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Effects of intense exercise on pregnancy - a review of the literature

Weronika Kmiotek, Radosław Oronowicz, Gabriela Różańska-Smuszkiewicz, Paweł Smuszkiewicz-Różański, Aleksandra Karuś, Grzegorz Jama, Paweł Staszczak, Barbara Jaworska, Dagmara Ragan

Weronika Kmiotek
Clinical Regional Hospital No. 2 named after St. Hedwig of Anjou in Rzeszów Lwowska Street
60, 35-301 Rzeszów
weronika55.12@o2.pl
ORCID: https://orcid.org/0009-0009-7699-0585

Radosław Oronowicz
Regional Hospital named after Dr. H. Jankowski, 16 Szpitalna Street, 37-200 Przeworsk
Radoslaw.oronowicz@gmail.com
ORCID: https://orcid.org/0009-0008-8784-3858

Gabriela Różańska-Smuszkiewicz
Clinical Regional Hospital No. 2 named after St. Hedwig of Anjou in Rzeszów Lwowska Street
60, 35-301 Rzeszów
gabrielarozanskaa@gmail.com
ORCID: https://orcid.org/0009-0005-3857-8830

Paweł Smuszkiewicz-Różański
Health Care Centre in Strzyżów, 700th Anniversary Street 1, 38-100 Strzyżów
pawels161@gmail.com
ORCID: https://orcid.org/0009-0009-3178-2029

Aleksandra Karuś
University of Rzeszów, St. Tadeusza Rejtana 16C, 35-310 Rzeszów
aleksandrakarus@gmail.com
https://orcid.org/0009-0007-9478-7674

Grzegorz Jama
Clinical Regional Hospital No. 2 named after St. Hedwig of Anjou in Rzeszów Lwowska Street
60, 35-301 Rzeszów
grzegorzjama@gmail.com
ORCID: https://orcid.org/0009-0004-8108-5428

Paweł Staszczak
SPZOZ University Clinical Hospital No. 1 named after Norbert Barlicki in Łódź.
dr. Stefana Kopcińskiego 22, 90-153 Łódź
pawel.staszczak@stud.umed.lodz.pl
ORCID: https://orcid.org/0009-0005-8324-9956

Barbara Jaworska
Independent Health Care Center of the Ministry of Interior and Administration in Lublin
Grenadierów Street 3, 20-331 Lublin
barbaraewajaworska@gmail.com
ORCID: https://orcid.org/0009-0000-9155-5084

Dagmara Ragan
T. Marciniak Lower Silesian Specialist Hospital - Emergency Medicine Centre
General August Emil Fieldorf Street 2, 54-049 Wrocław
dagmara.ragan@gmail.com
ORCID: https://orcid.org/0009-0002-2423-0698

Abstract
Introduction and Purpose: We are increasingly seeing new trends on social media regarding intense strength training in pregnant women. How much should women in a physiological pregnancy exercise? The aim of this piece is to trace the guidelines and set a healthy limit for such an important aspect during pregnancy.
Materials and methods: A literature search was conducted using the medical databases PubMed and Google Scholar. Articles were retrieved in English, employing the key words: "strength training", "activity during pregnancy", „intensive exercise" and „ physical activity guidelines" appropriate configurations.
Conclusions: The available guidelines and medical literature show that it is worthwhile to regularly practise sport both during and in preparation for pregnancy. In a healthy, physiological pregnancy, there is a wide range of activities to choose from, through which health benefits can be achieved, such as strengthening muscles, improving performance, alleviating pregnancy complaints (constipation, pain, nausea) and improving wellbeing, and much more. However, there are contraindications to certain exercises for specific conditions during pregnancy. You should consult your doctor on a case-by-case basis.
Key words: strength training during pregnancy, pregnancy course, intensive exercise, activity during pregnancy, exercise for women, physical activity guidelines, pregnancy.

Introduction

Intense strength training and other forms of strenuous physical activity are becoming increasingly popular among women, including those who are pregnant. The increased interest in an active lifestyle is leading many pregnant women to seek out safe forms of physical activity. Regular exercise is widely recognised as healthy, but during pregnancy both the intensity and type of exercise should be adapted to the evolving needs of the body. [1]. Pregnancy is a time when a woman's body undergoes a number of important changes to support the development of the baby and prepare for childbirth. Therefore, undertaking intense exercise should be well thought out and consulted with a doctor to avoid potential risks [1]. Strength exercises involve the use of resistance to strengthen and increase muscle mass. They are popularly chosen by pregnant women as a form of activity. These exercises can have many health benefits for the mother-to-be, but it is crucial that the intensity and type of exercise is tailored to her individual needs and health condition. Strength training exercises, when done correctly and with proper care, can be as safe as other types of physical activity for pregnant women[2]. This thesis posits that strength exercise is as safe and beneficial to the health of pregnant women as other forms of physical activity, provided that the intensity and type of exercise are appropriately adapted and that regular consultation with a health care practitioner is carried out. This thesis will be developed by analysing the changes in the pregnant woman's body, recommendations for physical activity, the benefits of regular exercise and a comparison of different forms of physical activity for pregnant women.

