Thieme

Progressive Muscle Relaxation Training During Pregnancy: Effects on Mental State, Delivery and Labour Pain – a Prospective Study

Progressives Muskelentspannungstraining in der Schwangerschaft: Auswirkungen auf psychischen Zustand, Entbindung und Wehenschmerzen – eine prospektive Studie

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ABSTRACT

Introduction
Progressive muscle relaxation is a widely used technique for relaxation, but studies are rare about efficacy on pregnancy and perinatal outcomes. Aim of our study was to determine whether progressive muscle relaxation affects anxiety and depression levels of pregnant women, pregnancy outcomes, labour pain and analgesic requirements.

Materials and Methods
156 pregnant women were enrolled in a prospective non-randomized controlled cohort study. The control group received standard antenatal care and classes only, while the intervention group additionally received progressive muscle relaxation training once a week for six weeks. Anxiety, depression and current strain were measured in a pretest-posttest experimental design using self-report scales at baseline (1st survey), 5 weeks later (2nd survey) and during puerperium (3rd survey). Numeric Rating scales were used for measuring labour pain and satisfaction with analgesic treatment in the 3rd survey.

Results
Fifty complete questionnaires from each group were analysed. There were no differences in mental status between the groups at baseline. Progressive muscle relaxation training significantly reduced depression levels. Trait anxiety, reflecting a person's basic anxiety decreased significantly in both groups during puerperium. No differences in pregnancy outcomes, labour pain and analgesic requirements could be shown within both groups in general. Nonetheless, women attending more than five progressive muscle relaxation courses reported significantly less labour pain within the group and compared to controls.

Conclusion
Pregnant women could benefit from progressive muscle relaxation training if used continuously. Relaxation methods

should be a substantial part of prenatal care and available for everyone.

ZUSAMMENFASSUNG

Einleitung
Die progressive Muskelentspannung ist eine weitverbreitete Entspannungstechnik, aber es gibt nur wenige Studien zur Wirksamkeit dieser Technik in der Schwangerschaft und über die Auswirkungen auf das perinatale Outcome. Ziel unserer Studie war es, herauszufinden, wie sich die progressive Muskelentspannung auf das Ausmaß an Ängsten und Depressionen von schwangeren Frauen, das Schwangerschaftsoutcome, die Schmerzen während der Entbindung und den Schmerzmittelbedarf auswirkt.

Material und Methoden
Es wurden 156 schwangere Frauen in eine prospektive nicht randomisierte kontrollierte Kohortenstudie aufgenommen. Die Kontrollgruppe erhielt nur die Standard-Schwangerenvorsorge und Geburtsvorbereitungskurse, während die Interventionsgruppe zusätzlich 6 Wochen lang einmal in der Woche ein progressives Muskelentspannungstraining erhielt. Angst, Depression und aktuelle Belastung wurden in einem Prätest-Posttest-Versuchsdesign anhand von Selbstauskunftsskalen zu Beginn der Studie (1. Befragung), 5 Wochen später (2. Befragung) und im Wochenbett (3. Befragung) gemessen. Für die Messung der Wehenschmerzen und der Zufriedenheit mit Schmerzbehandlung wurden bei der 3. Befragung numerische Bewertungsskalen verwendet.

Ergebnisse
Insgesamt wurden 50 komplett ausgefüllte Fragebogen von jeder Gruppe analysiert. Es gab keine Unterschiede im psychischen Zustand zwischen den Gruppen zu Beginn der Studie. Das progressive Muskelentspannungstraining hat die Depressionswerte signifikant verringert. Im Wochenbett nahm das Merkmal Trait-Angst, welches die grundlegende Ängstlichkeit einer Person widerspiegelt, in beiden Gruppen signifikant ab. Generell gab es keine Unterschiede im Schwangerschaftsoutcome, in den Wehenschmerzen und im Schmerzmittelbedarf innerhalb der beiden Gruppen. Aber die Frauen, die an mehr als 5 progressiven Muskelentspannungskursen teilgenommen hatten, berichteten, dass sie signifikant weniger Schmerzen während der Entbindung verspürten, verglichen mit anderen Frauen in ihrer Gruppe und mit der Kontrollgruppe.

