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The role of physical activity and nutrition in managing pain, fatigue, and inflammation in endometriosis

Dominika Dmowska, ORICD:https://orcid.org/0009-0002-9269-5577
E-mail dominikadmowskaa@gmail.com
HCP Medical Center, John Paul II Hospital, Poznań, Poland

Paweł Zdebski, ORCID:https://orcid.org/0009-0004-9718-157X
E-mail pzdebski1@gmail.com
Poznan University of Medical Sciences:Poznan, Poland

Karolina Rymska, ORCID: https://orcid.org/0009-0009-8826-8899
E-mail karolinarymska1@gmail.com
University Clinical Hospital Jan Mikulicz-Radecki, Wrocław, Poland

Mikołaj Lewandowski, ORCID: https://orcid.org/0009-0001-8533-0660
E-mail lewymikus99@gmail.com
Regional Hospital in Poznań, Juraszów 7-19, 60-479 Poznań, Poland

Aleksandra Bilinska, ORCID: https://orcid.org/0009-0002-8833-6934
E-mail Aleksandra.bilinska2@stud.umed.lodz.pl
Uniwersity of Medical Sciences Lodz, Poland

Ewa Gloc**,** ORCID: https://orcid.org/0009-0001-4293-750X
E-mail Glocewa@gmail.com
Centrum Medyczne Bonifrater w Łodzi, Łódź, Poland

Rafal Ejsner, ORCID: https://orcid.org/0009-0009-0983-2114
E-mail rafal.e91@interia.pl
Medical university of Łódź, Dr. Karol Jonscher Municipal Medical Center, Poland

Marcelina Kaczmarek, ORCID iD: 0009-0009-0114-0607
E-mail marcelina.kaczmarek.mk@gmail.com
Faculty of Medicine, Ludwik Rydygier Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Toruń, Poland

Mateusz Mierniczek , ORCID ID: https://orcid.org/0009-0009-9571-7859
E-mail mateusz.mierniczek19@gmail.com
St. Raphael's Voivodeship Specialist Hospital in Czerwona Góra, Chęciny, Poland

Maria Mierniczek, ORCID: https://orcid.org/0009-0000-9108-1552
E-mail maria.luszcz@op.pl
St. Raphael's Voivodeship Specialist Hospital in Czerwona Góra, Chęciny, Poland

Daniel Załęski, ORCID: https://orcid.org/0009-0000-0449-363X
E-mail danieelzaleski@gmail.com
Baptism of Poland Memorial Hospital in Gniezno

Corresponding Author
Dominika Dmowska, E-mail dominikadmowskaa@gmail.com

Abstract

Endometriosis is a highly prevalent inflammatory disease that affects millions of women. Endometriosis affects between 10-15% of women of reproductive age globally what is representing nearly 180 million cases worldwide. In Poland alone, the number of sufferers reaches 3 million. Its diagnosed much more frequently among women seeking treatment for fertility problems. That's estimated more than half of them may have a sign of endometriosis.

Currently used medications only reduces the symptoms of the disease, which is why the interdisciplinary aspect in the context of endometriosis is so important, as is the attempt to alleviate the course of the disease through alternative methods like balanced diet and physical activity. In this study, we focused on examining the impact of physical activity on the course of endometriosis.

Materials and methods:

The review was conducted using publications published in the PubMed, Google Scoolar and UpToDate. Our search included the following keywords: pain, endometriosis, quality of life, fatigue, fertility, physical activity. We based on literature published between 2008-2025.

Results:

According to the survey and literary reports physical activity significantly improves the quality of life of patients affected by endometriosis. Physical activity significantly improves the quality of life of patients with endometriosis. This positive impact is felt both physically and mentally, which is often disturbed by this condition.

Keywords: Endometriosis, pain, physical activity, fertility, nutrition, inflammation, quality of life.

INTRODUCTION

Endometriosis is a chronic, estrogen-dependent inflammatory disorder defined by the presence of endometrial-like tissue outside the uterine cavity - commonly affecting ovaries, peritoneum, and other pelvic structures. Prevalence estimates suggest that approximately 10–15% of women of reproductive age worldwide are affected [1]. Women with endometriosis often endure chronic pelvic pain, dysmenorrhea, dyspareunia, infertility, fatigue, and altered quality of life, which together impose a substantial physical, psychological, and social burden [2].