1. Changes in a woman's body during pregnancy

One of the changes that occur in a woman's body during pregnancy are those affecting the musculoskeletal system. These changes involve the musculoskeletal and osteoarticular systems and are necessary to provide space for the developing baby and to facilitate the birth process. These include an increase in muscle mass, softening and loosening of cartilage tissue, which in the pelvic and abdominal area allows the uterus, its ligaments and abdominal fascia to expand. In addition, there is stretching of the diaphragm and displacement of the pelvic bones in relation to each other[2]. Weight gain is one of the most visible effects of pregnancy and is a major cause of musculo-fascial changes. The recommended weight gain is usually between 10 and 12 kg. Exceeding 15 kg can make it more difficult to return to pre-pregnancy weight[3]. Much of this gain is due to water retention in the body, which is associated with increased activity of antidiuretic hormone, leading to sodium retention. As a result of these changes, the swellings characteristic of pregnancy often appear, usually moderate, which begin in the second half of pregnancy and affect both the upper and lower extremities. These swellings are most prominent towards the end of the day and may increase after physical activity or in high temperatures, but usually subside after a night's rest. Persistence of swelling for more than 24 hours may indicate possible complications[3]. Mechanical changes in a pregnant woman's body include an increase in weight in the pelvic region, leading to an anterior tilt of the pelvis, flexion contractures of the hip joints and hyperlordosis of the lumbar spine. These adaptations are designed to compensate for the shift in balance caused by uterine growth and increased breast size. As a result of this postural change, the centre of gravity shifts approximately 2 cm forward, which can lead to increased tension in the short muscles of the lumbosacral spine, resulting in pain.[4] Enlargement of the uterus leads to elevation of the diaphragm, which reduces the total lung capacity by approximately 5%. Relaxation of the intercostal attachments causes the thoracic circumference, transverse dimension and intercostal angle to increase. As a result of fluid accumulation, there is a softening in the

muscular system and the tendons and ligaments gradually become more elastic. In the sixth or seventh month of pregnancy, the rectus abdominis muscles lengthen by about 15 cm, which increases the risk of their separation from the midline. Approximately six to eight weeks before delivery, the uterus, together with the foetus, lowers and extends slightly out of the abdominal cavity, which reduces pressure on the diaphragm and increases respiratory capacity[4]. Changes in the osteoarticular system during pregnancy include loosening and softening of the intervertebral cartilages, the cartilage of the pubic conjunctiva and the sacroiliac joints. In addition, the intervertebral discs and intervertebral ligaments also relax. This can lead to poor posture, which in turn can result in chronic pain, mainly in the lumbosacral region of the spine.

2. Recommendations for physical activity in pregnant women

Before undertaking any form of physical activity during pregnancy, it is essential to consult your plans with the doctor in charge. This consultation allows an assessment of the woman's general health and the detection of any contraindications to exercise. Any complications or abnormalities during pregnancy, such as hypertension, gestational diabetes or the risk of premature birth, are absolute contraindications to increased physical exercise. In such cases, especially if symptoms such as cervical shortening, the occurrence of cramps or bleeding appear, it is recommended to stop all physical activity and to apply the so-called bed rigour [5]. Nevertheless, a pregnancy without complications provides an incentive to start gentle exercise, which is beneficial for both the mother and the developing baby. It is usually recommended to start physical activity from the 12th week of pregnancy, when the risk of miscarriage decreases significantly. However, it is important to remember that pregnancy is a dynamically changing condition, which requires regular confirmation from a doctor that there are no contraindications to continuing exercise. Regular follow-up visits allow monitoring of the condition and adjusting the intensity of exercise to the current needs and capabilities of the pregnant woman [5]. Women who were physically active before pregnancy should adjust the intensity and type of exercise, especially in the first trimester, due to the risk of miscarriage. It is recommended to avoid intense workouts and replace them with milder forms of activity that do not overtax the body. After the 12th week of pregnancy, it is usually safe to continue your favourite forms of activity, with appropriate caution. It is important that exercise is adapted to the changing body and growing abdomen, which may require modifying some exercises or avoiding them altogether [6]. For women who were not active prior to pregnancy, it is recommended to start activity between 12 and 35 weeks of pregnancy. It is advisable to start with gentle forms of activity such as walking, swimming, yoga or Pilates, which are safe and can be easily adapted to the woman's fitness level. Specially designed classes for pregnant women, led by certified trainers, are also suitable. These instructors are competent to adapt the exercises to the individual needs and abilities of each participant [6]. Participation in specialised classes for pregnant women requires medical approval, which is crucial for the safety of both mother and baby. Regular exercise during this period can provide numerous health benefits, including improved fitness, reduced risk of pregnancy complications, improved wellbeing and preparation for childbirth. Research confirms that physical activity during pregnancy can reduce the duration of labour, reduce the need for medical interventions and speed up recovery after delivery [7]. When exercising, it is crucial for the woman to be attentive to the signals sent by her body and to adapt the intensity and type of activity to her current capabilities. If worrying symptoms such as pain, dizziness, shortness of breath or bleeding occur, it is essential to stop exercising immediately and consult a doctor. Safe and regular exercise during pregnancy can benefit the health of both mother and baby, improving quality of life and preparing the body for childbirth and the postpartum period **[7].** Working with a doctor and a fitness instructor allows for a tailored exercise plan that is safe and effective. Properly selected physical activity during pregnancy is a key aspect of a healthy lifestyle and can have long-term benefits for both mother and baby. Regular exercise allows a woman to better cope with the physical and emotional challenges of pregnancy, which benefits her wellbeing and overall health.

