Systematic Review and Meta-Analysis

Effects of Pilates on the quality of life of pregnant women during pregnancy

A systematic review

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Abstract

Background: The practice of the Pilates method (PM) improves sleep quality, as well as it could decrease low back pain. This study aimed to evaluate the effects of Pilates on the quality of life (QoL) of pregnant women during pregnancy.

Methods: A systematic review examining perceived QoL, pain, and mental health in pregnant women practising the PM was conducted following the PRISMA 2020 criteria in the Pubmed, Scopus, Web of Science, and Trip Database electronic databases, including studies published between January 2013 and February 2024. Methodological quality was assessed using the critical appraisal tool for studies of the Joanna Briggs Institute.

Results: Ten publications addressing the key words on the topic were included involving a total of 499 pregnant women, of which 268 had practiced Pilates and 231 had received routine care. The results showed that, in 2 of the studies, pregnant women who had practised the PM during pregnancy showed an improvement in perceived QoL (chi-squared value = 5.597, $P = .018$), sleep quality ($P = .018$) and physical mobility ($P = .040$). Lumbopelvic pain (LBPP) was reduced in the group of pregnant women in eight of these studies (with values of $P < .001$ and $P < .05$), and 1 study reported no significant differences among these variables. In terms of mental health, 2 studies reported a decrease in anxiety ($P < .05$ and $P = .009$) and 1 study indicated lower depression levels (scores of control group from a mean of 6.19 to 7.54, and the intervention group from a mean of 8.61 to 4.59).

Conclusion: The PM shows benefits in improving the QoL of pregnant women who practise it during pregnancy. Other indicators such as LBPP and mental health also benefit from Pilates. The practice of physical activity, supervised by nurses and midwives, can lead to an improvement in pregnant women's perception of their own health and QoL.

Reporting Method: PRISMA Declaration.

Protocol Registration: PROSPERO registration number CRD42024513781.

Abbreviations: BDI = beck depression inventory, BMI = Body Mass Index, HADS = Hospital Anxiety and Depression Scale, LBPP = lumbopelvic pain, NHP = Nottingham Health Profile, ODI = Oswestry disability index, PM = Pilates method, QoL = quality of life, STAI = State-Trait Anxiety Inventory, VAS = Visual Analogue pain Scale.

Keywords: mental health, pain, Pilates, pregnancy, pregnant women, quality of life

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All data generated or analyzed during this study are included in this published article [and its supplementary information files].

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1. Introduction

The Pilates method (PM) was originally an exercise method devised by the German Joseph Hubertus Pilates.[1] In his childhood, J.H. Pilates suffered from various health conditions which led him, with a view to improving his own physical condition, to practice different sporting disciplines, and he also became interested in Greco-Roman philosophy and civilization.[1] For a number of years, he was professionally involved in various sporting activities until, during WWI, J.H. Pilates was commissioned to work in a hospital with the war wounded and began to train them using a technique based on the use of bed springs as a method of recovery for the bedridden wounded, observing that they regained muscle tone more quickly.[1] The original method developed by J.H. Pilates has evolved to the present day, where modern Pilates uses the fundamentals of the work, philosophy, and exercises designed by J.H. Pilates with modifications that make it suitable for people of all ages or with adaptations for different special situations in life, such as during pregnancy.[2] The PM is a physical activity based on exercises that involve both the body and the mind, requiring core stability (understood as the activation of the deep trunk muscles or Core that stabilizes the lumbar spine and pelvis), strength and flexibility, as well as attention to muscle control, body posture, and breathing.[3]

The practice of PM serves as a valuable approach for strengthening core muscles[4] and enhancing the quality of life (QoL) in pregnant women.[5] As a structured form of physical activity, PM provides both physiological[6] and psychological[7] benefits, contributing to improved self-perception and overall QoL among those who practice it.[8,9] Furthermore, it has been associated with a reduction in lumbopelvic pain (LBPP)[10,11] and positive effects on the mental health of pregnant women.[12,13] Several scientific societies have incorporated recommendations regarding physical activities that involve stretching, balance, and endurance exercises into their guidelines,[14–16] principles that are inherently integrated into PM exercise routines.[17]

QoL is an essential indicator used to evaluate the effect of a process, pathology, condition, or even in the absence of pathologies, on people's health. It can be defined as subjective and self-perceived and is susceptible to change.[18] Pregnancy influences women's perceived QoL, with differences being found between pregnant and non-pregnant women,[19] and this self-perception will undergo variations that may be associated with the inherent changes that occur during pregnancy.[20] When gestation is divided into trimesters, a significant increase in perception can be observed in the first trimester,[21] as well as at the beginning of the 2nd trimester, and a decline from the third trimester onwards, reaching its lowest point at the end of gestation.[22–24] Regarding the QoL domains that are adversely affected in pregnant women compared to nonpregnant women, notable areas include reduced physical mobility, heightened pain and discomfort, and increased levels of anxiety and depression, among others.[19] Given these challenges, it is essential to implement strategies aimed at enhancing QoL during pregnancy, as a higher QoL can contribute to a more positive gestational experience and improved overall well-being. Moreover, research has indicated that lower perceived QoL during pregnancy may be associated with adverse obstetric outcomes.[23] Several evidence-based interventions have been identified to enhance QoL in pregnant women when necessary, including physical exercise,[25] aquatic physical activity,[26] and social support.[27]

It is essential to inform and educate pregnant women about the benefits of incorporating physical activity throughout their pregnancy, with particular emphasis on the final trimester. This can help to reduce the prevalence of psychological conditions, which can have a negative impact on the QoL of the pregnant woman, particularly in the context of their psychological well-being.[28] Pregnancy represents an event in a woman's life that involves a series of physical and mental alterations that may entail changes in her lifestyle, even affecting her perception of her QoL. Changes during pregnancy, such as excessive weight gain,[29] possible adverse disruptions in the quality of sleep,[30] the occurrence of pain in the lumbopelvic area,[31] among others, can affect a woman's comfort and physical-mental well-being, favoring a detriment in the perception of her own QoL.