Schlussfolgerung
Schwangere Frauen können von progressiver Muskelentspannungstraining profitieren, wenn es kontinuierlich eingesetzt wird. Entspannungsmethoden sollten ein wesentlicher Teil der Schwangerschaftsvorsorge sein und allen Frauen zugänglich sein.

Introduction

Progressive muscle relaxation (PMR) is a widely used technique for relaxation. Many studies showed effects of PMR on several kinds of stress-related disorders, anxiety, pain, hypertension etc. Nevertheless, there are only few studies that determine the efficacy of PMR or other relaxation techniques on pregnancy and perinatal outcomes [1].

During childbearing years and especially during pregnancy women are very vulnerable to mood, anxiety disorders [2] and stress. Depression in late pregnancy is associated with an increased risk of epidural analgesia, operative deliveries and admission to neonatal care units [3]. There is increasing evidence that elevated stress levels during pregnancy are associated with increased risk of preterm birth [4] and low birth weight [5]. Maternal psychological distress is accompanied by hypothalamic–pituitary–adrenal axis dysregulation especially with an increase of cortisol levels what can negatively affect fetal development [6]. Increased maternal prenatal stress seems to have a long-lasting effect on the infant as a risk factor for psychopathology in later life [7]. Since elevated cortisol levels during pregnancy are associated with a poorer pregnancy outcome a reduction of these high levels might be necessary for prevention [8, 9]. Teixeira et al. could show that passive and active relaxation methods lead to a decrease of cortisol levels in pregnant women [10]. Some studies showed a benefit from PMR-related relaxation techniques or yoga in respect to the length of gestation, adequate birth weights, higher rates of pregnancy prolongation, reduction of caesarean sections and instrumental extractions [11, 12]. PMR seems an effective method to improve blood pressure, lung parameters, heart rate and their health-related quality of life in women with bronchial asthma even during pregnancy [13]. Combined with music PMR affects low back pain and quality of life during pregnancy positively [14]. Other methods like mindfulness-based interventions showed significant effects on reducing pregnancy and birth-related anxiety and postpartum depression in women screened positive for emotional distress during pregnancy [15]. In a recently published review and meta-analysis by Abera et al., they focused on the effects of different relaxation methods during pregnancy, including yoga, music, PMR, deep relaxation, guided imagery, mindfulness and hypnosis on maternal mental health and pregnancy and neonatal outcomes. They were able to demonstrate several benefits for the mothers in terms of mental health and stress reduction, but also improved birth weight and promising outcomes for perinatal outcomes and newborn outcomes. PMR was more likely to have a positive effect on the selected outcomes than other relaxation methods [16].

The purpose of our study was to evaluate PMR effects on anxiety and depression levels of pregnant women, selected pregnancy

outcome measures, labour pain, analgesic requirements and duration of labour.

Materials and Methods

Study design

In this prospective controlled cohort trial with a pretest-posttest experimental design pregnant women > 18 years having a singleton pregnancy between 19 to 38 weeks of gestation (wks) were included. The independent variable was a 6-week PMR training. The major dependent variables were anxiety, depression, pregnancy outcomes, neonatal outcome, type of delivery, length of gestation, duration of labour and analgesic requirements and labour pain.

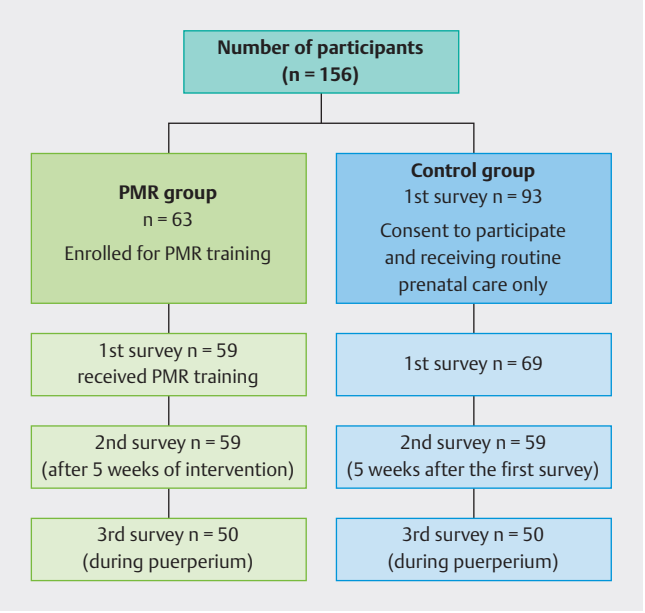
Participants

156 pregnant women were enrolled non-randomized in this study and received standard prenatal care (see ▶ **Fig. 1**):