3. Benefits of physical activity during pregnancy

The promotion of physical activity during pregnancy is primarily aimed at preparing women for the considerable effort involved in giving birth. It is not about achieving an athletic physique, which is inadvisable and dangerous for the foetus, but about staying fit and healthy. Regular exercise helps to maintain physical fitness, which translates into an easier and less painful natural childbirth, which is the safest form of pregnancy termination for both mother and baby [8]. A study by the University of London found that women who exercised regularly during pregnancy had a shorter duration of labour by around 25% compared to those who had a sedentary lifestyle [9]. The improved cardiorespiratory fitness resulting from regular exercise contributes to better oxygenation of the body, which is crucial during labour. The increase in muscle strength and joint mobility gained from regular exercise helps to make childbirth more efficient and less painful [9]. Regular physical activity during pregnancy can also alleviate typical pregnancy complaints such as back pain, swelling of the limbs, constipation or insomnia. Exercise promotes blood circulation, which prevents fluid retention in the body and reduces the risk of swelling. A study published in the Journal of Prenatal Medicine found that women who engaged in regular physical activity were less likely to experience back pain and had better sleep quality [10]. Exercise during pregnancy may also counteract the onset of prenatal depression. A University of Ottawa study found that regular physical activity reduces the risk of prenatal depression by 38%. Exercise, especially those that focus on breathing and relaxation techniques such as yoga or Pilates, can significantly improve mood and reduce stress [10]. Another benefit of physical activity during pregnancy is to better prepare the body for the postnatal period. Regular exercise helps the body recover more quickly after childbirth by increasing muscle strength and flexibility, which is particularly important in terms of the body's recovery after such an intense effort as childbirth. A study published in the Journal of Reproductive Health found that women who were physically active during pregnancy returned to their pre-pregnancy weight more quickly and had better postpartum fitness [11]. Regular exercise can also affect the health of the baby. A study by the University of Alberta found that babies born to women who were physically active during pregnancy had better health test scores and higher Apgar scores. In addition, maternal physical activity may influence the healthy cardiovascular development of the child and reduce the risk of obesity in the future [12]. Furthermore, a study by the University of Kansas found that physical activity during pregnancy can improve cognitive function in newborns. The results of this study suggest that children of mothers who were physically active had better scores on tests of cognitive development in the first months of life [13]. In conclusion, regular physical activity during pregnancy has numerous health benefits for both mother and child. It improves physical fitness, alleviates pregnancy discomfort, reduces the risk of complications and prenatal depression, and prepares the body for childbirth and a faster recovery after delivery. However, it is crucial that any form of activity is tailored to the individual needs and capabilities of the pregnant woman and is carried out under the supervision of a specialist and in consultation with a doctor.