Several studies have reported benefits of PM practice; however, their conclusions vary. One review article reported increased flexibility[32]; however, it did not specify the sample size, or the specific PM approach used. It only mentioned that the sample predominantly consisted of young and middle-aged women. Regarding improved muscular endurance,[33] another review article suggested that an optimal PM should last between 5 and 15 weeks, with a frequency of 1 to 5 sessions/week, each lasting 45 to 60 minutes. Most studies examined PM performed both on mats and with equipment, comparing it to other activities such as aerobics, strength training, and Taiji Quan. However, the samples mainly consisted of healthy adults and young or middle-aged women, with no specification of the exact sample size. Additionally, another review article reported improvements in mental health outcomes.[34] This study included a diverse population, comprising healthy adults, pregnant women (in 1 study), and individuals with type 2 diabetes mellitus or undergoing hemodialysis. The total sample consisted of 391 participants, 241 of whom practiced PM. The studies analyzed lasted between 4 and 12 weeks, with 1 to 3 sessions/week, each session ranging from 45 to 60 minutes.

The previous review by Ferraz et al[35] is noteworthy, as it, like our study, assessed perceived QoL and pain in pregnant women practicing PM. However, to strengthen the relevance of incorporating the PM into a healthy pregnancy, it is essential to analyze the existing knowledge on the subject, as this could help promote QoL throughout pregnancy, childbirth, and the postpartum period. In our review, we considered it appropriate to include the mental health dimension, as we perceive QoL not as an isolated factor but as 1 closely linked to psychological well-being. This perspective further substantiates the benefits of PM. Moreover, we incorporated additional studies, which may enhance the validity of the findings due to the larger sample size. Thus, this study aimed to assess the QoL of pregnant women practicing PM and to examine its influence on LBPP and mental health, both key indicators of perceived QoL.

2. Method

2.1. Design

A literature review was conducted on QoL, LBPP, and mental health in pregnant women who had practised the PM during pregnancy as part of a physical activity programme, using the systematic review format. For this purpose, the criteria of the PRISMA 2020 Declaration (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)[36] were followed. The implemented protocol has been registered in the International Prospective Register of Systematic Reviews, under registration number CRD42024513781.

2.2. Search methods

In formulating the research question, the PICO standard structure for formulating research questions was used (Table 1).

The research question was formulated as follows: "Does the practice of PM during pregnancy influence the QoL of pregnant women? Additionally, does it have a measurable impact on LBPP and mental health when compared to the absence of physical activity?"

For the creation of the search string in the international databases, the following English descriptors obtained from the Medical Subject Headings were used: pregnant woman, pregnancy, and

QoL, Health Related Quality of Life, pain, pelvic girdle pain, low back pain, pelvic pain, mental health, anxiety, depression, and exercise movement technics. "Pilates" was used as the free term. In order to maximize the search, free terms were added to the search using the Boolean operators AND and OR (Table 2).

The studies examined in this review utilized a range of assessment scales to evaluate the variables of interest. Pain and disability were measured using the Visual Analogue pain Scale and the Oswestry Disability Index (ODI). Quality of life was assessed through a cross-cultural adaptation of the Nottingham Health Profile (NHP) and the Quality-of-Life Questionnaire SF-12 (Short-Form 12 items). Mental health was evaluated using the State-Trait Anxiety Inventory (STAI), the Hospital Anxiety and Depression Scale (HADS), and the Turkish version of the Beck Depression Inventory (BDI).

2.3. Selection criteria

The following inclusion criteria were used for the selection of articles: studies published in English, French, Spanish, Portuguese, or German; research conducted between January 2013 and January 2024; and meta-analyses, randomized clinical trials, descriptive studies, cohort studies, or case-control studies. We also included articles that assessed the following indicators: QoL, mental health (anxiety/depression), and pain, with a focus on pregnant women who were either healthy or had a pregnancy-related condition that did not hinder physical activity. Additionally, we considered studies on women who practiced the PM as their primary physical activity program during pregnancy. No minimum time or frequency of sessions was required for study inclusion. Finally, we defined the PM as any exercise routine that was promoted, guided, and supervised by a specialist in PM.

The following exclusion criteria were applied: studies of low methodological quality, as determined by a quality assessment tool; systematic reviews, study protocols, and abstracts; studies involving pregnant women who had practiced PM on an ongoing basis before or after pregnancy; studies assessing the inclusion criteria indicators but in periods other than the prenatal stage; and studies combining PM with other structured exercise programs under specialist supervision, as this would not align with the objective of the present review.

2.4. Search outcomes

Table 3 shows the search process conducted on February 17, 2024 on the Pubmed, Scopus, Web of Science, and Trip Database databases using the different search strings, filtering from January 2013 to February 2024.

The search was carried out independently by 2 reviewers using the agreed descriptors and the combination of Boolean operators specified in the search strategy. Articles were then read and selected according to the inclusion and exclusion criteria.

2.5. Quality appraisal

The methodological quality of the studies was evaluated independently by both reviewers using the study tool of the Joanna Briggs Institute at the University of Adelaide (Australia).[37] This tool enables the assessment of the methodology employed in research, with the objective of identifying any potential bias in its design, procedure, or analysis. In the present review, the versions for randomized clinical trials,[38] for systematic reviews,[39] for cohort studies,[40] and for analytical cross-sectional studies[40] were used.

2.6. Data abstraction and synthesis

A narrative synthesis of the data was conducted by the research team, organizing the main findings into 4 categories. The evidence was compiled into a primary results table for visualization purposes, and no further analyses, such as meta-analysis, were considered.

The data obtained from the systematic review are presented as mean values, standard deviations, percentages, and statistical significance limits based on the *P*-value of <.05 was used.

3. Results

3.1. Study selection

A total of 88 articles were identified from the aforementioned databases using the search strings listed in Table 3. After discarding 40 duplicate articles, a total of 48 remained. Then, 20 articles were excluded after reading the title and abstract.

