



NICOLAUS COPERNICUS
UNIVERSITY
IN TORUŃ



Quality in Sport. eISSN 2450-3118.

Journal Home Page

<https://apcz.umk.pl/QS/index>

KOŁODZIEJCZYK, Julia, PIETRZAK, Maria, ŁUPINA-ROMANIUK, Marcela, CHAWRYŁO, Aneta, PIETRAŚ, Paulina, PIECUCH, Dominika, OLEKSIŃSKA, Karolina, ŚWIETLICKA, Gabriela, STOLARCZYK, Michał and PRACON, Karolina. Exercise as a Therapeutic Intervention in Gestational Diabetes Mellitus: A Narrative Review of Clinical Outcomes and Glycemic Control. Quality in Sport. 2026;55:71071. eISSN 2450-3118. <https://doi.org/10.12775/QS.2026.55.71071>

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 Lp. 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 2026.

This article is published with open access under the License Open Journal Systems of Nicolaus Copernicus University in Toruń, Poland. Open Access: This article is distributed under the terms of the Creative Commons Attribution Noncommercial License, which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author(s) and source are credited. This is an open access article licensed under the terms of the Creative Commons Attribution Non-commercial Share Alike License (<http://creativecommons.org/licenses/by-nc-sa/4.0/>), which permits unrestricted, non-commercial use, distribution, and reproduction in any medium, provided the work is properly cited.

The authors declare that there is no conflict of interest regarding the publication of this paper.
Received: 20.04.2026. Revised: 05.05.2026. Accepted: 10.05.2026. Published: 11.05.2026.

Exercise as a Therapeutic Intervention in Gestational Diabetes Mellitus: A Narrative Review of Clinical Outcomes and Glycemic Control

Julia Kołodziejczyk (JK)

University Clinical Hospital No. 4 in Lublin, Poland, Doktora Kazimierza Jaczewskiego 8,
20-954 Lublin, Poland

julkak00@wp.pl

<https://orcid.org/0009-0009-2526-0937>

Maria Pietrzak (MP)

Stefan Cardinal Wyszyński Regional Specialized Hospital in Lublin, Krasnicka 100, 20-718
Lublin, Poland

marysiapietrzak2@gmail.com

[ORCID: https://orcid.org/0009-0002-5751-3248](https://orcid.org/0009-0002-5751-3248)

Marcela Łupina-Romaniuk (ML-R)

University Clinical Hospital No. 4 in Lublin, Poland, Doktora Kazimierza Jaczewskiego 8,
20-954 Lublin, Poland

marcela.lupina2000@gmail.com

<https://orcid.org/0009-0003-1821-7910>

Aneta Chawryło (AC)
Stefan Cardinal Wyszyński Regional Specialized Hospital in Lublin, Krasnicka 100, 20-718
Lublin, Poland

chawrylo.anet2503@gmail.com

[ORCID:https://orcid.org/0009-0003-2412-6900](https://orcid.org/0009-0003-2412-6900)

Paulina Pietraś (PP)

University Clinical Hospital No. 1 in Lublin, Poland
Stanisława Staszica 16, 20-081 Lublin, Poland

paulina.pietras1929@gmail.com

<https://orcid.org/0009-0004-9124-5149>

Dominika Piecuch (DP)

1 Military Clinical Hospital with Outpatient Clinic in Lublin
aleje Racławickie 23, 20-049 Lublin, Poland

piecuchdominika24@gmail.com

<https://orcid.org/0009-0005-7836-4810>

Karolina Oleksińska (KO)

Stefan Cardinal Wyszyński Regional Specialized Hospital in Lublin, Krasnicka 100, 20-718
Lublin, Poland

karolinaolek19@gmail.com

[ORCID: https://orcid.org/0009-0004-3046-9835](https://orcid.org/0009-0004-3046-9835)

Gabriela Świetlicka (GŚ)

Medical University in Lublin, Lublin, Poland

gswietlicka00@gmail.com

[ORCID https://orcid.org/0009-0005-7746-4879](https://orcid.org/0009-0005-7746-4879)

Michał Stolarczyk (MS)

Independent Public District Hospital in Łęczna
Krasnystawska 52, 21-010, Łęczna, Poland

michal_stolarczyk200@wp.pl

<https://orcid.org/0009-0009-7704-1154>

Karolina Pracon (KP)

1 Military Clinical Hospital with Outpatient Clinic: Lublin, Lublin, PL

karolinapracon1@gmail.com

<https://orcid.org/0009-0001-9934-7279>

Corresponding Author

Julia Kołodziejczyk (JK)

julkak00@wp.pl

Abstract

Background:

Gestational diabetes mellitus (GDM) is one of the most common metabolic complications of pregnancy and is associated with adverse maternal and neonatal outcomes. Lifestyle modification remains the cornerstone of treatment, with increasing attention directed toward the therapeutic role of physical activity.

