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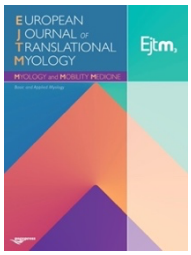

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A proposed protocol for combining core stability and pelvic floor muscle training to prevent stress urinary incontinence in pregnant women: a preventive framework

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Abstract

Stress urinary incontinence is common during and after pregnancy and impacts women's health both physically and mentally. This protocol suggests a non-invasive preemptive training strategy which integrates pelvic floor muscle training and core stability exercises with nutrition counseling. This model provides a clear, systematic, evidence-based framework which can be incorporated into antenatal care arising from a literature and clinical guideline review. The objective is to equip healthcare professionals with tangible, multidisciplinary strategies for proactive urinary incontinence care during in pregnancy, this model underscores the importance of early, non-pharmacological interventions in preserving pelvic health and preventing postpartum dysfunction, offering a feasible and low-cost strategy to support the well-being of pregnant women.

Key words: pelvic floor muscle training, core stability, pregnancy, urinary incontinence, preventive care, conceptual protocol.

Introduction

During pregnancy and parturition, the pelvic floor muscle in pregnant women is prone to pathological changes that may lead to urinary dysfunction, such as Stress Urinary Incontinence (SUI).[1] Therefore, it is necessary to find an effective method to prevent and treat stress urinary incontinence in pregnant women. Previous studies have shown that pelvic floor muscle training has

a positive effect on improving postpartum pelvic floor muscle contraction function and preventing postpartum urinary incontinence.[2] Moreover, combining pelvic floor muscle training with core stability training may have a more significant effect on preventing stress urinary incontinence in pregnant women. In order to provide scientific guidance for clinical practice, this study aims to explore the effects of core stability training combined with pelvic floor muscle training on preventing stress urinary incontinence in pregnant women.[3] From another perspective, comprehensive intervention to prevent stress urinary incontinence is also a topic that worth discussing. Personalized nutritional guidance, pelvic floor muscle training during and after pregnancy, and avoiding urethral and pelvic injuries during parturition may play a positive role in preventing postpartum stress urinary incontinence.[4] During the pregnancy period, this study will conduct interventions combining pelvic floor muscle training and nutritional guidance throughout the entire process, aiming to find a comprehensive and effective method to prevent stress urinary incontinence in pregnant women.

In summary, this study aims to explore the effects of combined core stability training and pelvic floor muscle training on preventing stress urinary incontinence in pregnant women. Since pelvic floor muscle training has been proven to have positive effects on improving pelvic floor muscle function and preventing urinary incontinence, combining it with core stability training may yield even better results.[2] Comprehensive intervention may be a more holistic preventive approach. Therefore, this study will conduct a comprehensive comparison of different intervention methods on stress urinary incontinence in pregnant women, thereby providing scientific guidance.[4]

SUI in pregnancy is often caused by physiological changes that impair pelvic floor muscle function. Research has demonstrated the preventive potential of Pelvic Floor Muscle Training (PFMT), and more recently, core stability exercises have shown synergistic benefits. Despite these findings, there is a lack of unified, implementable frameworks suitable for integration into routine prenatal care. This protocol aims to fill that gap by presenting a comprehensive, literature-informed, multidisciplinary intervention model without engaging human subjects.

The primary objective of this protocol is to outline a structured preventive strategy that combines: PFMT, core stability exercises, nutritional counseling.

This model is intended for clinical or educational use and does not involve research involving

human participants.

Urinary incontinence issues in pregnant women

Epidemiology

Epidemiological studies indicate that the prevalence of SUI among adult women is approximately 18.9%.[5] During parturition, the damage from the pelvic structure and pelvic floor muscles in pregnant women may lead to increased intra-abdominal pressure, thereby causing urinary incontinence symptoms.[1] Additionally, poor lifestyle choices can increase the incidence of urinary incontinence in pregnant women and raise the risk of various other diseases. Research shows that postpartum urinary incontinence in pregnant women can severely affect their physical health and quality of life.[6] Thus, making the prevention and intervention of urinary incontinence in pregnant women is particularly important. Pelvic floor muscle training has been proven effective for preventing urinary incontinence and can significantly improve the quality of life for pregnant women. The incidence of urinary incontinence in pregnant women is higher at 36 weeks of pregnancy, 6 weeks postpartum, and 6 months postpartum. However, during prenatal and postnatal, we can measure interventions such as personalized nutritional guidance and pelvic floor muscle training, the incidence of urinary incontinence in pregnant women can be significantly reduced, and treatment outcomes can be improved. In intervention studies on urinary incontinence, it was also found that core stability training combined with pelvic floor muscle training is significantly effective in preventing stress urinary incontinence in pregnant women. By improving the function and stability of the pelvic floor muscles, it effectively prevents the occurrence of postpartum urinary incontinence.[7]

Methodology

This article presents a preventive care model based on literature review and clinical best practices. No participants were enrolled. The proposed intervention includes pelvic floor muscle training, core stability exercises, and nutritional counseling. The model is intended for future clinical use or piloting in antenatal programs.