Subsequently, 18 articles were eliminated after full-text reading for different reasons; the type of study (n = 8), and not related to the aim of this study (n = 10). Figure 1 details the process followed for the identification, screening, and selection of the studies included in this review.

Finally, 10 articles measuring QoL and/or pain and/or mental health in pregnant women who had practised the PM during pregnancy were included in the review.[5,10–13,35,41–44] To synthesize the articles included in the review, a table has been created in which the main characteristics of the studies are presented, including information on the author/s, location, main objective, type of research, sample, tools used, main results, and methodological quality (Table 4). The methodological quality of the studies has been depicted in Supplementary Files 1–4, Supplemental Digital Content, https://links.lww.com/MD/O719.

3.2. Study characteristics

The studies were carried out in a variety of countries, with 1 in South Korea,[41] 4 in Turkey,[5,11–13] two of them in Brazil,[35,42] 1 in Australia,[43] 1 in Cyprus,[44] and 1 in Indonesia.[10] On the basis of these data, a wide geographical dispersion in the results obtained can be observed.

In relation to the sample collection period, one of the studies did not provide the dates of data collection[41]; another 1 used data from 2016 to 2018[44]; 1 study used data collected in 2017[10]; another study obtained the data in 2018[11]; in another

Table 1

PICO format: keywords.

P: Population	Pregnant woman/ Pregnant woman with low back pain
I: Intervention	Pilates Method Training/Practice
C: Comparison/Alternative	No Pilates Method practice
O: Outcomes/Results	Perceived Quality of Life, Pain/Disability Scale, Mental Health

Table 2

Search terms.

MeSH	Search strategy
Pregnant woman	Pregnant woman OR pregnancy OR pregnant women
Pregnancy	Pregnancy
Quality of life	Life Quality OR Health Related Quality of Life OR HRQoL
Pain	Pelvic girdle pain OR low back pain, OR pelvic pain
Mental health	Anxiety OR depression
Exercise Movement Techniques	Exercise Movement Techniques OR Pilates

Table 3

Search strategy carried out on the different databases.

Database	Search strategy	Date of search	Results
Pubmed	("pregnant woman"[Title/Abstract] OR "pregnant women"[Title/Abstract] OR "pregnanc*"[Title/Abstract]) AND ("quality of life"[Title/Abstract] OR "Life Quality"[Title/Abstract] OR "health related quality of life"[Title/Abstract] OR "health related quality of life"[Title/Abstract] OR "hrqol"[Title/Abstract] OR "pain"[Title/Abstract] OR "Pelvic Girdle Pain"[Title/Abstract] OR "Low Back Pain"[Title/Abstract] OR "pelvic pain"[Title/Abstract] OR "mental health"[Title/Abstract] OR "anxiety"[Title/Abstract] OR "depression"[Title/Abstract]) AND ("pilates"[Title/Abstract] OR "Exercise Movement Technics"[Title/Abstract])	17/02/2024	19
Scopus	(TITLE-ABS-KEY ("pregnant women" OR "pregnant woman" OR pregnanc* OR pregnant*) AND TITLE-ABS-KEY ("quality of life" OR "Life Quality" OR "health-related quality of life" OR "health related quality of life" OR hrqol OR pain OR "Pelvic Girdle Pain" OR "Low Back Pain" OR "pelvic pain" OR "mental health" OR anxiety OR depression) AND TITLE-ABS-KEY (pilates OR "Exercise Movement Technics"))	17/02/2024	25
Web Of Science	"pregnant wom?n" OR pregnanc* (Topic) and "quality of life" OR "Life Quality" OR "Health-Related Quality Of Life" OR hrqol OR pain OR "Pelvic Girdle Pain" OR "Low Back Pain" OR "pelvic pain" OR "mental health" OR anxiety OR depression (Topic) and pilates OR "Exercise Movement Technics" (Topic)	17/02/2024	33
Trip Database	("pregnant woman" OR "pregnant women" OR pregnanc*) AND ("quality of life" OR "life quality" OR "health-related quality of life" OR "health related quality of life" OR hrqol OR pain OR "pelvic girdle pain" OR "low back pain" OR "pelvic pain" OR "mental health" OR anxiety OR depression) AND (pilates OR "exercise movement technics")	17/02/2024	11
Total			88

