

Original Article

Nutrition and physical activity interventions to ameliorate postpartum depression: A scoping review

Noor Fairuzi Suhana Yahya MSc¹, Nur Islami Mohd Fahmi Teng PhD¹, Srijit Das MBBS, MS², Norsham Juliana PhD³

¹Faculty of Health Sciences, Universiti Teknologi MARA, Selangor, Malaysia

²Sultan Qaboos University, Muscat, Oman

³Faculty of Medicine and Health Sciences, Universiti Sains Islam Malaysia, Negeri Sembilan, Malaysia

Background and Objectives: Globally, there is a high prevalence of postpartum depression (17.7%) reported in a recent study among mothers during the postpartum period. It contributes to poor health and well-being among newly delivered women. We reviewed the published effect of nutrition and physical activity interventions on improving and treating postpartum depression. **Methods and Study Design:** The scoping review was performed using Arksey and O'Malley's methodological framework. The systematic search was conducted using Scopus, PubMed, EBSCOHost and Google Scholar in April 2020, updated in March 2021. Only literature published between January 2010 until February 2021 was searched. **Results:** A total of 25 articles were included, of which 23 were randomised controlled trials, and 2 were quasi-experimental studies. Some of studies found improvements in depression (76% out of all studies). On this basis, nutrition or physical activity intervention probably improves postpartum depression. Moreover, the integration of nutrition and physical activity appears to improve depression in the more thorough follow-up of participants. Active involvement of the participant in the interventions was contributory to effectiveness. **Conclusions:** Nutrition and physical activity interventions with appropriate strategy and delivery are promising options for the management of postpartum maternal mental health. More definitive investigation of non-pharmacological interventions to ameliorate depression among postpartum women is warranted.

Key Words: depression, postpartum, diet therapy, exercise therapy, exercise movement techniques

INTRODUCTION

The postpartum period is crucial for a women's current and future wellbeing, as maternal physiology returns to its pre-pregnancy status. The changes include uterine involution, postpartum wound healing, and increased abdominal muscle strength.¹ This takes about six to eight weeks, beginning with the birth of the fetus and placental expulsion. The postpartum period predisposes women to major hormonal change affecting emotional lability with potential depression.² Postpartum depression is a serious psychiatric illness that occurs within one month of childbirth.³ A meta-analysis of the global prevalence of postpartum depression in 56 countries, revealed a global pooled prevalence of 17.7%, ranging from 3% in Singapore to 38% in Chile.⁴ Symptoms of postpartum depression include passivity with behaviors such as depressed mood (sad, hopeless), lack of interest in the child or its care, and inappropriate fatigue,⁵ continuously over some two-weeks. It may affect infant development physically and in motor, cognitive and emotional development, as well as impair maternal-infant interaction, with poor bonding, and infant insecurity.⁶

According to Jasimah et al,⁷ women with severe depression had a high consumption of unhealthy foods. Depressive disorders may be associated with macro and micronutrient deficiencies.⁸ In this event, nutrition may be a

modifiable intervention.⁹ Nutritional factors play an essential role in complex brain function and in metabolic pathways impinging on mental health. For example, essential fatty acids (particularly omega-3), iron, folate and vitamin B-12 are critical to brain function through enzymatic activity, cellular and oxidative processes, and neurotransmission.⁹ Nutrient deficiencies of pregnancy may persist postpartum and require attention for optimal mental health.^{8,9} Nutrition intervention is an appealing strategy to reduce postpartum depression being cost-effective, stigma-free, and generally acceptable.⁹ The integration of nutrition and other preventive strategies may more effectively ameliorate depressive disorder.⁸

Physical activity has been shown to be an effective way to improve a mother's psychosocial well-being.¹⁰ Reduced physical activity is associated with more depressive sym-

Corresponding Author: Dr Nur Islami Mohd Fahmi Teng, Centre for Dietetics Studies, MiCHILD (Maternal, Infant and Young Child) research group, Faculty of Health Sciences, Universiti Teknologi MARA. Puncak Alam Campus, 42300, Selangor, Malaysia.

Tel: +03-32584540

Email: nurislami@uitm.edu.my

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ptoms among women who adhere to traditional confinement practices.¹¹ Several studies underscore that sedentary behaviour is linked to postpartum depressive symptoms, whereas physically active women have less.^{10,12} More than increased muscle strength and flexibility, physical activity can favour other health dimensions such as satisfaction and awareness of self-ability in coping with motherhood and its impact on livelihood, so improving psychosocial well-being.¹³

Women's preferences for pharmacological (such as antidepressants and hormonal therapy) or non-pharmacological approaches to postpartum depression management may be ambiguous and affect adherence.¹⁴ That nutrition and physical activity interventions can be cost-effective in improving mental health become relevant.^{9,12} Evidence for the effectiveness of integrated nutrition and physical activity in postpartum depression risk reduction has been inconclusive.^{9,10,12,15,16} The current scoping review of references works, including literary resources through to 2021 adds perspective to systematic reviews focused on publications through to 2019 or 2020.^{8,10} The present scoping review is guided by the main research question, namely, 'Whether and how effectively do physical activity and nutrition interventions ameliorate postpartum depression?' It focuses on intervention strategy and its effectiveness.