4. Strength training for women

Strength exercises, also known as resistance training, are a form of physical activity whose main aim is to strengthen muscles and increase their endurance by working against various forms of resistance. These exercises can be performed using weights, exercise machines, resistance bands or even your own body weight. Regularly incorporating strength training into your fitness routine helps to improve your overall physique, increase your metabolism and improve bone and joint health. For pregnant women, strength training, when modified appropriately and with caution, can offer benefits such as better support for growing body weight, helping to maintain healthy weight gain and overall wellbeing. Strength exercises are a key part of fitness programmes for many women, including those who are pregnant. They use resistance to strengthen muscles and increase muscle mass. While this type of activity can provide many health benefits for mothers-to-be, it requires a specific approach and adaptation to the changing body and needs of the pregnant woman [14]. Essentially, the benefits of strength training include improving overall fitness, supporting increasing body weight and helping to maintain healthy weight gain, which is important for both mother and baby. Research by the American College of Obstetricians and Gynecologists indicates that regular physical activity, including strength training, can help prevent gestational diabetes, reduce stress and improve sleep quality [15]. Regular strength exercises can significantly help pregnant women to cope with the additional stresses that pregnancy brings. They strengthen the abdominal and back muscles, which is particularly beneficial as many women experience lower back pain as a result of a growing abdomen. Changes in posture, which are the natural result of a shift in the centre of gravity, can be mitigated by strengthening the muscles responsible for maintaining correct posture. In addition, a skilfully planned strength training programme can contribute to an easier birth by increasing the endurance and muscle strength needed during the birthing action. A study published in the Journal of Physical Activity and Health found that women who continued moderate strength exercise during pregnancy had shorter births and fewer complications than those who were less active [16]. Strengthening the pelvic muscles is particularly important as they can play a key role in facilitating labour. By improving blood circulation in the pelvic area, these exercises can also shorten the duration of labour and reduce the risk of complications. Therefore, it is advisable that strength training exercises are carried out under the guidance of a specialist who will help to tailor the exercises to the individual woman's needs and abilities, always with maximum caution. A study conducted by the University of Western Ontario found that pregnant women participating in strength exercise programmes had better health outcomes for both themselves and their babies, compared to those who avoided such activity [17].

However, strength exercise is also associated with some risks, particularly during pregnancy. Increased production of relaxin, a hormone that makes joints and ligaments more flexible to facilitate childbirth, can also increase the risk of injury during exercise. Therefore, it is important to avoid overexertion and focus on exercise technique. Additionally, intense strength training can lead to hypertension, which is undesirable in pregnancy and can lead to complications such as pre-eclampsia. A study by the Norwegian School of Sport Sciences found that intense exercise can increase the risk of hypertension in pregnancy, highlighting the need for moderation and consultation with a doctor [18]. Also, overheating the body during heavy workouts is dangerous for both the mother and the developing foetus. High body temperature can negatively affect the development of the baby, so it is recommended that exercise is performed in a cooler environment with adequate ventilation and access to fluids. A study published in Obstetrics & Gynecology found that overheating the body during the first trimester of pregnancy can increase the risk of birth defects, further emphasising the importance of controlling body temperature during exercise [15]. Before embarking on any

strength exercise programme, it is essential to consult with your pregnancy doctor to ensure that there are no health contraindications. Adapting exercise to the trimester of pregnancy, current health status and individual capabilities is crucial for safety. It is also recommended that exercise is carried out under the supervision of an experienced instructor to ensure not only safety, but also the effectiveness of the workout. A study conducted by the University of North Carolina confirmed that pregnant women exercising under the supervision of professionals had a lower risk of injury and better health outcomes than those who exercised alone without adequate support [19]. Weight-bearing exercise can be beneficial to pregnant women if performed with care and appropriate precautions. It is important that women are aware of both the benefits and potential risks of this type of activity. With proper planning and supervision, strength training can support the health of the mother and baby, preparing them for a healthy and safe delivery. When combined with an appropriate diet and regular medical consultations, physical activity in the form of strength training can significantly improve the quality of life of the mother-to-be and contribute to favourable birth outcomes [20]. Strength training exercises for pregnant women are specifically tailored to support the health of mother and baby, while minimising the risk of injury. It is crucial that strength training is well planned, regular and conducted under the supervision of a qualified instructor, especially during pregnancy. Before starting any training programme, it is essential to obtain approval from the doctor in charge of the pregnancy. The doctor will assess the health of the mother and the pregnancy and rule out any contraindications to strength training. This will allow for safe and effective exercise that is tailored to the individual needs and abilities of the pregnant woman [21]. Every workout should begin with a warm-up to prepare the body for exercise. The warm-up should last between 10 and 15 minutes and include low-intensity exercises such as marching in place, shoulder and hip circles and gentle stretching. The warm-up aims to increase blood flow to the muscles, improve flexibility and reduce the risk of injury [22]. After the warm-up, you can move on to the actual strength training, which should focus on strengthening large muscle groups such as leg, back, chest and shoulder muscles. It is important to use moderate weights and perform the exercises in a controlled manner, with an emphasis on correct technique. Exercises may include squats, deadlifts, bench presses and bodyweight exercises such as push-ups and planks [22]. Strength training for pregnant women should be tailored to the trimester of pregnancy. In the first trimester, most exercises can be performed without much restriction, but the intensity should be moderate and back exercises limited to avoid excessive cardiovascular loading. In the second trimester, when the abdomen begins to enlarge, it is important to avoid exercises that may put pressure on the abdomen or cause discomfort. Standing, sitting or side exercises are more appropriate [23]. In the third trimester, due to significant weight gain and changes in balance, exercise should be further adapted. It is advisable to avoid exercises that require intense jumping or rapid movements. The focus should be on exercises that strengthen the pelvic muscles in preparation for childbirth. Gentle stretching and breathing exercises can help manage the pain and stress of pregnancy and childbirth [23]. The final phase of the workout, the cool-down, should last about 10 minutes and include gentle stretching and breathing exercises to help relax the body and mind. Regularity is key to gaining the benefits of strength training, so it is recommended to exercise at least two to three times a week. [23] When strength training during pregnancy, it is crucial to adapt to the signals sent by your own body. Every woman reacts differently and methods that are effective for one may not be suitable for another. If pain, dizziness or any discomfort occurs during exercise, it is important to stop the activity immediately and seek medical advice. It is also worth remembering that the aim of strength training in pregnancy is not to achieve maximum physical fitness, but to maintain health and prepare the body for childbirth and subsequent recovery [24]. Strength training for pregnant women, when carried