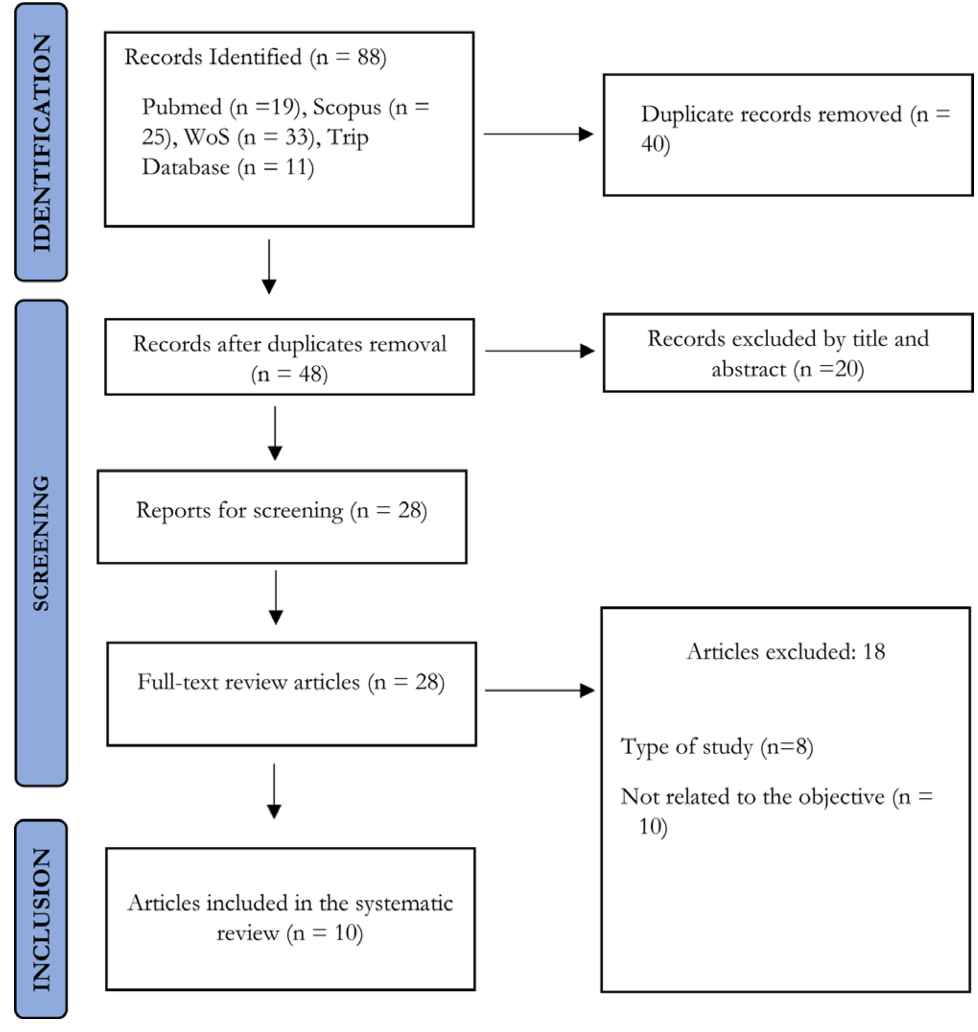

Figure 1. Identification of studies via database (PRISMA Flow Diagram).

two, the period was 2019 to 2020[13,42]; 1 study was carried out in 2020[5]; and finally 3 studies used data collected in 2021.[12,35,43]

Of the total of 10 studies included in the analysis, 5 were RCTs (with no indication of the type of blinded method used),[10,12,41–43] 2 were a double-blind RCT,[5,11] 1 cohort study,[13] 1 study was retrospective and descriptive,[44] and 1 study was a meta-analysis.[35]

All studies included a population of pregnant women who had practised the PM during pregnancy, as well as other factors (LBPP/LBP and mental health/anxiety/depression) that may

Table 4

Characteristics of the studies included in the systematic review.

Study and context	Objectives	Design Participants	Program	Quality of life, pain, or anxiety/depression assessment instruments	Conclusions and results pre-post
Sonmezer et al,[5] Turkey	To analyze whether the practice of Pilates would produce an improvement in, among other aspects, low back pain and quality of life in pregnant women	Double-blind RCT 40 (Intervention Group n = 20 and Control Group n = 20)	Clinical Pilates exercises were performed individually 2 times a week for 8 wk Warm-up and a main work out session. The total exercise program consisted of 18 different exercises designed to stretch, strengthen and balance the body and lasted for 60 to 70 min each session	• Socio-demographic data • Visual Analogue Scale (VAS) for pain • Oswestry Disability Index (ODI) • Cross-cultural adaptation of the Nottingham Health Profile (NHP) Questionnaire version	Two groups were analyzed, involving a sample of pregnant women with low back pain. One group received conventional care plus education on ergonomics for daily life without physical activity, and the other group, which was the experimental group, also practised the Pilates method together with conventional care Quality-of-life measures using the NHP, the sleep ($P = .048$) and physical mobility ($P = .007$) parameters significantly improved in the Pilates exercise group posttreatment values, the improvement in the sleep and physical mobility parameters in the NHP was significantly higher than in the control group ($P = .018$, $P = .040$, respectively) Low back pain, the study shows that the VAS score improved significantly in the Pilates exercise group at the end of the training period ($P < .001$), as compared to the initial scores. When comparing posttreatment values, the improvement in pain levels in the experimental group was significantly higher than in the control group ($P < .001$)
Oktaviani,[10] Indonesia	To assess the effects of Pilates exercises to reduce back and waist musculoskeletal pain in pregnant women in the 3rd trimester	RCT 40 pregnant women (Intervention Group n = 20 and Control Group n = 20)	Once a week for 8 wk. This workout group performed a warm-up exercise comprising mild breathing and stretching for 10 min. This was followed by the main workout, which lasted for 50 to 60 mins, and a cool-down routine lasting 10 min	• Socio-demographic data • Visual Analogue Pain Scale (VAS)	A total of 40 pregnant women were divided into 2 groups, a control group (that followed a standard pregnancy exercise regimen) and a Pilates group (that completed a Pilates exercise regimen) The reduction in the level of pain was found to be significantly greater in the group of pregnant women who completed the Pilates workout ($P < .05$)
Yildirim P et al[11] Turkey	To clarify the impact of a Pilates-based therapeutic exercise on disability, pain, mood, and sleep quality in patients with pregnancy-related lumbopelvic pain (LBPP)	Double-blind RCT 34 pregnant women (Intervention Group n = 17 and Control Group n = 17). n = 17)	Twice a week for 60-min per session for 12 wk The exercise program was performed based on centring, control, precision, concentration, breath, and flow The Pilates program was achieved at a low-moderate intensity They trained using a Pilates ball as exercise equipment. The movements that required 0-degree extension of the knee (e.g., saw, corkscrew, and single leg stretch) were modified and performed with the knee slightly flexed At the end of each exercise session, stretching exercises were performed	• Socio-demographic data • Visual Analogue Pain Scale (VAS) • Hospital Anxiety (-A) and Depression (-D) Scale (HADS)	Two groups were formed (both including pregnant women with lumbopelvic pain). All subjects received usual prenatal care and education about preventing LBP, the benefits of regular exercise, and using hot compresses when LBP exacerbates. The Pilates group also received a supervised Pilates exercise programme It was observed that there was a significant effect of Pilates on the VAS (SD = 3.0 points; 95% CI: 1.9–3.9), HADS-A (SD = 3.6 points; 95% CI: 2.2–4.9), and HADS-D (SD = 2.6 points; 95% CI: 1.5–3.6). In the control group, statistically significant differences were not found in any of these outcomes ($P > .05$)

(*Continued*)

Table 4
(*Continued*)