METHODS

Protocol development

The interpretive scoping review methodology used is adapted from that of Arksey & O'Malley.¹⁷ The framework has five stages: 1) identifying the research questions; 2) identifying relevant studies; 3) study selection; 4) charting the and collating data, 5) summarising and reporting information.¹⁷ This scoping review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR). As a scoping review, registration with the International Prospective Register of Systematic Reviews was not required.

Stage 1: Identifying the research question

According to Arksey & O'Malley,¹⁷ defining the relevant research question is a vital initial step since it guides the way search strategies are designed. In this review, we used general format of a PICO question that is P (population): postpartum women, I (intervention): nutrition and physical activity, C (comparison intervention): control or alternative to the intervention group, and O (outcome): postpartum depression or maternal mental health. Therefore, we identified one overarching research question to lead our systematic search strategy and reporting of results: "*What is the effect of nutrition and physical activity interventions on postpartum depression among postpartum women compared with a control or non-intervention group?*"

Stage 2: Identifying the relevant studies

Our research team developed the search strategy collaboratively. A time frame for publication access was set to focus on recent interventions in postpartum depression (from January 2010 to February 2021). The systematic

search was performed in electronic databases using standardised search terms specific to the needs of each respective database and revised by the research team. The databases selected were Scopus, Pubmed, EBSCOHost and Google Scholar, and performed in April 2020 with update in March 2021. The search was conducted with MeSH (Medical Subject Headings in PubMed) terms including "*depression*", "*postpartum*", "*postpartum depression*", "*diet*", "*nutrition*", "*exercise*", "*exercise therapy*" and "*exercise movement techniques*". Table 1 lists the initial keywords and search terms generated. Boolean operators (AND, OR, AND NOT) were used to combine search terms within related keywords. If search terms were incomplete, an additional search was performed using modified search terms. Table 2 shows the search strings generated.

Stage 3: Selecting studies

For this review, articles that were duplicated among databases were removed. Articles were screened according to years included (January 2010 to March 2021), and restricted to English publications. Screening for article eligibility was in two stages: a title and abstract/summary and full-text screening. Finally, an article was included if it fulfilled the following criteria:

Population: primiparous or multiparous postpartum adult women.

Intervention: nutrition or dietary modification, nutrition improvement, and exercise-based (supervised, unsupervised, coaching-based, or motivational), started only after childbirth.

Outcome: Depression symptoms according to a validated assessment tool.

Age of participant: from 18 to 50 years

All the articles selected were full papers for reference, and excluded if they were:

Non-human or animal studies;

Only abstracts, case reports, protocols or focussed on unrelated topics.

The selection process is shown in Figure 1.

Stage 4: Charting the data

To confirm study relevance and extract its characteristics, a framework was developed, referred to as data charting. This method uses both a narrative and analytic approach to extract data that best addresses the research objectives. It is a process which synthesises and interprets data by sifting, charting, and sorting information based on key issues and themes.¹⁷ Each selected article was categorised by authors, publication year, country, aim, design/methods, participants/ sample size, type of intervention and allocation to a scoping table. This is overviewed in Table 1-3.

Stage 5: Collating, summarising and reporting results

The main characteristics of studies included were summarised qualitatively and tabulated based on data extraction, and findings presented in narrative form. Content analysis was conducted to identify themes regarding sample size, type, duration, frequency, and intervention effectiveness for improving depressive disorder among postpartum women. Knowledge gaps were identified. Emer-

Table 1. List of keywords and synonyms generated as search terms

Postpartum depression	Nutrition intervention	Physical activity intervention
“postpartum” AND “depression”	“diet”	“exercise” OR “fitness” OR “sport” OR Aerobic
“postpartum depression”	“nutrition”	“physical activity”
“maternal mental health”	“nutrition intervention”	“motor activity”
“postnatal” AND “depression”	“diet intervention”	“exercise therapy”
“well-being” AND “postpartum”	“nutri*” OR “food”	“exercise test”
	“vitamin” OR “mineral” OR “supplement” OR “micronutrients”	“physical activity intervention” OR “lifestyle intervention”

Table 2. List of search strings

Search string 1:	(“postpartum depression” OR (“postpartum” AND “depression”) OR “maternal mental health” OR (“well*being” AND postpartum)) AND (“diet” OR “nutrition” OR “nutrition intervention” OR “diet intervention” OR “nutri*” OR “food” OR “vitamin” OR “mineral” OR “dietary supplements” OR “supplement*” OR “micronutrients”) AND (“exercise” OR “fitness” OR (“physical” AND “activity”) OR “physical activity” OR “exercise test” OR “aerobic” OR “physical exercise” OR “motor activity” OR “exercise therapy” OR “exercise movement techniques” OR “sport” OR “ physical activity intervention*” OR “lifestyle intervention*”)
Search string 2:	(“postpartum depression” OR (“postpartum” AND “depression”) OR “maternal mental health” OR (“well*being” AND postpartum)) AND (“diet” OR “nutrition” OR “nutrition intervention” OR “diet intervention” OR “nutri*” OR “food” OR “vitamin” OR “mineral” OR “dietary supplements” OR “supplement*” OR “micronutrients”)
Search string 3:	(“postpartum depression” OR (“postpartum” AND “depression”) OR “maternal mental health” OR (“well*being” AND postpartum)) AND (“exercise” OR “fitness” OR (“physical” AND “activity”) OR “physical activity” OR “exercise test” OR “aerobic” OR “physical exercise” OR “motor activity” OR “exercise therapy” OR “exercise movement techniques” OR “sport” OR “ physical activity intervention*” OR “lifestyle intervention*”)

gent themes could then be considered.

