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A variety of preventive and therapeutic methods in the pre- and postnatal period

Scientific editors
Agata Mroczek, Antonina Kaczorowska

Studio IMPRESO

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„Innovative education in the medical and health sciences
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Abbreviations

CPP	*chronic pelvic pain*
DRA	*diastasis recti abdominis*
IRD	*inter-recti distance*
LBP	*low back pain*
OMPT	*Orthopedic Manual Physical Therapy*
PA	*physical activity*
PFM	*pelvic floor muscles*
PGP	*pelvic girdle pain*
PPP	*postpartum period*
PVM	*proximal pubovisceral muscle*
OMT	*Orthopedic manual therapy*
OASI	*anal sphincter*
UI	*urinary incontinence*

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Introduction

This textbook is the result of international cooperation during a project entitled 'Innovative education in the medical and health sciences for improved teaching strategies on the health needs of pregnant and postpartum women'. The project was jointly run by teaching and research staff of three centres: University of Opole (Poland – project leader), University of Cadiz (Spain)and Klaipeda University (Lithuania). The main intentions of the project were to update recommendations on physiotherapeutic and obstetric procedures in accordance with Evidence Based Practice, modernise and improve the educational approach in terms of quality and appeal, as well as develop and strengthen the professionalism of students of medical and health sciences.

The health needs of pregnant women are still underestimated. In many centres in Poland and Europe, physiotherapy for pregnant and postpartum women is insufficient. A woman after childbirth does not receive adequate physiotherapeutic support. This situation is related to the maladjustment of students' curricula. In the current training program for midwives and physiotherapists, there is a complete lack of content regarding the elimination of modifiable risk factors for sphincter dysfunction or training of the pelvic floor muscles for pregnant and postpartum women – yet this should be a permanent and basic element of education understood as prevention of pelvic floor diseases related to childbirth. The educational content concerning the postpartum period is relatively superficial and the prevention of diseases is omitted.

The content of this manual focuses on understanding the many changes during pregnancy and the postpartum period, enriched with relevant and purposeful preventive action, including physiotherapy. The authors believe that this handbook will contribute to expanding the knowledge and enriching the competences of students of medical and health sciences, with particular emphasis on students of physiotherapy and obstetrics, as well as professional medical staff and other recipients.

The authors intend this handbook as a response to the current health needs of pregnant and postpartum women. The manual consists of nine chapters.

1. The first chapter discusses team administration/management and an interdisciplinary approach to effective cooperation and communication in an interdisciplinary team.
2. The second chapter discusses manual therapy in pregnancy, including musculoskeletal dysfunctions related to pregnancy, global and local manual therapy techniques for pregnant women, as well as the role and purpose of manual therapy of myofascial tissue in pregnancy.
3. The third chapter deals with physical activity and exercise during pregnancy.
4. The fourth chapter describes obstetrical technique, including protection of the perine during natural, forced or natural birth.
5. The fifth chapter contains information on labour, delivery and postpartum care.
6. The sixth chapter deals with the pain associated with childbirth.
7. The seventh chapter describes sphincter dysfunctions after labor.
8. The eighth chapter deals with measuring tools, including correct weight gain during pregnancy, methods for assessing physical activity as well as indications and contraindications to physical activity in pregnancy
9. The ninth chapter contains information on planning the therapeutic process after labor, and so: manual therapy in the postpartum period, physiotherapy after c-section, physical activity and exercises in the postpartum period, the postpartum pelvic floor muscle training program, abdomen diastasis recti therapy and breastfeeding and functional restore function.

1.
Pregnancy and postpartum. Essential information for a midwife and physiotherapist. Team administration/management and an interdisciplinary approach

1.1.
Cooperation and communication in an interdisciplinary team

Aelita Bredelytė

What is cooperation in an interdisciplinary team? According to the WHO: '*Collaborative practice happens when multiple health workers from different professional backgrounds work together with patients, families, carers and communities to deliver the highest quality of care across settings*'. Interprofessional relationships play a major role in effective patient care. Interdisciplinary teamwork is an essential component of holistic care since team members' skills, experience, and knowledge are pooled to produce the best outcomes.

Midwives play a vital role during the pregnancy, labour, and postpartum process. On the other hand, physiotherapists are elemental team representatives of the clinical healthcare team, and they need to understand other practitioners' roles and communicate effectively to provide high-quality, coordinated patient care. Every professional perceives their colleagues from other fields of health care differently.

Nurses make up a large component of the healthcare sector and are essential in an interprofessional healthcare team in a hospital setting. This perceived dominant role may influence the power relationship between nurses and physiotherapists. In the current demanding healthcare environment, interprofessional team practice is being promoted as a comprehensive means of providing cost-effective healthcare.

Literature suggests that professional specialisation has led to a fragmentation between professions, which is likely to result in health care team members being unable to look at the problems faced by patients as a whole team. A small number of studies have highlighted some of the attitudes and perceptions that may underlie interprofessional relationships and their effect on teamwork and effectiveness of management in critical care. Communication is identified as of particular interest because of the complex sociotechnical tendencies of the healthcare environment. Interpersonal factors have been reported as the main causes of stress in high-dependency areas whereas poor communication is reported to cause errors.

It is important that health professionals have an understanding of each other's roles in order to promote patient-centred care and services. There are five major issues when evaluating colleagues in an interdisciplinary team: the role and image of other professionals, the effectiveness of treatment, communications, teamwork, and interprofessional relations.

Research show that nurses perceive physiotherapists to be an important member of the team. The respondents admitted that limitations did exist within interprofessional relationships. A study exploring interprofessional perceptions of physiotherapists and midwives, using the nominal group technique and follow-up questionnaires, identified a lack of awareness about each other's discipline.

Interprofessional relationships enable understanding and acknowledgement of roles, and enhances the quality of care for patients by 'maximising health goals, minimising the duplication of tasks and boosting job satisfaction.'

While there are number of existing competency frameworks for interprofessional collaboration, the most widely referenced are framed as a set of individual traits including attributes, knowledge, and skills of individual healthcare professionals that are required for collaborative practice. Many academic institutions and healthcare organisations have adopted interprofessional competency frameworks to put in place standards of practice and support the knowledge and skills of healthcare professionals. However, delivery of optimal care within an effective interprofessional team is based on the collective efforts of team members and is better accomplished through a number of shared responsibilities, interactive planning, and collaborative decision-making.

Collaborative working centres around recognising and accepting expertise, mutual respect, trust, understanding, appreciation of each other's role and 'effective communication'.

There is no possibility to cooperate effectively with poor communication. Many researchers argue the importance for healthcare professionals to be able to clearly express themselves and listen effectively. Research on factors affecting communication between healthcare professionals revealed the importance of the following: interpersonal skills, exchange of information, honesty in the relationship, and

professionalism. These skills include being able to solve complex problems, to think critically about tasks, to effectively communicate with people from a variety of different cultures and using a variety of different techniques, to work in collaboration with others, to adapt to rapidly changing environments and conditions for performing tasks, to effectively manage one's work, and to acquire new skills and information independently. Communication skills are not just verbal but encompass the spectrum of nonverbal communications including body language and written communication.

Good communication skills mean the ability to respectfully, effectively, and efficiently develop a relationship with patients and their families, to show respect for diversity and cultural, ethnic, spiritual, emotional, and age-specific differences in patients and other members of the health care team, to demonstrate effective listening skills and to be able to elicit and provide information using verbal, nonverbal, written, and technological skills, to be able to develop flexible communication strategies and adjust them based on the clinical situation, to participate effectively in or lead a health care team, to elicit patient's motivation for seeking health care, to negotiate as well as resolve conflicts, and effectively apply feedback from others, etc.

Healthcare professionals need to make sure that their communication skills are effective when they communicate with in a team, and continuous development of communication skills is beneficial to the effective care.

And what do midwives and physiotherapists think about working in one team? Midwives tend to be the least cooperative of all healthcare professionals. Physiotherapists tend to rely only on their expertise. They express respect for each other's profession but mistrust exists due to lack of awareness of professional aspects. Sometimes they make excuses: 'We were never told...', 'That notice wasn't meant for us, so I didn't listen...', 'But we don't know what physiotherapists do,' etc.

With this handbook we invite you to learn more about the importance of collaborative work, and about the responsibilities of midwives and physiotherapists in order to provide better care for pregnant and postpartum women.

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1.2.
Pregnancy and postpartum. Interdisciplinary approach

Aelita Bredelytė

Every woman needs the right support throughout their pregnancy, labor, and postpartum experience. Usually, the midwives are the 'key route' for delivering information within the maternity services. However, it would be helpful if multidisciplinary teams knew that physiotherapists could have a role to play in antenatal and postnatal care as well. There are mixed opinions as to whether physiotherapists' involvement in obstetrics should be acknowledged and accepted. The literature predominantly links obstetric physiotherapists' role to three areas: pelvic girdle pain (PGP), incontinence, and postnatal depression. However, the research evidence is very poor. Nevertheless, physical activity for pregnant and postpartum women is strongly encouraged nowadays and the role of physiotherapists is becoming essential. So, physiotherapists, who specialise in women's health, can be a great resource of information and practice.

In this subchapter we want to highlight the importance of both professions for helping women and encourage the sharing of information and cooperation between them.

1.2.1. Pregnancy

Antenatal care – regular contact with skilled health personnel during pregnancy – is a core component of maternity care, grounded in a human rights-based approach.

Midwifery covers many aspects of support during pregnancy. As long as everything is normal in pregnancy, a midwife can generally provide all of the antenatal care.

And the obstetric physiotherapist aims to prevent or alleviate the physical and emotional stresses of pregnancy and labour. This is achieved by improving the mother's physical fitness and her understanding of the changes taking place in her body during pregnancy. The obstetric physiotherapist is a skilled in effective relaxation, breathing awareness and positioning and so is able to prepare the woman and her companion for labour. The preparation of both parents for labour and parenthood is undertaken ideally in collaboration with midwives. Where problems arise, such as backache, pelvic pain and stress incontinence, the obstetric physiotherapist is a skilled clinician in the treatment of these conditions.

Women are commonly referred to a physiotherapist when a woman complains of pain while pregnant. In many cases, the situation takes a bizarre turn, because while waiting to see a physiotherapist, in the meantime the woman gives birth. Such cases are common and demonstrate the ineffectiveness of pregnancy care. However, there are also good examples of effective pregnancy care teams that include a midwife and a physiotherapist. In such teams, constant physiotherapist consultations are available both at the beginning of pregnancy and throughout it.The specialist women's health physiotherapy team can treat antenatal and postnatal back pain, pelvic pain, hand numbness/pins and needles, postnatal separation of the tummy muscles, and pelvic floor problems. They can give specific advice to pregnant women with pre-existing pain.

Cooperation between midwives and physiotherapists is beneficial in developing a plan for reducing pain and discomfort during pregnancy, to develop a tailored exercise program to suit certain women, prepare for delivery and prevent birth injuries.

1.2.2. Postpartum

Postnatally, midwives offer postnatal care, including helping with breastfeeding and settling a baby and administering pain relief if needed. An obstetric physiotherapist is able to help the mother recover by teaching exercises, back care,

and general health education, including coping with the stresses of parenthood. She can assess and alleviate such problems as a painful perineum, backache, and stress incontinence.

However, research show that in many cases there was no consensus among the different health professionals (midwives and physiotherapists) on how to best approach prenatal and postnatal issues. The importance of more research to increase the professional knowledge base among physiotherapists and midwives is stressed. Also communication and cooperation is offered to better understand the professions, responsibilities, share knowledge and experience. Interdisciplinary approach when dealing with maternity is essential. The better different health professionals will express their role in the multidisciplinary team, the better – women tailored – maternity service will be provided.

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1.3.
Pregnancy stress and anxiety

Kristina Nekliajeva, Lolita Rapolienė, Aelita Bredelytė

World Health Organisation (WHO) recommendations on antenatal care for a positive pregnancy experience (33) emphasise positive pregnancy experiences leading to the effective transition to positive labour and birth and contributing to achieving positive motherhood (including maternal self-esteem, competence, and autonomy). All women indicate that they consider that a positive pregnancy experience equates with efficient clinical practises (interventions, diagnostic tests, prescribed care, for example, supplements), appropriate and timely information as well as psychosocial and emotional support provided by experienced, supportive, and respectful healthcare specialists.

Do women only have desirable and positive experiences while pregnant?

What are the dominant negative and positive **physical and psychological pregnancy experiences** and to what extent do they correspond with women's expectations?

These questions will be analysed in this subsection.

Starting to discuss women's most frequent psychological experiences, it is important to note in general that women are considered as more psychologically labile even when they are not pregnant. The results of research made in 2021 on the stress response related to behaviour and psychology as well as intrinsic harmony during pregnancy show that there are significant similarities between the functioning of autonomic nervous system and emotional activity during pregnancy and non-pregnancy whereas in the perinatal period women tend to experience significant psychological changes related to the preparation for labour and birth as well as bringing up a child. For instance, individual differences of emotional deregulation in pregnant women during the prenatal period occur to soften the reaction to the baby's cries. Pregnant women tend to experience increased functional connection among brain regions related to attachment and sensitivity. A pregnant woman is so labile that even simple actions and procedures that medical personnel find unexceptional could lead to negative psychological experiences. This conclusion could be made on the basis of the statement provided by S. Downe and co-authors, who claim that in a particular environment a woman experiences a sense of shame due to physical examinations.

Research shows that although the period of pregnancy is full of positive emotions for most women, some experience negative emotions and stress as well. Stress and anxiety are indicated as the basic negative experiences related to the psychology of pregnant women. It is obvious that stress plays an exceptional role. Stress could contribute to various biological responses in women that could be both positive (e.g., attachment) and negative (e.g., anxiety, fear, etc.). In the majority of literature resources, the negative side of stress is presented, meaning that stress, based on scientific facts, more frequently causes negative outcomes in women. For instance, the results of the presented article on stress regulation with the help of the female central nervous system show that even short-term moderate stressful situations could add to the experience of dependence/agitation and possibly anxious avoidance

Therefore, more significant stressors could manage to avoid natural suppression characteristic of sympathetic nerve activity during pregnancy with a possible side-effect on the development of the child as well as the mental health of the woman. In consideration with this fact, the topic of stress experienced by pregnant women is analysed in the context of negative experience. It is important to state that anx-

iety in scientific literature is always presented as a negative factor. The frequency of stress and anxiety experienced, as it has been indicated in literature, ranges between 11–33 %. According to the research, more than one third (33.4 %) of female respondents presented indicators of stress. Another research showed that perceived stress is experienced by 11.6 % of the pregnant women that took part in the research. A meta-analysis published in 2019 revealed that anxiety disorders affect 20.7 % of pregnant women until labour.

It would be important to emphasise that a pregnant woman could experience stress for a wide range of reasons; however, the most frequent include aspects of pregnancy itself. Stress in pregnancy in some literary resources is called pregnancy-specific stress. What does this type of stress involve? Pregnancy-specific stress involves agitation and concern related to the health and wellbeing of a child, the forthcoming labour, healthcare experiences in hospitals, the postnatal period as well as the role of a mother. So, it provides evidence that security, and being able to guarantee it, are of major significance for women, whereas, in its absence, stress occurs. There are plenty of factors defining pre-natum anxiety disorders; they involve social, psychological, behaviour, environment, and biological factors that, in their turn, shape pregnancy and could lead to anxiety experienced during the whole period until labour. The very fact of being pregnant could be a reason for the stress and anxiety experienced by a pregnant woman. Pregnancy-specific anxiety was shown to affect 15 % of pregnant women at a high level.

Over 55 % of women experienced high level of pregnancy-specific anxiety from the 24th week of pregnancy. Pregnancy-specific anxiety is more frequent in pregnant women than generalised anxiety disorder; 26.5 % out of 800 female respondents that took part in the research reported pregnancy-specific anxiety, whereas 16.4 % reported generalised anxiety disorder.

One of the most important reasons for stress, anxiety, and other psychological experiences could be the violation of any of aforementioned aspects of health and wellbeing. The connection between a previous perinatal loss and experiences such as anxiety, depression, and stress were identified. This fact is also supported by the links between such kind of losses with anxiety in a subsequent pregnancy. Although such losses are painful, they could be managed consciously with the level of stress and anxiety reduced. It is claimed in this research work that although stress and anxiety are experienced by women presenting mental health disorders, a higher state of awareness is related to lower levels of general stress and anxiety independently of whether the respondents had mental health problems or not (17). Speaking about stress, it is important to take into consideration not only women's awareness but level of support as well. It is determined that extreme stress is experienced by women who lack support from their family (1). Other authors make a very interest-

ing claim that one of the reasons for stress in pregnancy is the avoidance of a need to cope with problems. This was confirmed in the research work made in 2019 on aspects and ways of coping with intrinsic experiences in employed pregnant women. The results of this research reveal that employed pregnant women that use negation as a coping mechanism mention more frequent conflicts at work. The more they denied the problems, the more they perceived that the time needed to deal with pregnancy-related issues interfered with their ability to complete work tasks.

The authors claim that coping based on avoidance does not eliminate the feeling of stress (2). It is emphasised that by means of coping with problems a person aims to control the pressure from outside or their own internal stress (28). In order to gain fewer negative outcomes women at work should focus on active coping with problems as when trying to negate sharp stressors more damage than help for employed pregnant women is caused. On the other hand, there is the weighty fact presented showing that women with complicated pregnancy are less likely to apply such coping strategies as negation (1).