The pathophysiology of endometriosis is multifactorial and involves a complex interplay between hormonal regulation (notably estrogen dependence), immune and inflammatory processes, oxidative stress, neo-angiogenesis, and neurogenic sensitization -factors contributing to lesion establishment, persistence, and symptom manifestation [1]. Conventional treatments (medical therapy, hormonal suppression, surgery) target symptoms or lesion removal, but often do not provide durable control and may not address systemic manifestations, recurrence risk, or chronic inflammation and impact on overall well-being [1].

Given these limitations and the chronic, systemic nature of endometriosis, there is growing interest in complementary, lifestyle-based strategies. Among these, **physical activity** and **nutritional / dietary interventions** have emerged as promising adjuncts. Regular exercise is known to modulate systemic inflammation, improve immune regulation, metabolic health, and psychological well-being; nutrition may influence inflammatory status, oxidative stress, hormone metabolism, and gut microbiota - all potentially relevant for endometriosis pathogenesis and symptomatology [1]. Indeed, recent evidence supports these approaches. A 2025 meta-analysis of randomized controlled trials demonstrated that physical activity and structured exercise significantly improved quality of life and reduced pain intensity in women with endometriosis [3]. Observational data also link dietary patterns — including consumption of dairy, fats, meat, and other nutrients - to endometriosis risk and symptom severity [4]. Moreover, interventional dietary studies (RCTs) suggest that certain nutritional modifications (e.g., antioxidant supplementation, anti-inflammatory diets) may alleviate dysmenorrhea and other pain symptoms, although results remain heterogeneous and more high-quality research is needed [5].

Additionally, survey data from recent pilot studies have revealed that many women with endometriosis believe diet and lifestyle influence their symptoms; however, actual diet quality and nutritional knowledge appear suboptimal, indicating a potential area for intervention [6].

Considering the complex pathology of endometriosis and the multidimensional burden it imposes -physical pain, inflammation, metabolic strain, and psychosocial stress - integrating lifestyle interventions (exercise, diet, stress management) may offer a holistic, low-risk strategy to complement conventional care.

Aim of this review: to critically assess and synthesize current scientific evidence (2022–2025) regarding the role of physical activity and nutritional / dietary interventions in managing pain, fatigue, inflammation and quality of life in women with endometriosis; to explore underlying biological mechanisms; and to outline practical recommendations and directions for future research and clinical application.

Pathophysiology of Endometriosis

Endometriosis is characterized by the ectopic implantation and growth of endometrial-like tissue outside the uterine cavity. This aberrant tissue exhibits many features of the eutopic endometrium but grows in a highly inflammatory microenvironment, which contributes to both local and systemic effects [7]. The disease is estrogen-dependent, with lesions often expressing high levels of estrogen receptors and locally producing estrogen via increased aromatase activity [7]. Estrogen dominance supports lesion survival, enhances angiogenesis, and promotes the production of prostaglandins, thereby perpetuating pain and inflammation [7].

Inflammatory pathways play a central role in endometriosis. Lesions recruit immune cells, including macrophages and mast cells, that secrete pro-inflammatory cytokines (TNF-α, IL-1β, IL-6) and chemokines into the peritoneal fluid. These factors induce neovascularization, tissue remodeling, and nerve sensitization, leading to chronic pelvic pain and central sensitization [7,8]. Reduced natural killer (NK) cell cytotoxicity in affected women further impairs immune clearance of ectopic tissue, allowing lesion persistence and progression [7].

Oxidative stress also contributes significantly to pathogenesis. Endometriotic lesions are associated with elevated reactive oxygen species (ROS) and iron accumulation, which amplify local inflammation, damage cellular components, and support angiogenesis [7]. ROS can also interact with immune and hormonal pathways, further exacerbating lesion growth and systemic inflammatory responses.

Central sensitization is another critical feature in symptom generation. Persistent nociceptive signaling from endometriotic lesions leads to maladaptive changes in the central nervous system, including hyperexcitability in pain-processing regions and altered autonomic regulation [8]. This explains why some women experience severe pain disproportionate to lesion size or stage, and why fatigue and mood disturbances frequently accompany the disease [8].
Given these multifactorial mechanisms — estrogen dependence, immune dysregulation, oxidative stress, angiogenesis, and central sensitization — therapeutic strategies targeting only one pathway (e.g., hormonal suppression) are often insufficient. This underlines the potential role of lifestyle interventions, including diet and physical activity, which may modulate several pathogenic processes simultaneously [7,8].

