SMOLIŃSKA, Karolina, GAJDA-BATHELT, Monika, DĄBEK, Monika, ANTCZAK, Tomasz, KULCZYCKA, Julia, PERLICKA, Zuzanna, POPOW, Weronika, CIOŁKOSZ, Michał, JANIA, Katarzyna and SADKOWSKA, Paulina. Movement-Based Interventions in Pregnancy: The Effects of Exercise on Labour, Maternal and Foetal Outcomes. Quality in Sport. 2025;43:62341. eISSN 2450-3118.
https://doi.org/10.12775/QS.2025.43.62341
https://apcz.umk.pl/QS/article/view/62341

The journal has been awarded 20 points in the parametric evaluation by the Ministry of Higher Education and Science of Poland. This is according to the Annex to the announcement of the Minister of Higher Education and Science dated 05.01.2024, No. 32553. The journal has a Unique Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 l.p. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).
The authors declare that there is no conflict of interest regarding the publication of this paper.
Received: 15.06.2025. Revised: 05.07.2025. Accepted: 05.07.2025. Published: 09.07.2025.

Movement-Based Interventions in Pregnancy: The Effects of Exercise on Labour, Maternal and Foetal Outcomes

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Abstract

Physical activity during pregnancy is established to be a safe and effective strategy to improve maternal and neonatal health. The objective of this article was to investigate the effects of physical activity on the mother, foetus and delivery outcomes. We reviewed literature on physiological adaptations to exercise during pregnancy, maternal and foetal outcomes, and the influence of physical activity on labour duration, mode of delivery, oxytocin administration, perineal trauma, and other perinatal parameters. The findings suggest that regular, moderate physical activity may reduce the risk of gestational complications such as diabetes and hypertension, shorten labour duration, decrease the risk of operative delivery, reduce the need for analgesia and have a beneficial effect on the foetus. Further randomized controlled trials are required to confirm the association between physical activity and pregnancy outcomes, possibly including the differentiation between exercises of various intensity, as well as to provide standardized recommendations.

Keywords (EN): physical activity, pregnancy, childbirth, maternal health, labour duration, foetal health

Introduction

Physical activity during pregnancy has been a topic of both concern and interest, and while it is known to reduce the risk of morbidity and mortality among the general population, its effect on pregnancy has been raising a lot of questions. Traditional approach has been to advise physically active pregnant women to reduce their level of exertion and nonexercising pregnant women to abstain from initiating arduous activities (Davies et al. 2003). Those recommendations were based on concerns that exercise may affect pregnancy outcomes due to

increased core body temperature during embryogenesis, which could elevate the risk of congenital anomalies. There were also concerns that during exercise the oxygenated blood and energy substrates are shifted to maternal skeletal muscles away from the developing foetus, disturbing its growth (Davies et al. 2003).While previously restricted by cautious guidelines, recent studies have highlighted safety and numerous benefits of physical activity for both the mother and foetus in uncomplicated pregnancies. The American College of Obstetricians and Gynecologists recommends that pregnant women with uncomplicated pregnancies engage in ≥30 minutes of moderate physical activity on most (if not all) days of the week to improve their health and wellbeing (Melzer et al. 2010).

Healthy pregnancy is known to cause significant cardiovascular, respiratory and metabolic adaptations. Some of the changes in haemodynamic function are increase in cardiac output up to 50% by late pregnancy or decrease of systemic vascular resistance and diastolic blood pressure (Carpenter et al. 2015). It is speculated that the already significant changes in a pregnant woman's physiology mask the influence of prenatal exercise, however it appears to result in an enhanced ventricular ejection performance or decreased diastolic blood pressure (Carpenter et al. 2015). Due to gestational weight gain the metabolism at rest is increased, resulting in higher energy expenditure, hence in order to perform a given amount of exercise a higher cardiorespiratory effort is required (Lotgering et al. 1985). Additionally, during pregnancy, the increased weight gain, ligament laxity and weakened abdominal muscles cause the body's centre of gravity to shift anteriorly, further resulting in anterior pelvis tilting and increasing thoracic and lumbar curves (Savla et al. 2024).

Despite numerous changes induced by pregnancy, pregnant women benefit from regular physical activity the same way as the general population and are recommended to include exercising in their daily routine. Furthermore, there are studies stating that physical activity during pregnancy can lead to shorter labour, reduce the need for instrumental or caesarean delivery and reduce the need for analgesia. However, some authors suggest that physical fitness does not influence duration of labour (Ferreira et al. 2019, Davenport et al. 2018) or use of analgesia during delivery (Zhang et al. 2023). This article analyses the current state of research and evidence on how prenatal physical activity influences the labour process, birth outcomes, and maternal-foetal well-being.

