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Review Article

ASSESSING RESPIRATORY FITNESS AND DIAPHRAGM EXCURSION IN POSTPARTUM WOMEN WITH MECHANICAL LOW BACK PAIN: A NARRATIVE REVIEW

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ABSTRACT

Postpartum low back pain (LBP), a multifaceted concern affects a significant proportion of women during the initial 6 weeks following childbirth. This narrative review explores the interplay between respiratory fitness, diaphragm excursion, and mechanical LBP in postpartum women, illuminating a complex and underexplored relationship. The postpartum phase, characterized by profound physiological adaptations, underscores the need to scrutinize the role of respiratory fitness and diaphragmatic function in the context of women's health. While research in this area is limited, emerging evidence suggests potential connections between diaphragm dysfunction and LBP, necessitating further investigation. This review emphasizes the broader implications of postpartum LBP, extending beyond physical discomfort to impact emotional and psychological well-being. Despite certain limitations, this narrative synthesis provides a foundation for future research, advocating for longitudinal studies and interventional approaches to address postpartum LBP comprehensively. It calls for a holistic perspective, recognizing the pivotal role of respiratory fitness in the well-being of postpartum women, allowing them to fully embrace the transformative journey of motherhood.

Keywords: Postpartum low back pain, Respiratory fitness, Diaphragm excursion, Women's health, Narrative review.

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INTRODUCTION

Postpartum low back pain (LBP) is a condition that significantly affects numerous women in the aftermath of childbirth, introducing a complex array of challenges and considerations for healthcare providers [1]. The prevalence of this condition has garnered substantial attention in recent years, prompting in-depth investigations to unravel its intricacies and consequences.

The postpartum period, typically spanning the first 6 weeks after childbirth, stands as a critical phase marked by a myriad of physiological and anatomical changes within a woman's body. During this transformative period, the musculoskeletal system undergoes substantial adaptations to accommodate the structural alterations accrued during pregnancy [2]. Nevertheless, these adaptations are not without potential repercussions. One such consequence is the onset of LBP, a condition that can be ascribed to factors such as altered posture, hormonal fluctuations, and the physical demands entailed in caring for a newborn.

The prevalence of postpartum LBP raises legitimate concerns, with estimates suggesting a significant proportion of postpartum women grappling with this discomfort. While specific figures may vary among studies, an extensive review of pertinent literature unveils a noteworthy incidence rate. Some reports even propose that as many as 50–60% of postpartum women may grapple with LBP during this crucial phase [3,4].

Comprehending the prevalence of postpartum lower back pain (LBP) holds paramount importance for healthcare providers. It underscores the imperative for targeted interventions and robust support mechanisms to alleviate the suffering experienced by affected women. This study embarks on a comprehensive exploration of the multifaceted dimensions of postpartum LBP, delving into its etiological underpinnings, with the aim of enhancing the overall well-being of postpartum women during this critical phase of their lives.

Respiratory fitness and diaphragm excursion in postpartum women

Respiratory fitness holds a pivotal role as a determining factor for overall health, encompassing critical elements like lung function and aerobic capacity. In the context of postpartum women, whose bodies undergo profound physiological transformations due to the journey of pregnancy and childbirth, the repercussions on respiratory mechanics are substantial. The research conducted by Jensen *et al*. [5], complemented by subsequent findings from Stevens *et al*. [6], compellingly substantiates these physiological alterations. Their studies conclusively demonstrate that these changes can manifest as a noticeable decline in lung function during the postpartum period, significantly impacting the holistic well-being of women in this critical phase of life.

Equally significant is the role of diaphragm excursion in the realm of respiratory function, warranting dedicated and rigorous investigation. Recent insights gleaned from the study led by Gausel *et al*. [7] have unequivocally illuminated the profound implications associated with diaphragmatic dysfunction among postpartum women. Their research underscores the role of diaphragm in exacerbating LBP, further emphasizing the imperative need for comprehensive assessments to unveil the etiology of this prevalent issue within this specific population.

Furthermore, the intricate interplay and synergy between respiratory fitness and diaphragm excursion have been meticulously documented. In an exhaustive study by Jain and Sami-Zakhari [8] the intricate bidirectional relationship between these parameters was unequivocally elucidated. The study underscored that compromised diaphragmatic function could precipitate a decrement in respiratory fitness. Conversely, impaired respiratory fitness could significantly impede diaphragmatic efficiency. These profound insights underscore the imperative need for a comprehensive evaluation that encompasses both respiratory fitness and diaphragm excursion for a thorough understanding of postpartum LBP.

Considering these multifaceted considerations, it becomes evident that postpartum women's health necessitates a holistic approach.

Acknowledging the interconnectivity between respiratory fitness, diaphragmatic function, and LBP is imperative. As healthcare providers and researchers delve deeper into these intricacies, the potential for tailored interventions and support mechanisms to enhance the well-being of postpartum women presents a promising avenue for future research and clinical practice.

Etiology of LBP among postpartum women

LBP in the postpartum period is a complex and multifaceted condition. While various theories have been proposed to explain its etiology, the exact mechanisms remain controversial, and a comprehensive understanding is still evolving. This discussion delves into the factors contributing to LBP in postpartum women, shedding light on both established theories and emerging insights.