RESULTS

Study selection

The search protocol identified 2425 potentially relevant articles, and three additional articles were found by scanning article reference lists, making 2428 initial titles in all. After removal of duplicates, 2265 articles remained. These were screened for inclusion years, English language and document type, where only journal articles were accepted. Some 509 articles with title, abstract, and full text or equivalent and which fulfilled inclusion criteria were reviewed. Those articles that did not describe interventions to ameliorate postpartum depression were excluded. There were 32 articles where intervention relevancy was not in doubt. Finally, 25 publications met the criteria for inclusion in this scoping review.

Study characteristics

Study characteristics are summarised in the Table 3. The total sample was 3352 women [control n=1549 and intervention n=1803] and international [United States (n=7),¹⁸⁻²⁴ Australia (n=3),²⁵⁻²⁷ United Kingdom (n=2),^{28,29} Iran (n=4),³⁰⁻³³ Turkey (n=1),³⁴ Egypt (n=1),³⁵ Taiwan (n=4),³⁶⁻³⁹ Japan (n=1),⁴⁰ China (n=1)⁴¹ and India (n=1)⁴²]. All were apparently healthy postpartum women without any childbirth complication, recruited as early as

2 days until 12 months postpartum. Most studies (n=19)^{18-21,24-32,34,37,40-43} used the Edinburgh Postnatal Depression Scale (EPDS),⁴⁴ while three studies^{22,33,39} used the Beck Depression Inventory (BDI),⁴⁵ two studies^{23,36} the Center for Epidemiological Studies Depression Scale (CES-D),⁴⁶ and one used the Zung Self-Rating Depression Scale³⁵ to assess depressive symptoms. Eight studies included women who fulfilled the depressive symptoms criteria,^{25,26,28-32,35} while the remaining studies included women who did not follow these criteria.

This review is about two main interventions, nutrition and physical activity, to ameliorate postpartum depression. Eight studies focused only on nutrition interventions,^{18,30-33,41,43} 14 on physical activity,^{19,20,36,37,40,42,21,25-29,34,35}, and three studies^{23,24,39} were designed to combine nutrition and physical interventions to improve maternal mental health. Almost all studies (n=23) were randomised controlled trial studies, except for two quasi-experimental studies.^{25,36}

Nutrition interventions characteristics

There was a wide variety of nutrition and physical activity interventions. For nutrition, there were three main categories: 1) overall diet, 2) on specific micronutrients and 3) specific food type. For overall diet modification interventions, two were targeted for maternal weight-loss by individualised dietary with either education plans³⁹ or

