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Systematic Review/Meta-analysis

Nutrition Interventions for Lowering Cardiovascular Risk After Hypertensive Disorders of Pregnancy: A Systematic Review

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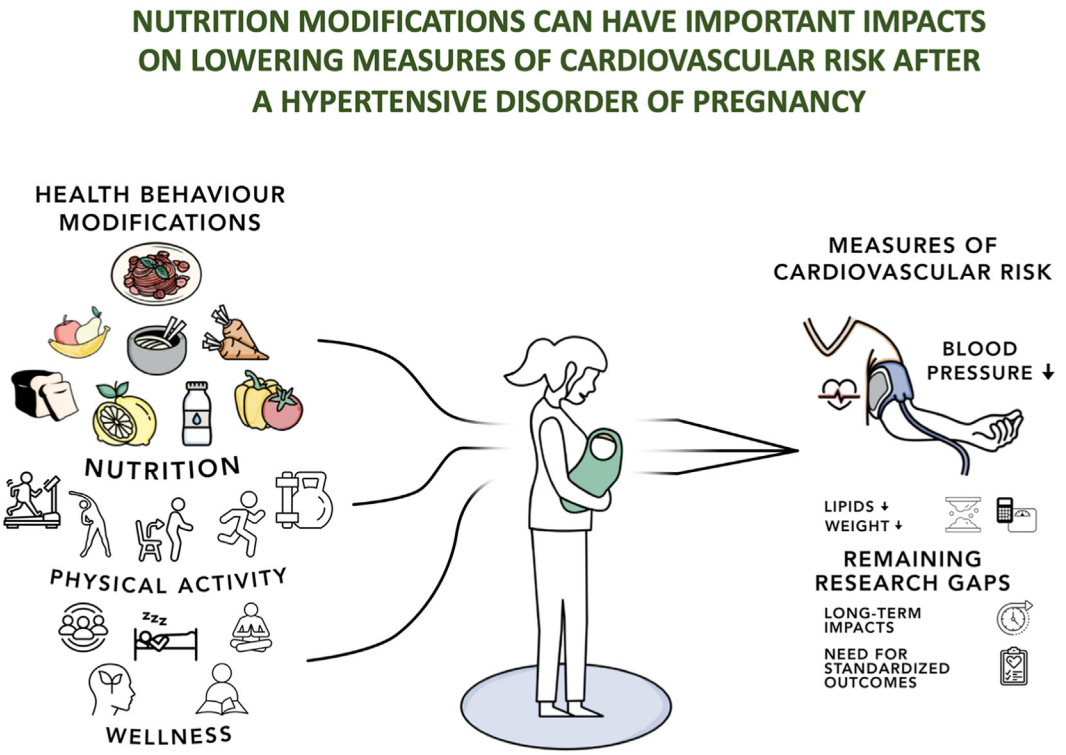

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ABSTRACT

Background: Hypertension is one of the most common medical problems during pregnancy. Hypertensive disorders of pregnancy (HDP) increase the risk of premature cardiovascular disease (CVD) 2- to 4-fold within 10 years after delivery. Early health behaviour modifications may prevent or manage several cardiovascular risk factors. Importantly, compared with women without HDP, fewer women with HDP achieve national dietary guidelines to prevent CVD. This highlights an opportunity for programs tailored for women post-HDP to support their nutritional behaviours as a key component of postpartum CVD preventive care. This systematic review investigated the impacts of nutrition modifications on lowering measures of CVD risk after HDP.

Methods: Four electronic databases (MEDLINE, EMBASE, CINAHL, Cochrane Library) were searched in October 2022 with a search strategy focused on nutrition programs/interventions and women post-HDP. Additional inclusion criteria were original research and reported outcome of CVD risk or cardiovascular risk factors.

Results: Six studies were included: 4 experimental trials and 2 prospective cohort studies. Of the nutrition interventions, 4 were embedded within comprehensive health behaviour intervention programs. Outcome measures varied, but all studies reported blood pressure. A narrative synthesis found that the range of changes in blood pressure varied from no change to clinically meaningful change.