Aim:

This narrative review aimed to evaluate the impact of exercise as a therapeutic intervention on glycemic control and clinical outcomes in women with GDM.

Material and Methods:

A literature search was conducted using the PubMed database, including studies published from 2021 onwards. The review focused on randomized controlled trials, systematic reviews, and meta-analyses investigating the effects of physical activity on glycemic control, insulin therapy, and maternal and neonatal outcomes in GDM.

Results:

Available evidence suggests that regular physical activity improves glycemic control in women with GDM, particularly by reducing postprandial glucose levels. Exercise may also decrease the need for insulin therapy and contribute to improved maternal outcomes, including reduced excessive gestational weight gain. Additionally, physical activity appears to lower the risk of macrosomia and other selected neonatal complications. The effectiveness of exercise interventions depends on their type, intensity, timing, and, importantly, adherence.

Conclusions:

Exercise represents a safe and effective adjunct in the management of gestational diabetes mellitus. However, its clinical impact is influenced not only by physiological effects but also by practical factors such as feasibility and long-term adherence. Individualized and structured exercise recommendations may enhance the therapeutic potential of physical activity in GDM.

Key words: gestational diabetes mellitus, physical activity, glycemic control

1. Introduction

Gestational diabetes mellitus (GDM) is one of the most common metabolic complications of pregnancy and constitutes a significant clinical problem due to its consequences for both the mother and the developing fetus. This disorder is primarily associated with an increase in insulin resistance characteristic of pregnancy, which leads to disturbances in carbohydrate metabolism and an increased risk of perinatal complications. (1)

The contemporary approach to the treatment of GDM is based mainly on lifestyle modification, including dietary interventions and increased physical activity. However, a growing body of evidence suggests that physical activity may play a much broader role than merely supporting treatment, becoming an important component that directly influences the course of the disease. (2)

The mechanisms underlying the beneficial effects of physical exercise primarily include increased tissue sensitivity to insulin, improved glucose uptake by skeletal muscles, and reduction of inflammation. In addition, attention has been drawn to the potential influence of physical activity on metabolic regulation through its effects on the gut microbiota and placental function, which may be important in the context of pregnancy complicated by GDM. (3)

The results of clinical studies and meta-analyses indicate that the implementation of training programs in women with gestational diabetes leads to significant improvement in glycemic parameters, both fasting and postprandial, and may also reduce glycated hemoglobin levels. Moreover, appropriately planned physical activity may reduce the need for insulin therapy and improve overall treatment outcomes. (2)

Despite the growing body of evidence confirming the effectiveness of physical activity in the treatment of GDM, its use in clinical practice remains insufficient. This is due, among other factors, to the lack of clear recommendations regarding the optimal type, intensity, and duration of exercise, as well as difficulties in maintaining regular activity among pregnant women. (1)

The aim of this narrative review is to evaluate the impact of physical activity as a therapeutic intervention on glycemic control and clinical outcomes in women with gestational diabetes mellitus, based on current scientific evidence.

2. Materials and methods

This narrative review was developed based on an analysis of current scientific literature regarding the impact of physical activity on the course of gestational diabetes mellitus. A literature search was conducted using the PubMed database as the primary source of evidence. Articles published from 2021 onward were included in the analysis, with a focus on the most recent and clinically relevant data. The selection process prioritized studies of high methodological quality, including randomized controlled trials, systematic reviews, and meta-analyses addressing the role of physical activity in the management of GDM.

The search strategy was based on combinations of keywords related to the topic of the study, including “gestational diabetes mellitus,” “exercise,” “physical activity,” “treatment,” and “glycemic control.” Additional terms related to pregnancy outcomes and insulin therapy were also considered to ensure comprehensive coverage of clinically relevant endpoints.

Studies were selected based on their relevance to the objective of evaluating the impact of exercise interventions on glycemic control, insulin requirements, and maternal and neonatal outcomes in women with gestational diabetes mellitus. Publications focusing on non-pregnant populations or lacking clear outcome measures related to GDM were excluded.

The final analysis included studies that provided data on at least one of the following outcomes: fasting or postprandial glycemia, glycated hemoglobin levels, need for insulin therapy, gestational weight gain, or selected obstetric and neonatal outcomes. Both interventional and observational studies were considered, provided they contributed meaningful clinical insights.

