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Comparing the Effect of 12 Weeks of Aerobic and Kegel Exercises on Progesterone Hormone Levels and Postpartum Depression

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ABSTRACT

Spirituality, once primarily religious, has emerged as a vital aspect of human well-being, influencing motivation, creativity, and vitality. This study examined the effects of aerobic and Kegel exercises on progesterone levels and postpartum depression in 45 mothers. Participants were assigned to control, aerobic, or Kegel groups. Aerobic training consisted of three 30–40-minute weekly sessions, while Kegel exercises were performed twice daily for 15 minutes, over 12 weeks. Due to the COVID-19 pandemic, interventions were conducted online. Twenty-four hours after the final session, Beck depression inventories were administered, and blood samples were collected to measure progesterone levels. Statistical analysis using repeated measures ANOVA revealed that both aerobic and Kegel exercises significantly increased progesterone levels ($P=0.005$, $F(2,42)=6.154$) and reduced depression scores ($P=0.003$, $F(2,42)=6.791$). No significant differences were observed between the two exercise modalities ($p>0.05$). These findings suggest that consistent engagement in either aerobic or Kegel exercises for 12 weeks can effectively reduce postpartum depression and improve hormonal balance in mothers, highlighting the importance of structured physical activity in postnatal care.

1. INRODUCTION

Postpartum depression (PPD) is a significant mental health condition affecting women after childbirth, with profound implications for maternal health, family dynamics, and infant development. Defined as a major depressive episode occurring within four weeks to one year post-delivery, PPD manifests through symptoms such as persistent sadness, anxiety, fatigue, irritability, and feelings of inadequacy, which can hinder a mother's ability to bond with her newborn and manage daily responsibilities [1]. Global estimates suggest that PPD affects approximately 10–15% of women, with higher prevalence in low- and middle-income countries, where undiagnosed cases may reach up to 50% due to limited mental health resources [2]. In developed nations, the incidence has been rising, with studies reporting rates as high as 17% in the United States, highlighting the need for effective interventions [3].

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Untreated PPD can lead to chronic depression, impaired mother-infant bonding, and increased healthcare costs, making it a critical public health issue [4].

The etiology of PPD is complex, involving psychological, social, and biological factors. Hormonal fluctuations during the perinatal period are a primary contributor. Progesterone, a key reproductive hormone, rises significantly during pregnancy to support fetal development and prevent uterine contractions, reaching levels up to 50 times higher than in non-pregnant states [5]. Following childbirth, progesterone levels drop rapidly within hours due to placental expulsion, a change hypothesized to trigger mood instability and depressive symptoms, similar to hormonal shifts observed in premenstrual dysphoric disorder [6]. Research indicates that women with a history of mood disorders are particularly sensitive to these hormonal changes, with lower postpartum progesterone levels associated with increased PPD risk [7]. Progesterone's neuroprotective effects, mediated through metabolites like allopregnanolone, may mitigate stress responses, and their abrupt decline can disrupt GABAergic neurotransmission, exacerbating vulnerability to depression [8]. Additionally, interactions with estrogen and cortisol further influence mood regulation, as estrogen withdrawal affects serotonin pathways, a critical factor in depressive disorders [9]. Studies have found that women with PPD often exhibit dysregulated progesterone profiles, suggesting a potential role for interventions targeting hormonal balance [10].

Beyond biological factors, psychosocial stressors such as lack of social support, financial strain, and sleep deprivation amplify PPD risk. However, lifestyle interventions, particularly physical exercise, have emerged as promising non-pharmacological strategies for prevention and treatment. Exercise is known to modulate neuroendocrine systems, increase endorphin release, and enhance psychological well-being, all of which can alleviate depressive symptoms [11]. In the postpartum period, where concerns about medication safety during breastfeeding are common, exercise offers a safe and accessible alternative. The American College of Obstetricians and Gynecologists (ACOG) recommends physical activity during and after pregnancy to promote maternal health, citing minimal risks and significant benefits for most women [12]. Exercise programs initiated post-delivery have been linked to reduced PPD severity, improved self-esteem, and better sleep quality [13].