Conclusions: This review found statistically nonsignificant yet clinically important improvements in measures of cardiovascular risk across a range of nutritional interventions in women after HDP. Further high-quality evidence is needed to inform the design and implementation of nutritional preventive cardiovascular care targeting this high CVD-risk population.

RÉSUMÉ

Contexte : L'hypertension est l'un des problèmes médicaux les plus fréquents durant la grossesse. Les troubles hypertensifs de la grossesse (THG) font augmenter le risque de maladies cardiovasculaires (MCV) prématurées de 2 à 4 fois dans les 10 années après l'accouchement. Des modifications précoces des comportements liés à la santé peuvent permettre de prévenir ou de prendre en charge plusieurs facteurs de risque cardiovasculaire. Notamment, par rapport aux femmes sans THG, moins de femmes atteintes de THG se conforment aux lignes directrices nationales en matière d'alimentation pour prévenir les MCV. D'où la possibilité qui s'offre aux programmes adaptés aux femmes post-THG d'encourager l'adoption de leurs comportements nutritionnels, une composante essentielle des soins de prévention des MCV dans la période du post-partum. La présente revue systématique visait à examiner les répercussions des modifications nutritionnelles sur la réduction des mesures du risque de MCV après les THG.

Méthodes : En octobre 2022, nous avons effectué des recherches dans 4 bases de données électroniques (MEDLINE, Embase, CINAHL, Cochrane Library) au moyen d'une stratégie de recherche axée sur les interventions/programmes nutritionnels et les femmes post-THG. Les critères d'inclusion supplémentaires étaient la recherche initiale et les résultats signalés du risque de MCV ou des facteurs de risque cardiovasculaire.

Résultats : Nous avons tenu compte de 6 études : 4 essais expérimentaux et 2 études de cohorte prospectives. Parmi les interventions nutritionnelles, 4 étaient intégrées aux programmes exhaustifs d'interventions sur les comportements liés à la santé. Les critères de jugement variaient, mais la pression artérielle était signalée dans toutes les études. Une synthèse narrative a permis de constater que l'étendue des changements dans la pression artérielle allait d'une absence de changement à des changements significatifs sur le plan clinique.

Conclusions : Cette revue a permis de constater des améliorations non significatives sur le plan statistique, mais importantes sur le plan clinique des mesures du risque cardiovasculaire de différentes interventions nutritionnelles chez les femmes après les THG. D'autres données probantes de grande qualité sont nécessaires pour faciliter l'élaboration et la mise en œuvre de soins de prévention nutritionnelle des maladies cardiovasculaires visant cette population exposée à un risque élevé de MCV.

Lay Summary

High blood pressure during pregnancy is a concern, both during and after pregnancy, as it increases the risk of heart disease 2- to 4-fold within 10 years. Preventive measures such as healthy diet and exercise can reduce these risks. Many factors make healthy nutrition challenging after high blood pressure in pregnancy. Six studies on nutrition supports for women with high blood pressure during pregnancy demonstrated promising improvements in risk measures, such as blood pressure, but more research is needed.

Hypertension is one of the most common medical problems during pregnancy, occurring in 5% to 10% of all pregnancies in Canada.[1] The hypertensive disorders of pregnancy (HDP) generally fall into 4 categories: gestational hypertension, pre-eclampsia (severe and nonsevere), eclampsia, and prepregnancy/chronic hypertension with superimposed pre-eclampsia,[1] each of which is independently associated with a 2- to 4-fold increased risk of cardiovascular disease (CVD) both during pregnancy and that persists for decades.[2,3] HDP is also associated with a high rate of accumulation of cardiometabolic multimorbidity (eg, hypertension, diabetes, dyslipidemia, and obesity) in the first 5 years after birth, often leading to premature CVD within approximately 10 years.[3] Importantly, many of these chronic diseases may be prevented through early health behaviour modifications,[4] yet there are major gaps in cardiovascular preventive care after HDP, resulting in an increased burden on women with HDP, their families, and health care systems.