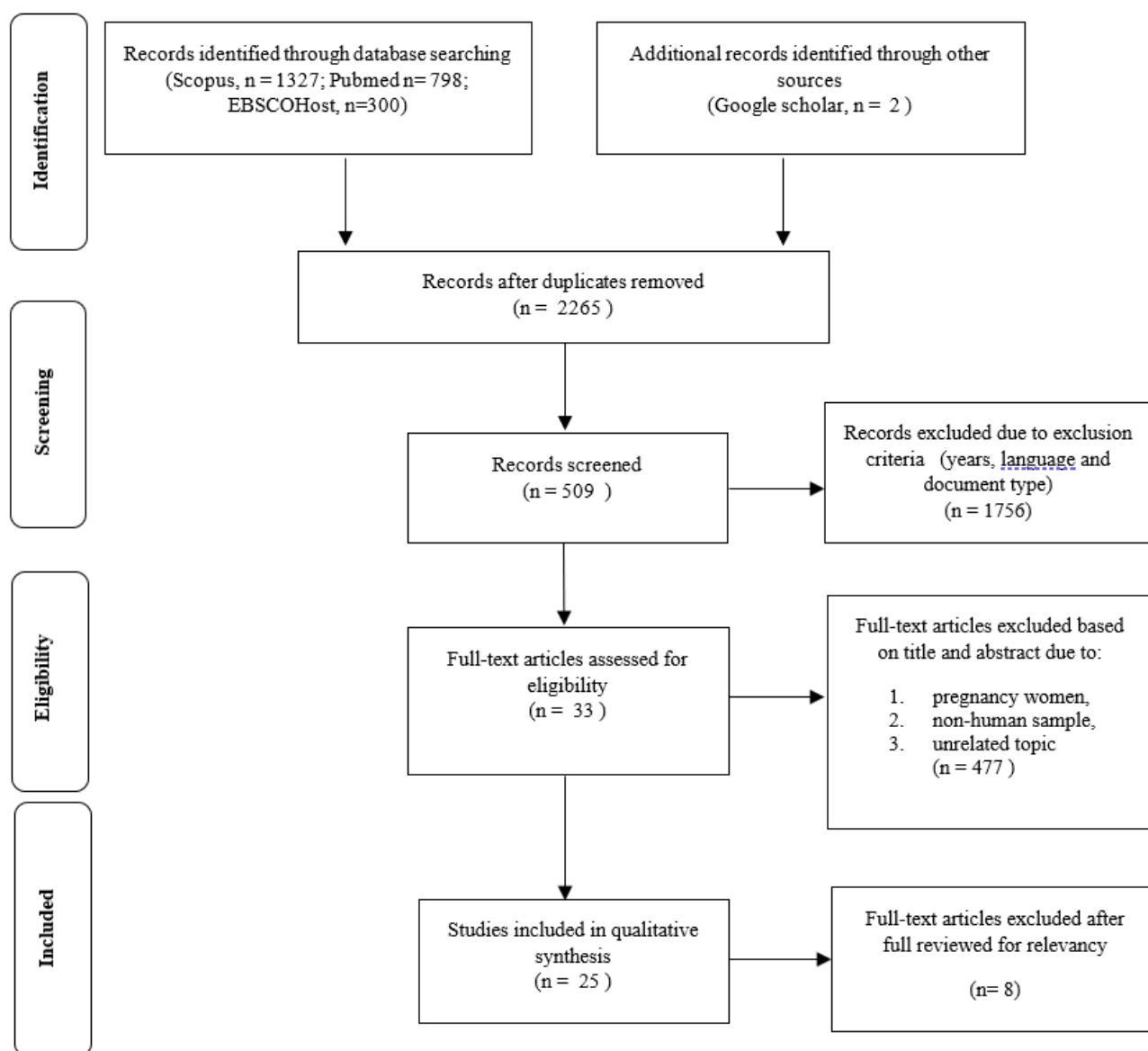


Figure 1. Summary of the selection of publications.⁶⁵

social cognitive theory-based internet intervention,²⁴ with depressive symptoms as a secondary outcome. On the other hand, Surkan et al,²³ with a primary focus on depressive symptoms, incorporated key messages such as limiting red meat to three or fewer servings per week. Intervention with specific micronutrients has been variously with supplementary vitamin D,³⁰ vitamin D and calcium,³¹ tryptophan and tyrosine²² and zinc and magnesium¹⁸ targeting depressive symptoms. Interventions lasted from three days (n=1),²² to two to three weeks (n=2),^{41,43} one to two months in most studies (n=4),^{18,31-33} six months (n=2)^{30,39} and as long as 12 months (n=2).^{24,47} The supplement dosage average about 1 capsule per day,^{18,22,30,32} or fortnightly.³¹ Specific foods used have included chamomile tea,⁴³ magnolia tea⁴¹ and saffron³³ to enhance mood and prevent depressive symptoms. The chamomile and magnolia teas were prescribed as one cup per day,^{28,30} whereas the saffron capsule was consumed twice daily.³³

Physical activity interventions characteristics

Physical activity interventions were classified into six

groups; 1) coaching and motivational health promotion techniques;^{19,23,24,28,29,39} 2) relaxation and breathing exercises;³⁵ 3) walking;^{21,25,26} 4) aerobic and/or yoga and/or Pilates;^{36,37,40} 5) cardiovascular and strength^{27,42} and; 6) resistance or more intense exercise following the postpartum period.^{20,34} Intervention durations varied between 1 to 4 months for most studies (n=10),^{20,25-27,34-37,40,42} 6 months in three studies,^{19,28,39} and up to 12 months in four studies.^{21,23,24,29} Meanwhile, the session time duration was reciprocal with session frequency in a week, where shorter sessions were more frequent^{19,34} and longer sessions were less frequent.^{27,36,42} This was evident with session frequency from one session for 60 minutes,^{27,36,42} to two sessions for 15 to 45 minutes,^{21,29,35,37} four sessions for 90 minutes each⁴⁰ and five sessions for at least 30 minutes each.^{19,34,47} However, Forsyth et al²⁸ recommended 150 min/week of moderate-intensity exercise without guidance about frequency. Similarly, Teychenne et al^{25,26} encouraged participants to set a self achievable goal and gradually increase it according to progress, without reference to duration or frequency.