Impact of Physical Activity on Maternal Health

Regular physical activity affects maternal outcomes by reducing the risk of gestational diabetes, hypertension, and excessive weight gain. Additionally, it is thought to have a positive effect on mood stability, reduced musculoskeletal discomfort, and decreased incidence of lower limb oedema and muscle cramps (Melzer et al. 2010). These benefits may be a result of improved immune modulation and metabolic profile associated with maintaining an exercise routine. Numerous studies have shown that physical activity, such as pilates, can cause significant improvements in maternal blood pressure, hand grip strength, hamstring flexibility and spinal curvature (Rodríguez-Díaz et al. 2017). Lower exercise frequency and extended sedentary time before pregnancy are linked to increased risk of prolonged nausea and vomiting during pregnancy (Zhang et al. 2020). Connolly et al. (2017) as well as Owe et al. (2019) have found that lack of leisure-time physical activity before or during pregnancy was associated with an increased odds of hyperemesis gravidarum.

The cervix and vagina expand due to foetal compression during vaginal delivery, and the muscles around the vagina and fascia stretch or break, resulting in varying degrees of damage to the pelvic floor (Wang et al. 2014). Those changes predispose urinary incontinence whereas physical activity, specifically pelvic floor muscle training, reduces the rate of urinary incontinence in nulliparous pregnant women (Dias et al. 2011). Pelvic floor muscle training during pregnancy is beneficial to woman's body and mind. It can enhance regional perfusion, increase pelvic floor muscle tension, and reduce venous compression caused by the pregnant uterus and pelvic fat deposition. It can also promote psychological well-being, facilitate vaginal delivery, diminish the need for caesarean section, and decrease the incidence of dystocia. Finally, it can help to prevent stress urinary incontinence, uterine prolapse and postpartum sexual dysfunction (Wang et al. 2014). Furthermore, pelvic floor muscle exercises may reduce the duration of second stage labour and decrease the incidence of severe perineal lacerations (Sobhgol et al. 2019). Exercise programs integrating pelvic strengthening can thus have direct benefits not only on birth mechanics but also on maternal health and postpartum recovery.

Influence of Physical Activity on Labour

Physical fitness induces several metabolic and hormonal changes that may affect contractility and endurance of the uterus, which can influence the course of labour (Ferreira et al. 2019). Multiple studies report a significant reduction in labour duration among physically active pregnant women. Barakat et al. (2018) found that exercise shortened both the first stage and total duration of labour without posing any risk for mother and foetus during pregnancy. The same result was found in a study by Clapp et al. (1990) which showed that labour began significantly earlier in the exercise group (277 ± 6 vs 282 ± 6 days). The women who continued to exercise had a lower incidence of abdominal (6% vs 30%) and vaginal (6% vs 20%) operative delivery, and active labour was shorter (264 ± 149 vs 382 ± 275 min) in those who delivered vaginally. Haakstad and Bø (2011) demonstrated that participants in the exercise group had a significantly shorter duration of active labour than those in the control group, with an average difference of 3.1 hours. Similarly, Melzer et al. (2010) found that the second stage of labour lasted 88 minutes in physically active women, compared to 146 minutes in those who were inactive. Perales et al. (2016) found significant differences in the duration of the first stage of labour between the exercise group and the control group (389.6 minutes vs 515.72 minutes), however the second and third stages of labour did not differ between the study groups. Dias et al. (2011) have found no difference between the training group and control group regarding labour.

Barakat et al. (2012) also showed that the percentage of caesarean and instrumental deliveries in the exercise group were lower than in the control group (15.9%; 11.6% vs 23%; 19.1%). Haakstad and Bø (2011) revealed that the rate of vaginal delivery was higher among exercising women than in the control group (85.7% vs 62.3%). Davenport et al. (2019) found that prenatal exercise reduced the odds of instrumental delivery in the general obstetrical population, however there was no relationship between prenatal exercise and preterm/prelabour rupture of membranes, caesarean section, induction of labour, length of labour, vaginal tears, fatigue, injury, musculoskeletal trauma, maternal harms and diastasis recti. The study of Ferreira et al. (2019) showed that the intervention group (exercising participants) had a lower rate of induced births in comparison with the control group. Those findings were in compliance with another study by Pereira et al. (2022), which showed that the exercise group had a lower rate of labour induction and fewer operative vaginal deliveries than the control group (17.5% vs 33.3%; 20.6% vs 38.1%). Zhang et al. (2023) conducted a systematic review that included 60

randomized controlled trials, providing strong evidence that prenatal physical activity can reduce the risk of caesarean delivery by 13% and instrumental delivery by 16%. Furthermore, women with higher fitness levels required less oxytocin for labour induction or augmentation (Baena-García et al. 2021).