At present, health-behaviour modifications are recommended by international groups as first line for the reduction

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See page 203 for disclosure information.

of cardiovascular risk and prevention of cardiovascular risk factors for women after HDP.[5,6] The postpartum period provides an early opportunity to identify and mitigate CVD risk factors through implementing healthful behaviours centering around physical activity, healthy nutrition, sleep, stress management, and so forth.[7] However, epidemiologic data demonstrate that women with HDP have lower adherence to national dietary guidelines to prevent CVD compared with women without HDP.[8] Further, in the early postpartum period, in addition to common gender-related barriers to health behaviours (eg, child care and lack of sleep), women with HDP report unique barriers to achieving recommended health-behaviour targets,[9,10] including high rates of postpartum mood disorders and having children with complex medical needs requiring additional support (eg, neonatal intensive care admissions, medical and developmental follow-up).[11,12]

Given these unique needs and barriers to nutrition-focused health behaviour modifications, there is a need to assess the evidence supporting the effectiveness of nutrition changes systematically in reducing cardiovascular risk in women post-HDP. As such, the objective of this systematic review is to assess to what extent changing nutrition, as a health-behaviour modification, decreases measures of cardiovascular risk in women who had HDP.

Materials and Methods

This systematic review reporting follows the standards set by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[13]

Search strategy

A comprehensive search of published peer-reviewed literature was conducted on several electronic databases (MEDLINE, EMBASE, CINAHL, and Cochrane EBM) from inception to October 26, 2022 (Supplemental Appendix S1). A 2-concept search strategy, which included both the population (women with HDP) and intervention (nutrition-focused) of interest, was developed in collaboration with a medical librarian and content expert. Specific cardiovascular outcomes were not included in the search strategy so as not to limit the search. Within each concept, subject headings and keywords were combined using the Boolean operator "OR," then both components were combined using the Boolean operator "AND." There were no restrictions on languages, countries, or publication dates. This systematic review was performed using a predetermined protocol registered with the international prospective register of systematic reviews (PROSPERO 2022: CRD42022368935).

Study selection

Title and abstract screening were done independently and in duplicate by 2 reviewers (M.M. and S.J.). Disagreements were discussed and resolved through consensus. Studies selected for full-text review included those studying nutrition as a health-behaviour intervention to decrease measures of cardiovascular risk in postpartum women who had HDP.

The same reviewers performed full-text review. Studies were included if they met the following eligibility criteria (see flow chart in Supplemental Appendix S2): (1) the study population included women post-HDP; (2) the participants were less than 10 years postpartum; (3) the study includes a nutrition-focused intervention (either alone or in combination with other health behaviours); (4) a study outcome of any measure of cardiovascular risk (eg, a cardiovascular risk score, blood pressure [BP], weight, lipid levels, glycemic control); and (4) the study was a published peer-reviewed article reporting original data. Experimental and observational study designs were both considered eligible. In the case of disagreements, a third reviewer (a content expert) facilitated discussion for consensus.

Outcomes

The primary outcomes of interest in this review were any markers of cardiovascular risk (eg, dyslipidemia, hypertension, cholesterol, overweight, obesity, diabetes, cardiovascular risk scores) or CVD.

Data extraction

A standardized data extraction form was used to extract data on study characteristics, participant characteristics, description of interventions, and cardiovascular outcomes (eg, BP, cholesterol, triglycerides, overweight, obesity, diabetes). Data were extracted independently by the same reviewers, and any disagreements were resolved through consensus and consultation with a content expert, as required.

Quality assessment

Experimental studies were assessed using the Cochrane Risk of Bias Tool,[14] and prospective studies were assessed using the Newcastle Ottawa Quality Assessment Scale.[15] Because of the nature of nutrition and health-behaviour interventions, blinding of participants is generally not feasible; therefore, any criterion relating to blinding of participants was considered not applicable. Risk of bias assessment was performed together by both reviewers to ensure agreement.

Results

Study identification

As outlined in the study flow diagram (Fig. 1), 10,612 citations were identified from the search strategy. After removing 1871 duplicate records, 8741 citations remained for title and abstract screening (Fig. 1). Of these, 49 articles were selected for full-text screening. Finally, 6 studies were eligible for inclusion in this systematic review. Inter-rater agreement at the full-text screening stage was very strong ($\kappa = 0.92$).