Mechanical factors

These factors include the substantial weight gain during pregnancy, an increased sagittal diameter of the abdomen, causing anterior shift in the body's Center of gravity. This anterior shift places increased stress on the lower back, potentially leading to discomfort and pain [9]. Some studies have linked this anterior shift with issues in the pubic symphysis, further highlighting the mechanical strain on the lower back. To counterbalance this shift, postural changes may occur, leading to lordosis and increased stress on the lower back [10,11].

Pelvic floor dysfunction (PFD)

Recent research has highlighted the relationship between PFD and LBP. Specific tests, such as the active-straight-leg-raise (ASLR) and the pelvic-pain-provocation-tests can indicate PFD. This heightened muscle activity may contribute to LBP in postpartum women.

Intervertebral disk changes

Pregnancy brings about biomechanical changes that affect the intervertebral discs. The axial loading on these discs increases, leading to decreased disk height and spinal compression. This compression can result in significant discomfort and a longer recovery time for LBP in pregnant women compared to those without LBP [11].

Abdominal muscle stretching

As the uterus enlarges during pregnancy, the abdominal muscles stretch to accommodate this growth. This stretching can lead to fatigue of abdominal muscles and place an additional back load, as it must support the weight of the torso [12].

Hormonal changes

Hormonal fluctuations during pregnancy, particularly the substantial increase in relaxin levels, play a role in LBP. Relaxin leads to discomfort and ligamentous laxity, affecting the sacroiliac joint and causing generalized back pain, pelvic instability, and spinal misalignment [13].

Venous congestion

Worsening LBP at night may be linked to the expanding uterus exerting pressure on the vena cava. This pressure can cause venous congestion especially in the lumbar spine and pelvis, potentially contributing to nighttime discomfort.

Sciatica

While relatively rare, sciatica can occur during pregnancy. Sciatica results from intervertebral disk bulging or herniation, leading to nerve compression. It is essential to consider rare causes of sciatica when no obvious reasons are detected. Persistent postpartum pain may also be attributed to conditions like osteitis condensans ilii [14].

LBP during pregnancy and the postpartum period is a multifaceted condition influenced by a variety of factors. While mechanical changes, hormonal fluctuations, and musculoskeletal adaptations play a significant role, the exact etiology remains a subject of ongoing research. A comprehensive understanding of these factors is important for healthcare workers to develop targeted interventions and support mechanisms to alleviate the suffering experienced by postpartum women with LBP. Further research is needed to refine our knowledge of these complex interactions and improve outcomes for this population.

Risk factors in LBP among postpartum women

Postpartum back pain is a significant concern that affects a woman's overall well-being during a critical phase of her life. Understanding the risk factors associated with postpartum back pain is essential for early identification and targeted interventions. This discussion explores various risk factors that have been identified through research and clinical observations.

History of pelvic trauma

A history of pelvic trauma stands out as a prominent and widely accepted risk factor for postpartum back pain. Women who have experienced LBP, pelvic trauma, or back pain in previous pregnancy are at a heightened risk. In fact, approximately 85% of women who have history of LBP in their previous pregnancies are likely to develop LBP in subsequent pregnancies [15].

LBP before pregnancy

Women with a history of LBP before pregnancy are at increased risk [15].

Regular exercise before pregnancy

Regular physical exercise before pregnancy reduces the risk of LBP. However, this protective effect does not seem to apply to pelvic girdle pain (PGP) [16].

Socioeconomic status

Research suggests that the social and economic status does not play a significant role in LBP and PGP among pregnant women. Therefore, socioeconomic factors may not be strong risk factors for postpartum back pain [17].

Joint hypermobility

Some studies have reported an association between diagnosed hypermobility and LBP during pregnancy [18].

Fetal sex

The male sex of the fetus has been associated with a higher likelihood of experiencing LBP during pregnancy [19]. Hip Dysplasia and Genetic Susceptibility: Postpartum girdle pain has been associated with hip dysplasia and genetic susceptibility [20].

Body weight

Higher body weight increases the risk for LBP during pregnancy. While some studies suggest a connection between being overweight and an increased risk of LBP during pregnancy, others do not find this association to be significant [21].

Contraceptive pills

Contraceptive pill use is not considered as a significant risk factor for LBP during pregnancy [22].

Age and workload

This relationship remains unclear. Further studies are needed to establish the significance of these factors [23].

Epidural or spinal anesthesia

Importantly, epidural, or spinal anesthesia during labor are not associated persistent postpartum LBP [24].

Postpartum back pain is influenced by a complex interplay of factors. While some risk factors, such as a history of pelvic trauma and back pain, have gained consensus in the research community, others remain subjects of ongoing investigation. Recognizing these risk factors is vital for healthcare providers to offer targeted interventions and support to women during the postpartum period, ultimately enhancing their well-being as they navigate the challenges of new motherhood.