Due to the narrative nature of this review, formal criteria of a systematic review and meta-analytic procedures were not applied. However, efforts were made to ensure a structured and transparent selection process, with emphasis on the scientific quality, consistency of findings, and clinical applicability of the included studies.

3. Results

3.1 Effect on glycemic control

Available evidence consistently shows that physical activity is an effective way to improve glycemic control in women with gestational diabetes mellitus. Numerous studies have demonstrated that introducing regular exercise leads to a meaningful reduction in blood glucose levels, both fasting and postprandial, which remains a key goal in GDM management. (11)

The effect appears to be particularly pronounced for postprandial glucose levels, which seem more responsive to physical activity than fasting glycemia. This is likely because exercise directly increases glucose uptake by skeletal muscles at the time when blood glucose levels are at their peak, helping to blunt post-meal spikes. (12)

Some studies have also looked at the impact of physical activity on longer-term markers of metabolic control, such as glycated hemoglobin (HbA1c). Their findings suggest that regular exercise can lead to a reduction in HbA1c, highlighting its role not only in short-term glucose regulation but also in improving overall metabolic control in GDM. (10)

The underlying mechanisms are multifactorial. Physical activity enhances glucose transport into cells through the activation of GLUT-4 transporters and improves insulin sensitivity in peripheral tissues. Importantly, some of these effects occur independently of insulin, which is particularly relevant in the setting of increased insulin resistance characteristic of gestational diabetes. (13)

Increasing attention has also been given to the timing of exercise. Evidence suggests that activity performed shortly after meals may be especially effective in reducing postprandial glycemia, as it better aligns with the metabolic changes occurring after food intake. (9)

Although the overall effect of physical activity on glycemic control is positive, its magnitude can vary depending on factors such as the type of exercise, its intensity and duration, as well as the level of adherence to recommendations. (10,15)

3.2 Impact on insulin therapy

Available data suggest that physical activity may play an important role in reducing the need for insulin therapy in women with gestational diabetes mellitus. Improved glycemic control associated with regular exercise often translates into a lower reliance on pharmacological treatment, which is particularly important in the context of minimizing medical interventions during pregnancy. (11)

This effect is mainly driven by increased insulin sensitivity and enhanced glucose uptake by skeletal muscles, leading to more efficient use of endogenous insulin. As a result, some patients are able to maintain target glucose levels without initiating insulin therapy, or with lower insulin doses. (13)

Interventional studies have shown that exercise-based programs can reduce both the frequency of insulin use and the required doses, especially when the activity is performed regularly and tailored to the patient's condition. These benefits have been observed in both aerobic and resistance training, suggesting that different types of exercise may be effective in the management of GDM. (14)

At the same time, the findings are not entirely consistent. Some studies have not demonstrated a significant impact of physical activity on the need for insulin therapy, which may be related to small sample sizes, short intervention periods, or low adherence to exercise recommendations. (17)

An important factor influencing the effectiveness of physical activity in reducing insulin requirements is the regularity and intensity of exercise. Evidence suggests that well-structured and consistently followed training programs can meaningfully support GDM management and reduce dependence on pharmacotherapy. (15)

3.3 Maternal outcomes

Available data indicate that physical activity in women with gestational diabetes mellitus may beneficially affect the course of pregnancy by improving metabolic parameters and limiting excessive gestational weight gain. Regular exercise is associated with better control of carbohydrate metabolism, which indirectly contributes to stabilization of the patient's clinical condition and reduction of the risk of metabolic complications. (7)

One of the important effects of exercise interventions is the limitation of excessive weight gain during pregnancy, which is relevant both for the course of pregnancy itself and for the risk of perinatal complications. Studies have shown that women who engage in regular physical activity are more likely to achieve gestational weight gain values consistent with recommendations, which may improve obstetric prognosis. (15)

Physical activity may also influence the mode of delivery. Some studies have observed a reduced rate of cesarean section in groups receiving exercise interventions, which may result from both improved glycemic control and an overall improvement in physical fitness. (14)

However, it should be emphasized that the findings regarding the impact of physical activity on individual clinical parameters are not entirely consistent. Some analyses did not show significant differences in the frequency of obstetric complications, suggesting that the effect of intervention may depend on many factors, such as exercise intensity, duration, and patient adherence to recommendations. (17)

Despite these limitations, most available data indicate that physical activity is a safe and potentially effective supportive element in the treatment of gestational diabetes mellitus,

contributing to improvement in the overall course of pregnancy and reduction of selected risk factors. (2)