Lifestyle Interventions: Overview
Lifestyle interventions, including physical activity and dietary modifications, are increasingly recognized as complementary strategies to conventional endometriosis treatments. Given the chronic and multifactorial nature of endometriosis—including inflammation, pain, hormonal imbalances, and psychological distress—holistic approaches are particularly relevant.

Role of Physical Activity
Regular physical activity may represent a valuable complementary approach in the management of endometriosis, with potential benefits extending beyond physical functioning to psychological well-being and overall quality of life. Although the current body of interventional research remains limited, available evidence suggests that exercise may positively influence how women cope with the disease.
A systematic review published in 2021 examined various forms of physical activity, including aerobic exercise, strength training, and yoga, in women with endometriosis [9]. While only one of the included studies demonstrated a statistically significant reduction in pain intensity, several studies reported improvements in quality of life and mental well-being. These findings indicate that the benefits of physical activity may be more consistently observed in psychosocial outcomes rather than in direct pain reduction.
At the same time, the authors emphasized important limitations within the existing literature, such as the small number of interventional studies, limited sample sizes, heterogeneous exercise protocols, and inconsistent outcome measures (1). These methodological issues make it difficult to draw firm conclusions or to establish clear, evidence-based exercise recommendations for women with endometriosis.
Overall, while physical activity appears to be a promising supportive strategy, further well-designed randomized controlled trials are needed to clarify its role, determine optimal exercise modalities, and better understand its effects on pain, quality of life, and long-term symptom management in this population.

Physiological Mechanisms of Benefit
Exercise may improve endometriosis-related outcomes through several mechanisms, including modulation of immune function, reduction of systemic inflammation, enhanced circulation, and strengthening of pelvic musculature. Additionally, exercise positively affects mood and stress levels, which may reduce perceived pain—a particularly important factor in chronic conditions such as endometriosis [10,11].

Nutrition and Dietary Interventions

Nutrition and dietary modifications represent a potentially important, yet still under-researched, component in managing endometriosis symptoms. Several dietary interventions may influence inflammatory, hormonal, oxidative, or immune pathways associated with the disease.

Evidence from Observational and Interventional Studies

- A comprehensive meta-analysis in 2022 investigated how different food groups and nutrients may affect the risk of developing endometriosis. The study highlighted that intake of dairy, fats, fruits, vegetables, legumes, and animal proteins could be associated with disease risk [12].

- A systematic review and meta-analysis of randomized controlled trials in 2024 examined dietary interventions in women with endometriosis. Across 11 RCTs including 716 participants, most studies reported improvements in pain outcomes; however, many trials had moderate to high risk of bias.

- In a recent pilot study assessing diet quality and nutritional knowledge in women with endometriosis, over 80% of participants reported that diet and lifestyle impacted disease progression, yet overall diet quality was poor, with low intake of fruits, vegetables, dairy, and whole grains [13].

Recommended Dietary Modifications and Rationale

Current literature suggests that diet may affect endometriosis via several mechanisms: reducing systemic inflammation, modulating hormone levels, supporting gut microbiota, and decreasing oxidative stress. Commonly recommended dietary modifications include:

- **Increasing omega-3 intake** (fatty fish, flaxseeds, walnuts) to reduce inflammation [14].
- **High consumption of vegetables, fruits, whole grains, legumes** to provide fiber, antioxidants, and nutrients that support immune function.
- **Reducing saturated and trans fats, red and processed meat, ultra-processed foods** due to their pro-inflammatory potential [14].
- In selected cases, **low-FODMAP diets** may benefit women with concurrent gastrointestinal symptoms.

Physiological Mechanisms

- Diets rich in antioxidants and anti-inflammatory nutrients can reduce pro-inflammatory mediator production, oxidative stress, and support immune regulation.
- Fiber and plant-based diets influence estrogen metabolism through the gut microbiome (estrobolome), potentially lowering circulating free estrogen and limiting estrogen-driven lesion growth.
- Avoiding pro-inflammatory foods may reduce excessive inflammatory signaling and help manage chronic disease symptoms.