M-L. Gau et al. (2011) in their study revealed that birth ball exercises resulted in statistically significant improvements in childbirth self-efficacy and pain. Mothers in the exercising group had shorter first-stage labour duration, required less epidural analgesia and fewer caesarean deliveries than the control group. Bolanthakodi et al. (2018) showed that the requirement of induction of labour and analgesics was significantly lower in the group practicing yoga. The participants who practiced yoga had significantly more vaginal deliveries, less caesarean sections, shorter first stage of labour and better tolerance of pain. Rodríguez-Díaz et al. (2017) found that participants who followed a physical activity programme of 8 weeks based on the Pilates method had significant improvements during labour, decreased number of caesarean sections and obstructed labour, episiotomies and use of analgesia. Aktan et al. (2021) state that the Pilates group had better general anxiety values, gained less weight and felt less pain during labour than the other groups, however there was no difference between the groups in terms of the duration of labour.

Effects of Physical Activity on Foetal Health

Maternal moderate-intensity physical activity during pregnancy is associated with several positive outcomes for foetal and newborn health, without adversely affecting foetal growth or development. Studies suggest that prenatal exercise may reduce foetal fat mass, enhance foetal stress tolerance, and promote more advanced neurobehavioral maturation (Melzer et al., 2010). Maternal physical activity has been linked to structural improvements in placental development, including increased placental cell proliferation, villous vascular volume, and overall placental size, particularly when exercise is continued during the second trimester (van Poppel et al., 2024). These adaptations are thought to enhance placental efficiency and oxygen exchange. Foetal autonomic function also appears to benefit from the mother's exercise, with studies reporting lower basal foetal heart rates in physically active women late in pregnancy, particularly during periods of foetal activity. While short (<3 minutes) heart rate decelerations have been observed with high-intensity exercise, these episodes were transient and the heart

rate returned to normal quickly. Clinically, lower rates of acute foetal stress indicators (such as abnormal foetal heart patterns, meconium-stained amniotic fluid, and low Apgar scores) have been reported among exercising women, alongside a modest reduction in birth weight that remains within healthy ranges (Clapp et al. 1990). Additionally, higher levels of maternal physical activity in early and mid-pregnancy are associated with reduced risk of both small- and large-for-gestational-age births (Hu et al.2024). Meta-analytic evidence from randomized controlled trials further supports a 39% reduction in the risk of macrosomia (birthweight > 4000g) among exercising women, with no increased risk of foetal growth restriction, low birth weight, or preterm birth (Davenport et al., 2018).

According to research of Shlomo and Mor (2023) children of women who kept physically active during pregnancy had less autism spectrum disorders and sleeping disorders, as well as better brain growth. Furthermore, higher levels of physical activity before pregnancy or in early pregnancy are associated with a significantly lower risk of developing gestational diabetes which means that children are less likely to be obese and have an impaired glucose tolerance or diabetes (Tobias et al. 2011). However, Louise et al. (2021) found no evidence that in overweight and obese pregnant women maternal dietary and/or lifestyle intervention during pregnancy modifies the risk of early childhood obesity. Similarly, Kong et al. (2016) state that higher leisure time physical activity before and during mid-pregnancy, and the change between them, were not associated with lower adiposity in mid-childhood.

Discussion

This review consolidates the current evidence on the effects of physical activity during pregnancy, highlighting its positive impact on maternal and foetal outcomes. Despite historical concerns regarding maternal hyperthermia, altered foetal oxygen supply, and energy diversion during exercise (Davies et al., 2003), recent research supports the statement that physical activity in uncomplicated pregnancies is safe and beneficial to both mother and foetus.

The evidence shows that physiological adaptations to regular exercise before pregnancy, such as increased cardiac output and blood volume, augment and support the necessary physiological changes in pregnancy (Carpenter et al. 2015). However, adaptations to exercise are easily lost when women stop being active. Thus, to obtain or maintain the beneficial adaptations to exercise, women have to become or stay regularly active throughout pregnancy (van Poppel et al. 2024). Despite the benefits, many women reduce or stop physical activity upon becoming

pregnant, due to fear, misinformation, or lack of guidance (Clarke and Gross 2004). Addressing these barriers through targeted education and healthcare professionals support is essential.

Regular exercise is consistently linked to better maternal outcomes (Melzer et al., 2010; Zhang et al., 2020; Connolly et al., 2017; Owe et al., 2019), emphasizing the importance of preconception and prenatal physical activity. Additionally, specific forms of exercise such as pelvic floor muscle training during pregnancy has demonstrated various benefits to the mother's health (Dias et al., 2011; Wang et al., 2014; Sobhgol et al., 2019).