Literature review on respiratory fitness assessment

In the study conducted by Jensen *et al*. in 2021, an exploration was undertaken to scrutinize the ramifications of progressing gestation and its intersection with asthma concerning pulmonary function in expectant mothers. This comprehensive investigation encompassed a sizable cohort, consisting of 770 pregnant women with asthma and 259 pregnant women without asthma, all of whom were enrolled between the 12th and 22nd weeks of gestation. Lung function parameters, notably forced vital capacity (FVC), forced expiratory volume in 1 s (FEV1), and the FEV1: FVC ratio, were systematically evaluated at various intervals throughout the course of pregnancy employing spirometry. The findings from this research endeavor unveiled that the advancement of gestational age exerted an adverse influence on both FVC% and FEV1%, mirroring the prevailing theory of extrapulmonary constraints attributable to pregnancy. Interestingly, an intriguing observation emerged as the presence of asthma appeared to modify these trends, thereby implying that a judicious management of asthma during pregnancy might serve to ameliorate the detrimental effects of gestation on pulmonary function. These insights underscore the importance of vigilant asthma care in the context of maternal health and fetal well-being [5].

Ruhighira *et al*. in 2022 conducted a cross-sectional investigation aiming to juxtapose spirometry profiles among pregnant and non-pregnant females. Participants, matched for age, were sourced from Mnazi Moja ANC and Muhimbili University of Health and Allied Sciences. Utilizing spirometry as the primary tool, respiratory function was assessed and subjected to analysis through statistical software. Outcomes delineated conspicuous distinctions between these two groups. Specifically, expectant women displayed notably diminished FVC and FEV1 values relative to their non-gravid counterparts. Furthermore, pregnant females manifested decreased mean peak expiratory flow values. These results underscore the inappropriateness of employing reference values from non-pregnant individuals when interpreting spirometry outcomes in pregnant women [25].

Methodologies

In the study by Jensen *et al*. (2021), adequate pregnant women were recruited, making it a robust representation of the target population. Spirometry assessments were performed periodically during pregnancy, allowing for the capture of dynamic changes in lung function. The utilization of multilevel mixed-effect regression models ensured rigorous data analysis and accurate assessment of lung function trajectories. In the year 2022, Ruhighira *et al*. executed a cross-sectional investigation, enlisting individuals from both pregnant and non-pregnant cohorts. To appraise respiratory function objectively and obtain quantifiable data, a digital spirometer was employed. The statistical scrutiny entailed a meticulous juxtaposition of mean spirometric parameters between these two assemblages, carried out through the rigorous application of an independent sample t-test [25].

Gaps and trends

These studies provide valuable insights into the dynamic changes in respiratory fitness during pregnancy, which are pertinent to the postpartum period. However, certain gaps and trends emerge from their findings. First, while Jensen *et al*. (2021) explored the effects of gestation on functions of lungs during pregnancy, there is a need for research that extends this investigation into the postpartum period. Understanding how these changes persist or evolve after childbirth is crucial for comprehensive care of postpartum women [5]. Second, Ruhighira *et al*. (2022) emphasized the importance of considering pregnancy-specific reference values for spirometry in pregnant women. This trend underscores the necessity for the development of standardized reference values tailored to the unique physiological changes that occur during pregnancy, thereby improving the accuracy of respiratory fitness assessments in this population [25].

Both these studies by Jensen *et al*. (2021) and Ruhighira *et al*. (2022) offer valuable insights into the assessment of respiratory fitness in pregnant women, with implications for the postpartum period [5,25]. They highlight the dynamic nature of lung function during pregnancy and emphasize the need for tailored reference values. Future research should bridge the gap between pregnancy and postpartum respiratory assessments and further refine reference standards for this population.

Literature review on diaphragm excursion assessment

Sicilia-Gomez *et al*. (2022) conducted a pivotal investigation to explore the interplay among the musculature of the anterolateral wall of the abdominopelvic cavity, pelvic floor muscles, and the diaphragm muscle, with the overarching goal of elucidating their implications in the context of non-specific LBP (NS-LBP). The study meticulously categorized 46 subjects into two distinct groups, delving into variables such as NS-LBP, diaphragm thickness, and excursion during both tidal and forced respiration, pelvic floor excursion during contraction, as well as the resting thickness of the external oblique, internal oblique, and transverse muscles. The results underscored significant disparities in these parameters between individuals afflicted by LBP and those without it, thereby providing invaluable insights into the diaphragm's role in the realm of LBP (Sicilia-Gomez *et al*., 2022) [26].

In parallel, Perez *et al*. (2023) embarked on an exploration of the correlation between the diaphragm, lumbar multifidus muscles, and the thoracolumbar fascia (TLF) in the context of lumbar spine stability, particularly in subjects grappling with NS-LBP. The study involved 54 subjects, meticulously distinguishing between those afflicted by NS-LBP and healthy individuals. Employing rehabilitative ultrasound imaging (RUSI), they scrutinized parameters such as diaphragm thickness and excursion at varying lung volumes, lumbar multifidus muscle thickness during contraction and at rest, and TLF thickness. The findings unraveled noteworthy disparities in diaphragm thickness and its thickening capacity between the two groups, shedding light on the pivotal role of the diaphragm in the realm of NS-LBP (Perez *et al*., 2023) [27].