out with care and under the supervision of a specialist, is a valuable part of a health programme. By adjusting exercise appropriately, it is possible to reduce the risk of gestational diabetes, which is crucial for the health of both mother and baby. In addition, regular strength training can significantly improve sleep quality, which is important for the overall wellbeing and mental health of the mother-to-be. Exercise also helps to reduce back pain, which is often a problem during pregnancy, and can facilitate childbirth by strengthening the relevant muscle groups. Thus, with the right support and preparation, strength training exercises can be an important and beneficial part of a healthy lifestyle during pregnancy.

5. Other forms of physical activity for pregnant women

Other forms of physical activity for pregnant women are just as important as strength training, as they help maintain overall fitness, improve mood and prepare the body for childbirth. Recommended forms of activity include walking, swimming, yoga, Pilates, stationary cycling and water exercise. Each of these forms of activity has its own unique benefits that can contribute significantly to the health of the mother and the developing baby. Walking is one of the safest and most accessible forms of physical activity for pregnant women. Regular walking helps maintain a healthy body weight, improves blood circulation and supports heart health. A study by the Harvard T.H. Chan School of Public Health found that daily walking can reduce the risk of pregnancy complications such as hypertension and gestational diabetes. In addition, walking outdoors can improve mood and reduce stress, which is particularly important during pregnancy [25]. Swimming and exercising in water are ideal for pregnant women, as water relieves pressure on the joints and spine, which helps to reduce pain and discomfort. The water also provides gentle resistance that strengthens muscles without putting too much strain on the body. Research published in the International Journal of Aquatic Research and Education shows that pregnant women who swim regularly have a lower risk of swelling and back pain. Exercising in water can also improve flexibility and muscle strength, which is beneficial in preparing for childbirth. Swimming is particularly recommended as it provides a holistic workout for the whole body, minimising the risk of injury, which is important in advanced pregnancy [26]. Yoga for pregnant women focuses on gentle postures, breathing techniques and relaxation. Practising yoga can help relieve stress, improve flexibility and strengthen muscles, particularly in the pelvic region. Research published in the Journal of Obstetric, Gynecologic & Neonatal Nursing shows that prenatal yoga can reduce symptoms of depression and anxiety and improve overall wellbeing. Regular yoga sessions also help prepare the body for childbirth by teaching breathing techniques that can be useful during the birthing process. Yoga also helps to maintain mental balance, which is crucial during a period full of emotion and physical change [27]. Pilates for pregnant women is similar to yoga, but focuses more on strengthening the deep muscles that support the spine and pelvis. Pilates exercises improve balance, coordination and flexibility, which can reduce the risk of injury. Research by the University of Melbourne has shown that Pilates can help reduce back pain and improve posture in pregnant women. The exercises are also helpful in maintaining abdominal muscle strength, which is important in the later stages of pregnancy and during labour. Pilates can also support the ability to relax and control breathing, which is invaluable during labour [25]. Stationary cycling is another safe form of physical activity for pregnant women. Exercising on a stationary bike helps to improve cardiovascular fitness, maintain a healthy body weight and strengthen leg muscles. A study published in the British Journal of Sports Medicine found that pregnant women who cycled regularly on a stationary bike had better health outcomes and fewer pregnancy complications. Stationary cycling is