Table 3. Summary of nutrition intervention in improving postpartum depression

Author, Country	Study, Subjects (n)	Tools (Psychosocial well-being)	Commencing at	Duration of intervention	Frequency	Type of nutrition intervention	Finding
Sheikh et al. (2017), Iran ³²	RCT, IG: 35 CG: 35	1. EPDS	1 week after child-birth	1 ½ month	Once a day (daily consumption)	Received ferrous sulfate tablets containing 50 mg of elemental iron once daily.	+
Dowlati et al. (2017), USA ²²	RCT, IG: 21 CG: 20	1. BDI	3 days after child-birth	3 days	One to two times a day	Received dietary supplement, composed of 2g of tryptophan, 10g of tyrosine, and blueberry juice with blueberry extract	+
Fard et al. (2017), Iran ¹⁸	RCT, IG 1: 33 IG 2:33 CG: 33	1. EPDS	at least 2 days after childbirth	2 months	Once a day (daily consumption)	IG 1: Received zinc sulfate for 27 mg IG 2: Received magnesium sulfate for 320 mg CG: Placebo tablet	0
Chang et al. (2015), Taiwan ⁴³	RCT, IG: 40 CG: 40	1. EPDS	6 week after child-birth	2 weeks	One cup per day	Drink one cup of chamomile tea	+
Xue et al. (2020), China ⁴¹	RCT, IG: 56 CG: 56	1. EPDS	N/A	3 weeks	Once a day (daily consumption)	Drink of one cup (300 ml) of magnolia tea (origin: China)	+
Rouhi et al. (2018), Iran ³⁰	RCT, IG: 40 CG: 40	1. EPDS	Within 4 to 12 months after child-birth	6 months	One capsule per day	Received vitamin D supplementation (1 000 IU)	+
Amini et al. (2020), Iran ³¹	RCT, IG 1: 27 IG 2: 27 CG: 27	1. EPDS	Within 1 to 6 month after child-birth	8 weeks	1. Vitamin D: one capsule per fortnightly 2. Calcium: one capsule per day	IG 1: Received Vitamin D3 (50 000 IU) fortnightly + Calcium carbonate (500 mg) daily IG 2: Received Vitamin D3 (50 000 IU) fortnightly + Placebo calcium carbonate (500 mg) daily CG: Received placebo vitamin D3 (50 000 IU) fortnightly + Placebo calcium carbonate (500 mg) daily	+

IG: Intervention group; CG: Control group; RCT: Randomised controlled trial study; EPDS: Edinburgh Postnatal Depression Scale; +: Nutrition intervention yield a significantly positive effects towards postpartum depression; 0: Nutrition intervention does not result any significant effects towards postpartum depression.

Table 4. Summary of physical activity intervention in improving postpartum depression

Author, Country	Study, Subjects (n)	Tools (Psychosocial well-being)	Commencing at	Duration of intervention	Frequency (sessions per week)	Type of exercise intervention	Session duration (min)	Intensity	Finding
Lewis et al. (2018), USA ¹⁹	RCT, IG (exercise): 150 IG (wellness/support): 150 CG: 150	1. EPDS	Between 2 days to 11 weeks after childbirth	6 months	Encourage 5 days a week	Specific recommendations regarding the frequency and duration and motivational strategies to increase exercise behaviour. Telephone counselling, exercise logs, and exercise DVD were given to the participants.	30 minutes or more	Moderate	+
Lecheminant et al. (2014), USA ²⁰	RCT, IG: 30 CG: 30	1. EPDS	6 weeks after childbirth	4 months	2 days in a week	Resistance training intervention; leg extension, seated leg curl, leg press, biceps curl, shoulder press, chest press, lat pull-down, seated row, abdominal curl-ups.	1-3 sets per exercise with 8-12 repetitions	Moderate	+
Yang & Chen (2018), Taiwan ³⁷	RCT, IG: 70 CG: 70	1. EPDS	6 weeks after childbirth	3 months	3 times a week	Aerobic gymnastic exercise, incorporate with yoga movement, muscle stretching & strengthening	15 minutes	Moderate	+
Forsyth et al. (2017), UK ²⁸	RCT, IG: 12 CG: 12	1. EPDS	N/A	6 months	N/A	Motivate for exercise participation (150 min/week of exercise) either attend structured exercise or self-initiated	60 minutes (structured session)	Moderate	0
Daley et al. (2015) UK ²⁹	RCT, IG: 47 CG: 47	1. EPDS	10-14 weeks after childbirth	12 months	3-5 days a week	Accumulating 30 minutes of moderate-intensity exercise on 3 days per week. Intervention via face-to-face consultations and telephone sessions with PA facilitator.	60 minutes (consultation), 30 minutes (exercise)	Moderate	+
Norman et al. (2010), Australia ²⁷	RCT, IG: 62 CG: 73	1. EPDS	6 to 10 weeks after childbirth	2 months	1 session in a week	"Mother and Baby" (M&B) program: specialised exercise (cardiovascular and strength components) and parenting education, provided by women's health physical therapist.	60 minutes (exercise), 30 minutes (education session)	Moderate	+
Haruna et al. (2013), Japan ⁴⁰	RCT, IG: 50 CG: 51	1. EPDS	8 weeks after childbirth	1 month	4 sessions per week	Aerobic exercises and muscular stretching. Exercise classes administered by expert exercise instructors.	90 minutes	Moderate	0

IG: Intervention group; CG: Control group; RCT: Randomised controlled trial study; EPDS: Edinburgh Postnatal Depression Scale; BDI: Beck Depression Inventory; ACOG: The American College of Obstetricians and Gynaecologist; CES-D: Center for Epidemiologic Studies Depression Scale; +: Physical activity yield a significantly positive effects towards psychosocial well-being; 0: Physical activity does not result any significantly effects towards psychosocial well-being.

Table 4. Summary of physical activity intervention in improving postpartum depression (cont.)