Sixty-three women signed up for additional PMR training. Fifty-nine started the training and 50 women completed the intervention – three had to quit early because of pregnancy complications (preeclampsia, cervical insufficiency and fetal growth restriction) and six because of personal not specified reasons.

As controls, 93 women gave their informed consent initially, but the response to the 1st survey was only 69 (74,2 %) answers, to the 2nd survey 59 (63,4 %) and to the 3rd survey 50 responses (54,3 %).

At the end of the study, complete results were available from fifty women in the intervention group (PMR group) and fifty women in the control group (CG). There were no differences regarding pregnancy related complications within the two groups.



▶ **Fig. 1** Participant flow diagram: the initial cohort included 156 singleton pregnancies of whom 63 signed up for additional progressive muscle relaxation (PMR) training and 93 women enrolled in the control group. The final cohort which completed the 3rd and therefore last survey included 50 women in each group: PMR and control.

Intervention

PMR training was based on Bernstein and Borkovec's version consisting of six 60-minute group sessions [17, 18]. The participants met once a week in the outpatient clinic of our department with an average number of five pregnant women per session. Participants could either practise in a seated or lying position depending on their preference. Additionally, they received a special CD with a recorded 25-minute lasting PMR-session, spoken by the group session leader, and the instruction to practise at home regularly.

During the first PMR intervention women were taught the widespread PMR version of Bernstein and Borkovec consisting of 17 muscle groups. In the following sessions, we gradually reduced the number of muscle groups so that all women were eventually able to achieve the same state of relaxation with nine muscle groups only (in the following order: dominant arm, non-dominant arm, face, neck, shoulder and upper back, abdomen, pelvic floor, dominant leg and non-dominant leg). This reduction of muscle groups is common during the PMR learning process to achieve better suitability for everyday use. There are also PMR methods in which only individual muscle groups are targeted [18].

Before each session, the PMR instructor checked the well-being of the pregnant women attending the course. To examine the physiological effects of the PMR training blood pressure and heart rate were measured before and after each group session (see Table S1, online). Before and after the intervention, the women in the PMR group completed a short questionnaire on current strain (KAB). Current strain was measured by using the short questionnaire for current strain ("Kurzfragebogen zur aktuellen Beanspruchung" – KAB) from Müller and Basler. It is a questionnaire with contrasting adjectives (tense vs. relaxed or unsettled vs calm etc.) that are opposed to each other. Between these adjectives, there is a 6-point rating scale and after adding the points of each pair of adjectives, the mean was calculated. "1" meant the smallest possible strain and "6" the worst [19].

The control group received common prenatal care and antenatal classes only.

Ethics

The local Ethical Committee of the Friedrich-Schiller-University, Jena, Germany approved the study (4782–05/16). All the participating women received a detailed description of the study and oral and written informed consent was obtained from each patient before participation in the study.

Outcome measures

Both groups received self-administered questionnaires regarding anxiety, depression and current strain at the baseline (1st survey), five weeks later (2nd survey) and during puerperium (3rd survey). The 3rd survey also included labour pain, satisfaction of analgesic treatment and for the PMR group questions about the benefits of the prior PMR intervention using numeric rating scales (min – max: 0 "no pain at all" – 100 "the worst pain ever possible") with therefore 11 possible answers. All pregnancy outcomes and an-

algesic requirements were obtained from obstetric data (type of delivery, length of gestation, duration of labour, analgesic requirements and neonatal outcome).