3.4 Fetal and neonatal outcomes

The impact of physical activity on fetal and neonatal outcomes in women with gestational diabetes mellitus appears to be generally beneficial, although the strength of this effect is not consistent across all studies. The most commonly reported finding is a reduced risk of excessive birth weight, which is clinically important given that macrosomia is one of the most frequent complications of poorly controlled glucose metabolism during pregnancy. Improved maternal glycemic control, particularly in the postprandial range, may limit excessive fetal exposure to glucose and thereby reduce the risk of excessive intrauterine growth. (7)

Some studies have also shown that exercise-based interventions may lead to lower birth weight compared with standard care, without any evidence of adverse effects on fetal development. This suggests that appropriately selected physical activity does not restrict fetal growth itself, but rather reduces the risk of pathologically increased birth weight associated with maternal hyperglycemia. (3)

Data on other outcomes, such as preterm birth or neonatal hypoglycemia, are less clear. While some analyses suggest a possible reduction in the incidence of selected adverse perinatal events, other reviews have not demonstrated a significant impact of exercise on overall neonatal outcomes. This inconsistency may be related to differences in study design, small sample sizes, and variability in the timing and intensity of the interventions. (1)

It is also worth noting that the benefits for the fetus and newborn are most likely indirect and linked to improved maternal metabolic control. The more effectively physical activity reduces maternal hyperglycemia, the greater the potential to lower the risk of complications related to excessive glucose transfer to the fetus. For this reason, physical activity can be considered not only as a tool for improving maternal biochemical parameters, but also as a factor supporting a more favorable intrauterine environment. (15)

3.5 Type, intensity and timing of exercise

Available data indicate that the effectiveness of physical activity in the treatment of gestational diabetes mellitus depends not only on whether it is implemented, but also on the type, intensity, and timing of exercise. Studies have examined aerobic training, resistance training, and combined interventions, and their results suggest that each of these forms may improve glycemic control, provided that they are applied systematically. (10)

Aerobic training primarily increases glucose utilization by muscles and improves overall physical fitness, whereas resistance exercise may additionally increase muscle mass and improve insulin sensitivity. It has been shown that both aerobic and resistance exercise can reduce glycemic values and decrease insulin requirements, indicating their potential role as components of GDM therapy. (7)

Due to the lack of clear evidence demonstrating the superiority of one form of activity over another, clinical practice recommends that exercise programs be individually tailored to the patient's abilities and preferences. In this context, mixed training that combines aerobic and resistance components may be particularly beneficial, as it allows simultaneous influence on different aspects of metabolism and increases the likelihood of maintaining regular activity. (10)

An important factor determining the effectiveness of intervention is exercise intensity. The best-documented benefits concern moderate-intensity activity, which is both metabolically effective and well tolerated by pregnant women. Too low an intensity may fail to produce significant clinical effects, whereas too high an intensity may limit the possibility of long-term adherence. (7)

Increasing attention is also being paid to the timing of physical activity. Data suggest that exercise performed after meals may be particularly effective in reducing postprandial glycemia, which is of key importance in the treatment of GDM. Physical activity undertaken during this period allows more efficient glucose utilization by muscles, thereby limiting its excessive rise in the blood. (9)

Regularity and duration of intervention are also important. Programs initiated earlier and carried out continuously produce better results than short-term or irregular actions. In practice, this means that daily or frequent moderate activity incorporated into the patient's daily routine is more important than isolated intensive exercise sessions. (12)

In summary, the optimal physical activity strategy in the treatment of gestational diabetes mellitus should be based on regular moderate-intensity exercise, tailored to the patient's capabilities and, whenever possible, performed after meals. The effectiveness of the intervention appears to depend more on its regularity than on the specific type of training used. (10)

3.6 Adherence and feasibility

The effectiveness of physical activity in the treatment of gestational diabetes mellitus depends not only on its metabolic impact, but also on the feasibility of implementing and maintaining recommendations in daily practice. Adherence appears to be one of the main factors determining the actual therapeutic effect. Even a well-designed exercise program may fail to produce the expected results if it is not performed regularly or if the patient does not have the conditions necessary to sustain activity over a longer period. (10)

Available data suggest that simpler programs, easier to perform and better suited to the everyday functioning of pregnant women, are more feasible to maintain than interventions requiring a high organizational burden. Forms of activity that can be carried out outside the clinical setting, such as walking, home-based exercise, or self-monitoring-based programs, seem particularly important. Environmental and community-based interventions are more accessible, less costly, and may be associated with greater patient satisfaction, which increases their practical usefulness. (15)

The type of training also affects the ability to maintain activity. In a study comparing resistance and aerobic exercise, both forms improved metabolic parameters, but the resistance training group showed better adherence to recommendations. This suggests that some types of physical activity may be not only effective, but also easier for patients to accept and perform consistently. (2)