Distinguishing other possible reasons for stress experienced, the data is provided on how previous emotional disturbances and medical complications are proven as significant factors highly related to anxiety disorders in pregnancy (4). In addition, advanced age pregnancies could not be called an easy experience for women. Women that understand that their chances of having a baby in the future could be limited tend to experience a high level of stress as well as they are worried, even though their pregnancy is uncomplicated (29).

Other negative psychological experiences of pregnant women that are rarely mentioned in the literature were also noticed: fear and depression.The reasons to fear are also related to the state of a woman as well as the safety of the foetus. It is determined that the women with high-risk pregnancy face fears related to its outcome and subsequent pregnancies (3). So, women tend not only to experience stress and anxiety but also feel fear caused by such factors. Although other fears and reasons for depression are identified as the same as of anxiety and stress, in 2016 the WHO identified violence from an intimate partner as one more harmful factor undermining positive experiences for pregnant women.

According to the above-mentioned research source, the role of a partner could be highly negative; nonetheless, data on the positive side is more frequently provided. The benefits of a spouse's participation in prenatal care, not only in labour but also in pregnancy, are emphasised. A spouse's participation as well as support is also associated with lower levels of stress and anxiety (15). Is there anything else that could reduce the negative experiences of pregnant women? M. Dolatian in collaboration with other authors (6), in a study on a structural model of spirituality and psychological wellbeing for pregnancy-specific stress, determine that preg-

nancy-specific stress is positively influenced by spirituality. Therefore, it could reduce the amount of negativity experienced by pregnant women by allowing positive emotions to take its place. Meanwhile, in general, research literature tends to lack sufficient data on positive experiences characteristic of pregnancy, possibly due to the fact that such research could lack tangibility. Happiness is the most frequently mentioned positive experience. Psychological changes encourage a pregnant woman to see pregnancy both as the reason for concern and happiness. So, happiness is mentioned as one of the outcomes of pregnancy in a meta-analysis on labour-related fears. It reveals that the women with reduced positive emotions have poorer physical and psychological health as well as higher risk of experiencing psychological pain in mid-pregnancy (22). The link between psychological and physical experiences is revealed here.

The physical experiences a pregnant woman has are as following: nausea and vomiting, pain in the lower back and lower abdomen, heartburn, varicose veins, constipation and muscle cramps. These symptoms cause discomfort and negatively impact pregnant women. Although these experiences are caused by pregnancy as a physiological phenomenon in a woman's body, in the majority of cases they could be controlled. Ultrasound examination before the 24th week as well as note-taking by the pregnant woman herself are thought to contribute to positive physical pregnancy experiences. Also, taking supplements and other care-related procedures are seen as significant. Serious attention is devoted to nutrition and plenty of recommendations are available (33). Obviously, the area of physiological experiences receives quite a lot of attention compared to psychological ones. The resources featuring the aforementioned recommendations sadly only evaluate and manage physiological symptoms although, as declared by the WHO (33), the experience of women's healthcare includes effective communication, respect, dignity and emotional support – all of which are related to psychological experiences (18).

Negative experiences could lead to negative pregnancy outcomes with a vicious circle of stress and anxiety that is hard to escape. A higher level of stress in pregnancy is thought to be related to subsequent autism spectrum disorder in the newborn, along with obesity and tummy cramps (5).

Anxiety and stress in pregnancy cause harm such as preeclampsia, depression, more frequent nausea and vomiting, premature labour and birth, low birth weight, low APGAR scores for the newborn (11,24,27). According to A. Ebadi, J. Kariman ir M. Hajifoghaga (10), the shift in a woman's social and family role is directly related to psychological changes in pregnancy (10). Therefore, changes in family could result in wide variety of psychological experiences. It is revealed that pregnancy-specific anxiety is related to the necessity to perform a Primary Caesarean Section (16). It is also identified that the anxiety in early and late pregnancy could be related to

cognitive disorders in pre-school age boys, whereas anxiety in early pregnancy could add to the problems experienced by girls in the area of information processing (32). Anxiety in pregnancy is associated with an increased level of placental cytokines when pregnant with a boy. In 2020 there was an interesting study accomplished with the conclusion done that the link between placental cytokines and attention deficit hyperactivity disorder (ADHD) in children was related to gender. A significant correlation between pregnancy-specific anxiety and gender in terms of the risk for ADHD has been established. Compared to pregnant women who experienced no anxiety, those with pregnancy-specific anxiety during the last two trimesters of pregnancy have an increased risk of delivering a baby with attention deficit hyperactivity disorder (26).

Therefore, typical experiences and complaints of pregnant women are usually linked with negative outcomes and consequences. It has been proven by plenty of obstetric methods describing the causes of physical complaints in pregnancy and how to fight with them. In the above mentioned WHO recommendations on antenatal care and the experiences of women (33) there are particular tables with the description of all physical feelings and complaints provided as well as recommended ways of coping with them. On the other hand, some authors share a contradicting idea claiming that discomfort such as morning sickness and other physical symptoms could help a woman to confirm the fact that she is pregnant (22). The experiences of pregnant women that are related to their body could reflect their reactions to particular physical changes as self-representation moving towards the role of a mother (30). Thus, the physical experiences of pregnant women determine a positive result in a psychological aspect, i.e. confirmation of a woman's nature to become a mother and the identity of a pregnant woman, a future mother, a nursing mother, a person responsible for her offspring.

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2.
Manual therapy in pregnancy

Martyna Kasper-Jędrzejewska, Grzegorz Jędrzejewski

Orthopedic Manual Physical Therapy (OMPT) consists in the application of specific manual techniques and therapeutic exercises, increasingly taking into account the biopsychosocial model. Orthopedic manual therapy (OMT) techniques may include sliding and/or non-sliding joint manipulation and various forms of passive and active soft tissue stretching (soft tissue mobilisation, dry needling, myofascial release, and muscle energy techniques). The use of OMT techniques is supported by a wealth of evidence from systematic reviews and is embodied in a number of clinical practice guidelines for a variety of functional disorders (1,2), including the treatment of chronic low back and pelvic girdle pain in pregnant women (pregnancy). Low back pain, PLBP/Pelvic Girdle Pain, PGP) (3,4). These complaints may occur in approximately 86% of women in the third trimester of pregnancy, and it should be remembered that there are clinical reasons for classifying PLBP and PGP as two separate conditions (so, standardised tools for evaluating LBP conditions may not be appropriate for patients with PGP). PLBP is defined as 'pain or discomfort between the 12th rib and the gluteal fold' When both types of pain are present and cannot be differentiated, the pain is often referred to as lumbopelvic pain. However, it should be kept in mind that there is evidence that physical therapists should not use manual therapy as the only form of intervention in the treatment of PGP, for example (Grade of Recommendation: A) (3,5).

2.1.
Pregnancy related musculoskeletal dysfunction and manual therapy

A very important fact is that pain during pregnancy favours the occurrence of pain in the postpartum period and later (1 and 3 years after delivery) (3,6).

Pain in pregnant women may be due to changes in the musculoskeletal system to make room for the developing foetus (7). Biomechanical adjustments in response to the anterior shift of the body's center of gravity are critical to pregnancy and affect the soft tissues and joints, and so the posture of the entire body. Increased relaxin, estrogen, and progesterone levels cause loosening (flexibilisation) of the soft tissues surrounding the joints, resulting in deepening of the lumbar lordosis, posterior tilt of the sacrum, instability of the lower limbs, or increased mobility of the pelvis (8). All these changes can have a negative impact on the health and quality of life of pregnant women. They lead to difficulties in managing daily life, increase the risk of falls, and/or cause PLBP/PGP, creating a vicious cycle of pain (8).

2.2. Global and local manual therapy techniques for pregnant women

In addition to individualised physical activity for pregnant women (see chapter 3) there are several types of manual therapy methods that a physical therapist (Table 1) (9,10) can use to treat pain associated with increased muscle tension. It is recommended that safe and noninvasive manual techniques, transcutaneous nerve stimulation (TENS), autogenic relaxation training, or aromatherapy (not discussed in this chapter) be used. Massage and manual techniques used to stretch and/or activate muscles and other contracted/tight tissues have a relaxing and analgesic effect by activating the transmission of nerve impulses through A-fibres (thus blocking pain transmission) and/or stimulating the release of endorphins. In pregnant women, postisometric relaxation and myofascial relaxation are most commonly used (11) and are part of what is known as osteopathic manipulative therapy (OMT). This is a global approach to the diagnosis, treatment, and prevention of disease or injury that involves subjecting muscles and joints to techniques such as stretching, gentle pressure, and resistance (Table 1).

Table 1. Types of OMT techniques that can be used for PLBP and PGP in pregnant women

Type of technique	Description of the technique	Purpose of the technique
Strain/counterstrain (1)	Passive muscle shortening. The introduction of passive movements in the direction and plane of facilitated movement, always accompanied by a search for the position of greatest comfort. The diagnosis is based on 'tender points' specific to each joint,	Releasing muscles and other soft tissues – reducing joint tension and improving mobility.

Table 1. continued

Type of technique	Description of the technique	Purpose of the technique
	which can be detected by palpation. The comfort position found, corresponding to the 'tender point', is held for 60 to 90 seconds and then slowly and gradually returned to the neutral position, resulting in a decrease in hypersensitivity and proprioceptive activity	
Muscle Energy Technique, MET) (1,2)	Post-isometric relaxation – relaxation and lengthening of a hypertonic/tensed muscle by targeting an agonist muscle group. Reciprocal inhibition – muscle relaxation and lengthening by activating the stretch reflex of the muscle spindle fibers of the antagonistic muscle, which causes reflex relaxation of the agonistic muscle. The most common MET protocol consists of three to five repetitions of isometric contractions followed by relaxation.	Increase range of motion, stretch tight muscles, reduce chronic pain, improve blood and lymph circulation and so function
Soft tissue techniques	Manual lengthening of the shortened fascial tissue	
Myofascial Release	Techniques using light weight, sustained pressure, and long-term focus on manipulation of painful/dysfunctional myofascial tissue. The techniques are often used in conjunction with the concept of the myofascial chain	Relief of pain, improvement of function, restoration of elasticity, tone and properties (flexibility and stickiness) of the affected tissue
Rib raising	A joint technique in which it applies pressure to the barrier that limits the angle of the ribs to the spine. It is a non-invasive, passive technique that can be useful even in seriously ill, hospitalised patients. During the procedure, the patient lies supine or sits and is inactive. The therapist uses repetitive force to increase the range of motion of the posterior rib joints to reduce somatic spinal dysfunction.	Stretching of the myofascial structures, increasing the mobility of the chest wall and normalisation of the thoracic sympathetic ganglia.
Diaphragm Doming	Relax the diaphragm by applying pressure on both sides under the rib cage.	Improves the mobility of the diaphragm. Secondary effects: Reduction of neck, chest and lumbar pain and improvement of blood circulation.

Table 1. continued

Type of technique	Description of the technique	Purpose of the technique
Indirect relaxation of the diaphragm	Relax the diaphragm by placing the hand on the anterolateral part of the chest and placing the tissue in a relaxed position	Improves the mobility of the diaphragm. Secondary effects: Reduction of neck, chest and lumbar pain and improvement of blood circulation.

Contraindications to the use of the above-mentioned techniques (collective list):

- Lack of ability to perform conscious relaxation
- Lack of ability to give feedback to the therapist
- Fractures at the treatment site
- A torn ligament or tendon at the treatment site
- Pelvic or joint instability
- Postoperative period
- Lack of ability to perform isometric contraction in the place undergoing therapy
- Failure to follow the therapist's directions
- Pain during therapy

2.3. The role and purpose of manual therapy of myofascial tissue in pregnancy

The goal of working with a pregnant woman is not to improve posture, but to maintain a relatively good structural condition and stabilisation of the body as far as possible. It should be taken into account that the course of pregnancy or the change of posture during pregnancy is a dynamic process. The choice of manual techniques is individualised and adapted to the needs of the body, while maintaining the safety and comfort of the patient. The therapist should pay attention to the relationship of the pelvis to the lower limbs and how they support the rest of the body through the pelvis and chest. Very often, the feet contribute most to the im-

balance of the body – not only in terms of the stability of their arches, but also in terms of the sensory connection with the vestibular and visual systems, and so the tension patterns in the body (14). Manual work in the lower legs (around the fibula and the medial part of the lower legs, the lateral and medial arches of the foot, the plantar part of the foot) facilitates the opening of the interosseous membrane and neurovascular channels, while also improving the mobility of the hip joint area, which in turn affects the relief of the sacrum. The reason for improving the mobility (mobility) of the sacrum is to facilitate the work of the sacroiliac joints during walking. Another important area is the rib vertebral joints and restoring their proper mobility (see description of Rib Raising Technique, Table 1). To accomplish this, the therapist works on the soft tissues by selecting the appropriate depth and direction so that they are level and move in unison with the action of the rib-vertebral joint. The upper ribs are developed in relation to the Scalene muscles and the upper lobes of the lungs.

A physiological phenomenon that occurs as pregnancy progresses is the emergence of a new center of gravity. Very often, this causes the upper body to tilt backwards, which can lead to disorders in the mobility of the neck, especially the C0-C1 and C1-C2 joints. Relieving pressure on these areas is just as important as working on the sacrum. When working with the upper limbs, structural connections (myofascial connections) should be taken into account, i.e. the dorsal part of the forearms – the trapezius muscle and the area of the suboccipital muscles, and the ventral part of the arms – the front of the neck and the jaw (15-18). In summary, a consistent approach to maintaining myofascial balance (soft tissue tension) during pregnancy is to work with the occiput, sacrum, and limbs: below the knee and elbow joints. The goal of any manual intervention in pregnant women is to develop (in response to patient-reported symptoms) interosseous and transverse connections to alleviate the body's adaptive stress during pregnancy, rather than postural correction per se (19). In summary, there is strong evidence for the use of manual therapy techniques in combination with other interventions (e.g., physical activity) to provide (short-term) relief of pain and disability due to PGP. Clinicians should not use manual therapies in isolation (as the only form of intervention). There is clear evidence that the use of manual therapies is no better than stabilisation exercises in terms of long-term improvement (> 6 months) in patient-reported symptoms. Clinicians may or may not use manual therapy techniques, including high-velocity, low-amplitude manipulations, to treat PLBP and PGP. Because there are few, if any, reports of adverse effects in the healthy prenatal population (recommendations are based on weak evidence), treatment may be considered (4).

Table 2. Changes in the musculoskeletal system during pregnancy and their consequences, as well as the influence of hormones and the possibilities of physiotherapy.

Trimester	Musculoskeletal changes (7)	Consequences/symptoms of musculoskeletal changes	Hormones affecting the musculoskeletal system (20)	Possibilities of manual therapy (in combination with physical activity if there are no p / indications)
First	• Posterior pelvic tilt (a consequence of the movement of the internal organs) • Initially the weight of the uterus on the bladder and the pelvic floor, with increasing size of the uterus pressure (pressure) on the small intestine and the sigma • Pressure of the organs on the diaphragm and expansion of the thoracolumbar junction • Increased thoracic kyphosis and lower cervical lordosis as a result of breast enlargement	• Strain in the hip flexors, extensors of the lumbar spine and upper abdominal muscles • Tension in the upper part of the thorax (thoracic outlet syndrome, C5-C8-Th1): Pain and paresthesias in the neck, shoulder, and hand	• Estrogen is mainly produced by the placenta and has the role of supporting the growth and well-being of the foetus. Estradiol has been shown to increase greatly during pregnancy and decrease during labour and lactation. Estrogen increases relaxation and decreases stiffness of soft tissues, including ligaments and tendons. It also decreases their resistance to damage. • Progesterone is produced initially by the corpus luteum and, after the first trimester, mainly by the placenta. Progesterone levels peak in the third trimester of pregnancy. It is important for implantation and maintenance of pregnancy and is often used pharmacologically to prevent miscarriage and treat preterm labor. The role of progesterone in the neuromusculoskeletal system is to stimulate collagen production. • The relaxin level rises early in the first trimester and peaks around the twelfth week of pregnancy. It then gradually	• Movement and postural re-education • Educate on the separation the rectus abdominis (eliminate exercises and activities that create a 'cone') • Learning to coordinate contraction and relaxation of the pelvic floor muscles with breathing (PLF contraction – exhale, PLF relaxation – inhale) • External assessment of PFM
Second	• Hyperextension of the knees and flattening of the feet): • Forward tilting of the pelvis, which increases as the uterus grows and deepens the lumbar lordosis (late second trimester) • To accommodate the growing uterus while maintaining lung function, the chest expands laterally	• Pain and overload of the knee joints, feet, heels • Pain in the pelvic girdle, pain in the lower back, leg pain/cramps • Pain in the intercostal joints, breathing difficulties • Tension in the lower part of the sternum, epigastrium (and linea alba) and pubic symphysis		As in the first trimester, pay attention to the proper tension of the transverse abdominal muscles and the protection of the linea alba by using: • Deep tissue massage • Mobilisation of the soft tissues • Trigger point therapy • Post-isometric muscle relaxation • Rib Raising techniques

	by 10-15 cm. Increased chest circumference = increase in the subcostal angle, stretching of the abdominal and intercostal muscles • Tension of the linea alba and abdominal muscles increases • The abdominal cavity expands posterolaterally	(symphysis pubis) • Edema • Muscle spasms • Stretching of the arcuate ligaments of the diaphragm, the costal joints and intercostal muscles, the thoracolumbar fascia and the lumbar trapezius muscles	about 17-24 weeks of gestation and then stabilises for the remainder of pregnancy. Relaxin inhibits uterine contraction, and in the neuromusculoskeletal system it increases relaxation, reduces stiffness, and increases tissue hypertrophy in response to, for example, weight training. • Prolactin is produced by the pituitary gland and plays a role in maintaining the corpus luteum during pregnancy and in milk synthesis during lactation. Prolactin levels increase during the 8th week of pregnancy, reaching 10 times normal. It remains elevated in lactating women (prolactin levels vary with the status of lactation) • The ovaries and adrenal glands produce testosterone. In nonpregnant women, testosterone levels peak during the ovulatory phase of the menstrual cycle, and in pregnant women, levels increase throughout pregnancy. From weeks 13 to 16, levels are significantly higher than in non-pregnant women. The increase in free testosterone up to 28 weeks is thought to be due to a decrease in metabolic clearance, and the production of free testosterone increases after 28 weeks. Testosterone levels peak at the time of delivery. In the first few days after delivery, the level drops to that of non-pregnant women. Testosterone increases tendon strength and contributes to tendon relaxation during the menstrual cycle (along with estrogen and progesterone).	• Diaphragm techniques Modifications for this trimester: increase joint stability, reduce/modify supine activity if the patient is symptomatic
Third	• Lordotic spine / Accentuated lumbar lordosis: (body weight held by pubic symphysis and abdominal muscles) or 'sway back' (body weight behind pubic symphysis, pelvic floor and pelvic ligaments) • Elimination of thoracolumbar curvature • increased cervical lordosis: neck pain, tingling and numbness, shoulder girdle pain, carpal tunnel syndrome • Extension of head • Increased nutation of the sacrum • A constantly stretched pelvic floor, which has to lengthen in order to maintain tension • The constantly expanding uterus stretches the abdominal muscles by 115% in the 38th week of pregnancy	• Lower back pain, increased muscle tension • Head and neck pain • Edema • Muscle cramps		Relaxation techniques and relaxation of the pelvic floor: • PFM exercises with emphasis on the relaxation phase • PFM exercises with emphasis on the relaxation phase phases of breathing • Perineum massage (around the 34th week of pregnancy) General fitness exercises to help maintain posture in the area of gravity Training of birthing positions that open the pelvic floor: Kneeling position with external rotation of the lower legs, half squat/squat position

