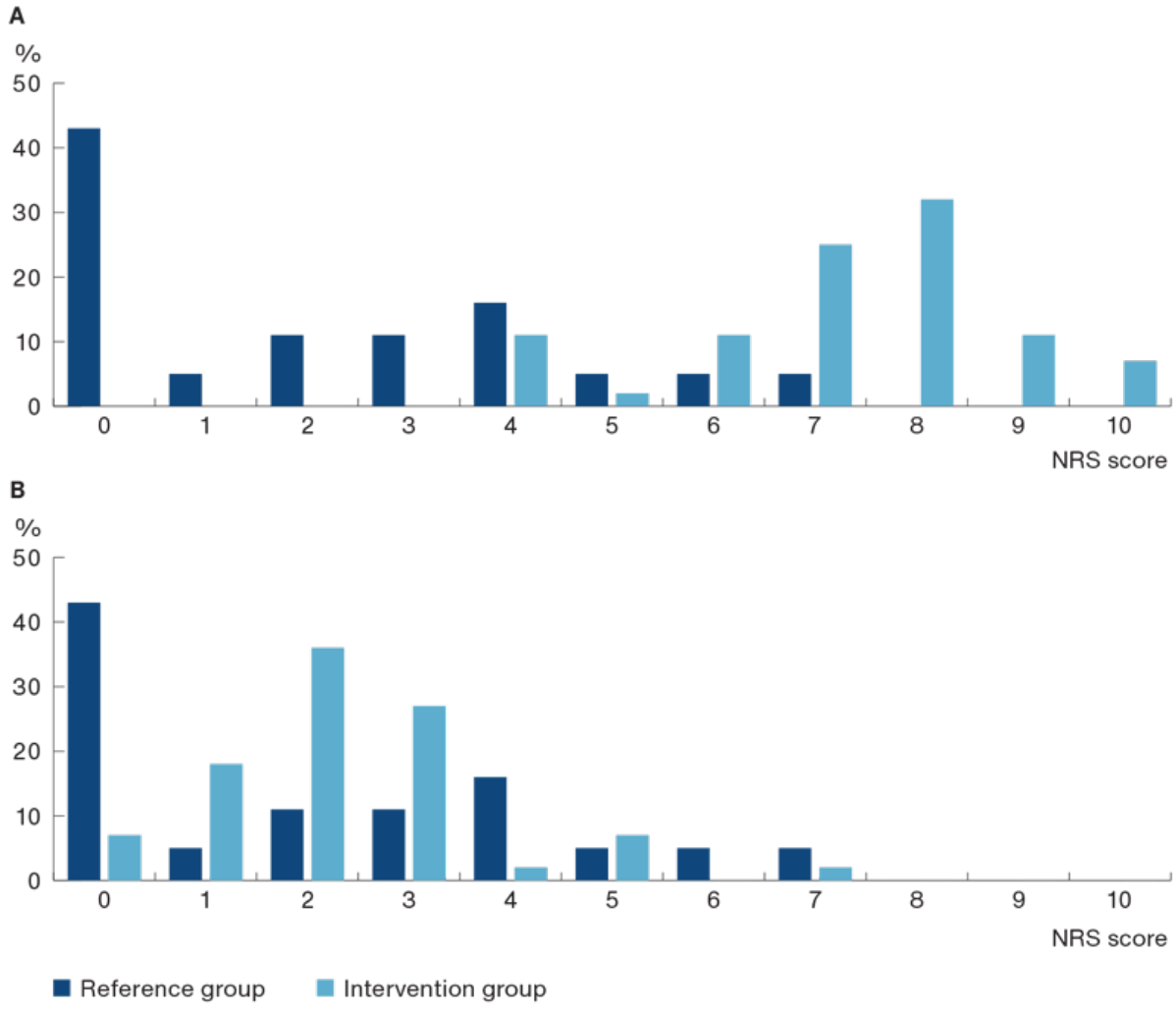
a) 6 participants were missing from the post-intervention group.
b) t-test of the post-intervention group versus the reference group.
c) 1 participant missing from the reference group.
d) The NRS ranges 0-10, 0 indicates no pain, and 10 indicates the worst imaginable pain.
e) The ODI ranges 0-100%, 0% indicates mild disability, and 100% indicates bed-bound or functional impairment.
f) The PGQ ranges 0-100%, 0% indicates no disability, and 100% indicates severe disability.