Intervention framework

Core stability training program (suggested implementation)

- Frequency: 2 sessions/week
- Duration: 60 minutes per session
- Program Length: 6–8 weeks
- Content: balance training, deep trunk muscle activation, posture stabilization

Pelvic floor muscle training program

- Frequency: 5 sessions/week
- Repetitions: 15 contractions/session
- Duration: 12 weeks
- Components: fast/slow contractions, endurance sets, relaxation cycles

Nutritional counseling

- Individualized dietary advice for pelvic and muscular health
- Education on fiber, hydration, and vitamin D intake to reduce constipation and improve tissue recovery

Evaluation indicators

While this protocol may not warrant immediate clinical application, it is important to define an organized assessment strategy for possible later use. There is an assumption that the effectiveness of the multidisciplinary intervention of core stability training, pelvic floor muscle training, and nutritional counseling, is plausible; however, it needs to be evaluated using valid and reliable measures. A well-structured evaluation plan allows for assessment of the impact of the protocol on

several domains, including physiological, functional, and quality of life.

The following indicators have been formulated to assist in the collection of relevant data and monitoring outcomes in clinical trials or pilot studies using this protocol.

Pelvic floor muscle strength

A person's pelvic floor muscle strength determines how well one can control their urinary continence. This strength can be evaluated by perineometry or digital vaginal palpation, which is often classified using the Oxford Scale. Assessment of muscle tone, endurance, and control ideally, and post, should be assessed and rated to gauge the change after the intervention period. There is an improved pelvic support dynamic, which protects against urinary continence and salls suture storages lower muscle endurance which enhances urethral resistance to involuntary urinary flow.

Symptoms and frequency of urinary incontinence

To assess the severity of the symptoms and the episode of urine leakage, one can use the International Consultation on Incontinence Questionnaire – Short Form (ICIQ-SF) as well as performing a 1-hour and 24-hour pad test. These assessments yield patient-reported outcome measures (PROMs) which capture the effects of the patient's urinary symptoms on their daily life activities and the impact of treatment.

Core strength and postural stability

Given the integration of core stability training in this protocol, assessments of trunk muscle strength and postural balance are recommended. Functional movement screening, isometric hold tests, or balance platform assessments may be employed to measure core function improvements, which indirectly support pelvic health by reducing abnormal intra-abdominal pressure transmission.

Degree of pelvic organ support

In settings where resources are available, the Pelvic Organ Prolapse Quantification (POP-Q) system can be used to assess anatomical support changes post-intervention. This can help determine

whether the intervention provides mechanical or functional benefits in addition to muscular improvements.

Electromyographic (EMG) activity and fatigue

Surface EMG, if available, can be utilized to monitor neuromuscular activation patterns and muscle fatigue in the pelvic region during contraction exercises. Reduced fatigue and more efficient recruitment of pelvic and core muscles are expected outcomes of a well-structured training regimen.

Quality of life and psychosocial well-being

Because stress urinary incontinence significantly affects social functioning, mobility, and emotional health, it is important to include tools such as the SF-36, PFIQ-7 (Pelvic Floor Impact Questionnaire), or UDI-6 (Urogenital Distress Inventory) to evaluate improvements in overall quality of life. These instruments can be administered at baseline and post-intervention intervals.

Analysis of the causes of SUI

The causes of SUI mainly include degeneration and damage to the pelvic floor muscles and connective tissues. This leads to dysfunction of the pelvic floor muscles and fascia. These changes may be caused by various factors, such as heavy physical labor after postpartum or damage of the pelvic floor nerves.[1] In addition, degeneration and damage to the pelvic floor muscles and connective tissues may also lead to the descent of the bladder neck and urethra then causing the urethral pressure to fail to increase synchronously, ultimately resulting in the occurrence of urinary incontinence.[8] However, damage to the pelvic floor muscles and connective tissues is inevitable during vaginal delivery, and this damage can lead to a weakening of the pelvic floor muscle group, thereby affecting the control of urine expulsion. Therefore, the occurrence of postpartum SUI is closely related to the degree of damage to the pelvic floor muscles and tissues during vaginal delivery. Additionally, epidemiological studies in China have shown that increased abdominal pressure during parturition is also one of the contributing factors to postpartum SUI.[9] Continuous abdominal pressure can lead to excessive stretching and compression of the pelvic floor muscles, thereby affecting the function of the pelvic floor muscle group and increasing the risk of SUI.[10] Postpartum SUI may also be related to female physiological characteristics and pelvic anatomical