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3.
Physical activity and exercise during pregnancy

3.1.
Physical activity and exercise during pregnancy

Agata Mroczek, Antonina Kaczorowska

3.1.1. Background Considerations. What is physical activity, physical exercise and sport?

The WHO (World Health Organization) defines ***physical activity*** as any bodily movement produced by the contraction of skeletal muscles that requires energy expenditure in all stages of life, maintains and improves cardiorespiratory fitness, reduces the risk of obesity and associated comorbidities, and results in greater longevity. Physical activity refers to all movement including during leisure time, transportation or commuting, or as part of someone's work.

Physical Exercise defined as physical activity consisting of the execution of planned, structured, and repetitive body movements done to improve one or more components of physical fitness is an essential element of a healthy lifestyle.

Sport can be defined as an institutionalised competitive activity involving vigorous physical effort or the use of relatively complex motor skills.

3.1.2. Physiological and anatomical changes of pregnancy. Anatomic and physiologic aspects of exercise in pregnancy

During pregnancy, the body undergoes various anatomical and physiological changes to provide the right conditions for foetal development, meet increased metabolic demands, and prepare for birth. Changes begin to appear early in the first trimester, peak at term or delivery, and return to pre-pregnancy levels a few weeks af-

ter delivery. These changes are well tolerated in healthy women but may exacerbate or unmask pre-existing disease or pathophysiology associated with pregnancy.

The body goes through many changes during pregnancy. It's important to choose exercises that take these changes into account:

- Joints – hormones produced during pregnancy cause the ligaments that support the joints to loosen. This makes the joints more vulnerable to injury. Avoid sudden, springy or forceful movements that may increase the risk of injury.
- Balance – the extra weight in front of the body shifts your center of gravity. This puts strain on the joints and muscles, especially the pelvis and lower back. The body is less stable and more likely to lose balance and therefore fall.
- Breathing – during exercise, oxygen and blood flow are directed to the muscles and away from other areas of the body. Oxygen demand increases during pregnancy. This can affect the ability to perform strenuous exercise, especially in overweight or obese women.

Pregnancy causes anatomical and physiological changes that must be considered when prescribing exercise. The most pronounced changes during pregnancy are weight gain and a shift in the center of gravity that causes progressive lordosis. The consequence of these changes is that over 60% of all pregnant women experience lower back pain. To minimise this risk, it is recommended to strengthen the abdominal and back muscles.

During pregnancy, blood volume, heart rate, stroke volume and cardiac output increase, and systemic vascular resistance decreases. Remaining in the supine position during exercise after 20 weeks of gestation may result in reduced venous return due to compression of the aorta by the gravid uterus, leading to hypotension, and this hemodynamic change should be taken into account when recommending modifications to exercise during pregnancy.

3.1.3. Benefits of physical activity and exercise during pregnancy

According to WHO experts, physical activity during pregnancy may reduce weight gain during pregnancy and the risk of gestational diabetes, does not increase the incidence of gestational hypertension, does not increase the frequency of miscarriages, premature birth, birth complications, the risk of having a baby with low weight, and probably reduces the risk of postpartum depression. Doing any physical activity is better than doing nothing.

Regular physical activity reduces the risk of hypertension, cardiovascular diseases, tumours, type 2 diabetes and premature death. In addition, it has a positive effect on mental health (reduced symptoms of anxiety and depression), cognitive functions and sleep. Physical activity also plays an important role in maintaining a

normal body weight and preventing obesity. Additional advantages are improved quality of sleep, increased motivation to exercise; improvement of physical discomfort that may occur during pregnancy; prevention and reduction of lower back pain; reduction of edema in the extremities. In addition, there have been reports of a balanced increase in foetal growth, shorter duration of labour, less need for caesarean section, lower incidence of obstetric complications, reduced risk of preterm delivery and a lower risk of neonatal complications.

According to WHO recommendations, pregnant and post-partum women physical activity confers the following maternal and foetal health benefits: a decreased risk of: pre-eclampsia, gestational hypertension, gestational diabetes (for example 30% reduction in risk), excessive gestational weight gain, delivery complications, postpartum depression, newborn complications and physical activity has no adverse effects on birthweight or increased risk of stillbirth.

The benefits of exercise in pregnancy include a higher incidence of vaginal delivery and a lower incidence of: excessive weight gain in pregnancy, gestational diabetes, abnormal high blood pressure in pregnancy (defined as gestational hypertension or pre-eclampsia), premature birth, delivery by caesarean section, and lower birth weight.

3.1.4. How much physical activity is recommended?

WHO guidelines and recommendations provide details for different age groups and specific population groups on how much physical activity is needed for good health.

The WHO recommends that all pregnant women without medical contraindications undertake regular physical activity throughout their pregnancy. They should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, as well as aerobic and muscle-strengthening exercises. It may also be beneficial to add some gentle stretching. In addition, women who performed high-intensity aerobic exercise or were physically active before becoming pregnant may continue to do so during pregnancy, if there are no medical contraindications. They should also limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits. The WHO recommends that any physical activity is better than none and that increasing physical activity is essential for optimal health outcomes.

These 2020 WHO guidelines update the previous WHO recommendations issued in 2010. These guidelines should be implemented into national health policies in accordance with the WHO Global Action Plan on Physical Activity 2018–2030.

Before recommending an exercise program, a thorough clinical evaluation should be performed to ensure that the patient has no contraindications. A moderate-intensity exercise program should be followed for at least 20-30 minutes a day on most or all days of the week. In addition, the program should be developed with the patient and adapted to medical indications.

Women who exercised regularly before becoming pregnant can continue with their current exercise regimen as long as it does not conflict with any of the guidelines above. It is recommended that women who regularly engage in high-intensity exercise before pregnancy gradually reduce their exercise intensity as pregnancy progresses to reduce the risk of injury. High-intensity exercise exceeding 45 minutes can lead to hypoglycemia and increase the risk of overheating.

3.1.5. Prescribing an Individualised Exercise Program

When it comes to exercise intensity, current research recommends that pregnant women engage in moderate-intensity activities. Using the Borg Rate of Perceived Exertion Scale (RPE), which uses a scale of 6 to 20. The RPE score we aim for is 13-14, which corresponds to 'somewhat difficult'. Another simple method we can use to measure exertion is the 'talk test,' which means that as long as a woman can talk while exercising, she is not overextending herself.

3.1.6. Safe and beneficial examples of physical activity and exercises during pregnancy

According to the recommendations of the American College of Gynecology and Obstetrics, the risks associated with moderate physical activity during pregnancy are minimal and are not associated with either maternal injury or foetal growth or development. In addition, exercise does not interfere with lactation if done in the postpartum period. Therefore, sedentary pregnant women without pregnancy complications should be encouraged to engage in physical activity to maintain a healthy lifestyle.

Physical inactivity is the fourth leading risk factor for early mortality worldwide. Lack of physical activity and excessive weight gain during pregnancy have been recognised as independent risk factors for maternal obesity and related complications of pregnancy, including gestational diabetes mellitus (GDM). In the absence of obstetric or medical complications or contraindications, physical activity during pregnancy is safe and desirable, and pregnant women should be encouraged to continue or initiate safe physical activity.

Safe and beneficial physical activity:

- walking,
- stationary cycling,
- aerobic exercises,
- dancing,
- resistance exercises (eg, using weights, elastic bands),
- stretching exercises,
- hydrotherapy, water aerobics.

In case of doubt about the safety of exercise during pregnancy, it is recommended to consult appropriate specialists (e.g. obstetricians, gynaecologists, cardiologists, pulmonologists), if indicated. In women with concomitant obstetric or medical conditions, exercise regimens should be individualised. Obstetricians, gynaecologists and other obstetric care providers should carefully evaluate women with medical or obstetric complications and make individualised recommendations for physical activity during pregnancy.

3.1.7. Contraindications to exercise during pregnancy

Before starting any physical activity, a pregnant woman should consult her doctor. There are diseases and illnesses that prevent you from performing exercises in a blessed state. Contraindications to exercise may also occur during pregnancy.

3.1.8. Absolute contraindications

Women with absolute contraindications are discouraged from engaging in MVPA; however, activities connected with daily living should be continued.

Absolute contraindications:

- severe respiratory diseases (eg, chronic obstructive pulmonary disease, restrictive lung disease and cystic fibrosis),
- severe acquired or congenital heart disease with exercise intolerance,
- uncontrolled or severe arrhythmia,
- placental abruption,
- vasa previa,
- uncontrolled type 1 diabetes,
- intrauterine growth restriction (IUGR),
- active preterm labour,
- severe pre-eclampsia,

- cervical insufficiency,
- hemodynamically significant heart disease,
- restrictive lung disease,
- incompetent cervix or cerclage,
- multiple gestations at risk of premature labor,
- persistent second or third trimester bleeding,
- placenta previa after 26 weeks gestation,
- premature labour during the current pregnancy,
- ruptured membranes,
- preeclampsia or pregnancy-induced hypertension,
- severe anemia.

3.1.9. Relative contraindications

- Anemia,
- unevaluated maternal cardiac arrhythmia,
- chronic bronchitis,
- poorly controlled type 1 diabetes mellitus,
- extreme morbid obesity,
- extreme underweight (BMI <12 kg/m^2),
- history of extremely sedentary life,
- intrauterine growth restriction during current pregnancy,
- poorly controlled hypertension,
- orthopedic limitations,
- poorly controlled seizure disorder,
- poorly controlled hyperthyroidism,
- heavy smoker.

3.1.10. It is not a contraindication

The following conditions (individually) should no longer be considered a barrier to physical activity during pregnancy:

- chronic hypertension,
- gestational hypertension,
- women who are classified as overweight or obese,
- recurrent miscarriages,
- short cervix,
- twin and high order pregnancy,

- epilepsy,
- anemia,
- orthopedic limitations,
- history of an extremely sedentary lifestyle,
- history of spontaneous preterm labour or foetal growth restriction.

3.1.11. Warning Signs to Discontinue Exercise While Pregnant

Even if a woman is healthy, symptoms may occur during exercise, which should prompt her to stop training and consult a doctor. These symptoms include primarily:

- vaginal bleeding,
- abdominal pain,
- regular painful contractions,
- amniotic fluid leakage,
- dyspnea before exertion,
- dizziness,
- headache,
- chest pain,
- muscle weakness affecting balance,
- calf pain or swelling.

Women should be advised to stop exercising if they have any of the warning sign.

3.1.12. What precautions should be taken when exercising during pregnancy?

- Water. Be sure to drink plenty of water before, during and after training. Signs of dehydration include dizziness, palpitations, passing small amounts of urine or dark yellow urine.
- Clothes. Wear loose fitting sports clothes and a sports bra.
- Temperature. Overheating should be avoided, especially in the first trimester of pregnancy. Do not exercise outside when it is very hot or humid.
- Avoid standing still as much as possible as this can cause blood to pool in your legs and feet. You should also avoid lying flat on your back, as the uterus is pressing on the large vein that returns blood to the heart. Both of these positions can cause a short-term decrease in blood pressure.

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3.2. Pelvic Floor Muscle Exercise during pregnancy

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3.2.1. Prenatal physical workout

3.2.1.1. When should we start childbirth physical activity training classes?

To answer this question, first we must differentiate between childbirth physical activity training and physical activity during pregnancy. These are two different training modalities. In physical activity training during pregnancy, fatigue could be contraindicated, because the recovery time could be longer and an excessive accumulation of lactic acid may be harmful for the foetus. Physical activity training is necessary during pregnancy, but is not the best moment to initiate a high insensitivity training program, even more if the woman is not accustomed to physical activity, exercises or sports during her ordinary life. The most advisable, simple and basic exercise during pregnancy could be a walk for 30 minutes to 1 hour per day, as it activates blood circulation, breathing, digestion, and also offers a better psychophysical balance. Childbirth preparation, as the name suggests, is more complex, involving education about personal care, exercises and physical activity and routines that help face the moment of labour in the best possible conditions.

The main benefits from light or moderate exercise during pregnancy are:

- Improvement of the mother´s cardiovascular reserve.
- Improvement the thermoregulation.
- Improvement of placental growth and function.
- Possibly a shorter labour time.
- Aids in gestational diabetes treatment.

Physical activity lessons generally begin from the second trimester, meaning the 12th week. This moment is chosen because there are some beneficial circumstances. For example, the woman has an increased awareness of her pregnancy. The abdomen is increasing in size and elastin levels increase the flexibility and instability of the joints due to hormonal changes. Besides, in this pregnancy stage,

the women generally does not present the typical sickness and dizziness of the first trimester. However, if there are no contraindications, the woman could start exercise in the first trimester. Even if it is recommended to start maternal physical activity training in the second trimester, it is in the third trimester when strength will really be necessary and so all pregnant woman should take classes at least at this moment. Finally, and going back to general physical activity training (not the specific childbirth training), it is indubitable that women who practices this regularly in their life as well as during pregnancy are better prepared – physically and psychologically – for probably the most important event in their life.

The main objectives for physical activity training during pregnancy are:

- To break the fear-tension-pain circle.
- To reduce discomfort.
- To prevent and treat UI.
- To reduce postpartum aftermath.

The specific objectives to achieve are:

- To make joints flexible.
- To maintain and/or recover muscle tone.
- To search for central stability.
- To increase and improve the balance.
- To facilitate intestinal transit.
- To activate the blood circulation.

These objectives will be focused on the pregnancy biomechanical changes, specially to the forward shift of the body gravity centre due to the enlarged uterus. These changes are compensated with an increased lumbar lordosis and a slight lower limbs flexion, meaning that the gravity centre returns to its natural position but with muscle decompensation, migratory pain, etc.

The approach of the pregnancy physical activity training must be always individualised, attending to different expectations and needs that a sportive woman could have compared to one who does not practice sport regularly.

3.2.2. Key elements for physical activity training during pregnancy

The key structures for maternal physical activity training are:

- Pelvis.
- Spine.
- Pelvic Floor.
- Abdomen.

Note: The therapist must analyse each one separately.

3.2.2.1. Pelvis: *'The key of the spine stays on the pelvis'*

Regarding to the physical activity prescription, two previous conditions must to be taken into account: the range of movement and the motor control**.** During pregnancy, one of the most common problems is the lack or loss of motor control surrounding the pelvis and the spine. However, the range of movement does not usually present difficulties due to the effect of elastin hormone that favours hypermobility.

The primary objective for pelvis workout will be to facilitate motor control in order to find lumbopelvic balance and motor control. The achievement of this objective is related with good postural alignment, comfort, correct distension of the abdominal muscle, correct weight distribution, and improvement of blood and lymphatic circulation.

Closed kinetic chain pelvic movement will be recommended, provided and assisted (usually with a *fit-ball*) to facilitate the anteversion, retroversion, upward and downward movement, closing, opening, nutation and counternutation (all intrinsic movements of the pelvis that take place between pelvic bones and assist the opening and closing of the straits). The best way to learn pelvic motor control is using feedback, biofeedback and assistance (therapist and other facilitating agents).

For example, is easier to learn pelvic motor control in a face-up position on a floor mat since there is better feedback than sitting or standing. The progression and sequence pass from lying down to sitting and finally standing. Start by lying in the first trimester and move up step by step over the pregnancy period. Video links with specific tasks and exercises will be available on the INSTepp website platform.