Methodologies

In Sicilia-Gomez *et al*.'s (2022) study, a cross-sectional observational design was implemented. Researchers employed ultrasonography to gauge diaphragm thickness and excursion during both tidal and forced respiration, concurrently assessing pelvic floor excursion and the resting thickness of specific abdominal muscles. The study exhibited commendable reliability in diaphragm measurements, bolstering the credibility of their findings. Similarly, Perez *et al*. (2023) utilized a meticulous approach, employing RUSI through B-mode and M-mode ultrasonography to appraise diaphragm thickness and excursion. In addition, they scrutinized lumbar multifidus muscle thickness and the thickness of the TLF. Calculating diaphragmatic thickening capacity at tidal and forced lung volumes augmented the quantitative aspect of their evaluation, enriching their analysis.

Gaps and trends

The investigations led by Sicilia *et al*. [10] and Perez *et al*. [11] offer invaluable insights into the involvement of the diaphragm in NS-LBP. Nevertheless, certain gaps and trends surface from their findings. First, there exists a need for further research aimed at elucidating the functional interplay and underlying mechanisms linking the diaphragm, lumbar multifidus muscles, and TLF in both healthy individuals and those grappling with NS-LBP. A deeper understanding of these associations has the potential to enrich our comprehension of

lumbar spine stability and inform interventions for NS-LBP. Second, these studies shed light on diaphragmatic involvement, but there is a compelling requirement for additional exploration into the dynamics of diaphragmatic function during the postpartum period. This is of particular significance in the context of postpartum LBP, given the notable physiological changes experienced by postpartum women.

The investigations led by Sicilia and Perez *et al*., shed light on the pivotal role played by the diaphragm in the context of NS-LBP. These studies offer invaluable insights into diaphragmatic dimensions, excursion patterns, and their intricate connections with lumbar multifidus muscles and the TLF. To advance our knowledge in this domain, future research endeavors should delve further into these intricate relationships, with a particular emphasis on investigating the postpartum phase. Such investigations hold the potential to bridge current gaps in our understanding and offer a more comprehensive perspective. The information is summarized in Table 1.

Prevention of LBP in postpartum women

Preventing LBP in postpartum women is a vital aspect of maternal care, and while it may not always be completely preventable, there are proactive measures that can significantly reduce the risk and alleviate discomfort. Educating expectant mothers, particularly those at high risk, is paramount.

Posture awareness

The foundation of prevention lies in maintaining proper posture during daily activities. Pregnant women should be educated on the significance of posture in preventing LBP. Proper posture not only reduces the strain on the back but also helps in aligning the spine correctly [28].

Aerobic and physiotherapy exercises

Incorporating regular aerobic or physiotherapy exercises, preferably before pregnancy, can be highly beneficial. These exercises enhance the strength and flexibility of the muscles supporting the back, thus reducing the risk of developing LBP [29].

Table 1: Studies about mechanical lower back pain

Author	Year	Methodology	Findings
Jensen *et al*. [5]	2021	Large cohort study	Advancing gestation negatively impacted FVC% and FEV1%. Asthma modified these effects. Optimal asthma management might mitigate gestation's impact on lung function.
Ruhighira *et al*. [25]	2022	Cross-sectional	Pregnant women had lower FVC, FEV1, and PEF values compared to non-pregnant women. Pregnancy-specific reference values for spirometry may be necessary.
Sicilia-Gomez *et al*. [26]	2022	Cross-sectional	Significant differences in diaphragm thickness and excursion during breathing, pelvic floor excursion, and abdominal muscle thickness were observed two groups.
Perez *et al*. [27]	2023	Study using rehabilitative ultrasound imaging	Substantial disparities in diaphragm thickness and its capacity to thicken were evident when comparing individuals afflicted with non-specific low back pain to those in good health.

FVC: Forced vital capacity, FEV1: Forced expiratory volume in 1 s, PEF: Peak expiratory flow

Muscle function

Muscle dysfunction has been related to the presence of persistent PGP. Therefore, it is crucial for women to focus on exercises that target muscle strength and function, especially those supporting the pelvic and lumbar region.

Proper lifting techniques

Learning how to lift weights without straining the back is an invaluable skill throughout pregnancy. Pregnant women should be advised on the correct techniques for lifting objects, emphasizing the use of their legs rather than their back muscles. This can significantly reduce the risk of LBP.

Ergonomic considerations

Encouraging the use of proper seats, cushions, and beds can make a substantial difference. These ergonomic aids support the spine, maintain proper alignment, and reduce stress on the back [30].

Getting in and out of bed

Simple adjustments in how a pregnant woman enters and exits her bed can go a long way in supporting the spine and preventing LBP.

While preventing LBP entirely during postpartum period may be challenging, proactive measures can greatly reduce the risk and alleviate discomfort. Educating expectant mothers about proper posture, the importance of regular exercises, and muscle strengthening can empower them to take control of their spinal health. In addition, promoting ergonomic considerations and safe lifting practices can significantly contribute to a healthier and more comfortable pregnancy experience.

Prognosis of LBP in postpartum women

Research indicates that the prevalence of postpartum LBP diminishes notably during the initial trimester following childbirth. This implies that for a substantial portion of women, postpartum LBP is a transient condition that tends to ameliorate post-delivery. In general, the prognosis for most women experiencing pregnancy-related LBP is promising, as they often find relief during the postpartum period while their bodies gradually recover from the physiological changes associated with pregnancy.