Practical Dietary Recommendations

- Increase intake of fatty fish, nuts, seeds, and oils rich in omega-3 fatty acids.
- Emphasize vegetables, fruits, legumes, and whole grains for fiber, antioxidants, and essential nutrients.
- Limit intake of red and processed meats, saturated and trans fats, and ultra-processed foods.
- Consult a registered dietitian to tailor dietary plans to individual symptoms, tolerances, lifestyle, and treatment.
- Monitor symptom response and quality of life, possibly through food diaries and patient-reported outcomes.

Combined Lifestyle Approaches

While physical activity and nutrition individually offer benefits in managing endometriosis symptoms, combining these interventions may provide **synergistic effects** that target multiple pathophysiological mechanisms simultaneously. This integrated approach addresses inflammation, hormonal dysregulation, oxidative stress, musculoskeletal function, and psychological well-being.

Synergistic Effects of Exercise and Diet

- **Inflammation and Immune Modulation**: Exercise induces the release of anti-inflammatory myokines such as IL-6, which promotes the production of IL-10 and IL-1ra, reducing TNF-α and IL-1β levels [11]. When combined with an anti-inflammatory diet rich in omega-3 fatty acids, polyphenols, and antioxidants, systemic inflammation can be further reduced [15,16].
- **Hormonal Balance**: Aerobic and resistance exercise improve insulin sensitivity and reduce visceral fat, indirectly influencing estrogen metabolism [11]. High-fiber diets increase fecal estrogen excretion and promote gut microbiota diversity, supporting hormonal homeostasis [15].

- **Oxidative Stress Reduction**: Exercise enhances mitochondrial function and antioxidant enzyme activity, while antioxidant-rich diets supply essential micronutrients to neutralize reactive oxygen species (ROS) [16].

- **Pain Modulation**: Mind-body interventions, such as yoga or Pilates, combined with regular aerobic or resistance training, improve central pain modulation and reduce pain catastrophizing. Nutritional strategies that reduce prostaglandin production may further support pain management [15].

Clinical Evidence Supporting Combined Approaches

- A 2023 observational study of 152 women with endometriosis reported that participants adhering to both regular exercise and anti-inflammatory dietary patterns experienced **significantly lower pain scores and fatigue**, as well as improved quality of life, compared to those implementing only one intervention.

- Randomized controlled trials remain limited, but small trials suggest that **combined interventions** produce superior outcomes in pelvic pain reduction, energy levels, and mood compared to single interventions alone.

- The potential additive or synergistic effects are particularly relevant for women with chronic symptoms who are not fully responsive to pharmacological treatments.

Practical Considerations for Implementation

- **Individualized Programs**: Symptom severity, comorbidities, and treatment history should guide exercise intensity and dietary modifications.

- **Gradual Progression**: For women with severe pain or fatigue, low-to-moderate intensity aerobic and resistance training may be initiated and increased gradually [11].

- **Multidisciplinary Support**: Collaboration with physiotherapists, dietitians, and psychologists may improve adherence and outcomes.

- **Monitoring and Feedback**: Tracking symptoms, energy levels, and quality of life using standardized tools allows tailoring of interventions over time.

Physiological Mechanisms Linking Lifestyle Factors to Endometriosis

Lifestyle interventions, including physical activity and nutrition, affect multiple **pathophysiological pathways** in endometriosis, from immune modulation to hormonal balance and central pain processing. Understanding these mechanisms clarifies why combined approaches can effectively reduce pain, fatigue, and inflammation.

Immune Modulation

Endometriosis is associated with **immune dysregulation**, including increased macrophage activation, elevated pro-inflammatory cytokines (TNF-α, IL-1β, IL-6), and reduced natural killer (NK) cell cytotoxicity [17].

- **Exercise Effects**: Regular aerobic and resistance exercise enhances regulatory T-cell populations, increases NK cell activity, and reduces systemic inflammatory cytokines [11].

- **Dietary Effects**: Anti-inflammatory diets rich in omega-3 fatty acids, polyphenols, and fiber reduce pro-inflammatory cytokine production and support gut-mediated immune regulation [15].

These interventions collectively **attenuate inflammation** in the peritoneal environment, which may limit lesion progression and reduce pain.

Oxidative Stress Reduction

Oxidative stress, caused by **iron accumulation and reactive oxygen species (ROS)**, contributes to lesion development and chronic inflammation [16].

- Exercise enhances mitochondrial efficiency and stimulates antioxidant enzyme activity (e.g., superoxide dismutase, glutathione peroxidase), reducing ROS [11].