STAI

Anxiety was measured by using the German version of the Spielberger State –Trait Anxiety Inventory (STAI), which measures two components of anxiety: state and trait. Trait anxiety is a rather stable behavioural disposition of the person. State anxiety can be understood as the temporary subjective perceived feeling of tension in response to a specific trigger. The STAI scale consists of 40 statements concerning different types of feelings. For evaluating the trait anxiety patients are asked how they generally feel, in the state part how they feel right now. Both scales are rated on a 4-point likert scale. The state items describe the intensity of feelings, ranging from *not at all* (1) to *very much* (4). The trait items measure the frequency of feelings, ranging from *almost never* (1) to *almost always* (4). The possible cumulative scores for both the scales range from 20 (not anxious) to 80 (high anxiety) [20]

BDI

Depression levels were assessed with the Beck's Depression Inventory (BDI), a 21-item self-report scale that measures the presence and intensity of depression symptoms. For each item, the patient must choose one out of four statements concerning one typical depression symptom. For those statements there is an assigned score ranging from 0 to 3. The total score is the sum of all chosen statements. A score > 18 indicates a depressive mood [21].

Statistics

Since most of our scores were not normally distributed, nonparametric statistics were used for statistical analysis. Wilcoxon test was performed to compare repeated measurements in each of the groups. Independent variables of both groups were compared by using Mann-Whitney U-Test. Categorical data were compared using Chi^2 test or Fisher Exact test. P values < 0.05 were considered statistically significant. We used SPSS, version 29.0 for statistical analysis.

Results

A total of one hundred completed data sets were evaluated. The PMR group consisted of 50 women [*mean age* 29 years (SD 4.21); *mean gestational age* 27 weeks (SD 4.49)] and the control group of 50 women [*mean age* 29 years (SD 5.79); *mean gestational age* 31 weeks (SD 2.63)]. Both groups were similar concerning gravidity, parity and pre-existing pregnancy complications (see ▶ **Table 1**).

▶Table 1 Comparison of baseline characteristics between the progressive muscle relaxation (PMR) group (n = 50) and the control group (CG; n = 50).

Variables at baseline	PMR	CG	p
Age (years)	29 (4.21)	29 (5.79)	0.281
Gravity	2 (1.37)	2 (1.51)	0.875
Parity	0 (0.59)	1 (1.38)	0.182
Gestational age (weeks)	27 (4.49)	30 (3.89)	< 0.001*
Preexisting pregnancy complications n (%)	11 (22)	17 (34)	0.181

Data shown as means (standard deviations) or n (%)
* Significant differences between PMR and CG ($p < 0.05$)
CG = control group; PMR = progressive muscle relaxation

▶Table 2 Comparison of state and trait anxiety, depression (BDI) and current strain (KAB) levels between the progressive muscle Relaxation (PMR) group (n = 50) and the control group (CG; n = 50).

Variables		PMR	CG
State-Anxiety	1st survey	37.54 (7.36)	40.88 (11.76)
	2nd survey	35.59 (7.73)	39.48 (11.50)
	3rd survey	36.48 (10.88)	36.41 (9.70)**a
Trait-Anxiety	1st survey	38.54 (9.63)	38.82 (11.09)
	2nd survey	35.88 (8.23)**b	36.92 (11.49)**b
	3rd survey	34.44 (9.11)**a	35.85 (10.84)**a
BDI ("depression")	1st survey	6.80 (3.91)	7.62 (6.35)
	2nd survey	5.92 (3.92)*b	7.23 (6.95)
	3rd survey	4.98 (3.48)*a	6.02 (3.92)
KAB ("current strain")	1st survey	3.087 (0.711)	2.993 (0.961)
	2nd survey	2.728 (0.637)**b	3.060 (1.039)
	3rd survey	2.930 (0.930)	2.675 (1.003)**a/b

a) significant differences compared to the 1st survey
b) significant differences compared to the survey before
data shown as means (standard deviations)
BDI = Beck's Depression Inventory; CG = control group; KAB = short questionnaire on current strain; PMR = progressive muscle relaxation
* $p < 0.05$; ** $p < 0.01$

Effects of PMR on anxiety and depression levels

There were no differences in state-anxiety ($p = 0.234$), trait-anxiety ($p = 0.817$) and depression levels ($p = 0.817$) between both groups at baseline (▶ **Table 2**). State anxiety levels did not change between the three surveys in the PMR group. In controls state anxiety decreased in puerperium compared to 1st survey ($p = 0.004$). Trait anxiety decreased significantly in both groups from the first to the second survey ($p < 0.001$) and continued to fall in the postpartum period.