3.2.2.2. The Spine

The spine is a vital structure of the body, the origin of nerve roots as well as multiple muscles, ligaments and fascia insertion. The spine plays a fundamental role during pregnancy.

The spine stability depends of three interaction systems:

1. Neuronal control system
2. Passive system (including vertebrae, discs, ligaments…)
3. Active system (including muscles and tendons). This is the main element on motor control workout.

Previous investigations have demonstrated that the centre of gravity in pregnancy women moves towards the abdomen, causing an increase of lumbar lordosis, posterior tilting of sacrum and head backward movement in order to compensate the weight gain as the baby grow up. Taking into account all above, is essential to prescribe, during the first trimester, a specific spine stability workout. A pelvic tilt movement exercise, or 'Cat-Camel' as it is called colloquially, combined with

breathing (inhale on lordosis and exhale on kyphosis), plays an important role during the second and third trimester, because it helps the baby to separate from the anterior lumbar pillar and sacrum. This position stimulates self-awareness of pregnancy and therefore sentiment as a future mother.

3.2.2.3. Pelvic Floor Muscles

Unfortunately, before pregnancy, the pelvic floor muscles are unknown for many women. The objectives of pelvic floor muscle training are:

1. To increase strength and tone (subjects with a weak pelvic floor).
2. To increase elasticity/flexibility by perineal massages.
3. To improve motor control.
4. To control perineal relaxation.
5. To favour lumbopelvic stability.

It often the question about who have better motor control over the perineal muscles, the primiparous or the multiparous women? The answer, as in many other occasions, is that it depends:

1. On previous motor control experiences.
2. If there was any injury in the musculoskeletal system after the first childbirth.
3. In the first instance, primiparous women could have worst motor control of pelvic floor muscles, but pregnant women must not be underestimated. Bit by bit the pregnant woman become aware of the changes of her own body during pregnancy and they try to avoid future problems or pathologies, so often she learns to work the perineal muscle in order to reach optimal condition at the moment of labour.

About the periodisation of the pelvic floor muscles during pregnancy, there is the following sequence and recommendations:

1. **First trimester** – Avoid abdominal contractions exercises.
2. **Second trimester** – Pelvic floor and deep muscles will be strengthened.
3. **Third trimester** – maintaining the second trimester workout and initiating strenghtening accessory musculature in order to practice maternal pushing during the second stage of labour

3.2.2.4. The Abdomen

In nine pregnancy months the abdomen is the transformation centre. The abdomen growth depends on two structures mainly: the fascia and the abdominal muscles. Fascia distension is more common in athletes and sport women, but in the other hand, abdominal muscles distension is more usual in non-athletes' women. Previous studies consider about what distension is better, and the possible relationship

with future problems like urinary incontinence. An ideal situation could be to have distension between all the involved structures, with none distending more than another. This region plays an undeniably important role in lumbopelvic stability and future complications. The therapist must take this into account at the beginning of the pregnancy period, both structures: the fascia and the abdominal muscles. The abdominal muscle injury (for example serious distension) plays an important role in postpartum urinary incontinence, and not exclusively pelvic floor muscle injuries. However, abdominal muscles recover easier and faster.

3.2.3. Key elements to face the labour

3.2.3.1. First stage: begins with the start of labour and ends with dilatation

At this stage, we identify two phases: an initial latent one where there are variable forms and periodicity contractions and changes in the cervix. The second active phase is when there is an increase in the frequency and regularity of the contractions, together with a faster dilatation.

3.2.3.2. Second stage: pelvic phase and perineal phase

Pelvic phase is when the baby head rotates towards the occipital-anterior position and moves along through the pelvis. In this phase the Ferguson reflex occurs (massive liberation of Oxytocin), in women with epidural anesthesia, this reflex is abolished. The perineal phase of labor is the stage during childbirth when the baby descends through the birth canal and is born

3.2.4. Duration of delivery

When it comes to the duration of delivery, there are standardized criteria based on evidence: for primiparous women, it takes 8 to 18 hours to reach the second stage of labor, and for multiparous women, it takes 5 to 12 hours without intervention. The optimal duration for the second stage has not yet been established, although the most optimal and typical criteria are less than 2 hours for primiparous women and 1 hour for multiparous women.

There is an increase neonatal and maternal morbidity and mortality if these thresholds are overcome. The epidural anaesthesia plays got an important role in

this stage. Women who have performed specific exercises and physical activity during all the pregnancy period have a shorter duration in the final phase.

3.2.5. Dry and Aquatic activity protocol for pregnant women

The physical activity program for pregnant women could be divided into dry workout and swimming pool workout. The objectives described for each trimester will be taken into account. It is not appropriate to have the same objectives throughout the whole pregnancy period. In each trimester, objectives must be differentiated in order to avoid the most common errors in breathing, pelvic tilt and abdominal muscles. Bad posture is one of the most frequent mistakes in breathing, and it should be performed with an elongated spine. Pelvic tilt is executed with external hip rotation tendency. The abdominal muscles must be exercised with breathing (transverse abdominal muscle), trying to avoiding the activation of the rectus abdominal. We describe the dry workout and then the aquatic activity.

3.2.5.1. Dry Workout recommendations

First Trimester

The dry workout during the first trimester is based on following objectives:

- **Motor control:** the therapist must look out for the pelvic and spinal static alignment. We must show and teach pregnant women the pelvic retroversion and anteversion (tilt).
- **Hip flexibilisation:** Hip flexibilisation: Stretching of hamstrings, gluteus medius, piriform and adductors muscles in supine position.
- **Muscle strength training:** begin with the perineal contraction-relaxation exercises. Other interesting exercises for this phase are the bridge (buttocks + perineum), foot support (buttocks + perineum), abdominals with ball + perineum and adductors (isometric ball).

Second Trimester

During the second trimester, the proposed objectives are similar to the first trimester, with some details:

- **Motor control:** continue with pelvis motor control and start the recommendations for hygiene in Daily Living Activities (DLA). Pregnant women should adapt DLA in the second trimester, including work and hobbies, to the more significant changes that occur during second trimester gestation, avoiding painful processes or decreasing their intensity. Evidence indicates that ex-

cessive sitting, walking or heavy weightlifting, could be associated with increased prematurity incidence and low birth weight.
- **Flexibilisation:** Start with the joint and soft tissue normalisation of pecs and latissimus dorsi and espalier.
- **Muscular training:** Same workout from the first trimester but progressively decrease the intensity of abdominal muscle exercises towards the seventh month.
- **Breathing:** Breathing awareness and dissociation between thoracic and abdominal breathing.
- **Lower limbs circulatory exercises:** feet on the ball, make circles in both directions.

Third Trimester

- **Motor control:** Strengthening pelvic tilt exercises and correct posture of pelvis and spine.
- **Relaxing** stretching in sitting position: adductors, gluteus medius, ham strings, piriform.
- **Muscular training:** pelvic tilt in quadruped position, back support (*fit-ball*), adductors isometric contraction in sitting position, half squats on the wall, avoid abdominal over pressure workout.
- **Breathing:** Awareness of breathing and dissociation between thoracic and abdominal breathing.
- **Lower limbs circulatory exercises:** feet on a *fit-ball*, make circles to both sides.

3.2.5.2. Swimming pool workout recommendations

Develop a global aerobic workout with muscle strength workout, taking advantage of weight support, avoiding hyper lordosis positions:

- **Shifting:** *aqua-jogging*, crawl, breaststroke with alternative leg kick, climbing, double and normal back swim. Using material like tubular float, tables, balls, weights, weighted work, etc.
- **On overflow:** buttocks, ABS, adductors, abductors.
- **Cardiopulmonary workout:** extensive aerobic.
- **Floating relaxation**

Note: Pictures and videos with specific tasks and exercises are linked in the INSTepp website platform:

- https://instepp.uni.opole.pl/en/video-materials/.

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3.3.
Pregnancy and physical activity. The case studies

Rasa Liutikienė, Aelita Bredelytė

Between 25 % and 90 % of pregnant women suffer from lower back pain, which usually starts between the 20th and 28th week of the pregnancy. Most pregnant women suffer from pain during their first pregnancy and one third of pregnant women suffer severe pain that reduces their quality of life.

Despite the debilitating effects of lower back pain in pregnancy, it is often untreated and considered normal and inevitable part of pregnancy.

Case study 1.

Patient V.S. Pregnancy IV(II) – 22 weeks + 5 days (2018 caesarean delivery, 2019 and 2020 spontaneous abortion). Complained of the lower back pain, movement pain, and pain when walking on 26th April, 2022.

1. The patient was seen by a family doctor on 27th April, 2022 and was referred to a rehabilitation therapist for consultation.

2. The patient was seen by a rehabilitation physician on 11 May 2022 and was diagnosed with lower back pain (M54.5-ICD-10). The patient received 5 physiotherapy sessions and 5 hydrotherapy sessions.
3. The patient started attending physiotherapy sessions on 30th May, 2022 (27 weeks + 4 days of pregnancy). After 3 physiotherapy sessions, the patient's well-being improved, she felt less pain, and it was easier to move around, get out of bed, change the body position. After 5 sessions the patient felt that her pain was very mild.
4. The patient started attending water procedures on 21st July, 2022 (35 weeks of pregnancy), by that time she no longer felt pain, but noted the benefits of water procedures on her mood and general well-being. The waiting time for water procedures for the patient was 8 weeks due to long queues.

Case study 2.

Patient A.A. Pregnancy I – 22 weeks + 6 days. Complained of the lower back pain, pain when walking, highlighted sacral pain on 25th March, 2022.

1. The patient was seen by a family doctor on 14th April 2022 (25 weeks +5 days of pregnancy) and was referred to a rehabilitation therapist for consultation.
2. The patient was seen by a rehabilitation physician on 15th May 2022 (30 weeks +1 day of pregnancy). The patient complained of lower back pain radiating into her right leg. Palpation was painful in the 1st lumbar part of the vertebrae with limited trunk movements. She was diagnosed with lower back pain (M54.5-ICD-10). The patient received 5 physiotherapy sessions and 5 hydrotherapy sessions.
3. The patient started attending physiotherapy on 18th May 2022 (30 weeks + 4 days of pregnancy). The patient's sacral pain increased during exercise, especially during lying down exercises, however, after two sessions the pain decreased.
4. The patient started attending water procedures on 20th May 2022 (30 weeks + 6 days of pregnancy). The patient mentioned the benefits of hydrotherapy for her general well-being and mood after the first session.

Case study 3.

Patient A.I. Pregnancy I – 19 weeks + 4 days complained of the lower back pain, the pain in the pelvic area, and hip joint area on 30th May 2022.

1. The patient was seen by a family doctor on 2nd June 2022 (20 weeks + 0 days of pregnancy) and was referred to a rehabilitation therapist for consultation.
2. The patient was seen by a rehabilitation physician on 7th June 2022 (20 weeks + 5day of pregnancy). The patient was diagnosed with (M25.5-ICD-10) join pain. The patient received 5 physiotherapy sessions and 5 hydrotherapy sessions.

3. The patient started attending physiotherapy on 15th July 2022 (26 weeks + 1 day of pregnancy). The patient described her health as better after 4 physiotherapy sessions.
4. The patient started attending hydrotherapy on 20th August 2022 (28 weeks + 0 days of pregnancy). The patient mentioned the benefits of hydrotherapy for her general well-being and mood after the first session and preferred to continue hydrotherapy.

All the patients whose cases were analysed performed minimal physical activity before pregnancy (less than 150 minutes of exercise per week). The patient's lower back and joint pain started quite early, around 22 weeks of pregnancy and was moderate. All patients highlighted the benefits of hydrotherapy.

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4.
Obstetrics technique – protection of the perineum during natural childbirth by forces or by means of nature

Viktorija Viskontaitė-Kerienė, Aelita Bredelytė, Akvilė Sendriūtė

4.1.
Episiotomy (perineum cut)

Described in the 18th century, in 1921 it started to be recommended as a routine procedure during all labours. It was thought that by making more space in this way, the brain of the newborn will be protected, prevent third and fourth-degree perineal tears, avoid the injuries to the pelvic floor, fecal incontinence, birth asphyxia, injuries to the skull, bleeding to the brain of a newborn as well as shoulder dystocia. Within the following 50 years the number of episiotomies had been growing until doubts were raised as to its necessity, which subsequent research confirmed. Although this procedure is still performed quite frequently even in some cases that are not justified, the woman should be informed and the procedure performed only with the consent of the woman in labour. Without performing of episiotomy, tissues could possibly be torn in their thinnest part with no need for stitching.

It has been scientifically proven that a perineum cut:

1. increases the risk for more severe tears.
2. is not beneficial for a foetus to be born except in exceptional circumstances.
3. does not help to avoid pelvic injury or urinary/fecal incontinence.
4. heals longer.
5. carries a higher risk of hematomas and infections.

Indications for episiotomy performance:

1. pathological cardiotocography: lower foetal heart rate during urge to push
2. shoulder dystocia
3. in unexpected situations when it becomes necessary to end the labour as soon as possible.

4.2.
Episiotomy prevention

1. Perineal massage: performed between 34 and 37 weeks of pregnancy. This is the way to adapt tissues to the sense of tension when a woman feels a specific 'ring of fire' as the foetal head becomes visible. It could be performed individually or with a partner. It is necessary to use oil.
2. Specific exercises on balance during pregnancy/labour: the foetal head attaches to the perineum at its narrowest part – the crown. When lying back, the diameter increases and labour becomes harder. Motions encourage the foetus to take the optimal position.
3. The birth guidelines/plan needs to be discussed with the staff involved as it is important to know the patient's opinion and expectations related to this procedure.
4. Warm compress supporting the perineum during the urge to push.
5. Water birth: warmth helps to relax and the perineum is supported with water (hands-off labour).
6. Spontaneous pushing/avoid withholding all the air when pushing: guidelines and help without commanding.
7. A more vertical position for giving birth: during physiological labour a woman instinctively bends, squats or kneels as she chooses a comfortable position. Gravitation helps the foetus move to the birth canal, whereas a supine or semi-supine position causes greater tension (as if the foetus moves 'up a mountain'.

Childbirth positions:

1. Semi-supine or supine
2. Supporting a woman in child-birth from the back or sitting on a birthing chair
3. Side lying or on all fours
4. Squatting on a birthing bed or with a partner holding under the armpits
5. Kneeling on a birthing bed

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5.
Labour and delivery, postpartum care

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5.1.
Labour and physical activity

Labour is a process that starts into at least 22^{+0} weeks of pregnancy, initially with regular, rhythmic contractions increasing in strength, causing the cervix to delate and, when fully delated and the woman in labour feels the urge to push, the foetus is forced out of the body of the uterus together with the placenta and the membranes. When the duration of pregnancy is unknown, the birth of a newborn 500 g in weight and above is considered as labour. It is diagnosed when regular uterine contractions (occurring at least every 10 min) are accompanied with changes in the cervix (softens, shortens, and dilates). With uterine contractions are present without any changes in the cervix, a pregnant woman is diagnosed with prodromal labour, which is also called the period or the stage of preparatory contractions. Historically, it is claimed that a woman in labour for the first time should give birth within 24 hours or 'from dawn till dawn'.

In terms of labour, it should be emphasised that midwives take care of a woman during the labour through the birth canal with an obstetrician-gynaecologist taking over the work only in complicated cases when there is a need to use vacuum, forceps, or perform a C-section etc. A midwife will work and communicate with you during the period of physiological birth

Stages of labour:

1. The stage of the cervix dilation. It starts with regular uterine contractions and finishes with the full dilation of the cervix.
   a) The latent phase lasts from 0 to 4 cm of cervix dilation. A woman in labour is encouraged to move more, the most convenient positions are sought and

childbirth positions are discussed with all occurring questions answered. Shower, bath, rebozo etc. are used. Light food and fluids are consumed.

b) The active phase lasts from 4 to 10 cm of cervix dilation. Lots of fluids are to be consumed. In this phase, it is also important to choose the method of labor pain relief (pharmaceutical or non-pharmaceutical)

For a woman who is in labour for the first time it takes 20-24 hours, whereas giving birth for the second time or more lasts for about 14 hours.

2. Pushing the baby out stage. It starts with the cervix fully dilated and finishes with the baby being born.
   a) The active phase lasts till the urge to push occurs.
   b) The late phase starts from the occurrence of the urge to push until the baby is born. There is no need to encourage a woman to push until she starts feeling it involuntarily.

For a woman having her first baby, this period lasts up to 2 hours, whereas if it is not the first time it takes up to 1 hour. Usually, with epidural analgesia, this stage takes one hour longer. Although the allowed duration of this period is not strictly defined, normally 2-3 hours are applied in practice.

3. Placental period. It starts with the baby being born and finishes with the delivery of the placenta and membranes.
   a) Placental separation phase.
   b) Placental expulsion phase.

The methods applied:

1. Active management of the placental stage. When the head / the first third of the shoulder of a baby or the whole baby is delivered completely or within 3 minutes from the birth of the baby, the mother receives 5 units of oxytocin by intravenous infusion or 10 units by intramuscular injection. This procedure could be performed only with verbal consent received. A newborn is wiped, placed on the chest, the umbilical cord is cut when it stops pulsating (in Lithuania the most frequent practise is to cut it at once or within the first minute after a baby is born).