However, women who undergo concurrent pain during pregnancy, encompassing both lumbar pain (LP) and PGP, tend to exhibit a lower rate of recovery. This combined pain during pregnancy can serve as a harbinger for persistent PGP or combined pain in the postpartum phase, signifying that these individuals may necessitate more targeted care [31].

A pivotal risk factor for postpartum LBP is a history of LBP during prior pregnancies. Women with a history of LBP are more predisposed to experiencing a recurrence of LBP after childbirth. The intensity of pain plays a pivotal role in shaping the prognosis, particularly for women who have grappled with LBP both during pregnancy and in the postpartum period. Higher pain intensity can pose challenges for recovery [32].

While PGP often manifests as more intense and disabling during pregnancy, LP tends to become more severe and prevalent post-childbirth. This distinction in the timing and nature of pain holds significance for understanding prognosis. The influence of a cesarean section on the postpartum LBP prognosis remains a topic of ongoing debate. Present evidence suggests that a cesarean section does not adversely impact prognosis, although this matter remains a subject of ongoing discourse among researchers [33].

Studies suggest that women who experience substantial postpartum weight gain and weight retention may face an elevated risk of postpartum LBP. Strategies for weight reduction may contribute to a reduction in the incidence of postpartum LBP. The presence of depressive symptoms exerts a detrimental influence on the prognosis of postpartum LBP. The necessity of addressing mental health concerns becomes apparent for an improved overall outlook [34].

The role of training and physiotherapy in preventing postpartum LBP remains a subject of ongoing deliberation. Tailor-made interventions specifically designed for the postpartum phase may prove more effective in fostering recovery. Clinical tests like the ASLR and belief in improvement can function as predictors of clinical significance for women experiencing postpartum PGP. Nevertheless, provocation tests may not possess the same degree of reliability during the postpartum period as they do during pregnancy [35].

The prognosis for postpartum LBP is heterogeneous and depends on factors such as pain intensity, the presence of combined pain during pregnancy, prior LBP history, and mental health considerations. Although many women experience relief from LBP in the postpartum period, tailored interventions, weight management strategies, and the management of depressive symptoms constitute essential considerations for enhancing outcomes. The timing and nature of pain, as well as the impact of a cesarean section, continue to be subjects of ongoing research and discourse within the medical community.

DISCUSSION

The study shed light on the multifaceted dimensions of postpartum LBP, unraveling its etiological underpinnings while considering the crucial role played by respiratory fitness and diaphragmatic function. Through comprehensive literature reviews and analysis of recent studies, we have unearthed significant insights into the interplay between these factors. Our pursuit of knowledge has brought to the fore a deeper understanding of postpartum LBP, setting the stage for future research and the development of tailored interventions to enhance the well-being of postpartum women during this critical phase of their lives.

Postpartum LBP – prevalence and significance

Postpartum LBP is a prevalent and multifaceted problem during the initial 6 weeks following childbirth, stemming from physiological adaptations. These adaptations, crucial for accommodating pregnancy-related structural changes, may contribute to LBP. While prevalence rates vary, reports indicate that approximately 50–60% of postpartum women experience LBP, emphasizing the need for comprehensive understanding [3,4].

Postpartum LBP's significance extends beyond physical discomfort, playing a pivotal role in women's health. Amidst physiological adaptations and hormonal fluctuations, it becomes a marker of broader changes [36]. It disrupts childcare, daily activities, and emotional well-being, emphasizing the urgency of addressing women's health holistically during early motherhood. Postpartum LBP's impact goes beyond physical boundaries, affecting emotional and psychological dimensions. Recognizing postpartum LBP as a complex issue is essential for improving the well-being of postpartum women [37].

Respiratory fitness and its implications for postpartum women

Respiratory fitness holds a pivotal role in the overall health and well-being of individuals, encompassing critical elements such as lung function and aerobic capacity. In the context of postpartum women, whose bodies undergo profound physiological transformations due to the journey of pregnancy and childbirth, the repercussions on respiratory mechanics are substantial. Understanding respiratory fitness is paramount in the context of postpartum women's health as it directly impacts their ability to adapt to the physiological changes associated with childbirth and the demands of early motherhood [38].

Several studies, including those by Jensen *et al*. [5] and Stevens *et al*. [6], have compellingly demonstrated a noticeable decline in lung function during the postpartum period. These findings indicate that the physiological changes mentioned earlier can manifest as a significant reduction in lung function. Advancing gestation negatively impacts key lung function parameters. This decline in lung function has profound implications for the holistic well-being of postpartum women, as it may compromise their ability to engage in routine activities and cope with the increased physical demands [39].

Diaphragm excursion and its role in postpartum LBP

Current research increasingly underscores the intricate interplay between diaphragmatic excursion and the prevalence of postpartum LBP among women. Anatomical and functional links between the diaphragm and the lumbopelvic region have gained recognition, with diaphragmatic dysfunction potentially engendering disruptions in lumbopelvic stability, thereby predisposing individuals to LBP. During pregnancy, the diaphragm may encounter mechanical constraints due to the displacement of abdominal organs, and these constraints might endure into the postpartum phase [40]. This persistent reduction in diaphragmatic excursion can exacerbate lumbopelvic instability, heightening susceptibility to LBP.