Depression levels decreased significantly in the PMR group from baseline to the 2nd survey ($p = 0.03$) and the 3rd survey ($p = 0.006$), but only in trend in the controls (▶ **Table 2**).

▶**Table 3** Comparison of pregnancy outcomes between the progressive muscle relaxation (PMR) group (n = 50) and the control group (CG; n = 50).

Variables	PMR	CG	p
Weight of infant (g)	3507 (507)	3538 (487)	0.082
Gestational age at delivery (week)	40.0 (1.1)	39.9 (1.1)	0.523
Type of delivery n (%)			
▪ normal vaginal delivery	33 (66)	32 (64)	0.955
▪ caesarean section	11 (22)	11 (22)	
▪ instrumental delivery	6 (12)	7 (14)	
Duration of labour (min)	405 (213)	461 (248)	0.322
1st stage	393 (207)	395 (228)	0.973
2nd stage	19 (30)	27 (41)	0.147
3rd stage	13 (19)	11 (7)	0.337

Data shown as means (standard deviations) or n (%)
CG = control group; PMR = progressive muscle relaxation

▶**Table 4** Evaluation of subjective efficacy after progressive muscle relaxation (PMR) training.

Variables	Yes	No	Unsure
Improvement of relaxation abilities (%)	86.4	13.6	–
PMR for relaxation in the future (%)	83.3	16.7	–
Expected effect of PMR on labour (%)	50	0	50

No effects of PMR on mode and duration of delivery

▶ **Table 3** shows the pregnancy outcomes of both groups. There were no differences concerning fetal weight, gestational age at delivery, type of delivery and duration of labour. Only a trend was seen to a shorter duration of labour in the PMR group, especially in the 2nd stage of birth (p = 0.147).

Significant improvement in the relaxation ability through PMR

The subjective efficacy of PMR is shown in ▶ **Table 4**. After the last PMR training 86.4 % of the women had noticed an improvement of their relaxation abilities. 83.3 % considered PMR to be a good method for themselves to relax in future.

In the third survey, the women were asked about their subjective impression of whether PMR had influenced their labour in any way (▶ **Table 4**). 75 % described a positive effect of PMR on labour using the following possible answers: “Yes, directly. I used PMR during labour” (4.2 %); “Yes, indirectly because my relaxation abilities had been improved or PMR had helped me to calm down and to be more relaxed the last weeks before birth” (70.8 %). No significant differences between the two groups in reported labour pain and analgesic requirements could be seen (see ▶ **Table 5**).

▶**Table 5** Evaluation of labour pain and analgesia using numeric rating scales in puerperium (3 rd survey) and comparison between the progressive muscle relaxation (PMR) group and the control group.

Variables	PMR	CG	p
Expected labour pain†	84.40 (11.28)	67.80 (29.64)	0.003*
Analgesic requirements (n = 39)			0.699
▪ no analgesic requirements	19 (48.7 %)	18 (46.2 %)	
▪ i. v. medication (e.g. Fentanyl)	14 (35.9 %)	17 (43.6 %)	
▪ epidural	6 (15.4 %)	4 (10.2 %)	
Satisfaction with analgesia†	64.44 (27.06)	63.68 (29.48)	1
Labour pain (n = 36)†	84.44 (12.06)	78.97 (18.89)	0.304
≤ 4 courses (n = 10)	92.00 (11.35)		
5 courses (n = 12)	80.83 (9.96)		0.030‡
6 courses (n = 14)	82.14 (12.51)		0.055

† Measured using numeric rating scales (f.e. 0 “no pain at all”, 100 “the worst pain ever possible”)
* Significant differences between PMR and CG (p < 0.05)
‡ Significant differences between ≤ 4 courses and 5 courses (p < 0.05)
Data shown as means (standard deviations) or n (%)
CG = control group; PMR = progressive muscle relaxation

Pain relief during childbirth improved through more frequent course attendance

However, we were able to show that the number of PMR classes attended had an influence on labour pain. Women who attended at least five PMR classes had significantly lower labour pain scores than women who attended fewer classes (p = 0.03).