Study and context	Objectives	Design Participants	Program	Quality of life, pain, or anxiety/depression assessment instruments	Conclusions and results pre-post
Aktan. et al,[12] Turkey	To investigate the effects on pregnancy and delivery outcomes of clinical Pilates exercises given with or without childbirth training	RCT 64 (Group 1 n = 21; Group 2 n = 21 and Group 3 n = 22)	The study involved an 8-wk clinical Pilates training program combined with a 4-wk childbirth preparation course. The Pilates sessions were held twice a week and followed a structured routine of moderate-intensity exercises (Borg Scale 12–14). Each session included a 10-min warm-up, 30 to 40 min of core exercises, and a 10-min cool-down The exercises were performed at different levels of progression: On the mat; On the mat against gravity; and ith resistance, using a medium-intensity red resistance band and an exercise ball Additionally, this training focused on breathing techniques for labor, relaxation methods for pregnancy and childbirth, and pelvic floor muscle exercises	• Socio-demographic data • State-Trait Anxiety Inventory (STAI)	A total of 64 pregnant women were randomly separated into 3 subgroups: Group 1, who received childbirth training with clinical Pilates exercises (n = 21); Group 2, who only received childbirth training (n = 21); and Group 3 as the control group (n = 22). The STAI questionnaire was first applied at week 32 to the 3 groups, and 4 wk later The results were similar in all groups before the programme ($P > .05$). There were statistically significant differences between the 3 groups when assessing the STAI scores obtained from the pregnant women in the third trimester (after the training programme). The differences revealed that pregnant women who had received childbirth training with Pilates exercises were less anxious than those in the other groups ($P < .05$)
Reis Y. et al,[13] Turkey	To investigate the effect of clinical Pilates exercises and prenatal education on obstetric and neonatal outcomes as well as the mental, physical, and sexual health of women during the prenatal and postnatal periods	Prospective cohort study 159 pregnant women (Study group n = 79 and Control group = 80)	From week 4 until week 32; from that week onwards, it became a home programme Was applied for 1 h, 2 d/a week for 4 wk before 32 wk of gestation. After the 32nd week, the exercises were continued in the form of a home program Exercise sessions with 10 min warm-up phase, 30 to 40 min the main exercise program, and 10 min the cool-down phases. The organized program consisted of mat-level, antigravity, and anti-resistance (with exercise band and exercise ball) exercises	• Socio-demographic data • Turkish version of the Beck Depression Inventory (BDI) • Visual Analogue Pain Scale (VAS)	Two groups were formed: the intervention group practised and also from 32 wk onwards there were 4 wk of maternal education for 1 h and 1 d/wk. In the control group, no intervention was carried out. As for the study of depression, the Inventory was administered before and after the intervention. Cases with a total score above 30 were considered severely depressed A significant difference was found between the 2 groups in their pre-intervention BDI scores, being significantly lower in the control group. In the following assessments, lower scores were obtained in the intervention group compared to the control group (Control group from a mean of 6.19 to 7.54 and the Intervention group from a mean of 8.61 to 4.59). The presence of low back pain in the control group increased significantly from 13.8% to 35% with advancing weeks of gestation, while it decreased significantly ($P < .05$) from 54.4% to 21.5% in the intervention group
Hyun, A.-H. et al,[41] South Korea	To determine the effect of home-based tele-Pilates exercise during the COVID-19 pandemic on the physical and mental health of pregnant women	RCT 14 pregnant women (Intervention group n = 7 and Control group n = 7)	The program consisted of 10 min warm-up (Low-impact stretching and Breathing), 30 min main 12 to 15 reps -3 set 10 s rest between sets, and 10 min cool-down exercises, 50 min/d, twice a week, for a total of 8 wk The exercise intensity was maintained at a 10 to 13 rating of perceived exertion (50–60% of the maximum heart rate) They gradually increased the exercise intensity every 3 wk, based on the subject's physical fitness level and pain status	• Socio-demographic data • Oswestry Disability Index (ODI)	Two groups were formed, an intervention group based on the practice of home-based tele-Pilates exercise and the control group. The ODI was used as an instrument for disability assessment in people with low back pain. The test was scored twice before and after the experiment, and the total score was recorded Changes in the ODI were significantly decreased in the PE group, compared to the control group (ODI: $P = .001$). Following the intervention, a significant decrease was observed in the ODI in the PE group (ODI: $P = .028$). There was no significant difference in the ODI in the control group

(*Continued*)

Table 4
(Continued)