Characteristics of included studies

An overview of the characteristics of included studies is presented in Table 1. Of the 6 included studies, 4 were

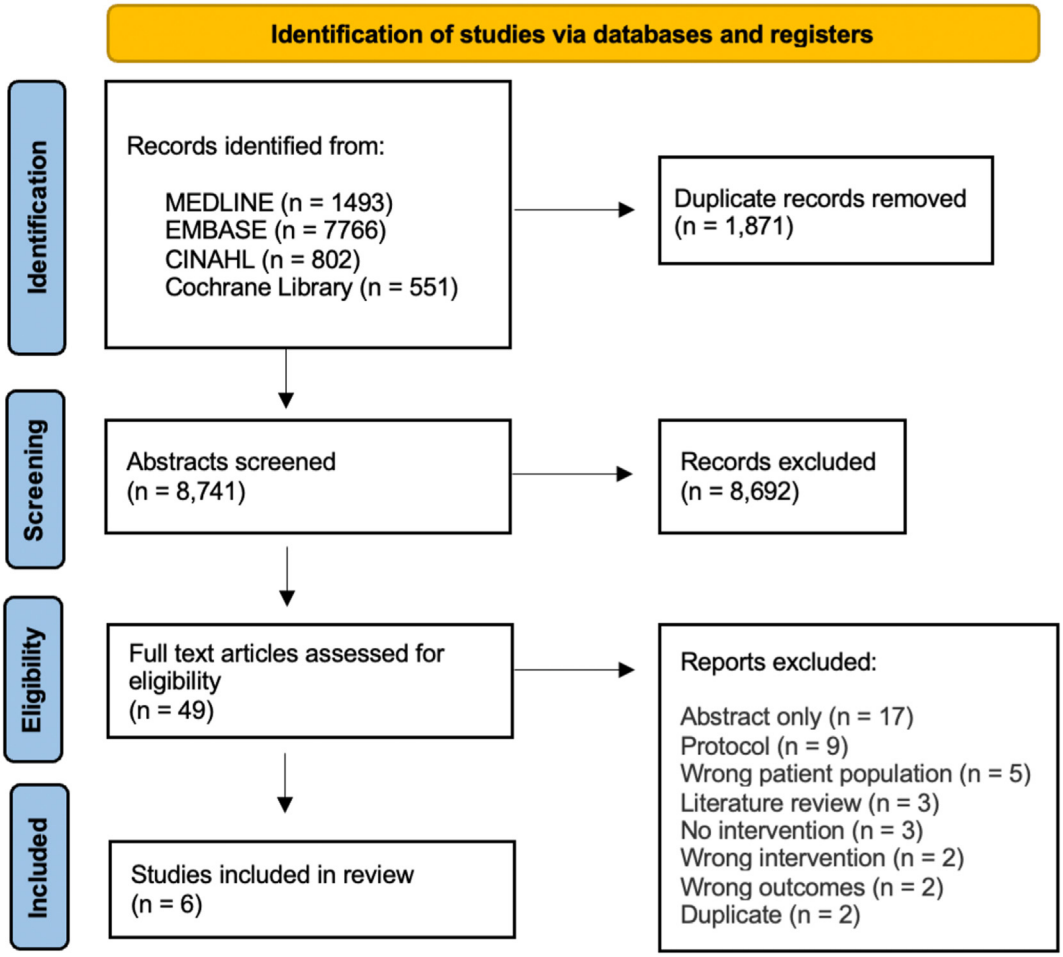

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram of screening process.

randomized controlled trials,[16-19] and 2 were prospective cohort studies.[20,21] The studies were conducted in 5 different countries between 2013 and 2022, with sample sizes ranging from 8 to 151 participants. Common cardiovascular outcomes reported include blood pressure (number, n = 6)[16-21], cholesterol (n = 3)[16,17,20], blood glucose (n = 2),[16,20] and cardiovascular risk score (n = 1).[16]

An overview of participant characteristics and the types of hypertensive disorders of pregnancy included in each study is presented in Table 2. The mean participant age reported by individual studies ranged from 29.1 to 40.0 years. All study populations included women with a history of pre-eclampsia (n = 6). In contrast, eclampsia (n = 1),[20] other severe pre-eclampsia such as, hemolysis, elevated liver enzymes, and low platelet count (HELLP) syndrome (n = 2),[19,20] and prepregnancy chronic hypertension with superimposed pre-eclampsia (n = 2)[19,20] were less common.