Discussion

In this prospective study we were able to show that additional PMR training during pregnancy offered quantifiable psychological benefits for the participating group of women (n = 50), particularly regarding depression parameters, well-being and labour pain compared to the control group (n = 50) that received standard prenatal care and antenatal classes only. PMR training led to a significant reduction in scores for trait anxiety and depression, but not for state anxiety. In general, no differences were found in pregnancy outcomes, labour pain and need for pain medication in either group. However, women who had attended more than five PMR classes reported significantly less pain during labour within the group and compared to the controls.

Trait anxiety levels decreased significantly in both groups between the surveys. Our results are in accordance with other reports that PMR has no effect on trait anxiety [22, 23]. For the first time we could demonstrate a reduction of trait anxiety during pregnancy in general. In contrast Bastani et al. reported significant differences of state and trait anxiety after PMR intervention but started with obvious higher levels of anxiety prior to intervention [12, 24]. The reduction in trait anxiety in general in our study could be interpreted as being caused by the closer attachment to clinical treatment due to participation – in the sense of the tender loving care principle. State anxiety was not influenced by PMR in our cohort. Other mind-body interventions based on music interventions seem to have more effects on state anxiety levels during pregnancy according to the review of Wulff et al. on music in obstetrics as an intervention to reduce tension pain and stress [25].

We found a positive effect of PMR on depression scores during pregnancy whereas Field et al. report only a trend in reduction of depression scores in pregnant women [26]. Recently the same positive effects were shown in Iranian and Indian women [27, 28].

Beddoe and Lee postulated that women benefit from additional mind-body intervention types to routine prenatal care concerning strain and well-being [1]. As KAB values, measuring current strain, reduced significantly during the time of PMR-Intervention but not in the control group our data support these findings.

Most of the women were satisfied with the subjective effect of PMR on their relaxation abilities and on the event of labour, but only two women were able to use PMR directly during birth – what might be the reason for less efficacy. In further studies midwives and doctors should encourage women to use PMR during birth after attending such a course. Even the current AWMF guideline on vaginal birth at term also acknowledges breathing and relaxation techniques for pain management and recommends that professionals should support women in using these techniques [29].

Interestingly duration of labour seems to be less in the PMR-Group especially the 2nd stage of labour which might be an effect of improved mind-body control and relaxation effects.

On the other hand, we could not find any differences in labour pain and analgesic treatment between PMR and controls at all. Notably, women with more than four courses of PMR training had significant lower pain levels than the other women. This indicates that a continuous training experience is essential to demonstrate relevant effects of PMR on labour pain. In addition, it is possible that women had the feeling that they had an active influence on their pain experience and thus experienced greater self-efficacy in contrast to passively accepting the pain. A form of self-empowerment to increase the self-confidence of the patients to be able to experience their birth in a self-controlled way.

Strength and Limitations

The strength of our study is the prospective design and the good adherence of the participants up to the 3rd survey postpartum. Nevertheless, the dropout rate within the control group (46,2 %) is a limitation of this study. However, this can be explained by the fact that the patients were asked to answer questionnaires on a voluntary basis without receiving anything in return, so a majority of patients did not submit the questionnaires after giving their initial consent. The number of complete data sets to analyse is chosen to other similar interventional study designs [12, 24]. A larger number could reinforce some tendencies and maybe confirm our results. Other limitations are the non-randomised study design. PMR training was offered to all interested pregnant women. A randomisation could lead to displeasure and refusal of participation. Therefore, the higher labour pain expectation in PMR group could be a non-balanced bias. Women who took part in the course probably had a higher level of burden and needed more support in labour preparation. There was no specific survey on fear of childbirth as part of the study, which might have specified this point. Nevertheless, the main measures depression, state and trait anxiety are well balanced in both groups at the baseline so our results should be reliable.

Conclusion

PMR training is a cost-effective, non-invasive intervention for improving anxiety and depression during pregnancy, but potentially also for pain management during labour, and should be offered especially to pregnant women with increased psychological vulnerability and increased labour anxiety.

Supplements

Table S1 presents the pre- and postinterventional measurements of systolic/diastolic blood pressure and heart rate, as well as the statistical analysis of the changes using the T-Test. All parameters were significantly reduced after PMR.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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