Study and context	Objectives	Design Participants	Program	Quality of life, pain, or anxiety/depression assessment instruments	Conclusions and results pre-post
Mazzarino et al,[43] Australia	To investigate the feasibility and outcomes of a Pilates-based childbirth education programme led by midwives. To assess as secondary outcomes, among others, quality of life and pain	RCT 18 (Intervention Group n = 11 and Control Group n = 7)	Pilates lessons (once a week for 6 wk from week 18 to week 20)	• Quality of Life Questionnaire SF-12 (Short-Form 12 items)	Two groups were established, the intervention group, which received Pilates lessons (once a week for 6 wk from week 18 to week 20) and the control group, which received usual antenatal care. Women's quality of life improved more significantly in the Pilates group throughout the clinical trial.*Pre SF-12 mean (SD)* Experimental group 81.0 (11.8) versus control group 69.78 (15.9) *Post SF-12 mean (SD)* Experimental group 83.3 (8.52) versus control group 68.1 (16.05) The difference between groups over time was statistically significant, with a chi-squared value = 5.597, $P = .018$. In terms of pain, no significant differences were found between the 2 groups
Sarpkaya-Guder,[44] Cyprus	To determine the childbirth stories of women doing prenatal Pilates and their views on the advantages of Pilates	Retrospective, descriptive study. 40 pregnant women	Prenatal Pilates sessions twice a week for at least 1 mo	• Socio-demographic data • Ad hoc questionnaire (antenatal and delivery/birth-related benefits, and newborn outcomes)	An interview on the advantages of practising the Pilates method during pregnancy revealed satisfaction and reduction of lower back pain Response's women: 82.5% answered "it made me happier"; 70% of respondents said "it helped me have a healthier and more comfortable pregnancy"; and 55% of respondents said it helped reduce lower back pain
Do Nascimento GRS et al,[42] Brazil	To verify the impact of Pilates training on blood glucose, urinary problems, sexual symptoms, pain and anxiety in women with gestational diabetes mellitus	RCT 25 pregnant women (Intervention Group n = 13 and Control Group n = 12)	The program consisted of 12 wk of training, 2 sessions per week (55–60 min each), from 24 to 28 wk of gestation to the end of the 3rd trimester (36–40 wk) The Pilates protocol used 10 different positions: spine stretch, spine twist, saw, mermaid, chest expansion, shoulder bridge, side kick – front and back, leg – small circles, scissors, and leg adduction. For progression of the exercises, the number of exercise repetitions was increased, and the position of each exercise was changed from beginner to intermediate and advanced. The movements were repeated 6 to 8 times each	• Socio-demographic data • Visual Analogue Pain Scale (VAS) • Nordic Musculoskeletal Questionnaire (NMQ) • Hospital Anxiety (-A) and Depression (-D) Scale (HADS)	For this study, 2 groups were formed. One of them practised Pilates for 12 wk and the other one, standard physical activity, where the pregnant women were instructed to walk on a flat surface for 30 min, 5 times a wk. At the start of the study, musculoskeletal pain was reported by 76% of the participants, with a prevalence of 60% (15 cases). Among the musculoskeletal pain conditions, low back pain was the most frequent in pregnant women There was a reduction in pain intensity as assessed by the visual analogue scale in the Pilates group, with a *P*-value (pre-post) = .005. Analysis of the level of anxiety and depression showed a significant improvement of anxiety in the Pilates group. The percentage of participants with symptoms of anxiety decreased from 38.5% to 0.0% in the experimental group ($P = .009$). In terms of depression levels, no significant differences were found between the 2 groups
Ferraz et al,[35] Brazil	To assess the efficacy of the Pilates method on the control of lower back pain in pregnant women	Systematic review and meta-analysis 65 pregnant women (Study group n = 33 and Control group = 32)		• Visual Analogue Pain Scale (VAS)	In the meta-analysis, there was a significant difference for pain in the comparison between the Pilates group and the control group without exercise

BDI = Beck Depression Inventory, HADS = Hospital Anxiety (-A) and Depression (-D) Scale, LBPP = lumbopelvic pain, NHP = Nottingham Health Profile, STAI = State-Trait Anxiety Inventory, VAS = Visual Analogue pain Scale.

have influenced their QoL. Some variations in the intervention and study population were found, for example, one of the studies used a tele-training method in times of the COVID-19 pandemic,[41] another 1 added the intervention of maternal education to the practice of PM exercises,[13] and another 1 had as a sample a pregnant population with a diagnosis of gestational diabetes.[42]

The assessment of QoL and the practice of the PM in pregnant women was the main objective of the review and was identified in 2 studies.[5,43] The relationship between LBPP and the practice of the PM in pregnant women was examined in 7 studies.[5,10,11,13,35,41,42] The mental aspect, in some of its forms, and the practice of the PM in pregnant women were investigated in 4 studies.[11–13,42] The impact of low back pain on QoL was analyzed in 1 study.[42] Other factors identified in relation to the psychological impact on pregnant women were anxiety[11,12,42] or depression.[11,13] QoL was assessed using different measurement tools such as the SF-12[43] and the NHP Questionnaire.[5]

Anxiety was assessed with 2 different rating scales: the Hospital Anxiety and Depression Scale (HADS-A) in its subscale referring to anxiety[11,42] and the STAI.[12] Depression was assessed using the Hospital Anxiety and Depression Scale (HADS-D) in its depression subscale[11] and another study used the BDI.[13] Pain was measured with the Visual Analogue pain Scale.[5,10,11,13,35,42]

Finally, other factors assessed in the different studies involved the Roland-Morris Disability Questionnaire to assess disability[11]; the Oswestry Low Back Disability Questionnaire[5,41] to measure the level of symptoms in patients with low back pain; the Borg scale to measure of perceived exertion and the indirect measure of exercise intensity,[12] also mentioned in another study when measuring intensity by increasing the intensity of exercise every 3 weeks depending on physical condition and reported pain[41]; and the Pittsburgh Sleep Quality Index, a scale for assessing sleep quality.[11]

3.3. Main results

3.3.1. The Pilates method. Most studies exhibited consistency regarding the gestational weeks during which the physical activity programs were initiated, with the commencement ranging from weeks 16 to 29 of pregnancy. In several investigations,[11,12,41] the frequency of PM sessions adhered to the recommendations of the American College of Obstetricians and Gynecologists.[15,45] Conversely, 1 article[10] referenced guidelines provided by the New York Pilates Academy International-Pilates and the San Francisco Balanced Body University-Pilates.

The interventions across the various studies predominantly aligned in terms of frequency, which was typically set at 2 sessions/week.[5,11–13,41,42,44] However, 2 studies reported a different frequency, wherein participants engaged in physical activity once a week.[10,43] The duration of the exercise sessions varied, with a minimum engagement of 4 weeks,[13,44] extending to 6 weeks,[43] 8 weeks,[5,10,12,35,41] and 12 weeks.[11,42] Notably, 1 study encompassed a 2-year period during which data were collected from pregnant women participating in the research within that timeframe.[44]

In terms of session duration, most studies reported an average of approximately 50 minutes,[41] while others indicated sessions lasting between 50 and 70 minutes.[5,10–13,35,42,43] The various research efforts typically incorporated a structure comprising 10 minutes of warm-up, 30 to 50 minutes of PM practice, followed by 10 minutes dedicated to recovery or cool-down.[10,12,13,35,41]

It is noteworthy that 1 study[43] involved a weekly PM session with an instructor, complemented by daily home practice for 30 minutes. In another investigation,[13] participants continued PM exercises until week 32 of gestation, subsequently transitioning to a home-based program that eliminated prolonged supine positions to prevent fatigue. Additionally, 1 study focused on a home-based tele-training intervention during the COVID-19 pandemic.[41]