The problem of adherence concerns not only the pregnancy period itself, but also the maintenance of beneficial habits in the longer term. Reviews emphasize that difficulties related to long-term compliance, limited possibilities for monitoring, and the lack of precise and easy-to-apply exercise protocols constitute one of the main barriers to effective physical activity-based therapy. For this reason, increasing importance is being attributed to care models that incorporate personalized recommendations, continuous support, and long-term reinforcement of healthy habits. (10)

It is also worth noting that the actual level of physical activity among women with GDM is often low. Analyses including women diagnosed with gestational diabetes have shown that energy expenditure related to physical activity remains lower than in the general population, indicating that recommending exercise alone does not always translate into behavioral change. This means that in clinical practice, creating conditions that make physical activity feasible, acceptable, and sustainable is just as important as recommending exercise itself. (16)

In summary, in the treatment of gestational diabetes mellitus, it is important not only whether physical activity works, but also whether it can be maintained in the patient's daily life. From a clinical perspective, the most valuable interventions appear to be those that combine

metabolic effectiveness with simplicity, safety, and a high likelihood of long-term adherence. (15)

3.7 Safety of exercise in GDM

Available data indicate that appropriately selected physical activity is a safe component of treatment for women with gestational diabetes mellitus. Interventional studies have not demonstrated an increased frequency of adverse obstetric outcomes among patients participating in exercise programs, suggesting that moderate, controlled physical activity may be incorporated into therapeutic management without a significant increase in risk for the mother or fetus. (7)

Randomized studies comparing different forms of physical activity have shown that both resistance and aerobic exercise may be used in pregnancies complicated by GDM without increasing the incidence of adverse events. Importantly, despite improvements in metabolic parameters, no significant differences were observed in the rate of unfavorable pregnancy outcomes between exercising groups, which further supports the safety of such interventions. (2)

However, the safety of an exercise program depends on its proper adjustment to the patient's clinical condition. Most available data concern moderate-intensity activity, which is best tolerated and most commonly recommended. This model of activity allows metabolic benefits to be achieved without placing excessive strain on the pregnant woman's body; therefore, in practice, it represents the most rational form of exercise for women with GDM. (10)

At the same time, it should be emphasized that the safety of physical activity does not imply complete freedom in exercise planning. The program should take into account gestational age, obstetric status, the presence of comorbidities, and the patient's overall physical capacity. From a clinical perspective, the most justified approach appears to be regular, predictable exercise performed in accordance with recommendations and under appropriate educational supervision. (10)

In summary, current evidence supports the view that physical activity used in the treatment of gestational diabetes mellitus is a safe intervention, provided that it remains moderate, planned, and adapted to the patient's capabilities. In this context, exercise should be regarded not only as an effective tool for improving glycemic control, but also as a management strategy that can be implemented without significantly increasing obstetric risk. (7)

3.8 Limitations of current evidence

Available literature indicates a beneficial effect of physical activity in the treatment of gestational diabetes mellitus; however, the strength of these conclusions remains limited by several important methodological issues. One of the most significant is the considerable heterogeneity of studies, including differences in the type of intervention, timing of initiation, exercise intensity, program duration, and methods of assessing therapeutic effects. Reviews have emphasized that such variability makes it difficult to formulate clear recommendations regarding the optimal exercise model for women with GDM. (1)

Another limitation is the small number of studies directly comparing individual types of physical activity. One systematic review indicated that, despite including different forms of exercise, there were no studies directly comparing aerobic with resistance training, which limits the ability to determine the superiority of one strategy over the other. In addition, some available randomized studies included relatively small patient groups and short interventions, which reduces the generalizability of their results. (1,2)

An important issue is also the heterogeneity of reported endpoints. Some studies focus mainly on glycemic parameters, others on insulin therapy, and still others on obstetric or neonatal outcomes. This reporting pattern makes comparisons across studies difficult and weakens the

ability to synthesize data. The literature has pointed out that the use of more standardized endpoints could improve the quality of future analyses. (1)

A practically important limitation is also the problem of adherence. Even if physical activity demonstrates a favorable metabolic effect under clinical trial conditions, maintaining regular exercise in the daily lives of pregnant women remains challenging. Analyses have emphasized the importance of difficulties related to long-term adherence, program complexity, and limitations in intervention control and monitoring, especially outside strictly supervised research settings. (10,15)

Additionally, it should be noted that some of the available data concern mainly short-term treatment effects, whereas much less is known about the durability of the obtained benefits. There is a lack of well-designed studies with longer follow-up that would allow assessment of whether improved glycemic control during pregnancy translates into more sustained health benefits for both mother and child. (10)