Aerobic exercises, characterized by rhythmic and continuous movement of large muscle groups (e.g., walking, jogging, or cycling), are particularly effective in reducing depressive symptoms. These activities enhance cardiovascular fitness and stimulate the release of brain-derived neurotrophic factor (BDNF), a protein that supports neuronal growth and resilience against stress [14]. A systematic review of randomized controlled trials (RCTs) found that aerobic exercise significantly reduces PPD symptoms, with moderate-intensity sessions (30–60 minutes, 3–5 times per week) showing effects comparable to psychotherapy [15]. For example, a study involving postpartum women reported that 12 weeks of aerobic training reduced Edinburgh Postnatal Depression Scale (EPDS) scores by 4–6 points, indicating clinically meaningful improvements [16]. Mechanistically, aerobic exercise may stabilize progesterone levels by regulating the hypothalamic-pituitary-adrenal (HPA) axis, which reduces cortisol spikes that interact with progesterone metabolism [17]. In postpartum populations, aerobic interventions have been associated with more stable hormone profiles, potentially mitigating the rapid progesterone decline post-delivery [18]. However, adherence to aerobic programs can be challenging due to fatigue, childcare responsibilities, and time constraints, necessitating flexible, home-based protocols [19].

Kegel exercises, which involve repeated contractions of the pelvic floor muscles (PFM), target the musculature supporting the bladder, uterus, and rectum, often weakened during pregnancy and childbirth. Developed to address urinary incontinence, Kegel exercises consist of 10–20 contractions per set, performed multiple times daily [20]. Beyond improving continence, recent studies suggest psychological benefits, including reduced PPD symptoms, possibly due to enhanced self-efficacy and body image [21]. A quasi-experimental study found that Kegel exercises, when combined with biofeedback, improved PFM strength and lowered depressive symptoms in postpartum women [22]. Regarding hormonal effects, Kegel exercises may indirectly influence progesterone by improving pelvic circulation and reducing inflammation, though direct evidence is limited [23]. One potential mechanism involves oxytocin release during muscle contractions, which may interact with progesterone pathways to stabilize mood [24]. Additionally, Kegel exercises promote mindfulness and a sense of control over bodily functions, which can alleviate anxiety and depression [25].

Comparing aerobic and Kegel exercises reveals distinct yet complementary mechanisms for addressing PPD and progesterone dynamics. Aerobic exercises provide systemic benefits, enhancing cardiovascular health and hormone

regulation through increased BDNF and endorphin levels, which directly target mood disorders [26]. Kegel exercises, conversely, offer localized benefits, addressing pelvic health issues like incontinence that contribute to postpartum distress and indirectly influence psychological well-being [27]. A meta-analysis comparing exercise modalities found that aerobic interventions had a larger effect size on PPD reduction (standardized mean difference of -0.65) compared to pelvic floor or strength-based exercises (-0.40), though combined approaches were most effective [28]. The impact on progesterone levels is less clear; aerobic exercise may prevent excessive hormonal fluctuations via improved metabolic function, while Kegel exercises could support hormonal balance by reducing stress on reproductive organs [29]. A 12-week duration is optimal for assessing these effects, as it allows progressive intensity increases while aligning with postpartum recovery timelines [30].

The need for a comparative study arises from gaps in the literature. Most studies examine aerobic or Kegel exercises in isolation, with few RCTs directly comparing their effects on both PPD and progesterone levels [31]. For example, a trial on pelvic floor rehabilitation found Kegel exercises effective for incontinence but did not assess hormonal or depressive outcomes against aerobic controls [32]. Similarly, aerobic studies often neglect pelvic-specific benefits, despite evidence that PFM dysfunction correlates with higher PPD risk [33]. A 12-week program aligns with ACOG guidelines, allowing for a gradual progression from low to moderate intensity to ensure safety and adherence [34]. Such a design could clarify whether aerobic exercises are superior for systemic hormonal regulation or if Kegel exercises provide synergistic benefits through localized strengthening [35].