The majority of the research studies[5,10–13,35,42–44] included a specialized PM instructor to facilitate the sessions. The training resources employed to instruct the pregnant women in PM were categorized into 3 groups: exercises,[5,13,42,43] the use of elastic bands,[13] and the utilization of PM Balls/Spheres.[11–13,43] Furthermore, 1 study incorporated a specific PM machine known as the "Reformer."[43] Most exercises were described in the studies' methods,[5,11,35,41,42] with 1 study categorizing the exercises into blocks,[13] others employing images for illustration,[11,42] and some simply listing the names of the exercises.[5,41]

3.3.2. Quality of life. In terms of QoL, 2 studies found a significant improvement in those groups of pregnant women who had practised the PM as part of a physical activity programme.[5,43]

3.3.3. Lumbopelvic pain. Data indicate that the PM plays a crucial role in addressing LBPP during pregnancy. The significance of LBPP is underlined by numerous studies that have specifically focused on women experiencing low back pain as their sample population.[5,10,11] Pain has been identified as a significant factor influencing QoL, with the majority of studies suggesting that a reduction in pain is associated with the practice of the PM,[5,10,11,13,35,41,42,44] with the exception of 1 study that found no significant differences.[43]

3.3.4. Mental health. PM has demonstrated a positive impact on mental health, evidenced by significant improvements in symptoms of anxiety and depression. In 2 studies, both depression and anxiety were assessed concurrently utilizing standardized questionnaires (HADS-A-D and BDI).[11,13] Furthermore, the pregnant women who participated in PM exhibited lower anxiety scores compared to those in the control group, indicating that the training effectively reduces anxiety levels among pregnant women ($P < .05$).[12,13] Regarding depression, a reduction was also observed in 2 studies following the PM intervention when compared to the control group ($P < .001$).[11,13]

4. Discussion

4.1. Main results

The perception of health related QoL among pregnant women serves as one of the critical metrics for evaluating the quality and effectiveness of maternal and child health interventions.[46] Previous literature has investigated the impact of PM on pregnancy, childbirth, and the postpartum period,[47–49] as well as the effects of physical activity on the QoL of pregnant women.[31,46] However, this review distinctly intended to provide a comprehensive analysis of the effects of PM on the QoL of pregnant women, and our findings indicate that, to varying degrees, the practice of PM can enhance the QoL of pregnant women and positively influence their mental health.

Additionally, PM has emerged as a recognized form of physical activity in the scientific literature in recent years, owing to its potential beneficial effects during both pregnancy and childbirth.[12,47,48] In examining the duration and organization of intervention programs based on the PM, the reviewed studies demonstrated a notable degree of homogeneity, indicating consistency in this aspect. Furthermore, PM is recognized as a safe practice that allows for the customization of exercises to meet the specific needs of pregnant women, without requiring complex equipment or special conditions for its implementation. The minimal variations in the PM programs included in this

review are regarded as advantageous, as the results consistently remained favorable despite these differences, thereby accentuating the intrinsic value of PM and generally yielding promising outcomes. This Acknowledgments is reflected in the findings of this review, which are particularly pertinent for professionals working with pregnant women, as they can recommend this activity and discuss its advantages with their patients.

4.2. Interpretation of results

4.2.1. Quality of life. The results of the present study are consistent with those of an earlier review and meta-analysis by Ferraz et al[35] in terms of improvement in perceived QoL levels. In addition, the present review adds more studies and also takes into account the mental health domain. QoL in pregnant women who practiced the PM during pregnancy was assessed in 2 studies.[5,43] Both Sonmezer et al,[5] who evaluated QoL using the Nottingham Health Profile (NHP), and Mazzarino et al,[43] who used the SF-12, coincide in an improvement in QoL. As can be seen in the study by Sonmezer et al,[5] the sleep and physical mobility domains were those in which a significant increase was observed with respect to the control group. In the study by Mazzarino et al,[43] significant changes in QoL related to the practice of PM were observed. However, their clinical meaningfulness is likely minimal. This could be argued based on the fact that physical exercise in general has a positive influence on psychological well-being, which, in turn, is related to perceived QoL.

Lower levels of QoL during pregnancy may be associated with various factors. Several studies[12,41,42,44] observed lower weight gain in the PM group compared to the control group, with *P*-values <.05. However, in another study[13] that also analyzed this variable, no significant difference was found between the 2 groups. It is important to note that greater weight gain during pregnancy is associated with poorer mood and a decrease in perceived physical QoL. Therefore, it is crucial to incorporate physical activity based interventions during pregnancy to help limit weight gain,[29] as excessive weight gain beyond the recommended Body Mass Index (BMI) at the beginning of pregnancy could negatively impact the physical function dimensions, thus adversely affecting QoL scores.[50]

4.2.2. Lumbopelvic pain. In our review, all the studies[5,10,11,13,41,42] which analyzed the effect of the PM on LBPP support the reduction of the latter, with the exception of Mazzarino et al,[43] who observed no difference in pain relief. This inconclusive finding was attributed to the small total number of pregnant women who participated in their trial (11 in the intervention group and 7 in the control group) and to the intervention used (6 weeks, 1 session/week),[43] compared to other trials that had a higher number of sessions per week, such as the Sarpkaya et al study,[44] where a reduction in LBPP was found.