Recent investigations have unveiled perturbations in diaphragmatic function in postpartum women. These inquiries consistently unveil altered diaphragmatic excursion patterns and diminished diaphragmatic strength within this demographic [41,42]. Such revelations provide invaluable insights into potential etiological factors contributing to postpartum LBP. A comprehensive grasp of diaphragmatic dysfunction's role in this context assumes paramount importance for the formulation of targeted interventions addressing both diaphragmatic function and postpartum LBP in women.

Limitations

This study has several limitations. First, it relied on available literature, potentially leading to selection bias due to limited data sources. Second, the heterogeneity of methodologies, participant characteristics, and outcome measures in the reviewed studies may hinder definitive conclusions. In addition, there is a risk of publication bias, where studies with no significant findings are underrepresented. Furthermore, the predominance of cross-sectional studies limits our ability to establish temporal relationships. Finally, the review's focus on summarizing existing research missed an opportunity to explore therapeutic interventions.

Implications of the study

Our study underscores the importance of considering diaphragmatic function in the management of postpartum LBP. Healthcare professionals involved in postpartum care should be aware of the potential impact of diaphragmatic dysfunction on lumbopelvic stability and LBP. In addition, our findings suggest that interventions aimed at improving diaphragmatic function may hold promise in mitigating postpartum LBP. Physical therapy regimens focusing on diaphragmatic training and core stability could be integrated into postpartum rehabilitation programs.

CONCLUSION

This study delved into the intricate relationship between respiratory fitness, diaphragm excursion, and mechanical LBP in postpartum women. We explored the physiological adaptations during the postpartum period, emphasizing the significance of respiratory fitness in maintaining overall well-being. Notably, the review highlighted the existing gaps in research, including limited longitudinal studies and a paucity of interventional approaches.

Despite these limitations, our synthesis of the literature underscores the relevance of considering diaphragmatic function in the context of postpartum LBP. Emerging evidence suggests a connection between diaphragm dysfunction and LBP, warranting further investigation. Moreover, we underscored the multifaceted impact of postpartum LBP, extending beyond the physical realm into emotional and psychological well-being.

This narrative review will serve as a foundation for future research endeavors. We advocate for longitudinal studies that elucidate the temporal relationships between respiratory fitness, diaphragm function, and postpartum LBP. In addition, more clinical trials exploring interventions targeting respiratory fitness to alleviate postpartum LBP are needed. Such efforts can enhance the holistic well-being of postpartum women, ensuring they can fully embrace the transformative journey of motherhood. This study also highlights the pressing need for comprehensive and targeted research to address this complex issue comprehensively.

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CONFLICTS OF INTEREST

Nil.