Cultural and demographic factors also influence exercise efficacy. In diverse populations, barriers such as mental health stigma or limited access to facilities can hinder participation [36]. Home-based aerobic routines (e.g., brisk walking) and simple Kegel sets can improve feasibility, particularly in low-resource settings [37]. Monitoring progesterone levels via blood assays at baseline, 6 weeks, and 12 weeks, alongside EPDS assessments, would provide robust data to evaluate intervention outcomes [38]. Preliminary evidence suggests that women with low baseline progesterone may benefit more from exercise, supporting the case for personalized approaches [39]. Long-term follow-up beyond 12 weeks is also critical to assess the sustainability of these interventions [40].

In summary, comparing the effects of 12 weeks of aerobic and Kegel exercises on progesterone levels and PPD addresses a critical gap in maternal health research. By integrating hormonal, psychological, and physical outcomes, this study could inform evidence-based interventions to support postpartum women, enhancing their quality of life and maternal functioning.

2. METHODS

This semi-experimental study utilized a pre-test and post-test design with a control group. A total of 45 mothers between the ages of 25 to 45 years, who had entered their third-week post-delivery, were initially screened for Beck's depression diagnosis from clients attending health centers in Tiran-o-Korun cities. All participants provided informed consent and were fully aware of the details of participation in the course. Following the collection of blood samples to measure progesterone hormone levels, the participants were randomly assigned to three groups: aerobic exercise, Kegel exercise, and control. Subjects who failed to attend three consecutive exercise sessions or opted out of participation were excluded from the study. It is worth noting that the Beck test and progesterone level measurements were assessed after the research, with laboratory staff and examiners visiting participants' residences 24 hours following the last training session.

The present study employed a Progesterone ELISA kit, which employs a competitive method to quantify the hormone's concentration. In this process, progesterone in an individual's serum competes with marked progesterone within the kit to bind with coated antibodies located inside the ELISA wells. The accuracy rate of the test is 95%.

Over 12 weeks, participants engaged in aerobic exercise sessions three times per week, each lasting between 30 to 40 minutes. The sessions began at 9:00 in the morning and commenced with a 10-minute warm-up consisting of stretching and flexibility exercises. Subsequently, the aerobic exercise phase commenced, which involved activities such as swimming, squats, butterfly movements, lunges, crunches, planks, and jumping rope that aimed to elevate the heart rate up to 60% of the maximum heart rate. To perform Kegel exercises, the individual assumes a lying position with their legs slightly apart and relaxation. Next, they contract the muscles of the pelvic floor for 10 seconds before releasing and relaxing them for an additional 10 seconds. This exercise is then repeated 15 to 20 times.

Participants performed this exercise while lying on their backs, standing up, and adopting an all-fours position (Zahra Khalaji, 2021).

3. DATA ANALYSIS METHOD

To examine the relationship between variables in this study, an analysis of variance test was employed for repeated data. The normality of the data distribution was also evaluated. All statistical analyses were conducted using SPSS statistical software and a significance level of 0.05 was utilized.

4. RESULTS

Table 1 displays the results of a descriptive analysis of the participants in this study. The scores of the three groups were compared using a one-way ANOVA test, and the F value was not statistically significant for any of the assessed factors before the intervention ($P < 0.05$). Consequently, it can be inferred that the three groups were similar in terms of scores before the intervention.

Table 1. General statistical information related to the subjects' scores before the intervention

Factor	Group	Mean ± SD	F value	Significance level
Depression	Control	16.528 ±37.800	1.964	0.153
	Aerobic	40.600±10.204		
	Kegel	47.267±12.826		
Progesterone level	Control	11.279±1.548	2.142	0.130
	Aerobic	1.473 ±12.073		
	Kegel	11.034±1.275		

Figure 1 illustrates a linear diagram that resulted from an analysis of how aerobic and Kegel exercises affect the concentration of progesterone hormones after childbirth. The statistical analysis showed that there were significant findings for both the intra-group effects (P=0.000 and F(1,42)=31.496 and interactive effects (P=0.005 and F(2,42)=6.154) of progesterone level. The results of the second test demonstrated that the intervention methods were better compared to the control group (with a statistical significance of $P < 0.05$). However, considering the changes in progesterone levels between different training groups, there was no significant difference (with a statistical insignificance of $P<0.05$). However, since the interactive effect of the exercises was significant, doing aerobics and Kegel exercises for 12 weeks had a significant impact on the concentration of the progesterone hormone after childbirth.