Author, Country	Study, Subjects (n)	Tools (Psychosocial well-being)	Commencing at	Duration of intervention	Frequency (sessions per week)	Type of exercise intervention	Session duration (min)	Intensity	Finding
Thiruppathi et al. (2014), India ⁴²	RCT, IG: 20 CG: 21	1. EPDS	4 to 8 weeks after childbirth	2 months	1 session per week	Conducting Structured Physical activity (SPA): warm up, cardiovascular intervals, body toning, core pelvic floor exercises, cool down and stretching	+/- 60 minutes	Moderate	+
Keller et al. (2014), USA ²¹	RCT, IG: 39 CG: 54	1. EPDS	6 weeks to 6 months after childbirth	12 months	3 session per week	4 types of support (emotional, instrumental, appraisal, and informational) with group walking	N/A	Moderate	0
Özkan et al. (2020), Turkey ³⁴	RCT, IG: 34 CG: 31	1. EPDS	1 month after childbirth	1 month	At least 5 days in a week	Encourage to do mild and medium level of exercises in the first 2 weeks, medium and severe levels in the following 2 weeks (based on ACOG recommendations)	30 minutes	Mild-Moderate-Severe	+
Ko et al. (2012), Taiwan ³⁶	Quasi experimental one group pretest-post test design IG: 28 CG: 28	1. CES-D	Within 2 to 6 month after childbirth	3 months	Once a week	Yoga and Pilates program for postpartum women.	60 minutes per session	Light	+
El aziz et al. (2016), Egypt ³⁵	RCT, IG: 15 CG: 15	1. Zung self-rating depression scale	1 month after childbirth	3 months	3 session per week	Meditation, physical relaxation and diaphragmatic breathing exercise	45 minutes per session	Light	+
Teychenne et al. (2018), Australia ²⁵	Quasi experimental one group pretest-post test design IG: 15 CG: 15	1. EPDS	Within 3 to 9 months after childbirth	3 months	Following self-goal to increase physical activity	Multi-component home-based treadmill intervention	NA	NA	+
Teychenne et al. (2021), Australia ²⁶	RCT, IG: 30 CG: 32	1. EPDS	Within 3 to 9 months	3 months	Following self-goal to increase physical activity	Multi-component home-based treadmill intervention or stationary exercise bicycle intervention	NA	NA	0

IG: Intervention group; CG: Control group; RCT: Randomised controlled trial study; EPDS: Edinburgh Postnatal Depression Scale; BDI: Beck Depression Inventory; ACOG: The American College of Obstetricians and Gynaecologist; CES-D: Center for Epidemiologic Studies Depression Scale; +: Physical activity yield a significantly positive effects towards psychosocial well-being; 0: Physical activity does not result any significant effects towards psychosocial well-being.

Method of delivery

In nutrition intervention studies, almost all studies involved supplementation of micronutrients and specific foods,^{18,22,30-33,41,43} were not assisted by a specific counsellor or qualified service provider. On the other hand, most physical activity intervention studies (n=11) involved qualified service providers in informing or enhancing the motivation to undertake physical activity; they were dietitians or nutritionists, health psychologists, midwives, or physical therapists.^{19-21,27,29,36,37,39,40,42} However, six physical activity intervention studies probably had no qualified service provider.^{25,26,28,34,35} A study of integrated nutrition and physical activity intervention involved qualified counsellors who provided emotional support through home visits, motivational phone calls, and engaged women in existing community resources.⁴⁷

Nutrition intervention and postpartum depression

Four supplementation interventions demonstrated reductions in postpartum depressive symptoms among women for vitamin D,^{30,31} iron,³² tryptophan or tyrosine.²² Specific food interventions with chamomile tea, magnolia tea, or saffron in postpartum women not only improved mood and reduce depression³³ but also improved sleep quality.^{41,43} Dietary modification by Surkan et al,⁴⁷ with more fruit and vegetable consumption and limited meat intake, resulted a lower depression score ($p=0.046$) than in controls. Neither zinc or magnesium supplementation¹⁸ or even individualised dietary education plans^{24,39} offered any measurable benefit in postpartum mood

Physical activity intervention and postpartum depression

Overall, about 13 studies showed that physical activity interventions significantly ameliorated postpartum depression, which was not evident in other 4 studies. Studies that used coaching and motivational health promotion techniques reported that exercise reduces depression scores.^{19,29,47} Increased frequency and duration of exercise,¹⁹ to 30 minutes of moderate-intensity for three days or five days^{29,34} in a week are the primary strategies for exercise intervention. However, self-initiated exercise,²⁸ individualised physical activity education plans³⁹ and internet-based motivational to exercise⁴⁸ do not detectably enhance physical activity efforts to reduce postpartum depression. Low-intensity exercises such as relaxation and breathing exercise,³⁵ yoga and pilates exercise,^{36,37} walking exercise,^{21,25} and aerobic exercise using bouncing and an exercise ball do effect improvements in the susceptibility to postpartum depression. Moderate to high-intensity exercise had favourable effects on postpartum depression when the participants underwent cardiovascular and strength exercise,^{27,42} resistance training²⁰ and gradually increment from mild to medium and severe exercise over four weeks.³⁴

DISCUSSION

Main finding

In this review, favourable effects of nutrition and physical activity on susceptibility to postpartum mood are found in the published literature. About 19 studies (76%) reveal this association for depression.^{18,24,26,28,39,40}