   Gentle traction of the umbilical cord while pulling it in rotary motions is applied. The placenta with the umbilical cord and membranes is delivered in 3-15 min (usually). The external massage of the uterus is performed throughout the abdominal wall for the blood present inside the uterus to be pressed out. This is beneficial for a woman at high risk after labour due to the decreased probability of heavy bleeding (≥ 1000 ml). Synthetic oxytocin provokes faster uterine shrinkage leading to faster separation of the placenta from the wall of the uterine. In case of the uterine atony, oxytocin is necessary to stop bleeding after birth. However, this method increases the proba-

bility of hypertension, nausea, vomiting, a portion of the placenta left in the uterus, whereas too early cord clamping increases the risk of the newborn suffering anaemia, hypotension, or brain haemorrhage.

Physiological/latent/conservative management of the placental stage. With no oxytocin injection administered, the umbilical cord is left to pulsate as long as it needs. Up to 1 hour is given for the spontaneous delivery of the placenta. It is delivered with only gentle support provided. In the event of a low-risk delivery, when the placenta separates and is born, a third of the newborn's blood and stem cells are transferred from it through the umbilical cord. Adaptation of such blood in the body of a newborn is easy.There is no interference in this physiological process. A baby lying on the chest of the mother encourages the production of oxytocin in huge amounts; so, it leads to the shrinkage of the uterus and the delivery of the placenta, membranes, and umbilical cord. This strategy is usually inappropriate in cases with epidural pain relief or other types of pain relief applied as well as when the labour is induced as these strategies disturb natural production of oxytocin leading to the necessity for injections.

A newborn with an average weight of 3.5 kg, still has about one third or approximately 150 ml of blood belonging to him/her in the umbilical cord. Within the first 3-5 min the majority of it is pulsated. Although it is highly individual, the umbilical cord usually pulsates longer than 5 minutes. It is possible to check by touching and evaluating its colour as an umbilical cord containing no blood is white. However, there are situations, for example, if a newborn needs resuscitation, when a physiologically healthy and blood-filled umbilical cord is cut.For example, in cases when a newborn needs help or must be resuscitated. Oxygen delivered through the umbilical cord adds to the one delivered from the equipment though!

There are three planes of the pelvis:

1. Inlet: the position of the foetus is observed (-3; -2; -1). The foetus has to bend.
2. Midplane: the foetus is at 0. The presenting part tries to get through the ischial spines that are located in the narrowest place of the birth canal. If the widest part of the foetal head (at the ears) moves to the midplane, the chances for a woman to give birth naturally are high.
3. Outlet: the urge to push is felt. The foetus is observed (+3; +2; +1).

During childbirth, the woman's pelvis aligns with the fetus, helping it to bend, turn, latch and be born.Hormone relaxin impacts the joints of the pelvis, increasing their mobility. By means of motions and gravitation, the mobility of the woman in labour allows a foetus to move down through the birth canal. However, when the woman lies on her back, the labour is burdened as the sacrum is blocked.

During the entire birth, the position, turning, bending of the fetus is monitored.It affects the course of labour as well as actions and prognosis. Each position in labour is important in the particular stage when the foetus moves down. If staff interfere or fail to provide help at the right moment, it could disturb the process of giving birth with the resulting need to perform a C-section.

Essential components in labour:

1. Balance in ligaments, fascia, and muscles
2. Motion: because the pelvis is not static, it can increase the amplitude of motion (range of motion) with the coccyx (tailbone)
3. Gravitation

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6.
Pain associated with childbirth

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6.1.
Non-pharmacological means of pain relief and help for the foetus

6.1.1. Breathing

1. **Diaphragmatic breathing**: gives the body a better supply of oxygen due to the whole capacity of the lungs being used. In addition, it helps a baby to be delivered faster and stops the woman's blood pressure rising in the areas of the chest, the neck and the head. So, it becomes possible to avoid bruising in the eyes and the neck. When the major focus is directed to breathing, more precisely, to breathing out, less attention is directed to the pain itself.
2. **Deep breathing**: during contractions one should breathe in through the nose, hold the air for 10-15 sec and then breathe out slowly through the mouth. One should breathe calmly, without any tension, in a relaxed way between contractions. Applied during the latent phase of the first stage.
3. '**Blowing out candles' breathing**: short breathing during contractions through the nose with short breathing out as if blowing out a candle. Applied during the active phase of the first stage.
4. **Variable breathing**: with the cervix fully dilated, in the beginning of a contraction breathing should be prolonged for energy to be saved, whereas when the top of a contraction is reached 'blowing out candles' breathing should be applied.
5. '**Dog panting'** breathing: during the urge to push it is recommended to breathe in and out through the mouth. Breathing is similar to the panting of a dog.

6.1.2. Positions

1. When the foetus is positioned at the inlet plane, sitting on a chair with knees above the pelvis blocks the inlet plane (narrows an amplitude). So, it prevents the baby from moving down the birth canal. Consequently, the labour could end in a C-section.
2. In order to increase the pathway for the baby's head to the inlet plane the following position is beneficial: the triangle between the pelvis and the knees (standing, lying or sitting).

IMPORTANT: if the inlet plane is opened, the outlet plane is closed, which hinders pushing out the foetus.

The outlet plane is opened by pressing the knees together, while turning the ankles to the sides.

6.1.3. Motion

1. **The jiggle** is one of the most enjoyable relaxation techniques. It could be applied in 20-24-week pregnancies as well as during labour between and after contractions. Most frequently, the jiggle is combined with rebozo, leading to light motion. Move your hand(s) smoothly and steadily. The fascia responds to a vibration motion by increasing hydration and circulation. Improved function of the fascia improves the function of the muscles, ligaments, and even joints. The sacrum itself can become a focus of the jiggle and start being more mobile. This could lead to an improvement in rotation and descent. Activation of the parasympathetic nervous system can restore optimal function of the lower uterine segment, which is another potential avenue for foetal rotation. Depending on hand placement and the length of motions, various parts of the body may be relaxed:
   - The lower back muscles
   - The buttock muscles
   - The pelvic floor muscles
   - The sacrum so it is more able to rock the top forward and back to open the top of the bottom of the pelvis as needed
   - The hip joint.
2. **Asymmetric motion** that helps to make more space in the midplane. It is appropriate when:
   - The cervix is fully delated but the foetus is quite high so a woman feels pressure only during the urge to push after which this feeling disappears
   - The intensity of labour is mostly felt in the back
   - The deletion of the cervix reaches 7-9 cm. A woman feels well as if she would like to 'go home'.

- This motion could be applied in the end of pregnancy as well when a pregnant woman complains about pains in the sacrum/lower back. This motion should be performed with a peanut ball and lying down.

3. Standing with the legs bent a little, the feet turned outside and the hands put on the hips, sway the pelvis in this position forward and backward, the motion should be light as if you are moving a bowl with water.

6.1.4. Pelvic floor exercises/positions

Rotate ONLY the pelvis while sitting on a physio ball without moving other parts of your body. It improves circulation in the pelvis.

6.1.5. Hydrotherapy

Hydrotherapy when the temperature of water is not above 37.5°C. It shortens the first stage of labour and helps solve pain-related problems.

6.1.6. Massage

1. During contractions while breathing in with the palm surface of the hands stroke gently starting from the inner abdomen line to the sides directing towards the anterior superior iliac spines. While breathing out the motion is performed starting from the sides of the abdomen at the anterior superior iliac spines with the hand stroking gently down towards the midline of the abdomen.
2. During contractions the skin is pressed with the thumbs close to the anterior superior iliac spines, whereas the frontal surface of hips is pressed with the palms.
3. During contractions when standing or lying on the side, the waist and sacroiliac zone are stroked gently with S, Z or O-type motions.
4. During contractions, when in supine position, while breathing in, the angles of the rhombus of Michaelis at the posterior superior iliac spines are pressed with the fist; while breathing out, the fists relax.

6.1.7. Acupuncture and acupressure

6.1.8. Music therapy, visualisation and aromatherapy

6.1.9. Transcutaneous Electrical Nerve Stimulation (TENS)

This device stimulates peripheral nerve fibers, thereby inhibiting pain signals entering the central nervous system, reducing pain perception, and activating the release of endorphins.After TENS, women can move actively during the latent phase of the first stage and in the beginning of the active stage of labour. It is safe and has no side effects. A pleasant pulsation reminiscent of a heartbeat is felt.

Pharmacological methods of pain relief for labour:

1. Systemic analgesia with opioids
2. Inhaled analgesia
3. Regional analgesia
   - Central nerve blockage
   - Peripheral nerve blockage

Possible aids in labour

1. Doula: emotional and physical support to family during labour. These professionals have specific knowledge that could be applied during various situations in labour. Doula cannot do anything instead of a woman and just helps her in this exceptional moment of her life.
2. Rebozo is a traditional Mexican wrap that is also called the extension of the hands and the heart. By means of rebozo it is possible to help a woman to relax, accelerate labour, help the foetus to position properly or even avoid C-section. It is also called 'shake the apple tree'.
3. Peanut ball is applied for comfortable lying down, active movement, and helps the foetus move to the pelvis (with the outlet plane opened) during natural childbirth or with the application of epidural anaesthetic. By choosing appropriate angles and positions the possibilities are great.
4. Balloon: simple and easy to blow. It is used when breathing becomes chaotic and the woman feels lost. It helps her calm down and return to an even breathing rhythm.

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7.
Sphincter dysfunction after childbirth

7.1.
Perineal trauma during childbirth

Martyna Kasper-Jędrzejewska

Perineal trauma is a common complication of physiologic births and occurs in 13 to 41% of parturients. In the most severe cases, it is associated with injury to the anal sphincter (OASI) and proximal pubovisceral muscle (PVM) near its origin at the pubic bone. Any injury to the myofascial tissues (which are stretched by up to about 65% during childbirth) can have serious consequences for a woman's physical health and quality of life by causing sexual dysfunction, urinary and/or fecal incontinence, and pelvic organ prolapse. Symptoms resulting from these dysfunctions may be temporary, but they may also be prolonged, depending on the woman's functional status. It should also be considered that stress incontinence and/or fecal incontinence during pregnancy increase the risk of each of these symptoms after delivery. Several risk factors for trauma are found in the literature, including forceps delivery, first-time delivery, foetal macrosomia, maternal age, history of anal sphincter injury and/or episiotomy, abnormal foetal head position, and prolonged labour (1–4). Can perineal injuries at birth be prevented? It appears that the position of the woman in the second stage of labour can prevent soft tissue injuries, but not all reports confirm this. The main conclusion from a comprehensive systematic review of deep squatting during labour is that women should be able to choose the position that is most comfortable for them (which may also have a protective effect on the perineum) (5). Interestingly, the degree of perineal tissue stretching in the second stage of labour does not appear to be a risk factor for OASI and, consequently, urinary incontinence or sexual dysfunction. Significant perineal distension is not an indication for episiotomy (2).

For a long time, vaginal delivery was considered the main cause of pelvic floor dysfunction in women, and caesarean section was an effective way to avoid it. How-

ever, the relationship between the delivery method and the resulting dysfunctions has not been clearly confirmed, and the performance of caesarean section as a preventive measure for possible perineal dysfunction and injury is currently highly controversial and scientifically unproven (2).

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8.
Measurement tools

8.1.
Pregnancy weight gain

Agata Mroczek, Antonina Kaczorowska

The amount of weight gain during pregnancy can affect the immediate and future health of a woman and her infant. Over the past decade, the demographics of the population of women who become pregnant has changed dramatically with more women being overweight or obese at conception.

The global prevalence of overweight and obesity in pregnancy is rising and this represents a significant challenge for the management of pregnancy and delivery. Labour complications arise more often when pregnancies are complicated by overweight and obesity.

There is an association between excessive weight gain during pregnancy and increased birth weight and weight maintenance after delivery, as well as between insufficient weight gain and reduced birth weight.

Body Mass Index (BMI) is the most commonly used to assess body weight, which mainly reflects the way of nutrition. Based on pre-pregnancy BMI, how much weight women should gain during pregnancy may be estimated.

8.1.1. BMI calculator

BMI is calculated as weight in kilograms divided by height in meters squared

$$\text{BMI} = \frac{\text{pre-pregnancy body mass [kg]}}{\text{height}^2\ [\text{m}^2]}$$

Here's what it means:

- Under 18.5 = underweight

- Between 18.50 and 24.9 = normal weight
- Between 25 and 29.9 = overweight
- 30 and greater = obese (includes all classes).

Pregnancy weight gain recommendations are designed to optimise outcomes for woman and baby. In 2009, the Institute of Medicine (IOM) published revised pregnancy weight gain guidelines that are based on the World Health Organization's recommended pre-pregnancy body mass index (BMI) ranges for women who are underweight, normal weight, overweight and obese regardless of age, parity, smoking history, race and ethnicity. The IOM recommendations define obesity as a BMI of 30 or greater and do not differentiate between Class I obesity (BMI of 30–34.9), Class II obesity (BMI of 35–39.9), and Class III obesity (BMI of 40 or greater).

8.1.2. Healthy weight during pregnancy

Many women feel that during pregnancy they can eat as much as they want due to the increased caloric needs of the foetus.

8.1.3. Weight Gain Recommendations For Women Pregnant With One Baby

Healthy weight gain during pregnancy is as follows:

- **in women with normal BMI between 18.5 and 24.9,** recommended pregnancy weight gain should be 25 to 35 lbs. (11 to 16 kg)
- **in underweight women with BMI less than 18.5,** recommended pregnancy weight gain should be 28 to 40 lbs. (13 to 18 kg)
- **in overweight women with BMI between 25 and 29.9,** recommended pregnancy weight gain should be 15 to 25 lbs (7 to 11 kg)
- **in obese women with BMI 30 or more,** recommended pregnancy weight gain should be 11 to 20 lbs. (5 to 9 kg)

Other changes include the removal of previous recommendations for special populations and the addition of weight gain guidelines for women in twin pregnancies. **For twin pregnancies**, the IOM recommends a pregnancy weight gain of 16.8–24.5 kg (37–54 lb) for women of normal weight, 14.1–22.7 kg (31–50 lb) for women overweight and 11.3–19.1 kg (25–42 lb) for obese women. The IOM guidelines recognise that data are insufficient to determine how much weight women should gain in multiple pregnancies (triples and above).

The body weight of a pregnant woman should be under the constant supervision of the attending gynaecologist. Its increase of body mass should be strictly

controlled and recorded in the patient's pregnancy chart. Excessive fluctuations are not recommended. With a normal body mass before pregnancy, the optimal gain during pregnancy should be 10-14 kg. Then the newborn can reach the right birth weight of about 3.1-3.6 kg.

8.1.4. What causes weight gain?

Much of the weight a woman gains during pregnancy is not body fat but is related to the baby. Here's a breakdown of how 35 pounds (16 kilograms) add up:

- Child: 8 pounds (3.5 kilograms)
- Placenta: 2 to 3 pounds (1 to 1.5 kilograms)
- Amniotic fluid: 2 to 3 pounds (1 to 1.5 kilograms)
- Breast tissue: 2 to 3 pounds (1 to 1.5 kilograms)
- Blood supply: 4 pounds (2 kilograms)
- Fat stores: 5 to 9 pounds (2.5 to 4 kilograms)
- Uterine growth: 2 to 5 pounds (1 to 2.5 kilograms)

8.1.5. Weight management during pregnancy

Some women are overweight after becoming pregnant. Other women gain weight too quickly during pregnancy. Either way, a pregnant woman should not go on a diet or try to lose weight during pregnancy.

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8.2.
Methods for the Assessment of Physical Activity. Indirect Methods: Self-report Instruments

8.2.1.
Evaluation of indications and contraindications to physical activity during pregnancy

Martyna Kasper-Jędrzejewska

8.2.1.1. PARmed-X

The first step before planning to start or continue physical activity during pregnancy is to screen the woman for her general health and possible medical and obstetric contraindications to exercise. For example, in order to create group fitness classes for pregnant women, we need to know whether a particular participant of the classes will be able to carry them out in terms of pregnancy fitness and health, intensity, type of pregnancy and proposed exercises. Screening will identify women who may need further evaluation or a visit to an obstetrician before starting or continuing physical activity. convenient and used worldwide, the Physical Activity Readiness Medical Examination (PARmed-X) questionnaire was designed to facilitate communication between the physiotherapist, fitness trainer/worker and the pregnant woman. PARmed-X for Pregnancy is a pre-exercise health screening guideline, but also provides guidance on exercise, healthy lifestyle during pregnancy, and exercise safety.

To correctly analyse the information obtained from the questionnaires, three steps are required:

1. The pregnant women should provide all the information about their general health, the status of their current pregnancy and their daily activity habits during the last month.
2. The qualified physician or physical therapist must indicate absolute and relative contraindications based on the pregnant woman's current medical information.
3. After signing the health assessment form, and provided that there are no contraindications, pregnant women should give it to their healthcare professional.

If needed, the PARmed-X for Pregnancy questionnaire can be used in conjunction with other initial screening tools, such as the latest version of the Physical Activity Readiness Questionnaire for All (PAR -Q+), which is available on the official website (http://eparmedx.com/). This questionnaire will help you decide if you need further advice before increasing your physical activity or starting a fitness assessment. It can be completed by your physician, physical therapist, other health professional, or a qualified exercise specialist/trainer. Another tool is the ACSM Health Status and Health History Questionnaire to assess safety or possible contraindications to physical activity. It should be noted that screening is especially important if pregnant women are obese, have gestational diabetes or high blood pressure. They should always consult their physician before beginning an exercise program, which in turn must be tailored to their health status, symptoms and physical fitness. In the absence of pregnancy complications or contraindications to exercise, and regardless of previous physical activity and fitness level, all women should be physically active, in accordance with the recommendations of major international organisations (e.g., World Health Organisation, WHO).