TABLE 3 Sub-scores from the numeric rating scale (NRS), the Oswestry Disability Index (ODI) and the Pelvic Girdle Questionnaire (PGQ) at baseline and post-treatment of the intervention group and at baseline of the reference group.

	Intervention group				
	baseline (N_{ib} = 50)	post-intervention[a] (N_{ip} = 44)	p value	Reference group baseline (N_{rb} = 20)	p value[b]
NRS score[f], n (%)					
Mild pain: score 0-3	-	39 (89)	-	13 (68)	-
Moderate pain: score 4-6	14 (28)	4 (9)	-	5 (26)	-
Severe pain: score 7-10	36 (72)	1 (2)	-	1 (5)	-
ODI score[g]: disabling pain, median (min.; max)					
Pain intensity	4 (3; 6)	2 (1; 4)	< 0.001	2 (1; 3)	0.040
Personal care	3 (1; 5)	2 (1; 5)	< 0.001	1 (1; 3)	0.003
Lifting	4 (2; 5)	2 (1 ;5)	< 0 .001	1.5 (1; 5)	0.008
Walking	3 (1; 6)	2 (1; 4)	0.002	1 (1; 3)[c]	< 0.001
Sitting	3.5 (1; 6)	3 (1; 5)	< 0.001	1 (1; 2)[c]	< 0.001
Standing	4 (1 ;6)	3 (1; 5)	< 0.001	1 (1; 4)	< 0.001
Sleeping	3 (1; 6)	2 (1; 4)	< 0.001	1 (1; 3)	< 0.001
Sex-life	4 (1; 6)	2 (1; 6)	0.003	1 (1; 5)[c]	0.002
Social life	4 (2; 6)	3 (1; 5)	< 0.001	1 (1; 4)	< 0.001
Transport	4 (1; 5)	2 (1; 5)	< 0.001	1 (1; 3)	< 0.001
PGQ score[h], median (min.; max)					
Pain stress:					
Getting dressed	2 (1; 3)[e]	1 (0; 2)	< 0.001	0 (0; 2)[e]	0.002
Standing < 10 min.	1 (0; 3)[e]	0 (0; 2)	< 0.001	0 (0; 2)[e]	0.026
Standing > 60 min.	3 (0; 3)[e]	2 (0; 3)	< 0.001	1 (0; 3)[e]	< 0.001
Bending down	2 (0; 3)[e]	1 (0; 3)	< 0.001	0 (0; 2)[e]	< 0.001
Sitting < 10 min.	1 (0; 3)[e]	0 (0; 2)	< 0.001	0 (0; 0)[e]	0.003
Sitting > 60 min.	2 (0; 3)[e]	2 (0; 3)	< 0.001	0 (0; 2)[e]	<0.001
Walking < 10 min.	2 (0; 3)[e]	1 (0; 3)	< 0.001	0 (0; 2)[e]	0.052
Walking > 60 min.	3 (2; 3)[e]	2 (0; 3)	< 0.001	0 (0; 3)[e]	< 0.001
Climbing stairs	2 (0; 3)[e]	2 (0; 3)	< 0.001	0 (0; 2)[e]	< 0.001
Doing housework	2 (1; 3)[e]	2 (1; 3)	< 0.001	0 (0; 3)[e]	< 0.001
Carrying light things	1 (0; 2)[e]	1 (0; 2)	< 0 .001	0 (0; 2)[e]	0.092
Lifting heavy things	3 (1; 3)[e]	2 (0; 3)	< 0.001	0 (0; 3)[e]	< 0.001
Standing up/sitting down	2 (0 ;3)[e]	1 (0; 3)	< 0.001	0 (0; 3)[e]	< 0.001
Pushing a shopping cart	1 (0; 3)[e]	1 (0; 3)[e]	< 0.001	0 (0; 2)[e]	0.001
Running	3 (2; 3)[e]	3 (0; 3)[e]	0,012	0 (0; 3)[e]	< 0.001
Doing sports activities	3 (2; 3)[d]	3 (1; 3)[d]	0.056	0.5 (0; 3)[e]	< 0.001
Lying down	2 (0; 3)[e]	1 (0; 3)[e]	< 0.001	0 (0; 2)[e]	0.001
Turning in bed	2.5 (1; 3)[e]	2 (0; 3)	< 0.001	0 (0; 3)[e]	< 0.001
Having a normal sex-life	3 (0; 3)[e]	1 (0; 3)[e]	0.004	0 (0; 3)[e]	0.006
Pushing something with your foot	2 (0; 3)[e]	2 (0; 3)	0.032	0 (0; 3)[e]	< 0.001
Experienced pain:					
In the morning	2 (1; 3)	1 (0; 3)[e]	< 0.001	0 (0; 2)[e]	< 0.001
In the evening	3 (2; 3)	2 (1; 3)	< 0.001	1 (0; 3)[e]	< 0.001
Pelvic pain causes:					
Legs fail to support the body's weight	1 (0; 3)[e]	0 (0; 2)[e]	< 0.001	0 (0; 1)[e]	0.053
Things are done slower	3 (2; 3)	2 (0; 3)	< 0.001	0 (0; 3)[e]	< 0.001
Interrupted sleep	3 (0; 3)	1 (0; 3)	< 0.001	0 (0; 3)[e]	0.047