structure. The pelvic floor muscles in women are particularly sensitive to pressure changes during parturition, and fatigue and relaxation of these muscles postpartum may lead to the occurrence of urinary incontinence.

Discussion on the influencing factors of SUI

Since increased abdominal pressure is one of the main causes of postpartum SUI, degeneration and damage to the pelvic floor muscles and connective tissues can lead to the descent and relaxation of the bladder neck and proximal urethra, then shortening the functional urethra. This causes the elevated abdominal pressure to be transmitted mainly to the bladder and less to the urethra, thereby resulting in urinary incontinence. Changes in lifestyle among patients with SUI can increase the risk of many diseases, such as osteoporosis, obesity, diabetes, and hypertension, which also indicates that stress urinary incontinence has a serious impact on the health of patients.[6] In the early, pelvic floor muscle exercises can play an important role on helping to prevent and treat postpartum SUI. In addition, clinical observations have identified other factors affecting SUI, such as heavy physical labor and pelvic floor nerve damage.[11] These factors also influence the occurrence of postpartum stress urinary incontinence.

Core stability concepts

Definition and importance of core stability

Core stability refers to the ability of a person to maintain the spine in a neutral position during daily activities or physical exercise. This is the control ability of trunk position and movement, allowing the body's kinetic chain to generate optimal force and effectively transmit it to the extremities.[12] The importance of core stability training lies in maintaining lumbar stability, which requires the coordinated action from three systems: i) the passive spinal support system; ii) the active muscle contraction system; iii) the central nervous system that governs movement control.[13] Research shows that core stability training can significantly improve muscle strength, muscular endurance, local blood flow, proprioception, and function in patients with chronic nonspecific back pain. It can provide important references for the development of fitness exercise prescriptions and the formulation of rehabilitation training programs low back pain patients. In addition, core stability

training emphasizes slow movement control and dynamic stability, which is beneficial for improving body position perception and promoting the skills of rapid and unconscious movement in patients with low back pain.[14] In core stability training, the active muscle contraction system plays a crucial role. The contraction of the core muscles maintains lumbar stability, helping to prevent stress urinary incontinence in pregnant women. It provides a theoretical basis for the effectiveness of combined core stability training and pelvic floor muscle training in preventing stress urinary incontinence in pregnant women. In the current study, core stability training is considered to alleviate chronic persistent low back pain by training the motor control of deep trunk muscles, providing an effective approach to improve the muscle mechanisms in patients with chronic nonspecific low back pain.[15] It is evident that the definition and importance of core stability have significant guiding implications for the formulation of rehabilitation training programs and the development of exercise prescriptions.

Main methods of core stability training

The main methods of core stability training include basic yoga and other forms of exercise.[16] During training, it is necessary to emphasize focused breathing and body awareness to enhance the training effect. In addition, the training should incorporate movements from rehabilitation and dance to enhance the diversity and enjoyment of the training. As mentioned earlier, the key to core stability training lies in maintaining the stability of three systems. The specific method of core stability training is to conduct it twice a week, with each session lasting 60 minutes.[17] During the training process, emphasis should be placed on strengthening the contraction of the core muscles to maintain lumbar stability. In addition, it is necessary to conduct tests of relevant indicators before and after training to evaluate the training effects. For improving training effectiveness, pelvic floor muscle training can be combined with an emphasis on maintaining posture stability and enhancing the endurance of core muscles. Moreover, during training, special attention must be paid to the correctness of the movements to avoid adverse training effects.