Intervention characteristics and adherence

All 6 studies included a nutrition component, 2 of which focused on a low sodium diet as the intervention, whereas the remaining 4 implemented a healthy diet a part of a comprehensive health-behaviour intervention. Four studies included a physical activity component,[9,16,18,20] 1 study included mental health support,[16] 2 included health coaching,[8,20] and 1 included peer support.[18] The duration of the interventions ranged from 1 week[17] to 9 months.[18] A detailed description of each intervention is presented in Table 3.[17-21]

Several studies measured adherence to the nutrition interventions, which is important in interpreting the impact on cardiovascular risk measures. One study that examined a low- vs high- sodium diet showed 24-hour urine sodium excretion findings in keeping with good adherence to the low sodium diet. [17] Rich-Edwards et al. measured dietary adherence by using the validated DASH Online Questionnaire and a food frequency questionnaire. Overall, they found no significant difference between the intervention and control group's average Dietary Approaches to Stop Hypertension (DASH) diet compliance scores and relatively scores in the intervention group (23.6 to 25.0 on a scale ranging from 8 to 40).[18] The study by Reimer et al. reported a high adherence of 73% to the nutritional intervention, although no details were provided on measurement of adherence.[19] In the study by Hutchesson et al.,[16] 84.6% of participants agreed or strongly agreed that they were satisfied with the program, although adherence to the diet was not specifically

Table 1. Study characteristics

Study	Year	Country	Study design	Sample size			Duration of intervention	Cardiovascular outcomes reported			
				N	Intervention	Control		Blood pressure	Cholesterol	Blood glucose	CV risk score
Hutchesson et al.[16]	2020	Switzerland	RCT	31	16	15	3 months	✓	✓	✓	✓
Janmohamed et al.[20]	2015	Canada	PCS	21			6 months	✓	✓	✓	
Martillotti et al. [17]	2013	USA	RCT	40	21	19	1 week	✓	✓		
Rich-Edwards et al.[18]	2019	USA	RCT	151	76	75	9 months	✓			
Riemer et al.[19]	2021	Germany	RCT	29	14	15	26 weeks	✓			
Zoet et al.[21]	2022	Netherlands	PCS	8			8 weeks	✓			

CV, cardiovascular; PCS, prospective cohort study; RCT, randomized control trial.

reported. The studies by Janmohamed et al. and Zoet et al. did not assess adherence to their nutrition interventions.[20,21]

Cardiovascular outcome measures

Because of the heterogeneous nature of the reported outcomes and interventions (Table 3), data could not be pooled in a meta-analysis. Figure 2 outlines a narrative synthesis of changes in reported outcomes between intervention and control groups along with an indication of statistical significance. Notably, of the 6 included studies, only 1 showed statistically significant results.[19]

All studies reported systolic and diastolic BP, although there was considerable variability in BP measurement and reporting across studies. Two of the 6 studies reported a mean change in BP,[16,18] and only 1 included the standard deviation for the BP change. Four studies reported aggregate absolute BP measures at baseline and follow-up,[17,19-21] of which 2 included confidence intervals, and 2 reported a standard deviation. As shown in Figure 2, 5 of the 6 studies showed a decrease in systolic BP in the intervention group compared with the control group. Four studies showed a decrease in diastolic BP in the intervention group compared with the control group. Only 2 studies reported a change in mean arterial pressure (MAP), both of which showed a decrease.[19,21] However, only the study by Riemer et al. showed statistically significant decrease and involved an intensive, in-person supervised intervention focused on a Mediterranean diet.[19] The effect size in the systolic and diastolic BP were 2.52 and 2.23 mm Hg, respectively, with a significance level of $P < 0.05$.[19]

Two studies reported changes in total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides, blood glucose, body mass index (BMI), and waist circumference.[16,20] Three studies reported changes in weight[16,18,20] and Hutchesson et al. additionally reported on insulin, body fat, and absolute CVD 30-year Risk Score. Rich-Edwards et al. found that the intervention significantly increased women's CVD risk knowledge and sense of control and self-efficacy.