particularly recommended as it minimises the risk of falls and injury, which is important in pregnancy. Regular cycling exercise also helps to maintain physical activity, which contributes to better wellbeing and heart health [26]. Nordic Walking, or walking with poles, is a form of activity that engages more muscles than regular walking. It helps strengthen the upper body and improves cardiovascular fitness. Research in Finland has shown that Nordic Walking can significantly improve overall fitness and well-being in pregnant women. This form of activity is also beneficial for improving balance and coordination, which is important as pregnancy progresses. Nordic Walking is ideal for women who want to maintain a high level of physical activity without putting undue strain on their joints and spine. Regular walking with poles can also support weight control and improve mood [24. Any of these forms of physical activity can have health benefits for pregnant women, provided they are done in moderation and under the supervision of a specialist. It is important for mothers-to-be to choose forms of exercise that are comfortable and safe for them, while consulting with their pregnancy doctor before starting any new physical activity. Regular exercise can significantly improve the health of mother and baby, preparing them for a healthy and safe delivery. The benefits of physical activity include not only improved fitness, but also stress reduction, improved sleep and overall wellbeing, which is crucial during this unique time of life.

Conclusions

Research shows that regular exercise, including strength training, contributes to a shorter duration of labour, a reduced risk of pregnancy complications and a faster recovery after childbirth in women who practice it. In addition, regular physical activity can help alleviate common pregnancy discomforts such as swelling of the limbs, constipation or sleep problems, thereby improving sleep quality and overall well-being. However, moderation is important in everything. You should always consult your doctor about your condition and not exercise beyond your strength in order to feel the benefits of regular physical activity.

Summary

Intense strength training and other forms of strenuous physical activity are becoming increasingly popular among women, including those who are pregnant. Regular physical activity is recognised as beneficial to health, but during pregnancy the intensity and type of activity must be adapted to the changing needs of the body. Pregnancy is a time when a woman's body undergoes a number of important changes to support the development of the baby and prepare for birth. Therefore, undertaking intensive exercise should be well thought out and consulted with a doctor to avoid potential risks. The thesis of the present study was that strength training is as safe and beneficial to the health of pregnant women as other forms of physical activity, provided that the intensity and type of exercise are appropriately adapted and that the patient regularly consults with a general practitioner. Based on the information and research reviewed, this thesis was confirmed. Strength exercises, if properly adapted to the changing needs of a pregnant woman's body and conducted under the supervision of a specialist, can bring numerous health benefits. Such exercises help to maintain a healthy body weight, improve cardiorespiratory fitness, strengthen muscles and increase joint flexibility. Strengthening abdominal and back muscles can also alleviate painful conditions, such as back pain, that often occur during pregnancy. A comparison of different forms of physical activity, such as walking, swimming, yoga, Pilates or stationary cycling, shows that strength training

can be just as safe and beneficial, as long as it is done with the right intensity and technique. Each of these activities has its own unique benefits, but strength training offers the added support of muscle strengthening, which is particularly important in preparing for childbirth and coping with the additional stresses of pregnancy. In conclusion, the thesis that strength training is as safe and beneficial to the health of pregnant women as other forms of physical activity is confirmed. However, it is important that any activity is tailored to the individual needs and capabilities of the pregnant woman and that it is carried out under the supervision of a specialist and after prior consultation with a doctor. Regular exercise during pregnancy has numerous health benefits, supporting the healthy development of the baby and preparing the mother's body for childbirth.

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Author's contribution
All authors contributed to the article.
Conceptualization: Kmiotek W, Oronowicz R, Staszczak P, Jaworska B, Ragan D;
Methodology: Kmiotek W, Różańska-Smuszkiewicz G, Smuszkiewicz-Różański P;
Software: Kmiotek W, Karuś A, Jama G, Staszczak P, Jaworska B, Ragan D;
Formal analysis: Kmiotek W, Różańska-Smuszkiewicz G;
Investigation: Kmiotek W, Smuszkiewicz-Różański P, Karuś A;
Resources: Karuś A, Jama G, Staszczak P;
Data curation: Kmiotek W, Oronowicz R, Jaworska B;
Writing - rough preparation: Kmiotek W, Oronowicz R, Karuś A;
Writing - review and editing: Kmiotek W, Oronowicz R, Różańska-Smuszkiewicz G, Smuszkiewicz-Różański P, Karuś A, Jama G, Staszczak P, Jaworska B, Ragan D;
Visualization: Kmiotek W, Oronowicz R, Różańska-Smuszkiewicz G, Smuszkiewicz-Różański P, Karuś A, Jama G;
Supervision: Kmiotek W, Oronowicz R, Jama G, Jaworska B, Ragan D;
Project administration: Kmiotek W, Oronowicz R,, Ragan D;
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References:

[1] Gruszczyńska M., Bąk-Sosnowska M., Plinta R.: Health-related behaviors as an essential part of human life activities. Attitude of Poles towards their own health, Hygeia Public Health, 2015, 50(4):558-556, http://www.h-ph.pl/pdf/hyg-2015/hyg-2015-4-558.pdf.