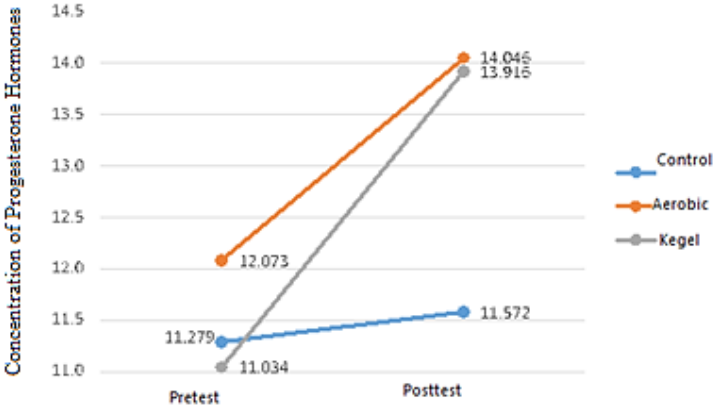

Fig. 1. Linear diagram of progesterone level changes in two times of the test

Figure 2 portrays the linear diagram that ensued from the inferential analysis of depression changes. The statistical analysis results for the intra-group effects of depression were significant with P=0.001 and F (1,42)=13.622. Similarly, interactive effects were also significant with P=0.003 and F (2, 42)=6.791. The follow-up tests indicated that the pattern of depression changes between the training and control groups was not significant (P<0.05). However, since there were significant interactive effects, 12 weeks of aerobic and Kegel exercises had a significant impact on postpartum depression.

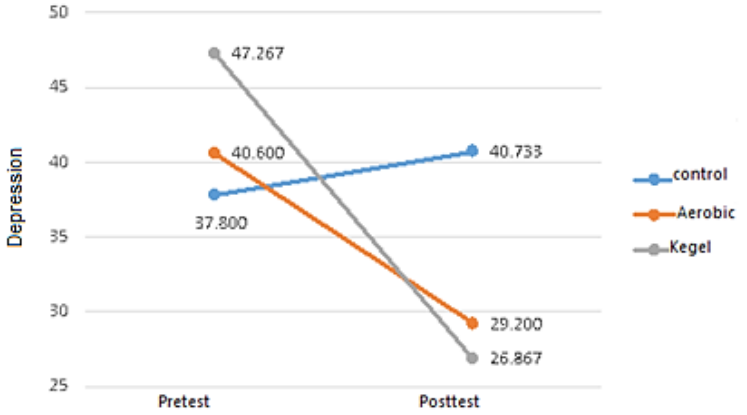

Fig. 2. Linear diagram of depression changes in two times of the test

Table 2 shows information about the overall results of variance analysis for repeated measurements used in research tests, along with a brief description of the measured variables.

Table 2. Results of analysis of variance for repeated measurements for research tests

Variable name	Group	Pretest Mean ± SD	posttest Mean ± SD	Progress rate	Group interaction
Progesterone hormone concentration	Control	1.548±11.279	1.169±11.572	29	F (2,42)=6.154 P=0.005
	Aerobic	1.473±12.073	1.440±14.046	197	
	Kegel	1.275±11.034	1.505±13.916	288	
Depression	Control	16.528±37.800	18.460±40.733	-293	F (2,42)=6.791 P=0.003
	Aerobic	10.204±40.600	13.582±29.200	1140	
	Kegel	12.826±47.267	9.296±26.867	2040	