Study quality assessment

Individual study quality assessments for the experimental and observational studies are shown in Supplemental Appendices S3 and S4. Overall, 2 of the 4 experimental studies were at low risk of selection bias.[16,19] However, Rich-Edwards et al.[18] in 2019, noted possible selection bias in their limitations, as participants were predominantly White, well educated, and most found out about the study while proactively searching for information about pre-eclampsia. The study by Zoet et al.,[21] a 4-way crossover trial that stopped prematurely, also showed a high risk of selection bias. Two of the 4 experimental studies were at high risk of attrition bias because of poor handling of incomplete outcome data.[19,21]

Both observational studies (Janmohamed et al.[20] and Martillotti et al.[17]) scored well in representativeness of the exposed cohort; ascertainment of exposure; and comparability of cohorts based on the design or analysis. Martillotti et al.[17] also did well in selection of the nonexposed cohort; 2 demonstrating that the outcome of interest was not present at the start of the study; and assessment of the outcome. Janmohamed et al.[20] had an adequate length of follow-up for outcomes to occur. However, neither study adequately completed a follow-up for all participants.

Table 2. Participant characteristics

Study	Mean age (years, SD)		Hypertensive disorders of pregnancy			
	Intervention	Control	Pre-eclampsia	Eclampsia	Other severe pre-eclampsia (eg, HELLP syndrome)	Prepregnancy/chronic hypertension with superimposed pre-eclampsia
Hutchesson et al.[16]	33.6 (4.6)	33.1 (5.1)	✓			
Janmohamed et al.[20]	29.1 (3.6)		✓	✓	✓	✓
Martillotti et al.[17]	39.8 (6.4)*	40.0 (6.5)*	✓			
Rich-Edwards et al.[18]	30.5 (4.8)	31.7 (4.5)	✓			
Riemer et al.[19]	31 (3.89)	31 (3.32)	✓		✓	✓
Zoet et al.[21]	39 (1.35)†		✓			

HELLP, hemolysis, elevated liver enzymes, and low platelet count; SD, standard deviation.

*SD calculated from 95% confidence interval.

†SD calculated from interquartile range.

Table 3. Intervention characteristics

Study	Description	Included components				
		Physical activity	Nutrition	Mental health support	Health coaching	Peer support
Hutchesson et al.[16]	A 3-month health-behavior intervention composed of 14 evidence-based program recommendations focused on modifiable CVD risk factors (nutrition, physical activity, stress management and weight management). These included eating plenty of fruit, vegetables, and whole-grain cereals, variety of healthy protein sources, selecting healthy unsaturated fat choices, and limiting salt intake, gradually building up to physical activity each week, doing muscle-strengthening activities, limiting the amount of time spent in prolonged sitting, identifying and managing emotional stress, and reaching and maintaining a healthy weight.	✔	✔	✔		
Janmohamed et al.[20]	At the initial clinical visit, a dietitian assessed each woman's diet and provided counselling in reading food labels, and education in the optimal dietary intake of fat, sodium, and fibre. Simple nutritional goals were established through individualized discussions with each woman. The clinic pharmacist also educated patients about new medications and counselled them about smoking cessation, if relevant. Women received counselling from all team members about the importance of regular physical activity and integration of physical activity into daily life. An individualized and integrated management plan was formulated for each woman, and the goals were reviewed and updated at each visit. This study evaluated changes from baseline to 6 months of follow-up.	✔	✔		✔	
Martillotti et al.[17]	Individuals received a low-sodium (LS) diet and a high-sodium (HS) diet for 1 week each. The sequence of the diets was randomized to prevent a sequence effect and the random allocation scheme was derived from a computer-generated list. During the LS period, individuals were instructed to reach a sodium intake of < 40 mmol/24 hours. The HS diet was obtained by adding 6 g/24 hours of sodium chloride to the individual's regular diet. 24-hour mean ambulatory BP was recorded on day 7 of each period, when subjects were expected to be on sodium balance.		✔			
Rich-Edwards et al.[18]	A 9-month health behaviour program that included access to a website with audiovisual modules on topics including healthy eating and physical activity. Participants also received personalized health behaviour coaching from a registered dietitian to help them set and meet positive health goals (6 scheduled calls, 3 scheduled e-mails, and interim ad hoc communication as initiated by participants). Participants also had access to an online community forum where they could communicate with each other and the health-behaviour coach.	✔	✔		✔	✔
Riemer et al.[19]	A 6-month intervention where individual nutrition counselling (3 90- to 120-minute sessions) concentrated on the Mediterranean diet as well as fat quality, whole-grain products, fruit and vegetable intake, and salt reduction. Exercise was performed once a week under laboratory conditions. Participants were responsible for additional weekly exercise in their daily routine consisting of brisk walks at intervals of 2 to 3 days.	✔	✔			
Zoet et al.[21]	A 32-week study that examined the effects of 4 interventions for 8 weeks each. In each woman, the effects of 8 weeks' inhibition of renin-angiotensin-aldosterone system inhibition (losartan 100 mg); sympathoinhibition (moxonidine 0.4 mg); low sodium diet (50 mmol NaCl/24 hours); and placebo on office blood pressure and 24-hour blood pressure (mean arterial blood pressure [MAP]) were determined.		✔			