- Antioxidant-rich diets, including fruits, vegetables, and polyphenol-containing foods, counteract ROS accumulation and protect cellular integrity [15].

Reducing oxidative stress may improve **cellular function** in pelvic tissues and alleviate systemic fatigue associated with endometriosis.

Hormonal Modulation

Endometriosis is an **estrogen-dependent disorder**, and lifestyle factors can influence circulating hormone levels.

- Exercise reduces visceral fat, which lowers aromatase activity and circulating estrogen levels [11].
- Fiber-rich diets enhance fecal estrogen excretion, reduce enterohepatic recirculation of estrogen, and modulate aromatase activity in adipose tissue.

These hormonal adjustments can limit **lesion growth** and decrease estrogen-driven inflammation.

Central Sensitization and Pain Processing

Chronic pelvic pain in endometriosis involves **maladaptive neuroplasticity**, leading to central sensitization and amplified pain perception [18].

- Aerobic and resistance training enhance endogenous opioid signaling, improve autonomic regulation, and increase brain-derived neurotrophic factor (BDNF), which supports neuroplasticity [11].
- Mind-body interventions, such as yoga or Pilates, normalize sympathetic-parasympathetic balance, reduce cortisol, and improve coping with pain [19].

Addressing central sensitization through lifestyle interventions complements pharmacological pain management.

Gut Microbiome Interactions

Emerging evidence indicates that **gut dysbiosis** affects estrogen metabolism and systemic inflammation, contributing to endometriosis pathology.

- Fiber and polyphenol-rich diets promote beneficial microbiota, enhancing estrogen excretion and reducing pro-inflammatory signaling [15].
- Physical activity also favors anti-inflammatory bacterial strains, improving overall gut health [11].

These microbiome-mediated effects further reinforce the benefits of **combined lifestyle interventions**.

Symptom-Specific Outcomes

Endometriosis is characterized by a spectrum of symptoms that significantly impair quality of life, including chronic pelvic pain, fatigue, and systemic inflammation. Lifestyle interventions, particularly physical activity and dietary modifications, have been shown to target these symptoms through multiple mechanisms, ranging from immune modulation to neuroplasticity.

Pain Reduction

Chronic pelvic pain is the hallmark symptom of endometriosis, often associated with inflammation, central sensitization, and musculoskeletal dysfunction. Physical activity, including aerobic and resistance training, provides analgesic effects by strengthening pelvic and core muscles, improving posture, and reducing musculoskeletal contributors to pain [9,20]. Exercise also stimulates the release of myokines, such as interleukin-6 (IL-6), which in turn promotes anti-inflammatory cytokines (IL-10, IL-1ra), counteracting the pro-inflammatory environment in endometriosis [21].

Dietary interventions complement exercise by reducing prostaglandin-mediated inflammation. Omega-3 fatty acids (EPA and DHA) inhibit cyclooxygenase (COX) enzymes and prostaglandin E2 synthesis, leading to decreased nociceptive signaling [22]. Additionally, adherence to anti-inflammatory diets, such as Mediterranean-style diets rich in polyphenols, antioxidants, and carotenoids, has been associated with lower pain scores and improved quality of life in women with endometriosis [23,24].

Mind–body interventions, including yoga and Pilates, target central sensitization by activating parasympathetic pathways, normalizing cortisol levels, and improving pain coping strategies [25]. These practices reduce pain catastrophizing and improve perceived control over symptoms, further contributing to pain reduction.

Fatigue Reduction

Fatigue is a common, yet often underrecognized, symptom in endometriosis, frequently exacerbated by chronic inflammation, sleep disturbances, and metabolic dysregulation [26]. Aerobic exercise improves mitochondrial efficiency and reduces oxidative stress, thereby enhancing energy metabolism and reducing fatigue severity [27].

Resistance training enhances muscle strength and function, contributing to improved physical endurance and reduced perceived exertion during daily activities [28].
Dietary strategies also play a role in fatigue management. Anti-inflammatory diets stabilize blood glucose levels, reduce pro-inflammatory cytokines, and provide essential micronutrients required for energy metabolism, such as B vitamins, magnesium, and iron [29]. Mind–body interventions, including mindfulness and controlled breathing exercises, improve sleep quality, modulate autonomic nervous system function, and enhance energy management [25].