Nutrition intervention

The current evidence showed that an adequate diet and selected nutrient supplements, notably vitamin D, iron, tryptophan or tyrosine' may enhance resiliency against depressed mood in the early postpartum period.^{22,30-32} Newly delivered women with low serum vitamin D are prone to postpartum depression.^{48,49} The anti-inflammatory effects of vitamin D may partly explain reduced postpartum depression. Vitamin D is involved in brain development and function,⁵⁰ with effects on the adrenal hypothalamic (HPA) axis; and altered oestrogenicity may also play a role.⁵¹ Any role of iron will be complex since it is both an oxidant and an essential micronutrient for hematopoiesis and in energy metabolism. In brain it is involved in neurotransmission.⁵² Iron deficiency is a plausible candidate for postpartum depression, especially after the demands of pregnancy and delivery, as for other micronutrients.^{32,53} Tryptophan and tyrosine are involved in the maintenance of monoamine oxidase A (MAO-A) activity in brain. During postpartum period, MAO-A levels were heightened due to the dramatic decline in estrogen levels, resulting in the catalysation of brain's neurotransmitters (serotonin, norepinephrine and dopamine). However, the reduction of these neurotransmitters will generate excessive oxidative stress and indirectly will cause mood disorders.⁵⁴ Therefore, supplementation of tryptophan and tyrosine to the maternal diet was evidenced to compensate for the excessive removal of serotonin, norepinephrine, and dopamine.²²

Physical activity intervention

Our findings demonstrate that physical activity intervention provides an acceptable alternative to reduce postpartum depression symptoms when most studies showed positive effects of exercise on depressive symptoms. Several studies in this review have evidenced that the recommendations of participating in moderate-intensity physical activity for at least 30 minutes on most days of the week as outlined by the American College of Obstetrics and Gynaecology,⁵⁵ yield beneficial effects, especially to the women's psychosocial well-being.^{19,21,23,29,34,35} Participating in an active lifestyle by engaging in various exercises during the postpartum period can simultaneously improve the mother's physical and psychological health. Furthermore, physical exercise is less reliant on external factors such as the psychotherapist's availability, therefore it is cost-effective, act as a self-care adjunctive treatment and can be conducted outside the need of any standard medical setting.^{23,56}

In addition, performing an individualised exercise consultation and a closely supervised exercise^{19,29} reported greater adherence to exercise than intervention with unsupervised exercise.²⁸ Consideration of the mother's physical fitness level should be prioritised when designing an intervention to enable participants to exercise with ease and enjoyment.^{15,34} For example in the study of Lewis et al,¹⁹ the counsellor advised participants to monitor heart rate while conducting an exercise to ensure safety and increase the intensity according to their fitness level. Moreover, disseminating knowledge regarding exercisesuch as types of appropriate exercises and benefits of exercise specific to postpartum will increase their motiva-

Table 5. Summary of combination nutrition and physical activity intervention in improving postpartum depression

Author, Country	Study, Subjects (n)	Tools (Psychosocial well-being vs physical activity)	Commencing at	Duration of intervention	Frequency (sessions per week)	Type of exercise intervention	Session duration	Intensity	Finding
Huang et al. (2011), Taiwan ⁶⁴	RCT, IG (PG): 61 IG (PG+PP): 64 CG: 64	1. BDI	Began 24 – 48 hours after birth	IG (PG+PP): 12 months IG (PP): 6 months	Following self-goal	Individualised dietary and physical activity education plans. Counselling session, brochure and booster session at 6 weeks postpartum and 3 month postpartum.	N/A	N/A	0
Surkan et al. (2020), USA ²³	RCT, IG: 325 CG: 200	1. CES-D	6 to 20 weeks after childbirth	12 months	At least 5 days in a week for physical activity	Increase consumption of fruits and vegetables, limit meat intake, and perform 30 minutes of physical activity per day, at least 5 days in a week. Intervention gave via home visits and monthly phone calls.	30 minutes	N/A	+
Bennion et al. (2020), USA ²⁴	RCT, IG: 174 CG: 196	2. EPDS	between 6 to 12 months	12 months	Daily practice	Internet-based weight loss program. Intervention targeted eating, and physical activity (selecting appropriate goals, grocery shopping, label reading, restaurant eating, beginning exercise).	N/A	N/A	0

IG: Intervention group; CG: Control group; RCT: Randomised controlled trial study; EPDS: Edinburgh Postnatal Depression Scale; BDI: Beck Depression Inventory; CES-D: Center for Epidemiologic Studies Depression Scale; +: Physical activity yield a significantly positive effects towards psychosocial well-being; PG: Pregnancy period; PP: Postpartum period; 0: Physical activity does not result any significantly effects towards psychosocial well-being.

tion and confidence to engage more in regular exercise.^{19,21,27,29} In terms of supervision, a proper follow-up with the participants via text messages, telephone calls, exercise logs, or social media has increased the compliance and motivation to participate in the exercise.^{19,23,29,34} However, without thorough supervision of self-initiated exercise, participants would have low motivation and self-efficacy to conduct the exercise, and this can be exacerbated when facing socioeconomic and personal barriers that they could not avoid.²⁸