Numerous studies support the association between prenatal physical activity and shortened labour duration (Barakat et al., 2018; Clapp et al., 1990; Haakstad & Bø, 2011; Perales et al., 2016; Melzer et al., 2010). Moreover, active women experience lower rates of caesarean and instrumental deliveries, and are less likely to require analgesia or labour induction (Barakat et al., 2012; Davenport et al., 2019; Ferreira et al., 2019; Pereira et al., 2022; Zhang et al., 2023). Some interventions, such as Pilates and yoga, have also been linked to reduced pain perception and improved childbirth self-efficacy (Rodríguez-Díaz et al., 2017; Aktan et al., 2021; Bolanthakodi et al., 2018; Gau et al., 2011). There are studies, including those by Ferreira et al. (2019), Zhang et al. (2023), and Dias et al. (2011), that reported no statistically significant differences in specific labour parameters.

The findings included in this study indicate that moderate physical activity during pregnancy is linked to healthier foetal development, improved placental function, lower risk of macrosomia, and better newborn outcomes without compromising foetal growth (Melzer et al., 2010; van Poppel et al, 2024; Clapp et al, 1990; Davenport et al, 2018; Hu et al, 2024). While some long-term effects on the child's metabolic status remain inconclusive, evidence supports benefits like reduced foetal stress, enhanced neurodevelopment, and lower risk of complications related to gestational diabetes (Shlomo & Mor, 2023; Tobias et al, 2011) The studies of Louise et al., (2021) and Kong et al., (2016) have found no association between maternal exercise and lower adiposity in mid-childhood or reduced risk of early childhood obesity. Similarly, Menke et al. (2022) found that prenatal exercise was not associated with infant body composition at birth.
Numerous authors have examined physical activity during pregnancy in a general context, while certain studies focused more specifically on activities such as pilates (Rodríguez-Díaz et al., 2017; Aktan et al. 2021), birth ball exercises (Gau et al. 2011), aquatic workouts (Carpenter

et al. 2015) or yoga (Bolanthakodi et al. 2018), exploring their impact on labour duration, delivery method, pain levels, and the use of analgesics during childbirth. Comparing the studies that focus on various types of exercise provides a limited perspective as they differ in intensity, engaged muscle groups and levels of resistance. The referenced research considered physical activity of differing durations, and distinguished between exercise bouts (Carpenter et al. 2015) and regular physical activity, which posed a challenge for direct comparison across studies. The variations mentioned above can alter physiological responses to exercise and thus have an influence on the results and reached conclusions. Therefore, future research would benefit from standardizing the methodology and categorization of physical activity to enhance comparability and clarify the interpretation of findings.

Despite variability across studies in exercise type, intensity, and population characteristics, the cumulative evidence supports the integration of physical activity into prenatal care strategies. The use of a prenatal exercise programme may help reduce medical interventions during labour, which in turn can improve the condition of the mother and the child, and therefore reduce the cost of perinatal care (Szumilewicz et al. 2013). However, it is still essential for the societies of obstetricians and gynaecologists to optimize exercise guidelines and personalize recommendations based on maternal fitness and pregnancy risk profiles.

Conclusion

Physical activity during pregnancy, when tailored to the individual and undertaken in the absence of contraindications, can be a safe intervention that offers substantial benefits for maternal, foetal and labour outcomes. It is shown to reduce the risk of gestational complications such as diabetes and hypertension, enhance musculoskeletal and pelvic floor health, and improve psychological well-being. Exercise is also associated with shorter labour, reduced analgesia and oxytocin use, and lower rates of caesarean and instrumental deliveries. Prenatal activity contributes to better cardiovascular and neurodevelopmental indicators without compromising growth of the foetus. Given the weight of current evidence, healthcare providers should encourage safe and regular physical activity throughout pregnancy, however further work on the subject is needed to refine specific recommendations and explore the impact of maternal fitness on pregnancy and its outcomes.

Disclosure:

Authors do not report any disclosures.

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Project administration:

All authors have read and agreed with the published version of the manuscript.

Founding Statement:

The study did not receive funding.

Institutional Review Board Statement:

Not applicable.

Informed Consent Statement:

Not applicable.

Data Availability Statement:

Not applicable.

Conflict of Interest Statement:

The authors declare no conflicts of interest.

Acknowledgments:
Not applicable.

Declaration of the use of generative AI and AI-assisted technologies in the writing process: In the preparation of this work, the author(s) used ChatGPT to enhance language clarity, improve readability, text formatting and basic data analysis, . Following the use of this tool, the author(s) have thoroughly reviewed and edited the content as necessary and accept full responsibility for the substantive content of the publication.

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