Regarding the evidence on reduction of LBPP, the review and meta-analysis by Ferraz et al[35] reported that the PM produced greater analgesia compared to conventional care. Other review with a larger number of articles also showed a reduction in low back pain related to this practice.[51] And the review and meta-analysis by Yilmaz et al concluded that PM did not reduce pain during pregnancy, but did decrease pain during childbirth.[49]

4.2.3. Mental health. Mental health is one of the domains that are part of the perceived QoL scales.[52] There was 1 study[53] and 1 meta-analysis[54] that supported the practice of physical activity and its benefits on perceived mental health. Regarding the improvement of symptoms related to mental health and the practice of the PM, Fleming et al[34] demonstrated this positive effect in a meta-analysis, although the participants were not pregnant women but the general population, and no statistically significant improvement in terms of perceived QoL was found. Another factor that can negatively influence perceived QoL during pregnancy is pregnancy-related anxiety,[55] as it is a dimension that can negatively influence the scores obtained in some QoL questionnaires.[50] Aktan et al[12] studied anxiety in pregnant women who practised the PM during pregnancy and found a significant improvement compared to the control group. Other investigators such as Yildirim et al[11] and Do Nascimento et al[42] used anxiety–depression joint scales, such as the Hospital Anxiety Depression Scale (HADS), and found improvements in both indicators, except for Do Nascimento et al,[42] who found no differences in the levels of depression between the 2 groups. This may be due to the fact that all the participants in their study had gestational diabetes (which was an inclusion criterion), a pathology in which a higher incidence of antepartum depression is observed, according to Lee et al[56] in their meta-analysis. Reis et al[13] did observe a reduction in depression levels in the experimental group (79 pregnant women), after a 32-week PM intervention and 4 weeks of maternal education, by using the BDI.

4.2.4. The Pilates method. When assessing the effects of an exercise programme and its relationship with the QoL of pregnant women, Gustafsson et al[57] found no differences with respect to pregnant women who had not done such exercises, although they noted that more studies would be needed to corroborate these results. On the other hand, there were studies that confirmed the improvement in the QoL of pregnant women, although they may either refer to physical activity in general[53,58,59] or to the PM in particular.[9,51] In some of the studies analyzed, women who practiced the PM during pregnancy showed an improvement in their perceived QoL levels.[43] In another study in which pregnant women were surveyed in a quantitative interview, expressions of satisfaction, happiness, comfort, and feeling healthier were reported by more than 70% of them.[44] In the study by Sonmezer et al,[5] where the Nottingham Health Profile Questionnaire (NHP) was used for the assessment of QoL, sleep and physical mobility were assessed as domains, and a statistically significant decrease in both indicators was observed with the practice of the PM. According with another researchers, the reduction in sleep disorders as well as in physical mobility could be due to the decrease in low back pain, as by reducing this pain with the practice of the PM, a positive impact on both domains could be achieved.[5]

With regard to the relationship between the trimesters of pregnancy and the QoL of pregnant women, the decrease in perceived QoL was slightly more pronounced in the 3rd trimester.[22] This may be due to the growth in uterine size and its relation to physical limitation,[24] the onset of sleep disorders,[24] and increased depressive symptoms.[23] The 3rd trimester of gestation begins at 28 weeks of gestation, a time at which different studies agree in terms of sample selection.[5,10,13,41–43]

4.2.5. Other variables to consider. Certain variables exist that the PM cannot influence; nevertheless, these variables may significantly impact the QoL of pregnant women and should be duly considered. One such variable is the parity of the pregnant woman. Multiparous women have reported a lower QoL compared to nulliparous women.[60] However, some studies have indicated that there are no significant differences in QoL among different groups of women with varying parity.[29] Therefore, it can be posited that multiparous women may benefit from interventions aimed at enhancing perceived QoL.

Furthermore, various socio-demographic factors appear to demonstrate evidence of an effect on the QoL of pregnant women. In this sense, advanced maternal age, typically defined in different studies as being above 35 years, seems to have a positive influence on social function and role limitations, particularly concerning emotional problems. Conversely, the physical

function domain appears to be associated with decreased scores of QoL in cases of advanced maternal age,[61] although additional studies are required to corroborate these findings.

There are also studies on the positive effect of sociodemographic factors on QoL, the main one being education level.[62] The practice of physical activity in itself, supervised by nurses and midwives, can lead to an improvement in pregnant women's perception of their own health, both physical and mental,[54] and in their QoL.[59] Social relationships resulting from joint physical exercise in a group context may also positively influence perceived health improvement in pregnant women.[63]

4.3. Limitations and strengths

The findings of this study should be interpreted with caution, as there are several limitations that may compromise the validity of the review. One of these limitations is the final number of articles included for synthesis after the evaluation process, leaving a sample of 10 articles. A further limitation is the sample size observed in the different studies, with the value ranging from n = 14 to n = 159. Another limitation is noted in the variability in the use of the different tools for collecting information on the assessment of QoL. Similarly, it has been observed that there is no specific questionnaire for the assessment of QoL in pregnant women that has been validated in the Spanish language. However, there are publications from other countries that have translated and validated specific QoL questionnaires for pregnancy in their languages.[64]

Among the strengths of this investigation, 7 of the 10 articles were randomized controlled trials and 1 was a meta-analysis, and this provides a higher level of evidence, which is an advantage. However, more blind and double-blind studies on the intervention would be required, as the data obtained from the pregnant women in terms of perceived QoL after taking part in the PM sessions could potentially be biased.

Future lines of research would include the validation of a specific instrument for assessing QoL in pregnant women and the need for a larger number of trials with a larger sample size in order to confirm these findings. Finally, further research is needed into the additional benefits that can be obtained from the practice of the PM during pregnancy to provide updated scientific evidence on exercise in pregnancy and its influence on areas such as physical and mental well-being and QoL.

5. Conclusions

Pregnant women are a population susceptible to having their QoL altered, partly due to various physiological, psychological, and social changes.

Based on the results of this review, during pregnancy, women's QoL seems to improve when they practice the PM. Overall, the findings support that the practice of the PM as a form of physical activity should be considered in order to reduce gestational LBPP, and that mental health indicators of anxiety and depression would also be reduced with such practice. Most of the studies included in this review were clinical trials, which would validate the results obtained.

Finally, based on the literature reviewed on perceived QoL and the practice of the PM, further studies would be desirable to advance our results in a larger sample size. This would give greater validity to these results and thus provide information to pregnant women on the benefits that the practice of the PM can bring. In addition, these new studies would make available updated scientific evidence on the practice of physical activity during pregnancy and its influence on areas such as physical and mental well-being, and QoL.

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