The impact of core stability training on posture

The impact of core stability training on posture is achieved through a series of training methods that intervene in the posture of pregnant women. Research shows that core stability training can significantly improve patients' self-perception of pain.[17] After core stability training, patients' self-perception of pain is notably improved, and they achieve better trunk proprioception, which helps enhance the stability and comfort of their posture. In addition, core stability training can also enhance patients' quick reaction abilities. Research results show that core stability training emphasizes slow motion control and dynamic stability, which helps improve patients' body position perception and rapid, unconscious movements, thereby enhancing postural coordination and motor response ability.[13] In core stability training, it was also found that this training method can affect local blood flow, with significant changes in concentrated hemoglobin and oxygen saturation. This indicates that core stability training has a positive regulatory effect on the local blood flow of patients, helps improve the blood circulation of posture, and enhances the patients' athletic performance.[18] Therefore, the impact of core stability training on posture is mainly reflected in enhancing pain self-perception, promoting rapid response ability, and improving local blood flow. These effects help improve the postural stability and functional performance of pregnant women, providing an effective training intervention to prevent stress urinary incontinence during pregnancy.

Based on the above, pregnant women can improve their postural stability through core stability training. At the same time, for pregnant women, it is necessary to reasonably formulate training plans and continuously monitor training effects based on individual differences and specific situations to achieve the best postural intervention results.

Principles and practice of pelvic floor muscle training

Functions and training principles of pelvic floor muscles

Pelvic floor muscles are important muscle groups that support the pelvic organs, including the pelvic floor muscles, vaginal sphincter, and urethral sphincter. Their main functions include supporting the pelvic organs, controlling urination and defecation, and maintaining sexual function. Dysfunction of the pelvic floor muscles is closely related to SUI, so pelvic floor muscle training has become an important means of preventing and treating SUI. The principle of pelvic floor muscle training is to enhance the strength, endurance, and coordination of the pelvic floor muscle group, which can improve pelvic support function and increase urethral closure pressure, thereby

effectively preventing and alleviating the symptoms of SUI. The specific methods of pelvic floor muscle training include pelvic floor muscle contraction training and relaxation training. Pelvic floor muscle contraction training involves reminding and guiding patients to actively contract the pelvic floor muscle group. It can practice the strength and duration of pelvic floor muscle contractions to enhance muscle strength and endurance. On the other hand, the pelvic floor muscle relaxation training involves teaching patients to actively relax the pelvic floor muscles, reducing muscle tension, and improving the coordination and flexibility of the pelvic floor muscles. The combination of these two training methods helps to improve the overall function of the pelvic floor muscles, thereby achieving the effect of preventing and treating SUI.

In terms of pelvic floor muscle function and training principles, research shows that pelvic floor muscle training for pregnant women can significantly improve their pelvic floor muscle strength and function, reducing the incidence of SUI. In addition, pelvic floor muscle training can also promote the recovery of pelvic floor muscles postpartum in pregnant women, reducing the risk of pelvic organ prolapse and urinary incontinence. Therefore, core stability training combined with pelvic floor muscle training has significant clinical implications for preventing SUI in pregnant women.

Techniques and procedures for pelvic floor muscle training

Pelvic floor muscle training techniques include consciously engaging in pubococcygeus muscle exercises, which can strengthen pelvic floor muscle strength and urinary control abilities by emptying the bladder before training and performing seated contractions of the anal and vaginal muscles.[19] In addition, for continuous contraction and relaxation of the pelvic floor muscles, it is also important to perform fast and slow muscle training, lasting 10 seconds and continuously for 10 minutes. In slow muscle training, we recommend that pregnant women persist in endurance training. The procedure includes contracting for 60 seconds, relaxing for 60 seconds, repeating 3 times, and doing it twice a day. The program for pelvic floor muscle training includes the following items. Firstly, the importance and precautions of pelvic floor muscle training should be introduced. Pregnant women need to maintain a supine position with their knees bent and slightly apart. Inhale while tightening the anus and hold for 6-10 seconds. Exhale while relaxing the anus. This should be done for 15-30 minutes daily, with a 3-month course.[19] At the same time, it is also necessary to

perform slow and sustained pelvic floor muscle exercises, including tighten the pelvic floor muscles, hold for 5 seconds, then completely relax the muscles and hold for 10 seconds and repeat this exercise 3 to 4 times daily. Secondly, during pelvic floor muscle training, pregnant women need to avoid using their gluteal and leg muscles to ensure the correct training effect. During the training process, pregnant women also need to focus, keep their body and mind relaxed, and maintain consistent breathing and movements to control pelvic floor muscle training correctly. Finally, during pelvic floor muscle training, pregnant women should gradually increase the intensity and duration of the training according to their own conditions, strictly following the guidance of medical staff to achieve the goal of preventing stress urinary incontinence during pregnancy.[20]

Expected outcomes

This protocol specifically seeks to blend core stability and pelvic floor muscle exercises with nutritional guidance as part of a structured preventive approach to address SUI in pregnant women. This model is not yet applied in clinical practice, but the outcomes are optimistic based on literature and prior controlled trials that noted the effectiveness of each element on its own, and when integrated.