[2]. Fraś M., Gniadek A., Poznańska-Skrzypiec J., Kadłubowska M.: Lifestyles of pregnant women. Hygeia Public Health, 2012, 47(4): 412–417, http://www.h-ph.pl/pdf/hyg-2012/hyg-2012-4-412.pdf.

[3] Godala M., Pietrzak K., Gawron-Skarbek A. i wsp.: Health behaviours of pregnant residents of Łódź. Part II. Physical activity and stimulant use Problemy Higieny i Epidemiologii, 2012, 93(1): 43–47, http://www.phie.pl/pdf/phe-2012/phe-2012-1-043.pdf.

[4] Starczyńska M., Karwacińska J., Stepanek-Finda B., Kiebzak W.: Historical background of physiotherapy. Studia Medyczne, 2011, 21, 71-77, https://studiamedyczne.ujk.edu.pl/doc/SM_tom_21/Historyczne%20podstawy%20fizjoterapii.pdf.

[5] Makowiec-Dąbrowska T.: Effects of physical activity at work and in daily life on the cardiovascular system. Forum Medycyny Rodzinnej, 2012, 6, 130–138, https://core.ac.uk/reader/268455170.

[6] Urtnowska K., Bułatowicz I., Radzimińska A., Woźniak M., Wiśniewski J., Zukow W.: Physiological changes in the locomotor system of a pregnant and related lumbar-sacral pain examination of the degree of feeling back pain during properly running pregnancy. Journal of Education, Health and Sport, 2015, 5(7), https://www.researchgate.net/publication/308951949_Physiological_changes_in_the_locomotor_system_of_a_pregnant_and_related_lumbar-sacral_pain-examination_of_the_degree_of_feeling_back_pain_during_properly_running_pregnancy.

[7] Fuerst N., Adamczewska K.: Physical Activity during Pregnancy, Prace Naukowe Akademii im. Jana Długosza w Częstochowie Kultura Fizyczna, 2017, 16(3),139–151. DOI http://dx.doi.org/10.16926/kf.2017.16.31

[8] Sass, A., and M. Mączka. “Physical Activity of Pregnant Women in the Light of Scientific Research - a Review of the Literature”. Journal of Education, Health and Sport, vol. 7, no. 8, Aug. 2017, pp. 550-65, https://apcz.umk.pl/JEHS/article/view/4776.

[9] Watkins VY, O'Donnell CM, Perez M, Zhao P, England S, Carter EB, Kelly JC, Frolova A, Raghuraman N. The impact of physical activity during pregnancy on labor and delivery. Am J Obstet Gynecol. 2021 Oct;225(4):437.e1-437.e8. doi: 10.1016/j.ajog.2021.05.036. Epub 2021 Jun 1. PMID: 34081895; PMCID: PMC10564562.

[10] Sánchez-Polán M, Nagpal TS, Zhang D, Silva-Jose C, Montejo R, Barakat R. The Influence of Physical Activity during Pregnancy on Maternal Pain and Discomfort: A Meta-Analysis. J Pers Med. 2023 Dec 28;14(1):44. doi: 10.3390/jpm14010044. PMID: 38248744; PMCID: PMC10817295.

[11] ACOG Committee Opinion No. 804: Physical Activity and Exercise During Pregnancy and the Postpartum Period: Correction. Obstetrics & Gynecology 138(4):p 683, October 2021. | DOI: 10.1097/AOG.0000000000004558

[12] Menke BR, Duchette C, Tinius RA, Wilson AQ, Altizer EA, Maples JM. Physical Activity during Pregnancy and Newborn Body Composition: A Systematic Review. Int J Environ Res Public Health. 2022 Jun 10;19(12):7127. doi: 10.3390/ijerph19127127. PMID: 35742376; PMCID: PMC9222359.

[13] Guinhouya, Benjamin & Duclos, Martine & Enea, Carina & Storme, Laurent. (2022). Beneficial Effects of Maternal Physical Activity during Pregnancy on Fetal, Newborn, and Child Health: Guidelines for Interventions during the Perinatal Period from the French National College of Midwives. Journal of Midwifery & Women's Health. 67. 10.1111/jmwh.13424.