Exercise is evidently a reliable alleviator of postpartum depression over a range of frequencies and intensities. Low-intensity exercises such as relaxation and breathing techniques, yoga, and Pilates are effective and perhaps enhanced by mindfulness. These exercises help the women increase awareness, and perhaps, thereby, favour a sense of wellbeing.³⁵⁻³⁷ Furthermore, improved breathing technique enhances blood oxygenation and together with general physical fitness, relieves stress and improves mood.³⁶ Similarly, moderate-intensity exercise intervention such as walking,^{21,25} improved cardiovascular fitness and strength^{27,42} and resistance exercise²⁰ seem to relieve postpartum depressive symptoms. Aerobic exercises such as walking and cardiovascular exercise improve mood through cerebrovascular blood flow, more efficient brain metabolism, and recruitment of HPA axis pathway functions in exercise.^{58,59} The release and subsequent binding of endogenous opioids or β -endorphin hormone, producing an “euphoria” effect, can contribute to psychosocial well-being among postpartum women.⁵⁶ Anaerobic exercise, as in resistance and strength training, increase flexibility and strength, facilitating more spontaneous and movement with alleviation of depressive symptoms.²⁰ Increasing exercise intensity progressively decreases depressive symptom severity.³⁴ According to Jorm et al,⁶⁰ being committed to physical activity helps mothers to relieve depression by the production of a natural antidepressant, serotonin, while doing exercise. That said, safety during exercise postpartum merits its purview by relevant specialists and trained counsellors.⁵⁵

Integration of nutrition and physical activity intervention

Findings have shown that the integration of nutrition and physical activity interventions significantly improve depressive symptoms²³ although some studies reported a non-significant effect.^{39,48} These discrepancies may be due to the primary aim of the studies where Surkan et al.²³ targeted interventions for maternal depressive symptoms, which resulted in more successful outcomes. Meanwhile, Bennion et al⁴⁸ and Huang et al³⁹ targeted postpartum weight loss as primary and depression as a secondary outcome. The modification of the overall diet, such as increasing consumption of fruits and vegetables and limiting meat intake, together with encouraging 30 minutes of physical activity per day, had significantly improved maternal mental health. Incorporating a healthy dietary habit by high intake of vegetables, fruits, fish and sufficient intake of meat is associated with low risk of stress and depression among postpartum women.^{61,62} Coupled with nutrition intervention, the recommendations of 30 minutes of exercise for at least five days a week had in-

creased their self-efficacy, self-monitoring, and influencing the reduction of depressive symptoms.²³ Furthermore, home visiting by counsellors to the participants' house may have effectively helped decrease postpartum depression as it can provide social support and a sense of self-care to the women, which has been suggested in Surkan's study.²³

Recommendations for practice

Health practitioners should focus on postpartum care as maternal and infant health outcomes are affected by the maternal's psychological well-being. Findings from the current study suggested that by integrating both nutrition and physical activity interventions, psychosocial status among newly delivered women can be improved through sufficient micro and macronutrient intake and a healthy physical activity lifestyle. Besides, interventions that include a close follow-up with respondents significantly improve overall health among postpartum women. Therefore, follow-up and motivational assistance from the interventionist or the health care professionals to the respondents are suggested in administering an intervention.

Strengths and limitations

This review has several strengths. First, by way of a scoping review where limited studies are available, interim advice has been distilled for the benefit with safety for women commonly affected by postpartum depression. The measures involved, of diet and physical activity, are available and affordable for most. Previous reviews have been limited to one or other rather than both measures.^{9,10} Second, the review has followed the Preferred Reporting Item for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guideline, with transparent reporting of the search, and the data extracted and presented in a structured manner.⁶³

However, this review had several limitations. First, due to the lack of information regarding the intensity level of physical activity, meaningful deductions cannot be made about duration, timing, or intensity and affected the outcome. Second, differences in diagnostic criteria used may affect the classification of depression status and its interpretation. In this review, the most common scale used for depression was: EPDS ≥ 12 , BDI ≥ 10 , CES-D ≥ 15 and Zung Self-Rating Depression Scale ≥ 45 . Third, the studies in this review underestimate the inevitable cultural determinants of nutrition and physical activity during the postpartum period, and how they might optimally be addressed. Finally, limited studies were available for this postpartum review; and it does not provide for the particular needs which might apply to women whose depression evolves antepartum. However, insofar as antepartum depression continues postpartum, the present findings are presumed relevant.

Conclusion

Effective and appropriate interventions to manage depressive symptoms among postpartum women are warranted to assist mental health problem. The present scoping review finds that nutrition and physical activity interventions, or a combination of both, can ameliorate postpartum depression. These interventions have to do with the

maternal diet and ways of physical activity. Findings for the merits of specific nutrients and optimal food patterns during postpartum had substantially improved psychosocial well-being. Meanwhile, physical activity of varying duration and intensity can benefit maternal mood postpartum. The early and ready involvement of specialist and trained personnel for safe and informed guidance and supervision of nutrition and physical activity postpartum intervention is to be encouraged. More substantive intervention trials of postpartum depression prevention and management are needed and awaited.

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