In summary, current evidence supports a beneficial role of physical activity in the treatment of GDM; however, its interpretation requires caution. The main limitations concern intervention heterogeneity, small study samples, short follow-up periods, adherence problems, and lack of standardization of reported outcomes. (1,10)

3.9 Clinical implications

Available data indicate that physical activity should be an integral element of the treatment of gestational diabetes mellitus rather than merely a supplementary measure. Incorporating regular exercise into standard management may contribute to improved glycemic control and reduce the need for pharmacotherapy, which is of considerable importance in clinical practice. (7)

From the physician's perspective, it is particularly important that recommendations regarding physical activity be simple, feasible, and tailored to the individual capabilities of the patient. The most practical approach appears to be recommending moderate physical activity, such as walking or low-load exercise, performed regularly, preferably daily or several times per week. (10)

An important component of clinical recommendations should also include the timing of exercise. Data suggest that activity undertaken after meals may provide particular benefits in terms of postprandial glycemic control, which has a direct impact on disease course and complication risk. (9)

In clinical practice, attention should also be paid to the need for patient education. Recommending physical activity alone is often insufficient—the effectiveness of intervention depends on understanding its importance, the possibility of implementation, and support in maintaining regularity. Therefore, individualization of care and the establishment of realistic, achievable goals play an important role in the management of women with GDM. (15)

It should also be emphasized that physical activity is a safe, well-tolerated, and relatively easy-to-implement intervention in outpatient settings. For this reason, it should be considered one of the basic elements of therapeutic management in women with gestational diabetes mellitus. (2)

4. Discussion

The results of available studies indicate that physical activity may play an important role in the treatment of gestational diabetes mellitus, particularly in the context of improving glycemic control. The most consistent data concern the effect of physical exercise on reducing postprandial glycemia, which is of key clinical importance because this parameter is strongly associated with the risk of fetal complications. (7,12)

Compared with other components of non-pharmacological treatment, physical activity appears to have an advantage in terms of its direct effect on glucose metabolism, resulting

from mechanisms independent of insulin action. Increased glucose uptake by muscles and improved tissue sensitivity to insulin form the basis of the observed clinical effects, confirming the rationale for including exercise as an element of therapy rather than merely prevention. (13)

At the same time, it should be emphasized that the effectiveness of physical activity is not uniform across all studies. Differences in study design, intervention type, and duration make it difficult to clearly identify the optimal exercise model. Some analyses did not demonstrate a significant effect of physical exercise on certain endpoints, which may be related to small sample sizes or insufficient intervention intensity. (1,17)

An important element that clearly emerges from the analyzed data is the significance of exercise timing. Activity performed after meals appears to be particularly effective in reducing postprandial glycemia, suggesting that appropriate alignment of physical activity with the patient's daily routine may increase its therapeutic effectiveness. (9)

Despite the observed metabolic benefits, the actual impact of physical activity on the course of pregnancy largely depends on the feasibility of its implementation in daily practice. The problem of adherence constitutes one of the main limitations of the effectiveness of this form of therapy, because even the best-designed exercise program does not produce results if it is not carried out consistently. (10,15)

In the context of maternal and neonatal outcomes, the data are less conclusive than for glycemic control. Although some studies indicate a reduced risk of macrosomia and selected perinatal complications, not all analyses confirm these observations, suggesting that the indirect effect depends on the effectiveness of metabolic control and the severity of the disease. (3,7)

From a clinical perspective, it is important that physical activity remains a safe, well-tolerated, and relatively easy-to-implement intervention. This means that it can be widely used as a component of treatment; however, its effectiveness requires appropriate patient education and individualized recommendations. (2)

In summary, physical activity is a valuable component of gestational diabetes mellitus therapy, particularly with regard to glycemic control. However, its full clinical potential depends not only on biological effects, but also on practical factors such as feasibility, regularity, and alignment of the intervention with the patient's lifestyle. (10)

5. Conclusions

Available scientific evidence indicates that physical activity is an effective component of the treatment of gestational diabetes mellitus, with beneficial effects on glycemic control and selected clinical parameters. Regular physical exercise may lead to a reduction in glucose levels, both fasting and postprandial, and may also reduce the need for insulin therapy. (7)

The benefits of physical activity also include improvement in the course of pregnancy, including limitation of excessive gestational weight gain and a potential reduction in the risk of obstetric and neonatal complications. This indicates that exercise interventions may influence not only metabolic parameters, but also the overall course of pregnancy complicated by GDM. (15)

At the same time, it should be emphasized that the effectiveness of physical activity largely depends on its regularity, appropriate adjustment to the patient's capabilities, and timing, especially in the context of postprandial glycemic control. This means that not only the fact of engaging in exercise matters, but also the way in which it is implemented. (9)