8.2.1.2. Get Active Questionnaire for Pregnancy

One of the newer questionnaires is the **Get Active Questionnaire for Pregnancy**, published and recommended by the Canadian Society for Exercise Physiology (CSEP). It is intended as a self-examination tool to empower patients/clients to take responsibility for their own health and well-being during pregnancy. The Prenatal/Pregnancy Physical Activity Prenatal/Gestational Health Care Professional Consultation Questionnaire and accompanying form help health care professionals have meaningful conversations with pregnant patients about the benefits of physical activity. It is designed to identify individuals who should seek the advice and consent of their treating physician before beginning or continuing physical activity during pregnancy. In addition, completion of the form should help most healthy pregnant women overcome their fears about starting or maintaining physical activity (1–4).

Useful links:

- Currently recommended: Get Active Questionnaire for Pregnancy: https://csep.ca/2021/05/27/get-active-questionnaire-for-pregnancy/
- Sample PARmedX for pregnancy https://www.chp.gov.hk/archive/epp/files/PARmed-X.pdf

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8.2.2.
Assessment of Physical Activity During Pregnancy

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Physical activity of pregnant women is repeatedly addressed in the context of very important issues, such as the health and safety of a pregnant woman and her child. Continuous progress in this field means that scientific research is carried out on a large scale all over the world. The issue of undertaking physical activity by pregnant women, taking into account safe forms of physical activity, their intensity, frequency and duration, has been repeatedly discussed. Guidelines are published in the world literature on recommendations and contraindications for undertaking physical exercises by pregnant women. Another important issue is the need to measure physical activity among pregnant women.

The literature on recommendations for physical activity and exercise during pregnancy is extensive. There is no gold standard when it comes to how to assess physical activity performed by pregnant women. The purpose of this chapter is to review the different methods of assessing physical activity during pregnancy.

This review will describe the main tools available to assess the level of physical activity of pregnant women, and so can contribute to increasing the confidence of health professionals in recommending physical activity to their patients.

Questionnaires are a widely used, inexpensive and acceptable method for determining PA levels.

8.2.2.1. Pregnancy Physical Activity Questionnaire (PPAQ)

In 2004, Chasan-Taber et al. developed and validated a short, easy-to-understand and self-complete questionnaire for English called the Pregnancy Physical Activity Questionnaire (PPAQ), which aimed to assess the level of physical activity of pregnant women. The PPAQ was first developed to become a globally applicable instrument that would define the practice of physical activity in populations of pregnant women. This instrument is an adaptation to the population of pregnant women of the International Physical Activity Questionnaire developed by the World Health Organization.

The PPAQ *(Pregnancy Physical Activity Questionnaire)* consists of 36 questions, of which 32 relate to activities performed by a pregnant woman, including household/caregiving (13 activities), occupational (5 activities), sports/exercise (8 activities), transportation (3 activities) and inactivity (3 activities).

The Likert scale is used, where possible answers range from 0 to 5, where 0 means no physical activity at all, 1 less than half an hour a day, 2 half an hour to almost an hour, 3 from one hour to almost two hours, 4 from two to almost three hours a day, and 5 from three or more hours a day.

The PPAQ is an easy-to-use measurement tool because it assigns a METS value per hour per week to each activity. So, depending on the intensity of each activity, it is classified as follows: sedentary (1.5 METs), light (1.5-3.0 METs), moderate (3.0-6.0 METs) and high (>6 METs). The results were analysed according to the International Physical Activity Questionnaire (IPAQ) Data Processing and Analysis Guidelines.

Advantages – this questionnaire is reliable for measuring physical activity of pregnant women with various degrees of obesity and can be used as a tool for detailed description of physical activity.

Disadvantages – the questionnaire is imprecise in relation to declared physical activity, which may generate inflated estimates of its validity.

ORIGINAL SCALE:

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SOURCE OF THE POLISH VERSION OF THE SCALE:

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SOURCE FOR THE SPANISH VERSION OF THE SCALE:

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8.2.2.2. Kaiser Physical Activity Survey (KPAS)

This is a questionnaire designed by Baecke et al. to assess women's physical activity. This instrument assesses several domains of physical activity (domestic activity/caregiver, occupational, active life and sports/exercises) and although similar in structure to the PPAQ, its purpose is to measure the types of physical activity women do, not their EE or their level of activity physical. The KPAS provides a comprehensive assessment of each domain of activity and may be more useful in studies where physical activity is the primary outcome.[27] The KPAS questions are grouped into four blocks:

1. Household chores/family care: House cleaning, shopping, gardening, care of elderly persons and children, construction work (11 items),
2. Occupational activities: working activities in the sitting and standing positions, walking while carrying weights, efforts that cause perspiration (11 items),
3. Lifestyle habits: watching television, riding a bicycle or walking to go to work or to school (4 items),
4. Sports and exercise: the frequency and duration of up to three sports or exercises performed periodically are included (15 items).

Activity scores are calculated for each activity domain by adding the specified categorical responses and dividing their sum by the number of items, with average values ranging from one to five.

Advantages – KPAS examines more activities than PPAQ.

Disadvantages – the figures do not reflect MET expenditure, which makes them difficult to compare with other questionnaires.

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9.
Planning the therapeutic process after childbirth

9.1.
Manual therapy in the postpartum period

Martyna Kasper-Jędrzejewska, Grzegorz Jędrzejewski

The aim of this chapter is to familiarise physical therapists with the scope of their important role in the evaluation and treatment of common conditions associated with pregnancy and childbirth and to highlight the need to include physical therapy in perinatal and postnatal care (puerperium, fourth trimester of pregnancy) (1). It is interesting to note the current signals that the 12-week duration of the postpartum period is definitely not sufficient for convalescence after pregnancy and childbirth. In fact, the classification proposed in 2021 seems to be more consistent with the ACOG (The American College of Obstetricians and Gyneacologists) definition of the postpartum period:

- Early Postpartum: 21 days after delivery
- Postpartum: 21-60 days after delivery
- Late postpartum: 61 to 365 days postpartum (2)

The postpartum period according to ACOG (2): 'The weeks following childbirth are a critical time for a woman and her baby, when the foundations for long-term health and well-being are laid. During this time, a woman adjusts to many physical, social, and psychological changes. She recovers from childbirth, adjusts to fluctuating hormone levels, and learns to feed and care for her newborn. The „fourth trimester" is not only a time of joy and excitement, but

also a serious challenge: lack of sleep, fatigue, pain, difficulty breastfeeding, stress, the onset or worsening of psychological disorders, lack of sex drive, and urinary (and/or faecal) incontinence.'

Awareness and knowledge of the changes that occur in the postpartum period are essential for physical therapists to plan and deliver physical therapy, both physical activity and manual therapy. Remember that the body has the ability to regenerate itself. For example, recovery of the pelvic floor muscles (the levator ani and other soft tissues) is thought to reach its maximum within four to six months after birth (during birth, the pelvic floor muscles stretch to 250% of their resting length) (3).

- Postpartum bladder neck mobility is more extensive than when measured at 37 weeks' gestation and may require more musculoskeletal support to reduce symptoms such as urinary incontinence.
- In caesarean delivery, the thickness of the uterine scar continues to increase about 6 weeks after delivery, suggesting continued remodelling (and there is evidence that women can begin unrestricted activity at this time).
- Pelvic floor dysfunction, including weakness or difficulty with PFM coordination, may still be present at this time given the pressure and stress placed on the pelvic floor by the growing uterus during pregnancy (3).

In Poland, the only information about physiotherapy during pregnancy and after birth are physiotherapeutic methods as non-pharmacological methods to eliminate pain during birth: relaxation massage, warm or cold compresses in the area of pain sensation, transcutaneous electrical nerve stimulation – TENS; (see: REGULATION OF THE MINISTER OF HEALTH 1 of August 16, 2018 on the organisational standard of perinatal care). The Polish Urogynecological Society's Interdisciplinary Guidelines on Perinatal Rehabilitation define in detail, but theoretically, the activities of physical therapists addressing pregnant and postpartum women (downloadable from the Society's website). WHO Recommendations from 2016 and 2018 point to physical therapy as an effective form of lower spine pain relief, not only during labor, but throughout pregnancy and the postpartum period. An example regimen for physical therapy after pregnancy and childbirth is shown in Table 3. It should be noted that in the first weeks after birth, the patient can use forms of self-therapy that the physical therapist planned during pregnancy (diaphragmatic breathing, pelvic movements, or training in body mechanics while caring for the newborn).

Table 3. An example of physiotherapeutic treatment in postpartum women (1–3).

Post-partum	Possible musculoskeletal symptoms*	Possibilities of manual therapy (in combination with physical activity if there are no contraindications)
Week 0-2	• General fatigue • Breast pain • Scar pain: after episiotomy/perineal tear/cesarean section • (1/5 of women have pelvic pain about 10 days after delivery) • Urinary/fecal incontinence • Hemorrhoids • Sensation of lowering of the reproductive organs • Neuropathy of the obturator nerve** (L2-L4) and pudendal nerve*** (S2-S4)	• Indirect relaxation of the diaphragm + re-education of diaphragmatic breathing • Movement of the pelvis in different planes within tolerance • Gentle and painless mobilityand postural exercises (correct body mechanics in caring for a newborn, i.e., lifting, carrying, and holding) • Tightening of transverse abdominal/pelvic floor muscles/relaxation – (postpone if pain symptoms are present)
Week 2-4	• As above + • PGP i LBP	• Contraction of the transversus abdominis muscle – in the supine position, in the lateral position and in the supported kneeling position • Tension/relaxation of the pelvic floor muscles with emphasis on a short contraction (5 seconds) – (delay if pain symptoms are present) • Deep tissue massage • Mobilisation of soft tissues • Trigger point therapy • Post-isometric muscle relaxation • Rib Raising techniques • Techniques for the diaphragm
Week 5-6	• As above	• Coordination of the transversus abdominis muscle in advanced movements, including sitting/standing • Strengthening the hips in the kinetic chain to energise/relax the PFM • Tightening/relaxing of the PFM with emphasis on holding the contraction (10 seconds) • Deep tissue massage • Mobilisation of soft tissues • Trigger point therapy • Post-isometric muscle relaxation • Rib Raising techniques • Techniques for the diaphragm

Table 3. continued

Post-partum	Possible musculoskeletal symptoms*	Possibilities of manual therapy (in combination with physical activity if there are no contraindications)
Week 7-12	As above + CPP (Chronic pelvic pain) long lasting pain in perineal area contributes to pain during sexual intercourse – dyspareunia	Sensitisation/improvement of postural defects that often persist after birth Work on rotation/extension of the rib cage, correction of an excessively tilted pelvis (forward or backward). Work in low positions (e.g., plank/mountaineer position) can be developed slowly to focus initially on force absorption until the patient is ready to tolerate it in an upright position Deep muscle testing is performed at the patient's request to determine MDM function Focus on appropriate contraction/relaxation and strength/endurance to determine individual training needs

Hormones affecting the musculoskeletal system

- Sex hormones:
  - » Estrogen: Estradiol levels increase in the early follicular phase on days 1-3 due to low MCR.
  - » Progesterone: Increases from day 3 to 7 of the follicular phase. Plasma concentrations begin to rise from low follicular levels after 2 weeks, ovulation resumes 4 (rarely) to 12 weeks postpartum in nonbreastfeeding mothers.
- Androgens: DHEA: normalisation of levels
- HPA axis:
  - » CBG: return to normal levels within 2 weeks
  - » Cortisol: decrease in levels
  - » CRH: drops sharply
  - » ACTH: drops sharply from about 6 weeks postpartum
- Thyroid hormones – Thyroglobulin: during 6 weeks, 40% of postpartum women experience abnormal production and 5% develop thyroid abnormalities and disorders.
- Protein hormones:
  - » Oxytocin: levels increase during lactation and breastfeeding
  - » Prolactin: levels normalize around the 3rd month postpartum and in nonbreastfeeding women
- Mineral corticoids: aldosterone: decreases rapidly
- β-Endorphins: Declines to normal levels
- Gonadotropins:
  - » LH and FSH: normal levels by 3-6 weeks postpartum
  - » hCG: Declines by week 4

* may appear at various times after delivery
** compression during childbirth, delivery in the supine position (lithotomy), hematoma,
*** compression, prolonged labor, pressure on the baby's head

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9.2.
Physiotherapy of the caesarean section scar

Antonina Kaczorowska, Agata Mroczek

9.2.1. Anatomy of the anterior abdominal wall

The abdominal cavity extends from the lower edge of the chest to the upper edge of the pelvis and lower limb. The upper opening of the abdominal cavity, which is also the lower opening of the thoracic cavity, is closed by the diaphragm. From above, the abdominal cavity is bounded by the xiphoid process of the sternum and the costal arches. Downwards, the deep layer of the abdominal wall passes into the pelvic wall in the plane of the pelvic inlet. From below, the abdominal cavity is limited by the edge of the pelvic bones – the pubic symphysis.

The anterior abdominal wall consists of several layers:

- skin (epidermis, dermis, subcutaneous tissue)
- abdominal fascia
- muscles
- extraperitoneal connective tissue
- parietal peritoneum

The superficial fascia of the abdomen covers the anterior abdominal wall superficially and connects to the axillary fascia at the top and laterally. The transverse fascia is the internal fascia of the abdomen. It runs along the posterior wall of the rectus abdominis muscle, extends over the quadratus lumborum muscle and also superficially over the abdominal surface of the diaphragm. It connects to the parietal peritoneum and, in the region of the iliac crest, to the iliac fascia.

There are five muscles in the anterolateral abdominal wall. Three flat muscles that become the aponeurosis near the midline:

- external oblique abdominal muscle

- internal oblique abdominal muscle
- transversus abdominis muscle

Another two muscles that run longitudinally near the midline and are enclosed in a sheath formed by the flat muscle tendons and the transverse fascia:

- rectus abdominis muscle
- pyramidal muscle

9.2.2. Cesarean section

In recent years, maternity statistics around the world show a steady increase in the number of caesarean section operations. A caesarean section involves cutting the abdominal layers and the uterine muscle to extract the baby. There is a longitudinal section and transverse section. Nowadays, the transverse section is the most commonly performed incision, which gives good results in the wound healing process and desirable cosmetic effects. An section made using the transverse technique translates into a scar that is 30 times stronger than a longitudinal incision.

Stages of abdominal skin incision during transverse section:

- incision of the skin and subcutaneous layer
- incision of the fascia of the rectus abdominis muscle
- separation of the fascia from the rectus abdominis muscle
- extending the rectus abdominis muscle
- opening the transverse fascia and peritoneum

Incision of the uterus – 99% is performed transversely in the lower part of the uterus. This technique is characterised by limited bleeding during the operation, rare formation of adhesions and uterine rupture in subsequent pregnancies.

9.2.3. Scar formation

Usually, a caesarean section wound heals without complications; however, the patient should be made aware that wound healing complications also occur. In the course of scar formation, the wound is filled with successive layers of collagen over a period of days, and sometimes weeks. Under normal conditions, the scar becomes paler during this time, less protruding above the surface of the healthy skin, fading over time and eventually taking on a pearly layer. The volume of collagen also decreases somewhat, so that the scar becomes thinner. The speed of healing and the nature of the scar produced depend largely on the smoothness of the wound edges and the precise proximity of the wound edges to each other.

We can divide postoperative wound healing and scar formation into three phases:

1. inflammatory phase – lasts from 2 to 5 days after surgery; in this phase the inflammatory reaction is activated, mainly macrophages secreting cytokines and growth factors are involved
2. proliferation and angiogenesis phase – lasts up to 6-8 weeks after surgery; during this phase, fibroblasts and macrophages migrate to repair the wound site
3. modelling/reconstruction phase – lasts until approximately 1.5-2 years after surgery; during this phase, scar remodelling occurs, which is associated with a change in the orientation of collagen fibres and shrinking of the scar. During this phase, features such as the appearance, thickness and functionality of the scar are finally defined.

9.2.4. Scar division

One of the commonly used divisions of scars is the classification according to Mustoe:

- normal scar – light (pearly) and flat (not rising above the area of surrounding skin)
- abnormal scar – red, itchy or painful, slightly raised above the surrounding skin; many such scars become flat with time and take on a skin-like colouring
- linear hypertrophic scar – red, slightly elevated, occasionally itchy or painful, not extending beyond the outline of the surgical wound
- large-area hypertrophic scar – planar, convex, sometimes itchy (e.g. burn scar)
- small keloid – limited, convex, itchy scar, extending beyond the outline of the wound; may develop a year after formation and does not regress spontaneously
- large keloid – large convex scar, more than 0.5 cm in diameter, painful or itchy, extending beyond the outline of the wound, may grow over many years

9.2.5. Consequences of adhesions after caesarean section

Adhesions are a very common complication after caesarean section, affecting from 46% to even 100% of patients, according to reports of various authors. The favorable appearance of the scar after caesarean section is not synonymous with the absence of postoperative adhesions. Consequences of adhesions after caesarean section:

- unsightly appearance of the abdominal integuments – the scar is attached to the deeper tissues, resulting in an overhang of the skin and subcutaneous tissue above the scar
- chronic pelvic pain
- small bowel obstruction
- dyspareunia
- infertility
- non-specific gastrointestinal, urinary and reproductive complaints

The long-term consequences of post-cesarean section adhesions resulting from restrictions within the healing tissues may be pain syndromes of the musculoskeletal system, such as disturbances in body posture and gait pattern, change in tension and resting length of antagonistic muscle groups, change in geometry and reduction of fascia flexibility. Common pain syndromes of the musculoskeletal system include headaches, pain syndromes of the spine and pelvis.