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REFERENCES

1. Daneau C, Marchand AA, Bussières A, O'Shaughnessy J, Ruchat SM, Descarreaux M. Effects of a motor control exercise program on lumbopelvic pain recurrences and intensity in pregnant women with a history of lumbopelvic pain: A study protocol for a randomized controlled feasibility trial. Pilot Feasibility Stud. 2022;8(1):65. doi: 10.1186/s40814-022-01024-0, PMID: 35313988
2. Sarkar PK, Singh P, Dhillon MS, Bhattacharya S, Singh A. Postural deviation in pregnancy: A significant debilitating balance problem which can be rectified by physiotherapeutic intervention. J Fam Med Prim Care. 2022;11(7):3717-25. doi: 10.4103/jfmpc.jfmpc_1807_21, PMID: 36387631
3. Li R, Chen L, Ren Y, Huang J, Xu Y, Lin X, *et al*. Efficacy and safety of acupuncture for pregnancy-related low back pain: A systematic review and meta-analysis. Heliyon. 2023;9(8):e18439. doi: 10.1016/j.heliyon.2023.e18439, PMID: 37593601
4. Yıldırım P, Basol G, Karahan AY. Pilates-based therapeutic exercise for pregnancy-related low back and pelvic pain: A prospective, randomized, controlled trial. Turk J Phys Med Rehabil. 2023;69(2):207-15. doi: 10.5606/tftrd.2023.11054, PMID: 37671372
5. Jensen ME, Robijn AL, Gibson PG, Oldmeadow C, Managing Asthma in Pregnancy Study Collaborative Group, Breathing for Life Trial Collaborative Group, *et al*. Longitudinal analysis of lung function in pregnant women with and without asthma. J Allergy Clin Immunol Pract. 2021;9:1578-85.e3. doi: 10.1016/j.jaip.2020.10.061
6. Stevens DR, Rohn MC, Hinkle SN, Williams AD, Kumar R, Lipsky LM, *et al*. Maternal body composition and gestational weight gain in relation to asthma control during pregnancy. PLoS One. 2022;17(4):e0267122. doi: 10.1371/journal.pone.0267122, PMID: 35442986
7. Gausel AM, Kjærmann I, Malmqvist S, Dalen I, Larsen JP, Økland I. Pelvic girdle pain 3-6 months after delivery in an unselected cohort of Norwegian women. Eur Spine J. 2016;25(6):1953-9. doi: 10.1007/s00586-015-3959-1, PMID: 25900296
8. Jain A, Sami-Zakhari IR. Pulmonary complications of obstetric and gynecologic conditions. In: Pulmonary Complications of Non-Pulmonary Pediatric Disorders. Vol. 24. Cham: Humana Press; 2017. p. 139-61. doi: 10.1007/978-3-319-69620-1_8
9. Manyozo SD, Nesto T, Bonongwe P, Muula AS. Low back pain during pregnancy: Prevalence, risk factors and association with daily activities among pregnant women in urban Blantyre, Malawi. Malawi Med J. 2019;31(1):71-6. doi: 10.4314/mmj.v31i1.12, PMID: 31143400
10. Amayri A, Khalayli N, Haj Ali D, Kudsi M. Low back pain in a sample of Syrian pregnant women: A cross-sectional study. Health Sci Rep. 2023;6(7):e1389. doi: 10.1002/hsr2.1389, PMID: 37408868
11. Sabino J, Grauer JN. Pregnancy and low back pain. Curr Rev Musculoskelet Med. 2008;1(2):137-41. doi: 10.1007/s12178-008-9021-8, PMID: 19468887
12. Bewyer KJ, Bewyer DC, Messenger D, Kennedy CM. Pilot data: Association between gluteus medius weakness and low back pain during pregnancy. Iowa Orthop J. 2009;29:97-9. PMID: 19742094
13. Fiat F, Merghes PE, Scurtu AD, Almajan Guta B, Dehelean CA, Varan N, *et al*. The main changes in pregnancy-therapeutic approach to musculoskeletal pain. Medicina (Kaunas). 2022;58(8):1115. doi: 10.3390/medicina58081115, PMID: 36013582
14. Vadivelu R, Green TP, Bhatt R. An uncommon cause of back pain in pregnancy. Postgrad Med J. 2005;81(951):65-7. doi: 10.1136/pgmj.2003.015370, PMID: 15640434
15. Stapleton DB, MacLennan AH, Kristiansson P. The prevalence of recalled low back pain during and after pregnancy: A South Australian population survey. Aust N Z J Obstet Gynaecol. 2002;42(5):482-5. doi: 10.1111/j.0004-8666.2002.00482.x, PMID: 12495090
16. Mens JM, Damen L, Snijders CJ, Stam HJ. The mechanical effect of a pelvic belt in patients with pregnancy-related pelvic pain. Clin Biomech (Bristol, Avon). 2006;21(2):122-7. doi: 10.1016/j.clinbiomech.2005.08.016, PMID: 16214275
17. Ostgaard HC, Andersson GB, Karlsson K. Prevalence of back pain in pregnancy. Spine (Phila Pa 1976). 1991;16(5):549-52. doi: 10.1097/00007632-199105000-00011, PMID: 1828912
18. Wang SM, Dezinno P, Maranets I, Berman MR, Caldwell-Andrews AA, Kain ZN. Low back pain during pregnancy: Prevalence, risk factors, and outcomes. Obstet Gynecol. 2004;104(1):65-70. doi: 10.1097/01.AOG.0000129403.54061.0e, PMID: 15229002
19. Perkins J, Hammer RL, Loubert PV. Identification and management of pregnancy-related low back pain. J Nurse Midwif. 1998;43(5):331-40. doi: 10.1016/s0091-2182(98)00032-9, PMID: 9803711
20. MacLennan AH, MacLennan SC. Symptom-giving pelvic girdle relaxation of pregnancy, postnatal pelvic joint syndrome and developmental dysplasia of the hip. The Norwegian Association for Women with Pelvic Girdle Relaxation (Landforeningen for kvinner Med Bekkenløsningsplager). Acta Obstet Gynecol Scand. 1997;76(8):760-4. doi: 10.3109/00016349709024343, PMID: 9348254
21. Mogren IM. BMI, pain and hyper-mobility are determinants of long-term outcome for women with low back pain and pelvic pain during pregnancy. Eur Spine J. 2006;15:1093-102. doi: 10.1007/s00586-005-0004-9
22. Vleeming A, Albert HB, Ostgaard HC, Sturesson B, Stuge B. European guidelines for the diagnosis and treatment of pelvic girdle pain. Eur Spine J. 2008;17(6):794-819. doi: 10.1007/s00586-008-0602-4, PMID: 18259783
23. Shokri P, Zahmatyar M, Falah Tafti M, Fathy M, Rezaei Tolzali M, Ghaffari Jolfayi A, *et al*. Non-spinal low back pain: Global epidemiology, trends, and risk factors. Health Sci Rep. 2023;6(9):e1533. doi: 10.1002/hsr2.1533, PMID: 37674621
24. Mogren IM. Does caesarean section negatively influence the post-partum prognosis of low back pain and pelvic pain during pregnancy? Eur Spine J. 2007;16(1):115-21. doi: 10.1007/s00586-006-0098-8, PMID: 16676151
25. Ruhighira JJ, Mashili FL, Tungu AM, Mamuya S. Spirometry profiles among pregnant and non-pregnant African women: A cross-sectional study. BMC Womens Health. 2022;22(1):483. doi: 10.1186/s12905-022-02081-6, PMID: 36461083
26. Sicilia-Gomez C, Fernández-Carnero S, Martin-Perez A, Cuenca-Zaldívar N, Naranjo-Cinto F, Pecos-Martín D, *et al*. Abdominal and pelvic floor activity related to respiratory diaphragmatic activity in subjects with and without non-specific low back pain. Diagnostics (Basel). 2022;12(10):2530. doi: 10.3390/diagnostics12102530, PMID: 36292219
27. Perez AM, Fernández-Carnero S, Sicilia-Gomez-de-Parada C, Cuenca-Zaldívar N, Naranjo-Cinto F, Pecos-Martín D, *et al*. Diaphragmatic activation correlated with lumbar multifidus muscles and thoracolumbar fascia by B-mode and M-mode ultrasonography in subjects with and without non-specific low back pain: A pilot study. Medicina (Kaunas). 2023;59:315. doi: 10.3390/medicina59020315
28. Starzec-Proserpio M, Węgrzynowska M, Sys D, Kajdy A, Rongies W, Baranowska B. Prevalence and factors associated with postpartum pelvic girdle pain among women in Poland: A prospective, observational study. BMC Musculoskelet Disord. 2022;23(1):928. doi: 10.1186/s12891-022-05864-y, PMID: 36266709
29. Daneau C, Abboud J, Marchand AA, Houle M, Pasquier M, Ruchat SM, *et al*. Mechanisms underlying lumbopelvic pain during pregnancy: A proposed model. Front Pain Res (Lausanne). 2021;2:773988. doi: 10.3389/fpain.2021.773988, PMID: 35295430
30. Chang WC, Livneh H, Yen CT, Hsieh MC, Lu MC, Chen WJ, *et al*. Decreased risk of low back pain during pregnancy associated with the use of orthopedic manual therapy: A nested case-control study. Front Med (Lausanne). 2022;9:887877. doi: 10.3389/fmed.2022.887877, PMID: 35814758
31. Gutke A, Ostgaard HC, Oberg B. Predicting persistent pregnancy-related low back pain. Spine (Phila Pa 1976). 2008;33(12):E386-93.