Despite the growing amount of data confirming the beneficial effects of physical activity, the available evidence is not free from limitations, such as intervention heterogeneity, small study groups, and adherence-related issues. These factors make it difficult to formulate clear and universal clinical recommendations. (10)

From the perspective of clinical practice, physical activity should be regarded as a fundamental element of gestational diabetes treatment; however, its effectiveness depends on the feasibility of implementing it in the patient's daily life. Therefore, the individualization of recommendations and support for patients in maintaining regular activity are of key importance. (2)

In summary, physical activity is a promising, safe, and effective method supporting the treatment of gestational diabetes mellitus; however, its actual clinical impact depends not only on biological effects, but also on factors related to practical implementation and long-term adherence to recommendations. (7)

Disclosure

Author's Contributions Statement

Conceptualization: Julia Kołodziejczyk

Methodology: Marcela Łupina-Romaniuk, Maria Pietrzak

Check: Gabriela Świetlicka, Paulina Pietraś

Resources: Dominika Piecuch, Aneta Chawryło

Data Curation: Karolina Oleksińska, Maria Pietrzak

Writing-rough preparation: Julia Kołodziejczyk, Paulina Pietraś

Writing-review and editing: Dominika Piecuch, Michał Stolarczyk

Supervision: Marcela Łupina-Romaniuk, Karolina Pracoń

Funding Statement

This study did not receive external funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

The authors confirm that the data supporting this study are available in the article's references.

Acknowledgments

Not applicable.

Conflict of Interest Statement

The authors deny any conflict of interest.

Declaration of the use of AI:

In preparing this work, the authors used ChatGPT to improve the language, readability, and text formatting. After using this tool, the authors reviewed and edited the content as necessary and accept full responsibility for the substantive content of the publication.

References

1. Keating N, Coveney C, McAuliffe FM, Higgins MF. Aerobic or Resistance Exercise for Improved Glycaemic Control and Pregnancy Outcomes in Women with Gestational Diabetes Mellitus: A Systematic Review. *Int J Environ Res Public Health*. 2022 Aug 30;19(17):10791. doi: 10.3390/ijerph191710791. PMID: 36078508; PMCID: PMC9518565.
2. Xie Y, Zhao H, Zhao M, Huang H, Liu C, Huang F, Wu J. Effects of resistance exercise on blood glucose level and pregnancy outcome in patients with gestational diabetes mellitus: a randomized controlled trial. *BMJ Open Diabetes Res Care*. 2022 Apr;10(2):e002622. doi: 10.1136/bmjdr-2021-002622. PMID: 35383101; PMCID: PMC8984031.
3. Zhang L, Wang F, Tashiro S, Liu PJ. Effects of Dietary Approaches and Exercise Interventions on Gestational Diabetes Mellitus: A Systematic Review and Bayesian Network