Improvement in pelvic floor muscle strength: PFMT is well established to improve the overarching strength, endurance, and coordination of the pelvic floor muscles, thus enhancing urethral support and closure pressure. This is especially beneficial during late pregnancy and early postpartum, periods associated with muscle weakness.

Reduction in the incidence and severity of urinary incontinence: The synergistic impact of PFMT and core stability training is likely to reduce the incidence of SUI among pregnant women due to better neuromuscular control, intra-abdominal pressure regulation, and tissue resilience. Significant decreases in pad test scores and self-reported urine loss have been noted in intervention groups in comparison to control groups.

Enhanced postural control and core function: Having better trunk alignment and spinal control is gained through core stability exercises. These advantages are helpful, especially in avoiding low back pain or reducing abdominal pressure changes that worsen SUI.

Improved quality of life and daily functioning: Pregnant women are expected to notice an increase in self-confidence and improved mobility in addition to a better mental state overall, which is the result of the protocol minimizing physical discomfort and leakage.
Indicators for monitoring and evaluation: These interventions are expected to measure the efficacy with both objective and subjective measures like SUI episode counts and quantitative muscle strength assessments or standardized questionnaires.

Conclusions

Core stability training combined with pelvic floor muscle training for pregnant women can significantly reduce the incidence of stress urinary incontinence, a conclusion that has been validated by multiple clinical observations [21].

The preventive protocol combining core stability training with pelvic floor muscle training offers a promising, multidisciplinary approach to reducing the risk of SUI in pregnant women. Based on a synthesis of published clinical research, this framework is supported by strong evidence indicating that such combined interventions can enhance pelvic floor muscle strength, improve postural control, and significantly lower the incidence of postpartum urinary leakage.

Although this conceptual protocol does not include direct clinical implementation, the reviewed literature suggests that both pelvic floor and core stability exercises are independently effective, and even more impactful when integrated into a structured regimen during pregnancy. In particular, studies have shown that women who engaged in such training had lower rates of positive pad test results, better urinary control, and improved quality of life during the postpartum period.

The positive rate of the pad test in the observation group is significantly lower than that in the conventional group, and the scores for urination and pelvic floor muscle contraction ability are also better than those in the conventional group, indicating that pelvic floor muscle training can effectively prevent the occurrence of postpartum urinary incontinence. Further research results show that the application of pelvic floor muscle training combined with pelvic floor muscle electrical stimulation not only reduces the incidence of postpartum urinary incontinence but also effectively promotes the rapid recovery of pelvic floor muscle function, thereby improving the quality of life for pregnant women. Early pelvic floor muscle rehabilitation exercises have also been

shown to have a significant impact on preventing postpartum urinary incontinence. The incidence of postpartum urinary incontinence in the observation group of pregnant women was significantly lower than that in the control group, providing strong evidence for the effectiveness of early pelvic floor muscle rehabilitation exercises in preventing postpartum urinary incontinence.

By formalizing these insights into a unified, implementable model, this protocol provides healthcare professionals with a guideline that can be adapted for antenatal education, physiotherapy programs, and preventive care. Future clinical studies are recommended to validate the effectiveness of this protocol in real-world settings and to explore the additional benefits of including nutritional counseling and neuromuscular biofeedback in routine prenatal care.

Ultimately, this model underscores the importance of early, non-pharmacological interventions in preserving pelvic health and preventing postpartum dysfunction, offering a feasible and low-cost strategy to support the well-being of pregnant women.

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Conflict of interest

The authors declare no potential conflict of interest, and all authors confirm accuracy.

Ethics approval and consent to participate

This study is a conceptual protocol that does not involve any data collection, human participants, or medical interventions. Therefore, it does not require ethical review or approval.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

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Table 1. Evaluation indicators for future implementation.

Indicator	**Measurement Tool**	**Assessment Timepoint**	**Purpose**
Pelvic floor muscle strength	Perineometer or digital palpation	Before and after intervention	To assess the functional improvement of pelvic floor musculature
Urinary incontinence symptoms	ICIQ-SF or pad test	36 weeks of pregnancy and 6 weeks postpartum	To evaluate changes in SUI frequency and severity
Postural stability and core strength	Functional movement screening or balance test	Mid and late pregnancy	To measure the effectiveness of core stability training

Quality of life	SF-36 or UDI-6 questionnaire	Before and after program	To assess patient satisfaction, confidence, and lifestyle impact