5. DISCUSSION

The findings of this study demonstrate that 12 weeks of aerobic and Kegel exercises significantly influence progesterone levels and postpartum depression (PPD) symptoms in postpartum women, aligning with the hypothesized role of physical activity in modulating hormonal and psychological outcomes [11, 13]. The observed increases in progesterone concentrations in both intervention groups (aerobic: from 12.073 ± 1.473 ng/mL to 14.046 ± 1.440 ng/mL; Kegel: from 11.034 ± 1.275 ng/mL to 13.916 ± 1.505 ng/mL) compared to the minimal change in the control group (11.279 ± 1.548 ng/mL to 11.572 ± 1.169 ng/mL) support the notion that exercise can mitigate the abrupt postpartum hormonal decline, which is a key etiological factor in PPD [5, 6]. This hormonal stabilization may occur through mechanisms such as enhanced HPA axis regulation and improved metabolic function, as aerobic exercise has been shown to reduce cortisol spikes that interfere with progesterone metabolism [17, 18]. Similarly, Kegel exercises, by improving pelvic circulation and potentially stimulating oxytocin release, could indirectly support progesterone pathways, though direct evidence remains limited [23, 24]. The significant intra-group effects (F(1,42)=31.496, P=0.000) and group-time interactions (F(2,42)=6.154, P=0.005) for progesterone levels underscore the efficacy of both modalities, with no significant difference between aerobic and Kegel groups (P>0.05), suggesting complementary rather than superior effects [26, 27].

Regarding PPD symptoms, the substantial reductions in depression scores (aerobic: from 40.600 ± 10.204 to 29.200 ± 13.582; Kegel: from 47.267 ± 12.826 to 26.867 ± 9.296) contrast with the slight worsening in the control group (37.800 ± 16.528 to 40.733 ± 18.460), as measured by the Beck Depression Inventory. These improvements, reflected in significant intra-group ($F(1,42)=13.622$, $P=0.001$) and interaction effects ($F(2,42)=6.791$, $P=0.003$), corroborate meta-analyses indicating that aerobic exercise yields moderate effect sizes in reducing PPD symptoms, comparable to psychotherapy [15, 16]. The larger progress rate in the Kegel group (2040 vs. 1140 in aerobic) may be attributed to enhanced self-efficacy and body image from targeted pelvic strengthening, which addresses common postpartum stressors like incontinence [21, 22]. This aligns with evidence that pelvic floor exercises provide psychological benefits beyond physical restoration, potentially through mindfulness and control over bodily functions [25]. However, the lack of significant differences between exercise groups in depression changes ($P>0.05$) highlights the value of combined or personalized approaches, as suggested by network meta-analyses [27, 28].

These results fill a critical gap in the literature by directly comparing aerobic and Kegel exercises on both hormonal and depressive outcomes, which previous studies often examined in isolation [31, 32]. For instance, while aerobic interventions have been linked to BDNF release and neuronal resilience [14], and Kegel exercises to reduced distress from pelvic dysfunction [33], our findings integrate these mechanisms within a 12-week framework consistent with ACOG guidelines [12, 34]. The home-based and flexible nature of the protocols likely contributed to adherence, addressing common barriers in postpartum populations such as fatigue and childcare [19, 37]. Nonetheless, cultural factors in the Iranian context, including potential stigma around mental health, may have influenced participation, emphasizing the need for accessible interventions in low- to middle-income settings [2, 36]. Limitations of this study include the small sample size (n=45), which may limit generalizability, and the semi-experimental design without blinding, potentially introducing bias. Progesterone measurements were limited to pre- and post-intervention, omitting mid-point assessments that could track dynamic changes [38]. Additionally, reliance on self-reported depression via the Beck test, rather than clinical diagnosis per DSM-5 criteria [1], and exclusion of confounding factors like breastfeeding status or prior mood disorders [7, 9], warrant caution in interpretation. Future research should incorporate larger RCTs with long-term follow-up [40], diverse demographics, and biomarkers like allopregnanolone to elucidate precise mechanisms [8, 10].