- Meta-analysis. *Adv Nutr.* 2024 Dec;15(12):100330. doi: 10.1016/j.advnut.2024.100330. Epub 2024 Oct 29. PMID: 39481539; PMCID: PMC11629230.
4. Huang S, Magny-Normilus C, McMahon E, Whittemore R. Systematic Review of Lifestyle Interventions for Gestational Diabetes Mellitus in Pregnancy and the Postpartum Period. *J Obstet Gynecol Neonatal Nurs.* 2022 Mar;51(2):115-125. doi: 10.1016/j.jogn.2021.10.007. Epub 2021 Nov 27. PMID: 34843670; PMCID: PMC9165696.
 5. Dingena CF, Arofikina D, Campbell MD, Holmes MJ, Scott EM, Zulyniak MA. Nutritional and Exercise-Focused Lifestyle Interventions and Glycemic Control in Women with Diabetes in Pregnancy: A Systematic Review and Meta-Analysis of Randomized Clinical Trials. *Nutrients.* 2023 Jan 9;15(2):323. doi: 10.3390/nu15020323. PMID: 36678193; PMCID: PMC9864154.
 6. Wu S, Jin J, Hu KL, Wu Y, Zhang D. Prevention of Gestational Diabetes Mellitus and Gestational Weight Gain Restriction in Overweight/Obese Pregnant Women: A Systematic Review and Network Meta-Analysis. *Nutrients.* 2022 Jun 9;14(12):2383. doi: 10.3390/nu14122383. PMID: 35745114; PMCID: PMC9231262.
 7. Huifen Z, Yaping X, Meijing Z, Huibin H, Chunhong L, Fengfeng H, Yaping Z. Effects of moderate-intensity resistance exercise on blood glucose and pregnancy outcome in patients with gestational diabetes mellitus: A randomized controlled trial. *J Diabetes Complications.* 2022 May;36(5):108186. doi: 10.1016/j.jdiacomp.2022.108186. Epub 2022 Mar 29. PMID: 35379538.
 8. Zeng G, Niu J, Zhu K, Li F, Li L, Gao K, Zhuang Y, Zhang B, Han X, Ye G, Gao Z, Li H. Effects of non-pharmacological interventions on depressive and anxiety symptoms in pregnant women: a systematic review and network meta-analysis. *EClinicalMedicine.* 2024 Dec 18;79:103011. doi: 10.1016/j.eclinm.2024.103011. PMID: 39802308; PMCID: PMC11718295.
 9. Suján MJ, Skarstad HM, Rosvold G, Fougner SL, Follestad T, Salvesen KÅ, Moholdt T. Time restricted eating and exercise training before and during pregnancy for people with increased risk of gestational diabetes: single centre randomised controlled trial (BEFORE THE BEGINNING). *BMJ.* 2025 Sep 9;390:e083398. doi: 10.1136/bmj-2024-083398. PMID: 40925657; PMCID: PMC12418603.
 10. Xu H, Liu R. Comprehensive management of gestational diabetes mellitus: practical efficacy of exercise therapy and sustained intervention strategies. *Front Endocrinol (Lausanne).* 2024 Oct 3;15:1347754. doi: 10.3389/fendo.2024.1347754. PMID: 39421534; PMCID: PMC11484007.
 11. Tandon N, Gupta Y, Kapoor D, Lakshmi JK, Praveen D, Bhattacharya A, Billot L, Naheed A, de Silva A, Gupta I, Farzana N, John R, Ajanthan S, Divakar H, Bhatla N, Desai A, Pathmeswaran A, Prabhakaran D, Joshi R, Jan S, Teede H, Zoungas S, Patel A; LIVING Collaborative Group. Effects of a Lifestyle Intervention to Prevent Deterioration in Glycemic Status Among South Asian Women With Recent Gestational Diabetes: A Randomized Clinical Trial. *JAMA Netw Open.* 2022 Mar 1;5(3):e220773. doi: 10.1001/jamanetworkopen.2022.0773. PMID: 35234881; PMCID: PMC8892226.
 12. Bennett G, King N, Redfern K, Breese BC. Supervised physical activity and the incidence of gestational diabetes mellitus: a systematic review and meta-analysis. *J Matern Fetal Neonatal Med.* 2023 Dec;36(1):2155043. doi: 10.1080/14767058.2022.2155043. Epub 2022 Dec 13. PMID: 36514828.
 13. Li X, Luo R, Qiao B, Ou H. Exercise Intervention Improves Blood Glucose Levels and Adverse Pregnancy Outcomes in GDM Patients: A Meta-Analysis. *Comput Math Methods Med.* 2022 Sep 22;2022:9287737. doi: 10.1155/2022/9287737. PMID: 36238491; PMCID: PMC9553359.

14. Kouiti M, Hernández-Muñiz C, Youlyouz-Marfak I, Salcedo-Bellido I, Mozas-Moreno J, Jiménez-Moleón JJ. Preventing Gestational Diabetes Mellitus by Improving Healthy Diet and/or Physical Activity during Pregnancy: An Umbrella Review. *Nutrients*. 2022 May 14;14(10):2066. doi: 10.3390/nu14102066. PMID: 35631207; PMCID: PMC9144260.
15. Igwesi-Chidobe CN, Okechi PC, Emmanuel GN, Ozumba BC. Community-based non-pharmacological interventions for pregnant women with gestational diabetes mellitus: a systematic review. *BMC Womens Health*. 2022 Nov 29;22(1):482. doi: 10.1186/s12905-022-02038-9. PMID: 36447189; PMCID: PMC9710028.
16. Jones DL, Kusinski LC, Griffiths L, Rennie KL, Oude Griep LM, Meek CL. Dietary intakes and physical activity of women with gestational diabetes are not associated with continuous glucose monitoring metrics; secondary analysis of the DiGest trial. *Clin Nutr ESPEN*. 2025 Dec;70:29-35. doi: 10.1016/j.clnesp.2025.08.007. Epub 2025 Aug 12. PMID: 40812416.
17. Zhang J, Wang HP, Wang XX. Effects of aerobic exercise performed during pregnancy on hypertension and gestational diabetes: a systematic review and meta-analysis. *J Sports Med Phys Fitness*. 2023 Jul;63(7):852-863. doi: 10.23736/S0022-4707.23.14578-6. Epub 2023 Apr 17. PMID: 37067246.