BP, blood pressure; CVD, cardiovascular disease.

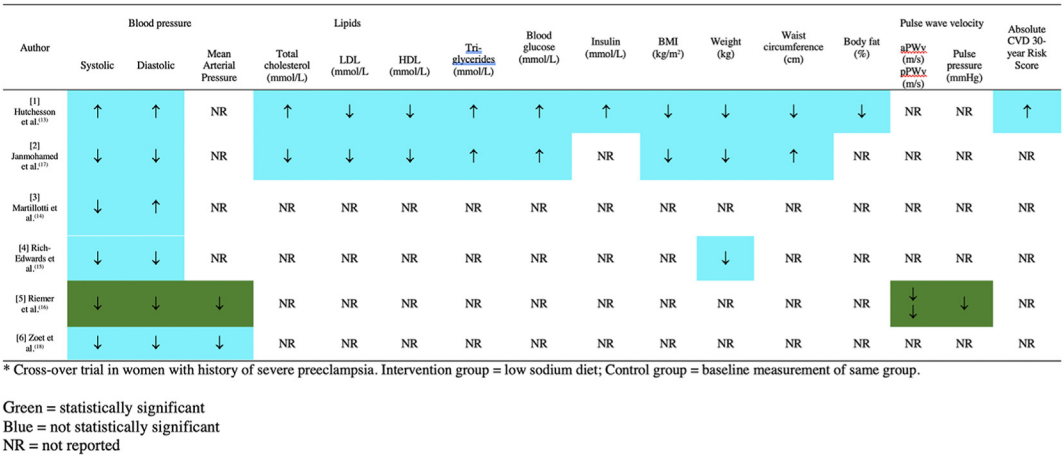

Figure 2. Summary of changes in cardiovascular outcomes for intervention groups compared with control groups in the 6 included studies.

Discussion

This review highlights a major gap in research on cardiovascular preventive care for women post-HDP with only 6 published studies focused on nutrition interventions globally. It also emphasizes the potential clinical importance of nutrition interventions in lowering risk of CVD following an HDP. Among the 6 studies included, there was considerable heterogeneity in the types of nutrition interventions and reported outcomes. A narrative approach was used to summarize both the characteristics of the nutritional interventions of the included studies as well as the impact of the interventions on clinical outcomes.

Regarding the impact of the nutrition interventions on cardiovascular risk factors, the most reported cardiovascular risk factor was blood pressure in all 6 studies (Fig. 2). However, because of inconsistency in BP measurement, a meta-analysis was not possible. From a narrative perspective, 5 of the included studies reported a trend toward a decrease in systolic BP, and 4 studies reported a trend toward a decrease in diastolic BP after the interventions. In only 1 study, were these results statistically significant. This trend in decreases in BP is consistent with the results of nutritional studies in other populations of women: postmenopausal women,[22] women with metabolic syndrome,[23] and women with prehypertension (120 to 139/80 to 89 mm Hg).[24] This is an important observation, as a decrease in BP has been correlated to a decrease in cardiovascular-related mortality[25] and is a commonly used surrogate measure of CV risk.[26]