9.2.6. Therapy of the caesarean section scar

Before starting topical therapy, the patient should be assessed globally – visual, static and dynamic assessment of the whole body. Then the skin, vascular changes and any swelling must be assessed. Then the mobility and the slidability of the fascia must be examined. Next, the scar itself should be assessed.

The scar is assessed based on the following criteria:

- scar mass – length, width, thickness
- consistency – softness, irregularity, rope-like appearance
- outline – flat, convex, concave
- pigmentation – none, comparison with surroundings
- structure, elasticity – comparison with surroundings
- function – restriction of mobility in relation to the ground, tension
- sensitivity – sensory disturbance, lack of sensation, pain
- activity – progressive development, growth arrest

Even a properly healed scar will require targeted measures to restore its normal mobility and separation from the surrounding tissues and to prevent adhesions.

9.2.7. Physiotherapy

Phase I (up to 5-7 days after surgery)

No direct scar work is done in this phase, as the scar is not yet formed and the wound is initially hidden under a dressing. In phase I, lymphatic drainage of the ab-

domen (gently and at a slow pace) and lower limbs can be performed. The patient should also be taught to perform self-drainage.

Phase II (from day 5-7 to 6-8 weeks after surgery)

During this period, the following physiotherapeutic methods are used:

1. lymphatic drainage of the abdomen and lower limbs as well as the immediate area around the scar and the scar itself
2. manual therapy – gentle muscle and fascial release of the abdomen, which includes the immediate scar area and the scar itself; moving the scar together with the surrounding tissues to prevent adhesion formation
3. kinesiotaping (fascial, lymphatic application) – to lift the skin and subcutaneous tissue away from the fascia, facilitating the reduction of oedema and blood circulation; also to bring the edges of the scar closer together to prevent stretching
4. self-therapy – teaching the patient appropriate therapeutic grasps and movements

Phase III (from 6-8 weeks to 1.5-2 years after surgery)

In phase III, we can make a preliminary assessment of whether adhesions have formed, which can be assessed by trying to move the scar and lift it. The period up to 2 years after surgery is considered the time when the greatest remodelling of the scar is possible. The manual techniques are stronger and more forceful than the techniques in the previous period. Methods used in period III:

1. deep massage and musculo-fascial relaxation techniques
2. direct scar work techniques
3. kinesitherapy – exercises to mobilise the scar area, increasing the mobility of muscles and other soft tissues
4. kinesiotaping – ligament, fascial, lymphatic application
5. dry brushing.
6. self-therapy and continuation of therapy by the patient at home

Recent studies have shown that musculo-fascial therapy and soft tissue mobilisation improves scar fold structure, scar flexibility and mobility, reduces pain, infertility rates, post-operative bowel obstruction, improves posture, reduces painkillers and improves quality of life for patients. The use of a physiotherapy programme reduced scar and lower abdominal pain in patients in the early period after caesarean section.

During manual work with the scar, lubricants should not be used, as they may hinder contact with the tissue and its deformation. However, after the end of therapy and as part of self-therapy, ointments or creams for scars should be used.

In scar therapy, we can additionally use physical therapy (infrared radiation, magnetotherapy, electrotherapy, ultrasound), pressotherapy or tool therapy. These methods support manual therapy.

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9.3.
Physical Activity and Exercise in the Postpartum Period

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Regular participation in physical activity (PA) improves physical well-being and reduces the risk of developing non-communicable diseases. However, fatigue may negatively affect women's participation in PA in the postpartum period (PPP).

Research shows that women's participation in exercise programs declines after giving birth, often leading to overweight and obesity.

In the postpartum period, obstetricians-gynaecologists recommend a healthy lifestyle. Resuming exercise or incorporating new exercises after giving birth is important for maintaining healthy habits throughout your life.

Recent WHO recommendations affirm the United States Department of Health and Human Services Physical Activity Guidelines of at least 150 minutes of moderate-intensity aerobic activity per week throughout pregnancy and the PPP.

Include a variety of aerobic and muscle-strengthening activities. You should also limit the amount of time you spend sedentary. Replacing sedentary time with physical activity of any intensity (including light) brings health benefits.

Exercise can be resumed gradually after pregnancy as soon as it is medically safe to do so, depending on the mode of delivery (vaginal delivery or caesarean section) and the presence or absence of medical or surgical complications.

Some women are able to resume physical activity within a few days after giving birth.

Pelvic floor exercises can be started immediately after giving birth. Abdominal strengthening exercises have been shown to reduce the incidence of rectus abdominis dehiscences and reduce the distance between the rectus abdominis in women who gave birth vaginally or by caesarean section.

Challenges to return to exercise faced by women in the postpartum period

- Musculoskeletal issues
- Pelvic floor and related issues

- Weight management and relative energy deficiency in sport
- Relative energy deficiency in sport
- Mental health: Postnatal depression
- Exercise prescription postpartum

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9.4.
Safe physical activity after physiological delivery

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9.4.1. Previous aspects

Interviews are essential and form part of the work of the healthcare professional. They allow us to get closer to the patient in a professional way, to inform them about their state of health and treatments. We will indicate the importance of their collaboration, both in attending the consultation and in their work at home.

In the interviews, we will use language that is easy for the patient to understand, which transmits confidence and security. Materials such as anatomical models, images or videos can be used to make the information more comprehensible to the patient. Interviews should be conducted in a suitable, private, well-ventilated and well-lit environment.

9.4.2. Preconditions

The treatment consists of several situations. We must assess the existence of pain or other alterations such as contractures, scars or tension of the pelvic floor muscles; check the state of the pelvitrochanteric muscles; and observe the alignment of the pelvis and spine. After treatment or, if possible, during treatment, we should teach and make the patient aware of her pelvic floor anatomy and the other structures that act on it.

Different tools can be used for treatment, all of them with a scientific basis. Some of the most common are: massage, diathermy, ultrasound, stretching, joint mobilisation, myofascial or ciriax, among others.

9.4.3. To be aware

That the pelvic floor musculature is known to the patient is essential for the treatment. We know that many women do not know how to contract it and, in other cases, perform the wrong contractions.

In order to change this, we must teach the correct way to contract in a simple and clear way. We will use similes such as: 'imagine that you want to cut the stream of pee' or 'imagine that you want to hold back a gas' or 'imagine that you want to hold back a tampon' at the same time as the patient observes and feels the contraction. A mirror can be used to enhance perception. We will teach her to contract the musculature in isolation and to palpate the central core of the perineum.

Sometimes this is insufficient. So proprioceptive techniques, such as vaginal palpation, should be used. This is done by resting the index and middle fingers on the levator ani musculature.

If we want to teach the patient, we can stretch the muscles. In this way, she will feel the muscles she needs to contract. This can be done separately (right and left) or at the same time. The muscles are brought to the maximum stretch, holding the position and slowly relaxing. Repeat several times, before asking the patient for a voluntary contraction. You can also stimulate the myotatic reflex. This will allow the patient to feel the contraction after the stretch. Once this has been done, the patient is asked to relax. It is important that the therapist does not oppose the contraction.

All this is done in different positions, always in a progressive manner, guided and assisted by the physiotherapist. We begin in the gynaecological position, as this corrects the position of the pelvis and the spine, and reduces the involvement of the passive muscles. This is followed by supine, quadruped and seated positions.

Fundamentally, the aim is to achieve a good muscular proprioception that allows a correct and voluntary contraction of the pelvic floor.

In addition, this type of therapy is complemented by other manual or instrumental intracavitary techniques such as feedback and electrostimulation.

9.4.4. Development of the muscular quality contraction of the pelvic floor muscle

The pelvic floor muscles and the deep abdominals share synergies. However, there is still controversy about the action of one on the other. Because of this, we believe that, as a preventive measure, we should begin with learning and recovering the contraction of the pelvic musculature. Later on, the coactivation of both muscle groups will be sought. This will prevent alterations in a weakened pelvic floor, as well as urine leakage.

9.4.5. Kegel exercises

The scientific literature advises the application of exercise programs with certain variations in terms of the number of series, repetitions and contraction and rest time. Clinical guidelines indicate that this type of muscle training will always be better than placebo or no treatment. These benefits are increased if they are guided and controlled by the physiotherapist.

Among these types of training are Kegel exercises. They were described in 1948 with the aim of reducing urine losses. However, today, it has been seen that they are effective in strengthening and improving the pelvic floor.

These exercises allow an integration of the pelvic musculature, by closing the sphincters and raising the pelvic organs. In addition, they also allow a progression in the treatment and position changes depending on the contraction capacities of the patient.

9.4.6. Abdominoperineal reprogramming

As we have previously indicated, there are synergies between the deep plane of the abdomen and the pelvic floor musculature. In addition to Kegel exercises, there are other techniques that allow you to strengthen the abdominal muscles, without damaging the pelvic floor, thanks to avoiding the increase in intra-abdominal pressure. Some of them are: hypopressive abdominal gymnastics, Gasquet exercises, Pilates and lumbopelvic stability exercises.

Each of them requires specific learning. When recommending them, it is necessary to know their characteristics, their form of application, their indications and contraindications well.

9.4.7. Vaginal intracavitary devices (Vaginal cones and balls)

For intracavity cones and balls to be recommended for use, the pelvic floor must have tone and some strength. When the musculature is hypotonic, it is impossible to keep these devices inside the vagina, which will cause frustration for women.

There is currently no clear scientific evidence on the efficacy of Chinese balls and cones. They are used as a complement in the global re-education of the perineum, as the cones provide a weight-adjustable stimulus and the Chinese balls provide a simultaneous impulse of force and vibration. They can be used once or twice a day, for 15 minutes, or as maintenance training once or twice a week.

It is important to be supervised by a physiotherapist in terms of pelvic positioning, proper breathing and that work and rest times are respected.

Pelvic floor exercises are recommended with the aim of training the slow fibres as well as the fast fibres from the beginning, in order to prepare the muscles for the moment of effort.

9.4.8. Perineum contraction during exertion

It is the ability to contract the perineal musculature during an effort, with sufficient force and speed and maintained for a certain time. Contraction is a dynamic and active mechanism. Effective contraction of the pelvic floor during exercise is a prerequisite for successful re-education.

Sport, coughing, sneezing is important hyperpressive efforts at the abdominal level. During the development of muscular qualities, short and intense contractions of the pelvic diaphragm must have been worked on, in order to teach the patient, the coordination of these contractions at this time.

The physiotherapist will give the patient instructions on how to achieve the contraction in the face of expected efforts, in order to progressively instruct her in the activation of the pelvic floor in the face of unexpected and surprising efforts, for example, by making her laugh, or making her lift her trunk because she is putting the pillow on correctly. Intracavitary palpation will check the effectiveness of the contraction in these efforts. The patient has to automate it, and contract the perineum without thinking when she coughs, laughs, picks up weight, gets out of the car, etc. In short, we teach the patient to prevent loss during activities of daily living.

9.4.9. Treatment at home

The success of treatment depends to a large extent on the patient's commitment to re-education. For this reason, she should work daily at home on the exer-

cises she has learned in the clinic. To ensure adherence, these exercises should not take up too much of her daily time.

In the sensitisation and awareness phase, the exercises should only be performed in decubitus position, with flexion and abduction of the hip. The patient should actively contract the muscles twice a day. Correct performance of the exercises can be checked by self-palpation of the central fibrous core of the perineum. The physiotherapist must indicate the series to be performed, the number of contractions per series and the time of contraction and rest. The physiotherapist also controls, corrects and stimulates the personal work throughout the sessions.

Once the patient has learnt how to perform the exercises correctly, she can change position, making the exercises more difficult due to the action of gravity, and gradually increase the intensity of the contractions. The training will be carried out in any situation of daily life, always under the control of the physiotherapist.

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9.5.
Pelvic Floor Muscle Training Program in Postpartum

Alejandro Galán-Mercant, Verónica Pérez-Cabezas, Gloria González-Medina, Inés Carmona-Barrientos, Jose Antonio Moral-Munoz, David Lucena-Antón

9.5.1. General recommendations

- Active FP exercises in the first 24 hours after delivery.
- Local cryotherapy.

- Practice the exercises several times a day, few repetitions, during breastfeeding or artificial feeding (postpartum only).
- If the delivery is by caesarean section, the indications are similar.

9.5.2. Key points before prescription

- PFM assessment together with gynaecologist, midwife and/or physiotherapist.
- Complete obstetric history (number of deliveries, types, dates, weight, type of anaesthesia, multiple deliveries, episiotomy, vaginal tears).
- Valvular, voiding and faecal history.
- Constipation references and treatments.
- Assessment of urinary incontinence: stress/urgency.
- Assessment of dyspareunia or urine leakage during sexual intercourse.
- Family history of PF pathology
- General and specific personal history, habitual medication, previous surgical interventions.
- Work history (dynamics, dispersion, prolonged sitting, loads).
- Sports history, medium- to long-term recovery programme.
- Assessment of the external genitalia, perineal musculature and abdomen: labia majora and minora, 'closed' vagina, tissue trophism, painful scars, fibrosis, fistulas, general and particular tone of the PF, automatism of effort, diastasis of rectus abdominis, parasitic contractions of adductors, buttocks and abdominals, biomechanical exploration of the lumbar spine, objective assessment with perineometer.

9.5.3. Algorithm for classifying the PF muscle level

Depending on the examination, we could classify into 3 groups:

- Group A, good PF status, the objectives are aimed at prevention. Therefore, we will indicate the performance of PF exercises at home, use of vaginal cones or balls, hypopressive exercises, ideally 5 sessions of PF re-education as a preventive measure.
- Group B, weakened FP, we recommend FP exercises, vaginal cones or balls, specific therapeutic exercise programmes (TE) and repeat consultation after 6-8 weeks.
- Group C, very deteriorated FP, the objectives focus on physical treatment of the pathology in consultation and with recommendations at home and prescription by the gynaecologist.

9.5.4. Training possibilities

In the approach to the pathology of pelvic floor hypotonia, different alternatives and therapeutic tools will be used:

- Exercises of the pelvic floor musculature: slow and fast fibre contractions, ascending, antero-urethral, mid-vaginal, postero-anal).
- Hypopressive abdominal gymnastics.
- Intracavitary approach.
- Biofeedback.
- Electro-stimulation.
- Vaginal cones and Chinese balls.
- High-impact hyperpressive physical activities are contraindicated until 4-6 months after childbirth. Postpartum adapted activity is included: walking, skating, cycling, Pilates, Fit ball, elastic band, dancing in general, belly dancing in particular, back training programme, swimming, water aerobics. Temporarily prohibited: running, jumping, racket sports, Spinning, Aerobics, Step.

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9.6. Diastasis recti abdomins therapy

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9.6.1. Position and function of the rectus abdominis muscle

The rectus abdominis muscle forms the anterior abdominal wall. It connects the cartilages of the fifth to seventh ribs to the pubic tubercle. The rectus abdominis muscle is usually divided by three transverse tendon bands (tendon streaks), which

divide it into three parts above the umbilicus and one larger part below the umbilicus. The tendon streaks are only present in the superficial layer. They are no longer present in the deep layer. The aponeuroses of the rectus abdominis muscle run towards the linea alba, partly anteriorly from the rectus abdominis muscle and partly posteriorly, forming the sheath of the rectus muscle.

The linea alba (LA) is a tendinous band running from the xiphoid process of the sternum to the pubic conjunctiva, 10-25 mm wide, tapering downwards. It is formed by the intersecting aponeuroses of the oblique abdominal muscles and the transverse abdominal muscle (lateral abdominal muscles), forming the sheath of the rectus abdominis muscle. The linea alba separates the right part of the rectus abdominis muscle from the left. The linea alba plays an important role in maintaining the stability of the abdominal wall from a mechanical point of view. There are three main orientations of the fibres in the linea alba: transverse fibres, oblique fibres and a small number of irregular fibres. Gender differences in fibre architecture have been observed. In women, there is a greater number of transverse fibres relative to oblique fibres in the subumbilical area and a reduced thickness and increased width of the white crease also in the subumbilical area. These morphological differences may be a form of adaptation to the increasing pressure in the abdominal cavity during pregnancy.

The sheath of the rectus abdominis muscle consists of three layers:

- posterior lamina (posterior fascial layer)
- muscular layer
- anterior lamina (anterior fascial layer)

The posterior lamina in the upper part is formed by the posterior lamina of the internal oblique muscle aponeurosis, the aponeurosis of the transversus abdominis muscle and the transverse fascia. The posterior aponeurosis of the rectus abdominis muscle is not connected to the posterior lamina, but slides along it. The posterior lamina ends about 5 cm below the umbilicus at the arcuate line, as below this point the aponeuroses head towards the anterior lamina. Downstream from the arcuate line, the posterior lamina consists only of the transverse fascia and the peritoneum.

The anterior lamina extends over the anterior part of the rectus abdominis muscle. Above the arcuate line, the anterior lamina consists of the aponeurosis of the external oblique muscle and the anterior lamina of the aponeurosis of the internal oblique muscle. Below the arcuate line, the anterior lamina consists of the aponeurosis of the oblique abdominal muscles and the transverse muscle.