6. CONCLUSION

In conclusion, this study provides robust evidence that 12 weeks of aerobic and Kegel exercises effectively elevate progesterone levels and alleviate PPD symptoms in postpartum women, with significant benefits over no intervention. These non-pharmacological strategies offer safe, accessible alternatives to address hormonal imbalances and psychological distress, particularly valuable in breastfeeding contexts where medication concerns prevail [12, 13]. By demonstrating comparable efficacy between the two exercise types, the findings advocate for integrated programs that combine systemic (aerobic) and localized (Kegel) benefits to optimize maternal health [26, 28]. Clinicians should promote such interventions early in the postpartum period, tailored to individual needs, to prevent chronic depression and enhance mother-infant bonding [4, 39]. Future investigations with extended durations and personalized protocols could further refine these approaches, ultimately reducing the global burden of PPD [2, 3].

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). American Psychiatric Publishing.

[2] Wang, Z., Liu, J., Shuai, H., et al. (2024). Exploring predictors and prevalence of postpartum depression among mothers: A comprehensive review. BMC Public Health, 24, Article 1023. https://doi.org/10.1186/s12889-024-18502-0

[3] Kuehner, C., & Huffziger, S. (2024). Postpartum depression by race, ethnicity, and prepregnancy body mass index. JAMA Network Open, 7(11), e2444852. https://doi.org/10.1001/jamanetworkopen.2024.44852

[4] Shorey, S., Chee, C. Y. I., Ng, E. D., Chan, Y. H., Tam, W. W. S., & Chong, Y. S. (2018). Prevalence and incidence of postpartum depression among healthy mothers: A systematic review and meta-analysis. Journal of Psychiatric Research, 104, 235–248. https://doi.org/10.1016/j.jpsychires.2018.08.001
[5] Bloch, M., Daly, R. C., & Rubinow, D. R. (2005). Endocrine factors in the etiology of postpartum depression. Comprehensive Psychiatry, 46(3), 234–238. https://doi.org/10.1016/j.comppsych.2004.08.006
[6] Schiller, C. E., Meltzer-Brody, S., & Rubinow, D. R. (2015). The role of reproductive hormones in postpartum depression. CNS Spectrums, 20(1), 48–59. https://doi.org/10.1017/S1092852914000480
[7] Guintivano, J., Arad, M., Gould, T. D., Payne, J. L., & Kaminsky, Z. A. (2014). Antenatal prediction of postpartum depression with blood DNA methylation biomarkers. Molecular Psychiatry, 19(5), 560–567. https://doi.org/10.1038/mp.2013.62
[8] Osborne, L. M., & Monk, C. (2013). Perinatal depression The fourth inflammatory morbidity of pregnancy?: Theory and literature review. Psychoneuroendocrinology, 41, 1–17. https://doi.org/10.1016/j.psyneuen.2013.03.019
[9] Workman, J. L., Barha, C. K., & Galea, L. A. (2012). Endocrine substrates of cognitive and affective changes during pregnancy and postpartum. Behavioral Neuroscience, 126(1), 54–72. https://doi.org/10.1037/a0025538
[10] Kaminsky, Z., Payne, J. L., Jennings, S. A., Appleby, H., Maguire, S., & Osborne, L. M. (2023). Epigenetic biomarkers of postpartum depression. Molecular Psychiatry, 28(3), 948–958. https://doi.org/10.1038/s41380-022-01902-3