[14] Connolly CP, Conger SA, Montoye AHK, Marshall MR, Schlaff RA, Badon SE, Pivarnik JM. Walking for health during pregnancy: A literature review and considerations for future research. J Sport Health Sci. 2019 Sep;8(5):401-411. doi: 10.1016/j.jshs.2018.11.004. Epub 2018 Nov 17. PMID: 31534815; PMCID: PMC6742678.

[15] Lin IH, Huang CY, Chou SH, Shih CL. Efficacy of Prenatal Yoga in the Treatment of Depression and Anxiety during Pregnancy: A Systematic Review and Meta-Analysis. Int J Environ Res Public Health. 2022 Apr 28;19(9):5368. doi: 10.3390/ijerph19095368. PMID: 35564762; PMCID: PMC9105819.

[16] Salas LA, Baker ER, Nieuwenhuijsen MJ, Marsit CJ, Christensen BC, Karagas MR. Maternal swimming pool exposure during pregnancy in relation to birth outcomes and cord blood DNA methylation among private well users. Environ Int. 2019 Feb;123:459-466. doi: 10.1016/j.envint.2018.12.017. Epub 2019 Jan 5. PMID: 30622071; PMCID: PMC6599635.

[17] Davenport MH, Ruchat SM, Sobierajski F, Poitras VJ, Gray CE, Yoo C, Skow RJ, Jaramillo Garcia A, Barrowman N, Meah VL, Nagpal TS, Riske L, James M, Nuspl M, Weeks A, Marchand AA, Slater LG, Adamo KB, Davies GA, Barakat R, Mottola MF. Impact of prenatal exercise on maternal harms, labour and delivery outcomes: a systematic review and meta-analysis. Br J Sports Med. 2019 Jan;53(2):99-107. doi: 10.1136/bjsports-2018-099821. Epub 2018 Oct 18. PMID: 30337349.

[18] Zhu, Z., Xie, H., Liu, S. et al. Effects of physical exercise on blood pressure during pregnancy. BMC Public Health 22, 1733 (2022). https://doi.org/10.1186/s12889-022-14074-z

[19] Małek, R., Warzyszak, P., Milczek, M., Żołyniak, W., Tomasik, M., Hawranik, I., Niski, S., Żaba, Z., Lisowska, A. and Skrzypek, M. 2023. Impact of physical activity in pregnant women on maternal health. Journal of Education, Health and Sport. 13, 1 (Jan. 2023), 319–325. DOI:https://doi.org/10.12775/JEHS.2023.13.01.047.

[20] Nascimento SL, Surita FG, Cecatti JG. Physical exercise during pregnancy: a systematic review. Curr Opin Obstet Gynecol. 2012 Dec;24(6):387-94. doi: 10.1097/GCO.0b013e328359f131. PMID: 23014142.

[21] Opala-Berdzik A., Bacik B., Kurkowska M.: Biomechanical changes in pregnant women Fizjoterapia, 2009, 7, 51–55, http://polona.pl/item/34154762

[22] Garshasbi A, Faghih Zadeh S. The effect of exercise on the intensity of low back pain in pregnant women. Int J Gynaecol Obstet. 2005 Mar;88(3):271-5. doi: 10.1016/j.ijgo.2004.12.001. Epub 2005 Jan 16. PMID: 15733880.

[23] Korżyńska-Piętas M, Dziaduszek K, Bolek B, Iwanowicz-Palus GJ, Bień A. Influence of physical activity on the proper course of pregnancy, delivery and postpartum period. Med Og Nauk Zdr. 2018;24(3):162-5. https://doi.org/10.26444/monz/94624

[24] Ćwiek D, Szczęsna M, Malinowski W et al.: Analysis of physical activity undertaken by women during pregnancy. Perinatol Neonatol Ginekol 2012; 5(1): 51-54, https://ppm.pum.edu.pl/info/article/PUM0b907d257d3d47b79086270032b0e962/

[25] Mączka, M. and Sass, A. (2017) “Pilates and mobilization methods in therapy for low back pain among pregnant women”, Journal of Education, Health and Sport, 7(8), pp. 473–488. Available at: https://apcz.umk.pl/JEHS/article/view/4760 (Accessed: 21 July 2024).

[26] Watson WJ, Katz VL, Hackney AC, Gall MM, McMurray RG. Fetal responses to maximal swimming and cycling exercise during pregnancy. Obstet Gynecol. 1991 Mar;77(3):382-6. PMID: 1992404.

[27] Carlsen, Oda C L et al. “Physical activity in pregnancy: a Norwegian-Swedish mother-child birth cohort study.” AJOG global reports vol. 1,1 100002. 27 Jan. 2021, doi:10.1016/j.xagr.2020.100002.