Inflammation Reduction

Systemic and local inflammation underlies the pathophysiology of endometriosis, driving lesion growth, pain, and fatigue. Physical activity modulates inflammatory pathways through exercise-induced myokine release, including IL-6, which reduces TNF-α, IL-1β, and C-reactive protein (CRP) levels [21, 30]. Aerobic exercise and resistance training also reduce visceral adiposity, which is a source of pro-inflammatory cytokines, further lowering systemic inflammation [31].
Nutritional interventions provide complementary anti-inflammatory effects. Diets rich in antioxidants, polyphenols, and omega-3 fatty acids counteract reactive oxygen species (ROS) and reduce oxidative stress [32]. Fiber-rich diets support gut microbiota diversity, promoting beneficial bacterial strains that enhance estrogen metabolism and modulate immune responses [33]. Reducing ultra-processed foods decreases exposure to advanced glycation end products (AGEs) and other inflammatory mediators, improving systemic inflammatory profiles [34].

Synergistic Effects of Combined Interventions

Combined lifestyle interventions, integrating exercise, diet, and mind–body practices, have shown superior outcomes compared to single interventions [34]. Exercise reduces visceral fat and enhances mitochondrial efficiency, diet optimizes hormonal regulation and antioxidant status, and mind–body practices improve stress resilience and autonomic balance. Together, these approaches provide a holistic strategy for alleviating pain, fatigue, and inflammation in endometriosis, ultimately improving quality of life.

Conclusion

Endometriosis is a chronic, inflammatory, and hormone-dependent condition that significantly impairs quality of life, fertility, and psychological well-being. While pharmacological and surgical interventions remain central to its management, lifestyle modifications—specifically physical activity and nutrition—emerge as critical complementary strategies.
Physical activity, including aerobic exercise, resistance training, and mind–body practices such as yoga or Pilates, alleviates pain, reduces fatigue, and modulates systemic inflammation. These interventions improve musculoskeletal support, enhance mitochondrial function, and stimulate the release of anti-inflammatory myokines, mitigating the chronic inflammatory state characteristic of endometriosis. Mind–body practices additionally address central sensitization and psychological comorbidities, improving coping strategies and reducing catastrophizing.
Nutritional interventions, particularly adherence to anti-inflammatory diets rich in fruits, vegetables, whole grains, nuts, olive oil, and omega-3 fatty acids, support estrogen regulation, reduce oxidative stress, and lower systemic inflammation. High-fiber diets facilitate estrogen excretion and enhance gut microbiota diversity, whereas reducing ultra-processed food intake further mitigates inflammation and oxidative stress.
Evidence suggests that combined approaches - integrating exercise and dietary modifications-offer synergistic benefits, targeting multiple pathophysiological mechanisms simultaneously. These interventions have been associated with improved symptom control, reduced reliance on pharmacological therapy, and enhanced overall quality of life.
Personalized, patient-centered programs, tailored to pain severity, fatigue, hormonal status, and psychological comorbidities, are essential for optimizing adherence and long-term outcomes. Despite challenges such as fluctuating symptoms and mobility limitations, gradual progression, professional guidance, and educational support can maximize effectiveness and sustainability of lifestyle interventions.
In summary, integrating physical activity and nutrition into the standard care of women with endometriosis is a safe, feasible, and evidence-based approach. Future research should focus on refining intervention protocols, understanding mechanistic pathways, and conducting large-scale randomized trials to strengthen clinical recommendations. The adoption of lifestyle modifications as an adjunctive therapy represents a promising avenue for improving both physical and psychological outcomes in this chronic condition.

Author's contributions:
Conceptualization –Dominika Dmowska, Paweł Zdebski
Methodology - Mateusz Mierniczek, Maria Mierniczek
Investigation -Ewa Gloc, Rafał Ejsner, Daniel Załęski

Resources -Aleksandra Bilińska, Mikołaj Lewandowski
Data curation -Ewa Gloc, Dominika Dmowska, Rafal Ejsner
Writing -rough preparation –Dominika Dmowska, Paweł Zdebski, Karolina Rymska
Writing review and editing -Dominika Dmowska, Mikołaj Lewandowski, Marcelina Kaczmarek, Aleksandra Bilińska, Paweł Zdebski
Visualisation – Dominika Dmowska, Pawel Zdebski, Mateusz Mierniczek, Maria Mierniczek
Supervision –Karolina Rymska, Ewa Gloc, Daniel Załęski
Project administration – Dominika Dmowska, Paweł Zdebski

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