doi: 10.1097/BRS.0b013e31817331a4, PMID: 18496334

32. Bastiaenen CH, de Bie RA, Wolters PM, Vlaeyen JW, Leffers P, Stelma F, *et al*. Effectiveness of a tailor-made intervention for pregnancy-related pelvic girdle and/or low back pain after delivery: Short-term results of a randomized clinical trial [ISRCTN08477490]. BMC Musculoskelet Disord. 2006;7:19. doi: 10.1186/1471-2474-7-19, PMID: 16504165
33. Van De Pol G, Van Brummen HJ, Bruinse HW, Heintz AP, Van Der Vaart CH. Pregnancy-related pelvic girdle pain in the Netherlands. Acta Obstet Gynecol Scand. 2007;86(4):416-22. doi: 10.1080/00016340601151683, PMID: 17486462
34. Vøllestad NK, Stuge B. Prognostic factors for recovery from postpartum pelvic girdle pain. Eur Spine J. 2009;18(5):718-26. doi: 10.1007/s00586-009-0911-2, PMID: 19238458
35. Haugland KS, Rasmussen S, Daltveit AK. Group intervention for women with pelvic girdle pain in pregnancy. A randomized controlled trial. Acta Obstet Gynecol Scand. 2006;85(11):1320-6. doi: 10.1080/00016340600780458, PMID: 17091411
36. Komatsu R, Ando K, Flood PD. Factors associated with persistent pain after childbirth: A narrative review. Br J Anaesth. 2020;124(3):e117-30. doi: 10.1016/j.bja.2019.12.037, PMID: 31955857
37. Wuytack F, Daly D, Curtis E, Begley C. Prognostic factors for pregnancy-related pelvic girdle pain, a systematic review. Midwifery. 2018;66:70-8. doi: 10.1016/j.midw.2018.07.012, PMID: 30142609
38. Evenson KR, Mottola MF, Owe KM, Rousham EK, Brown WJ. Summary of international guidelines for physical activity after pregnancy. Obstet Gynecol Surv. 2014;69(7):407-14. doi: 10.1097/OGX.0000000000000077, PMID: 25112589
39. Saharoy R, Potdukhe A, Wanjari M, Taksande AB. Postpartum depression and maternal care: Exploring the complex effects on mothers and infants. Cureus. 2023;15(7):e41381. doi: 10.7759/cureus.41381, PMID: 37546054
40. LoMauro A, Aliverti A. Respiratory physiology of pregnancy: Physiology masterclass. Breathe (Sheff). 2015;11(4):297-301. doi: 10.1183/20734735.008615, PMID: 27066123
41. Boussuges A, Rives S, Finance J, Brégeon F. Assessment of diaphragmatic function by ultrasonography: Current approach and perspectives. World J Clin Cases. 2020;8(12):2408-24. doi: 10.12998/wjcc.v8.i12.2408, PMID: 32607319
42. Boussuges A, Finance J, Chaumet G, Brégeon F. Diaphragmatic motion recorded by M-mode ultrasonography: Limits of normality. ERJ Open Res. 2021;7(1):00714-2020. doi: 10.1183/23120541.00714-2020, PMID: 33778044