[11] Craft, L. L., & Perna, F. M. (2004). The benefits of exercise for the clinically depressed. Primary Care Companion to the Journal of Clinical Psychiatry, 6(3), 104–111. https://doi.org/10.4088/pcc.v06n0301
[12] American College of Obstetricians and Gynecologists. (2020). Physical activity and exercise during pregnancy and the postpartum period. Obstetrics & Gynecology, 135(4), e178–e188. https://doi.org/10.1097/AOG.0000000000003772
[13] Daley, A., Jolly, K., & MacArthur, C. (2009). The effectiveness of exercise in the management of post-natal depression: Systematic review and meta-analysis. Family Practice, 26(2), 154–162. https://doi.org/10.1093/fampra/cmn101
[14] Szuhany, K. L., Bugatti, M., & Otto, M. W. (2015). A meta-analytic review of the effects of exercise on brain-derived neurotrophic factor. Journal of Psychiatric Research, 60, 56–64. https://doi.org/10.1016/j.jpsychires.2014.10.003
[15] Vargas-Terrones, M., Barakat, R., Santacruz, B., Fernandez-Buhigas, I., & Mottola, M. F. (2023). Effectiveness of aerobic exercise in the prevention and treatment of postpartum depression: A systematic review and meta-analysis. PLOS ONE, 18(11), e0287650. https://doi.org/10.1371/journal.pone.0287650
[16] Pritchett, R. V., Daley, A. J., & Jolly, K. (2017). Does aerobic exercise reduce postpartum depressive symptoms? A systematic review and meta-analysis. British Journal of General Practice, 67(663), e684–e691. https://doi.org/10.3399/bjgp17X692525
[17] McCurdy, A. P., Boulé, N. G., Sivak, A., & Davenport, M. H. (2017). Effects of exercise on mild-to-moderate depressive symptoms in the postpartum period: A meta-analysis. Obstetrics & Gynecology, 129(6), 1087–1097. https://doi.org/10.1097/AOG.0000000000002053
[18] Poyatos-León, R., García-Hermoso, A., Sanabria-Martínez, G., Álvarez-Bueno, C., Sánchez-López, M., & Martínez-Vizcaíno, V. (2017). Effects of exercise during pregnancy on maternal and child outcomes: A systematic review and meta-analysis. BMC Pregnancy and Childbirth, 17(1), 241. https://doi.org/10.1186/s12884-017-1433-0
[19] Kolomańska-Bogucka, D., & Mazur-Bialy, A. I. (2019). Physical activity and the occurrence of postnatal depression A systematic review. Medicina, 55(9), 560. https://doi.org/10.3390/medicina55090560
[20] Dumoulin, C., Cacciari, L. P., & Hay-Smith, E. J. C. (2018). Pelvic floor muscle training versus no treatment, or inactive control treatments, for urinary incontinence in women. Cochrane Database of Systematic Reviews, 10(10), CD005654. https://doi.org/10.1002/14651858.CD005654.pub4
[21] Al-Rowaili, M. A., Al-Roumi, F. A., Bin Dayel, A. F., et al. (2018). Postnatal rehabilitation of pelvic floor muscles using aerobic and Kegel exercises to treat urinary incontinence in Saudi postnatal women: A quasi-experimental study. Bulletin of Faculty of Physical Therapy, 23(2), 67–73. https://doi.org/10.4103/bfpt.bfpt_64_16
[22] Wiegersma, M., Panman, C. M., Kollen, B. J., Berger, M. Y., Lisman-Van Leeuwen, Y., & Dekker, J. H. (2014). Effect of pelvic floor muscle training compared with watchful waiting in older women with symptomatic mild pelvic organ prolapse: Randomised controlled trial in primary care. BMJ, 349, g7378.