a) 6 participants were missing from the post-intervention group.
b) t-test of the post-intervention group versus the reference group.
c) 1 missing answer.
d) 12 baseline/15 post-intervention missing answers.
e) 8 missing answers.
f) The NRS ranges 0-10; 0 indicates no pain, and 10 indicates the worst imaginable pain.
g) The ODI scores range 0-5; 0: no disability; 1: mild disability; 2: moderate disability; 3: severe disability; 4: crippling disability; 5: bed-bound or functional impairment.
h) The PGQ scores range 0-3; 0: not at all/none; 1: low degree/little; 2: some degree/moderate; 3: high degree/significant.

FIGURE 1 Numerical rating scale (NRS) pain scores for the intervention group compared with the reference group. The NRS ranges 0-10; 0 indicates no pain and 10 indicates the worst imaginable pain. **A**. Baseline NRS pain scores for the intervention group compared with the reference group. **B**. NRS pain scores for the intervention group post-treatment compared with the reference group at baseline.



In the intervention group, the ODI score for functional disability due to back pain decreased from 50.5 ± 13.2 at baseline to 28.6 ± 14.8 after treatment, $p < 0.001$ (Table 2). Similarly, the PGQ score for pain stress affecting daily activities decreased from 71.1 ± 11.9 to 47.7 ± 17.2, $p < 0.001$ (Table 2). The use of painkillers in the intervention group decreased from 24% to 14% after treatment, although the difference was not statistically significant ($p = 0.210$). There was no difference in painkiller use between the reference group and the intervention group after treatment ($p = 0.536$) (Table 2).

A comparison of ODI sub-scores before and after the intervention revealed a significant reduction in functional disability due to back pain across all domains, including pain intensity, daily activities, physical activity, sexual activity and social life (Table 3). However, the t-test sub-analysis indicated higher ODI scores in the intervention treatment group after treatment than in the reference group at baseline (Table 3). Similarly, the PGQ sub-score analysis before and after the intervention showed significant decreases in activity limitations and symptoms due to pelvic girdle pain, except when lying down ($p = 0.056$). Nonetheless, the t-test sub-analysis identified

significant differences between the post-treatment and reference groups in all domains except walking for < 10 minutes (p = 0.052), lifting heavy objects (p = 0.092) and failing leg support (p = 0.053) (Table 3).