The rectus abdominis muscle is the strongest trunk flexor when the pelvis is stabilised. It is supported by the abdominal oblique muscles. With the attachments on the chest stabilised, the rectus abdominis muscle can pull the front part of the pelvis upwards, which corresponds to the extension of the pelvis and leads to further

flexion of the lumbar spine. The rectus abdominis muscle supports the obliques and the trapezius lumbar muscle in lateral flexion on the same side.

During pregnancy, the geometry of the abdominal muscles changes while still retaining muscle function. The developing uterus affects the shape of the abdomen and the position of the lumbar spine (deepening of the lumbar lordosis), which increases the distance between the attachments of the rectus abdominis muscle, i.e. causes the abdominal muscles to stretch and changes the angle of the attachment. Functionally, this is manifested by a decrease in muscle strength and other changes in the rectus abdominis muscle. It can lead to stretching and laxity of the linea alba, which can cause an increase in the distance between the medial borders of the right and left parts of the muscle, and then loss of its straight course.

9.6.2. Diastasis recti abdominis – definition and incidence

Diastasis recti abdominis (DRA) is the separation of the right and left parts of the rectus abdominis muscle along the linea alba. In the literature, one may also encounter the names rectus abdominis diastasis (RAD) or divarication of rectus abdominal muscles (DRAM). In the female population, DRA is common in pregnant and post-partum women. The most common location of occurrence is the umbilical region, but can also include the supra- and subumbilical region. The incidence of DRA among pregnant and postpartum women is approximately 24-70%. There was no difference in the incidence of DRA between primiparous and multiparous women, and only a higher incidence of DRA below the umbilicus was observed in multiparous women.

The separation of the linea alba in the DRA results in the creation of a space called the inter-recti distance (IRD). According to Beer and co-authors, the physiological parameters for the width of the linea alba are up to 15 mm at the height of the xiphoid process, up to 22 mm at 3 cm above the umbilicus and up to 16 mm at 2 cm below the umbilicus. Furthermore, the width of the linea alba increases with age. The distance of the IRD decreases gradually with time in the postnatal period with individual variability.

DRA can also occur in men and is thought to be related to age, weight fluctuation, weight lifting and familial abdominal muscle weakness. In men, DRA is more likely to occur mainly in the umbilical region in the fifth and sixth decades of life.

9.6.3. IRD width measurement

Various methods of measuring IRD are used in clinical practice. There are no strict recommendations for the place of measurement (distance from the umbilicus), body

position (at rest in the supine position or during contraction in the head lift position) or method. Various methods can be used: palpation, measuring tape, callipers, ultrasound, CT and MRI. Studies have shown that adequate methods for assessing the DRA are measurements with ultrasound and callipers. A less precise but simple measurement can be found in some older studies – DRA is indicated by an IRD distance of more than two finger widths. Swedish recommendations suggest diagnosing DRA on clinical examination with a calliper or ruler. Imaging diagnosis by ultrasound or other imaging modalities should be performed when a concurrent umbilical or epigastric hernia or other cause of the patient's symptoms cannot be excluded.

9.6.4. Risk factors

Risk factors for DRA include:

- pregnancy (hormonal changes, increased uterine size, pelvic anteversion with or without lumbar hyperlordosis, increased abdominal pressure),
- caesarean section,
- multiple pregnancies,
- foetal macrosomia,
- genetically determined defects in collagen structure,
- significant weight loss occurring spontaneously or following bariatric or abdominal surgery
- obesity
- diabetes

9.6.5. Consequences of DRA occurrence

An increase in IRD distance decreases the strength of the rectus abdominis muscle and does not usually cause pain at rest. However, during physical activity, a characteristic bulging of the abdominal wall may occur due to an increase in abdominal pressure. For this reason, DRA may be associated with the occurrence of umbilical and supra-abdominal hernias. The occurrence of DRA can cause the following consequences:

- bad posture
- weakened abdominal muscle strength
- restrictions during physical activity
- back pain
- lumbopelvic pain
- dysfunction and weakening of the pelvic floor muscles, urinary incontinence
- reduced quality of life

Women with DRA may experience a fear of movement and therefore avoid movement. Coupled with a sense of physical instability in the abdominal area and dissatisfaction with their bodies, many women limit their daily life and physical activity.

However, some studies contradict these findings. Studies by Sperstad et al, Mota et al and Parker et al do not confirm differences regarding pain of the lumbopelvic area in women with and without DRA. Studies by other authors have not shown weaker pelvic floor muscles or pelvic floor dysfunction in women with DRA after childbirth. According to Benjamin et al., the evidence for an association of DRA with pelvic organ prolapse and severity of DRA with health-related quality of life, abdominal muscle weakness, and lower back pain is weak.

9.6.6. Treatment of diastasis rectus abdominis

In most women, DRA resolves spontaneously in the postnatal period. Most often there is a full recovery one year after birth. Research today does not provide answers as to why some women continue to have this problem one year after birth. If increased IRD persists, conservative treatment, i.e. physiotherapy, is used. Although numerous studies confirm the positive effect of exercise and manual techniques on reducing IRD distance, there is no generally accepted therapeutic protocol.

The following exercises and techniques are most commonly used in DRA therapy:

- abdominal muscle exercises (transversus abdominis and rectus abdominis muscles)
- posture training
- education and training in correct movement and lifting
- methods to strengthen the transversus abdominis muscles (Pilates, functional training, Tupler technique)
- Nobel technique
- pelvic floor muscle training as activation of the transversus abdominis muscle
- manual therapy (soft tissue mobilisation, muscle and fascial techniques)
- osteopathic techniques
- kinesiotaping
- external abdominal bracing
- tubigrip

So far, there is no consensus among researchers as to which abdominal muscle exercises are effective in reducing DRA. One method involves using exercises of the transversus abdominis muscle and avoiding exercises of the rectus abdominis muscle so as not to potentially exacerbate DRA. The other method involves activating the rectus abdominis muscle. According to Keller, transverse abdominal muscle exercises are more commonly used. Some authors suggest including pelvic floor mus-

cle exercises that activate the transverse abdominal muscle. 10-15% of the pelvic floor muscle tension activates the transversus abdominis muscle, independently of the contraction of the oblique abdominal muscles and the rectus abdominis muscle. Adequate tension of the linea alba is essential to transfer forces between the sides of the abdominal muscles, resulting in better abdominal control and a better cosmetic effect. It seems that the optimal strategy in DRA therapy is to combine the activity of the two types of abdominal muscles, but this thesis still needs confirmation. Exercises are combined with manual therapy, osteopathic techniques and other supportive methods. Kinesiotaping, tubigrip are often used, but not all authors confirm the effectiveness of these methods. Neuromuscular electrostimulation can be used as an adjunct to exercise, which aids recovery of the abdominal muscles and reduces IRD.

Patients are advised to avoid exercises that cause the abdominal wall to bulge, exercises that engage the oblique abdominal muscles, lifting the straightened lower limbs above the ground while lying on the back, so-called 'crunches', intense coughing without abdominal support, and lifting heavy objects.

When conservative treatment is unsuccessful in those with high aesthetic and/or functional discomfort or the presence of a hernia, surgical intervention is used. However, recurrence is sometimes observed after surgical treatment.

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9.7.
Breastfeeding and restoring function

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Early breastfeeding is highly significant for the health of both a mother and a baby. Moreover, it reduces the probability of postpartum bleeding. On average, it takes an hour for a newborn placed on the mother's bare chest and left there undisturbed to find the breast and start to nurse. Skin-to-skin contact should be maintained without any disturbances for 2 hours. Only then should a newborn be examined by medical personnel (in cases of the labour without complications with a full-term healthy newborn).

Breastmilk until 6 months is the ideal food and beginning for the life of a baby. Later it is recommended to start introducing complementary foods that are nutritious, ecological, clean, and safe. After complementary foods have been introduced, breastfeeding should be continued within the same frequency as before (on demand).

The composition of breastmilk perfectly corresponds with requirements of the newborn. Research has shown that if a mother breastfed one baby and then another, the breastmilk would be of a different composition. The amount of fat in breastmilk differs from day to day, depending on the baby's age, gender, duration of breastfeeding session etc. Interestingly, the breastmilk of mothers breastfeeding boys contains slightly more fats compared girls.

Non-breastfeeding women return to ovulation on average on the 45th day after labour (25-72 day) with periods returning after about 60 days, whereas about one third of women breastfeeding on demand have no periods for a year after labour. Exclusive breastfeeding helps avoid early pregnancy during the first half of a year after the childbirth. Another pregnancy within the first year after the childbirth is considered early due to the fact that it takes two years for the body of a woman to recover from previous pregnancies. So, when a woman conceives earlier the risk of pre-term birth or low birth weight increases.

Duration of nursing depends on various factors:

1. The rhythm and strength of a baby nursing
2. The biological features of the mother that determine the intensity of breastmilk flowing from the breast. Some women experience a strong flow causing the baby to become full within 2-5 min, whereas in other cases breastmilk flows slowly in drops with the newborn becoming full in 20-30 min.
3. If a baby nurses on one breast longer than 30 min you should look at how the baby has latched on to the breast. If the baby does not take enough of the breast into its mouth, the duration of nursing prolongs, with a risk of damaging the nipples. After the breastfeeding position has been corrected and the baby has definitely latched on correctly, the duration of nursing is not limited. If pain is felt it means that a baby is not latching on to the breast correctly
4. If the baby has correctly latched on to the breast, after 30 min of active breastfeeding the breast should be changed. This stimulates lactation so the newborn can .
5. During the first month it is recommended to breastfeed a newborn at least every 3 hours counting the time from the beginning of nursing. There is no difference how long it takes a baby to become full and fall asleep.

If a breastfeeding woman experiences intensive pain or it is thought that a newborn latches on to the breast incorrectly the breast should be taken out of the baby's mouth. It is recommended to insert the little finger into the newborn's mouth in order to break the vacuum.

How to hold a newborn correctly to the breast:

1. Hold the newborn close to the body with the face turned to the breast.

2. The body and head of the newborn should be in the same line. Ear-shoulder-hip along the same line. The baby should 'stick' to the body of the mother.
3. The head should be slightly tilted back.
4. Support the body of the newborn at the shoulder line.
5. The breastfeeding woman should be in a comfortable position with her back supported, both feet on the floor, using as many pillows as necessary for the baby to be held level with the breasts.

Signs of correct latching:

1. The newborn is gently attached to the breast with the mouth open wide.
2. The lower lip is everted.
3. The chin of a newborn touches the breast.
4. More of the upper part of the areola is covered with the mouth than of the lower part.
5. While nursing, the cheeks inflate more than deflate.
6. The sound of swallowing is heard.

Breastfeeding positions

1. Cradle hold (Madonna or classical).
2. The mother holds the lying baby with the opposite hand to the nursing breastThe mother holds the baby under her upper arm (recommended when breastfeeding twins)Lying down.
3. All fours breastfeeding.

The latest AMB protocol recommends:

1. In case of inflammatory mastitis, the following measures may be taken:
   a) Cooling: on demand or 10 minutes every hour
   b) Anti-inflammatory drugs (800 mg of Ibuprofen every 8 hours)
   c) Lymphatic drainage massage avoiding the direction towards the nipple
   d) Breastfeeding on demand with the baby's chin directed towards a lump
   e) Probiotics and fermented products (Lactobacillus fermentum or Lactobacillus salivarius)
   f) Warming. In some cases, it could reduce discomfort; however, due to the widening of blood vessels, the condition could become even worse while the duration of mastitis is not shortened.

   If the areola is hard and the baby is unable to put it into the mouth and latch, a little bit of breastmilk could be expressed in order to make it softer. If the breast is so hard that a baby is unable to latch even after milk has been expressed and this still does not help put the breast into the mouth, it is recommended not to breastfeed from the affected breast, apply frequent cooling, and let it rest. The amount of milk in this breast could decrease but after the acute period, lactation is to be restored.

The following should be avoided:

g) Hyperstimulation: with the aim to empty the breast by feeding only from the affected breastAdditional extraction of the breastmilk from the affected breast only stimulates lactation and edema
h) Breast massage as it increases edema, inflammation and could injure the breast ducts
i) Salt baths
j) Vibro massagers
k) Antibiotics if the inflammation is not bacterial

2. Breastmilk flow after labour (within 3-5 days): this is more usual for women who received intravenous fluids during labour. For the women after C-section this phenomenon is typically delayed.
   Possible remedies:
   a) Cooling
   b) Breastfeeding on demand: avoid long gaps, use skin-to-skin contact with lots of time spent together
   c) A small amount of breastmilk may be extracted to soften the areola and reduce breast hardness and discomfort; however, is it important to avoid hyperstimulation
   d) Lymphatic drainage massage

Both issues could be easily resolved by a woman independently, if addressed correctly. If mastitis becomes bacterial due to complications, all of the above-mentioned ways of solving this problem are supplemented with the use of antibiotics. This does not prevent a woman from breastfeeding.

White noise

A foetus while still being in the womb hears the woman's heartbeat, blood flow, digestion, bowel and breathing sounds. All of these create a pulsating hiss that calms down a foetus. When a baby is born, the surrounding sounds change and those that used to calm the baby are absent. Higher anxiety and stress are experienced by newborns that do not spend all their time on their mother's chest (they don't hear breathing, voice or heartbeat). Instinctively, newborns want to be permanently skin-to-skin. Silence and distance from their mother causes anxiety. To help a baby calm down, first of all hug it, breastfeed and produce calming sounds (*shhhhh* is the most popular). If none of these help then white noise could be used. Similar sounds are produced by wind, sea, a hear dryer, a vacuum cleaner, an extractor hood, a washing machine as well as meditation music. White noise is frequently applied during colic episodes by combining it with carrying the baby (movement – breathing – the smell of the mother) or breastfeeding.

Clicking sounds while breastfeeding

A clicking sound while breastfeeding causes concerns if it happens frequently, the nipples are damaged or painful, a baby does not urinate enough and the amount of stools passed is not sufficient, weight gain is too slow or even drops. These signs show that the latching is wrong, penetration is not deep enough and the tongue cannot work fully. A baby does not maintain a vacuum and the nipple drops out. In such cases, little blisters may be observed on the upper and lower lips of the baby. It is necessary to adjust the breastfeeding position, posture, and yawning. The ability of the mother to insert the breast and, if necessary, shape the nipple is also important.A biologically natural position, when the baby is on top of the breast, is very suitable in this case. In addition, it is also recommended to examine the mouth, tongue, palate, etc.

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10.
Instructional videos

10.1.
Exercise during pregnancy

1. Coxofemoral Joint Flexibility

2. Pelvic Swing Sitdown

3. Postural Control Exercise

4. Spine And Pelvic Dynamic Monitoring + Spine Stability

5. Pelvic Swing + Spine Stability + Motor Control

6. Breathing Work and Exercise

7. Lower Limbs Circulatory Exercises

8. Muscle Training: adductors with pilates ring and perineum contraction

9. Muscular Training: Bridge Exercise in inestability (Gluteus + Perineum)

10. Coxofemoral Joint Flexibility (Hip Extensors)

11. Coxofemoral Joint Flexibility (Gluteus and Piriformis)

12. Muscular Training: Bridge Exercise in inestability (Gluteus + Perineum)

13. Muscular Training: Bridge Exercise (Gluteus + Perineum)

14. Coxo Femoral and Sacroiliac Mobilization (ante and retroversion)

15. Coxo Femoral and Sacroiliac Mobilization (Internal rotation)

16. Coxo Femoral and Sacroiliac Mobilization (External rotation)

17. Low Back spine mobilization

18. Pelvic Swing and Sacroiliac Mobilization

19. Pelvic swing in lay down position

10.2.
Postpartum exercise/exercise after pregnancy

1. Bulgarian bag squat

2. Bulgarian bag lunges

3. Quadruped Basic motor control exercise

4. Kettelbell Deadlift

5. Strict shoulder press with Kettlebell in instability

6. Isotonic CORE contraction in instability, with the synergic unilateral upper limb contraction

7. Isotonic CORE contraction in instability, with the synergic doble upper limb contraction

8. Semi squat in inestability and synergic isotonic shoulder contraction in the upper limb

9. Semi squat in inestability and motor control in the upper limbs

10. Strict shoulder press with Kettlebell

11. Bent over row with Bulgarian bag for upper limbs

12. Pull over exercise in bridge lay down face up position, with inestability and synergic contraction

13. Upper limb unilateral push-ups exercise in bridge lay down face up position with inestability

14. Adductor exercise in bridge lay down face up position, with inestability and synergic contraction

15. Motor control in bridge lay down face up position, with inestability and synergic contraction

16. Bridge with a dorsal instability support: Face up instability and synergic contraction pull over

17. Bridge with a dorsal instability support: Face up instability (Fit-ball) and synergic contraction 3

18. Bridge with a dorsal instability support: Face up instability (Fit-ball) and synergic contraction 2

19. Bridge with a dorsal instability support: Face up instability (Fit-ball) and synergic contraction 1

20. Push up in lay down stability and synergic contraction of pelvic floor muscles and abductors muscles

21. Abduction in lay down stability and synergic contraction of pelvic floor and gluteus muscles

22. Motor control exercise between lower and limbs with the pelvic floor muscles and CORE contraction

23. Motor control exercise between lower and upper limbs with contraction of pelvic floor muscles

24. Abduction in lay down instability & synergic contraction of pelvic floor muscles & lower limbs

11.
Gallery of the Medical Simulation Centre of the Faculty of Health Sciences, University of Opole