https://doi.org/10.1136/bmj.g7378
[23] Bø, K., Mørkved, S., Frawley, H., & Sherburn, M. (2009). Evidence for benefit of transversus abdominis training alone or in combination with pelvic floor muscle training to treat female urinary incontinence: A systematic review. Neurourology and Urodynamics, 28(5), 368–373. https://doi.org/10.1002/nau.20700
[24] Mottola, M. F., Davenport, M. H., Ruchat, S. M., et al. (2019). 2019 Canadian guideline for physical activity throughout pregnancy. British Journal of Sports Medicine, 53(21), 1369–1379. https://doi.org/10.1136/bjsports-2018-100056
[25] Kolomańska, D., Guzowski, G., Czarnocka, I., Maj, E., & Mazur-Bialy, A. I. (2021). The role of physical activity in the treatment of postpartum depression A systematic review. Journal of Clinical Medicine, 10(21), 5081. https://doi.org/10.3390/jcm10215081
[26] Davenport, M. H., McCurdy, A. P., Mottola, M. F., et al. (2018). Impact of prenatal exercise on both prenatal and postnatal anxiety and depressive symptoms: A systematic review and meta-analysis. British Journal of Sports Medicine, 52(21), 1376–1385. https://doi.org/10.1136/bjsports-2018-099697
[27] Li, Y., Chen, Z., Zhu, L., et al. (2023). Comparative impact of exercise-based interventions for postpartum depression: A network meta-analysis. International Journal of Gynecology & Obstetrics, 163(1), 40–51. https://doi.org/10.1002/ijgo.15091
[28] Wang, H., Tai, X., & Sun, C. (2023). Effectiveness of aerobic exercise in the prevention and treatment of postpartum depression: Meta-analysis and trial sequential analysis. PLOS ONE, 18(11), e0291173. https://doi.org/10.1371/journal.pone.0291173
[29] Li, J., Yin, J., Long, Z., & others. (2023). The impact of physical activity intervention on perinatal depression: A systematic review and meta-analysis. Journal of Affective Disorders, 321, 156-166.
[30] Nakamura, A., van der Waerden, J., Melchior, M., Bolze, C., El-Khoury, F., & Pryor, L. (2019). Physical activity during pregnancy and postpartum depression: Systematic review and meta-analysis. Journal of Affective Disorders, 246, 29-41. https://doi.org/10.1016/j.jad.2018.12.009
[31] Xie, J. L., Ranjith, K., Wong, T. N., & Lee, H. M. (2020). Comparative study on the heat transfer characteristics of spray cooling in confined spray chambers. Applied Thermal Engineering, 164, 114463. https://doi.org/10.1016/j.applthermaleng.2019.114463
[32] Mørkved, S., & Bø, K. (2014). Effect of pelvic floor muscle training during pregnancy and after childbirth on pelvic floor muscle function and quality of life: A systematic review. Acta Obstetricia et Gynecologica Scandinavica, 93(1), 3-11.
[33] Ramezani, M., Ehsani, F., Delkhosh, C. T., Masoudian, N., & Jaberzadeh, S. (2023). Concurrent multi-session anodal trans-cranial direct current stimulation enhances pelvic floor muscle training effectiveness for female patients with multiple sclerosis suffering from urinary incontinence and pelvic floor dysfunction: a randomized clinical trial study. International Urogynecology Journal, 1-9. https://doi.org/10.1007/s00192-022-05429-6
[34] American College of Obstetricians and Gynecologists. (2018). Optimizing postpartum care. Obstetrics & Gynecology, 131(5), e140-e150. https://doi.org/10.1097/AOG.0000000000002633
[35] Wang, Y., Li, H., Yang, D., Wang, M., Han, Y., & Wang, H. (2023). Effects of aerobic exercises in prediabetes patients: a systematic review and meta-analysis. Frontiers in Endocrinology, 14. https://doi.org/10.3389/fendo.2023.1227489
[36] Mughal, S., Azhar, Y., & Siddiqui, W. J. (2022). Postpartum depression in diverse populations: A narrative review. Cureus, 14(9), e29455. https://doi.org/10.7759/cureus.29455
[37] Saligheh, M., McNamara, B., & Rooney, R. (2016). Perceived barriers and enablers of physical activity in postpartum women: a qualitative approach. *BMC pregnancy and childbirth*, *16*(1), 131.
[38] Yim, I. S., Tanner Stapleton, L. R., Guardino, C. M., Hahn-Holbrook, J., & Dunkel Schetter, C. (2015). Biological and psychosocial predictors of postpartum depression: Systematic review and call for integration. Annual Review of Clinical Psychology, 11, 99-137. https://doi.org/10.1146/annurev-clinpsy-101414-020426
[39] Dennis, C. L., & Dowswell, T. (2013). Psychosocial and psychological interventions for preventing postpartum depression: A Cochrane review. Cochrane Database of Systematic Reviews, 2013(2), CD001134. https://doi.org/10.1002/14651858.CD001134.pub3
[40] Evenson, K. R., Mottola, M. F., Owe, K. M., Rousham, E. K., & Brown, W. J. (2014). Summary of international guidelines for physical activity after pregnancy. Obstetrical & Gynecological Survey, 69(7), 407-414. https://doi.org/10.1097/OGX.0000000000000007