Discussion

This study suggests that MT is implementable in a clinical setting within a public antenatal healthcare system and that an RCT is feasible. According to our findings, two treatments lasting 30 minutes with MT are sufficient to achieve significant back pain reduction, and such an antenatal back pain treatment protocol seems to be realistic and applicable. To achieve competence in performing MT, clinicians must complete a series of specialised courses leading to a master's degree in MT. Such courses are available in Denmark and most other EU countries, and the courses are standardised.

We further aimed to evaluate the effect of MT. A group of pregnant women who had not discussed back pain with their midwife were recruited as a reference group. This reference group was not a control group, as they received no MT treatment and were not followed over the same intervention period. Our results nonetheless indicated a significant reduction in pain intensity in the intervention group after the two treatment sessions, bringing it to a level comparable to that of the reference group.

To evaluate the patient-reported treatment effects, we used validated measurement tools, which strengthened the reliability of the results. Furthermore, the participants' response rate was high. At baseline, the mean gestational age differed between the two groups by approximately two weeks. This meant that when pain evaluation was assessed between the intervention and reference groups at post-intervention versus at baseline, the difference in gestational ages of the two groups had evened out (30.9 versus 30.7 days). In our study, pain reduction was demonstrated in pain intensity, daily activities and sleep quality - all clinically relevant outcomes. However, given the study design and the limited sample size, firm conclusions cannot be made. These preliminary findings, therefore, highlight the need for an adequately powered RCT.

MT influence blood pressure, and a recent prospective study investigated whether osteopathic techniques alter maternal-foetal hemodynamics [16]. They observed a reduction, that was not clinical relevant in maternal blood pressure, with an average heart rate decreasing from 88 to 81 beats per minute. For foetal monitoring, they assessed umbilical and cerebellar medial artery flow and found no changes following treatment.

The study population primarily comprised well-educated pregnant women of higher age (> 30 years) with a BMI > 25 kg/m^2, which may slightly limit the applicability of the study results.

In a Danish cohort study (n = 508), Backhausen et al. demonstrated that lower back pain was the most frequent (56%) reason for sick leave in the first 32 weeks of gestation, and more than one in four (28%) reported long-term sick leave during pregnancy [17]. A qualitative study demonstrated that sick leave due to back pain is experienced as being stuck in a painful body, being caught in an inflexible labour market and suffering from social isolation [18]. Recommendations from the World Health Organisation (WHO) highlight that pregnant women should maintain physical and sociocultural normality in pregnancy [19]. These recommendations emphasise that interventions, such as MT, may have implications beyond symptom relief A recent prospective study included 46 pregnant women in their third trimester and investigated how different osteopathic techniques affected patients' back pain and their quality of life, reporting substantial pain reduction regardless of the number of treatments received [8].

We demonstrated that only two treatments may be sufficient to bring pain intensity back to a level comparable to that of a normal population of healthy pregnant women, with a significant reduction in daily functional disabilities and physical activity limitations. Together, these improvements indicate an improved quality of life

and a positive socioeconomic and personal perspective. A reduction in the prevalence of sick leave during pregnancy may therefore be achieved as a positive effect of the intervention with MT, emphasising the importance of conducting an RCT.

Conclusions

This study demonstrated that a setup with two treatments of MT for back pain during pregnancy is implementable, and that an RCT would be feasible and is warranted. With only two treatments, this regimen is practical and realistic in a public setting. An RCT is required to confirm the strength of our findings.

Furthermore, with reservations for the small population and the weaknesses in the study design, we demonstrated a clinically significant reduction in pregnancy-related back pain intensity, daily activities, physical functioning and social life following treatments with MT.

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