Dietary interventions are often used during pregnancy to control weight gain and mitigate the risk of HDPs.[27-30] Many studies have investigated the role of health-behaviour interventions in mitigating the increased maternal cardiovascular risk post-HDP.[2] Each intervention is unique in its approach and in its targeted subgroup of HDP. For example, the 2019 randomized control trial by Rich-Edwards et al. included in this review used an online health-behaviour intervention for women after pre-eclampsia to increase participants' self-efficacy to eat healthily,[18] which could potentially contribute to decreasing cardiovascular risk. This intervention also used the DASH diet, as it is known to significantly reduce the risk of CVD in other general populations, whereas some other studies focused strictly on consumption of sodium.[31]

From a nutrition intervention perspective, 2 studies focused on a low sodium diet (1 targeted a sodium consumption of $<$ 40 mmol (920 mg) per 24 hours and the second $<$ 50 mmol (1150 mg) per 24 hours; 1 study focused specifically on the Mediterranean diet,[19] and 1 focused on the DASH diet.[18] Only 2 studies focused on diet alone (low sodium), whereas the other 4 studies delivered nutrition interventions as part of a comprehensive health-behaviour intervention that also included physical activity.

The Mediterranean diet has been found in other populations to be beneficial in supporting cardiovascular health and consists of a low consumption of meat; a moderate intake of dairy products and milk; and a high consumption of fruits, vegetables, legumes, and grains.[32] The nutrition intervention in the study by Riemer et al. was based on a Mediterranean diet and also focused on fat quality, whole-grain products, fruit and vegetable intake, and salt reduction. It found a clinically significant difference in pulse-wave velocity between the intervention and control groups and a clinically meaningful reduction in arterial stiffness. This was the only study included to demonstrate statistically significant impact on cardiovascular risk factors, which may not be caused by the type of diet alone, as nutritional interventions were delivered as part of an intensive in-person supervised program that also included weekly supervised exercise over 6 months.[19] This type of intensive in-person delivery of the intervention may have affected participant accountability and adherence to the diet compared with other studies. Thus, the actual method of delivery of a dietary intervention may be an important factor to incorporate when counselling post-HDP women to decrease their CVD risk, which also aligns with the findings of a meta-analysis focused on postpartum weight loss, which found that the combination of nutrition with physical activity resulted in greater improvements in CVD risk factors than nutrition interventions alone.[33]

The DASH diet, used by Rich-Edwards et al.,[1] is also a commonly used dietary intervention that has been associated with a decrease in CVD risk in other populations.[24,34] Key elements of the DASH diet to reduce blood pressure include a

high intake of fruits, vegetables, and low-fat dairy products and an overall reduction in consumption of saturated fats.[35] Despite an adequately powered sample size, Rich-Edwards et al. did not demonstrate statistically significant effects on CVD risk factors.[18] However, the study had 2 other important findings for those in the intervention group: an increase in patient-reported self-efficacy to eat healthily, which may be associated with longer-term health effects and low adherence to the DASH diet in the intervention arm.[18]

Although only 1 of the 6 included studies had statistically significant results, the findings still suggest that nutrition interventions, including those that are part of larger health-behaviour interventions, show promising benefits in improving CVD risk measures—particularly blood pressure—in women post-HDP. The lack of statistical significance largely reflects the small sample sizes in 4 of the 6 studies,[16,17,19-21] and thus the clinically significance of these positive improvements in cardiovascular risk measures with nutritional changes ought not be overlooked until larger studies are completed. The lack of statistical significance, may, in fact, reflect a common clinical challenge of adherence to nutritional interventions in postpartum women. This is important, as changes in blood pressure may be related to the specific type of nutritional intervention (eg, low sodium) as well as adherence, as the study with the highest reported adherence to the nutrition intervention (73%) was also the only study to find statistically significant improvements in blood pressure.[19] Thus, efforts to improve adherence to nutritional interventions in women after HDP require greater study. Finally, this review also showed no clear association between the nutrition interventions and other surrogate measures of CVD risk such as cholesterol, triglycerides, weight, and waist circumference. This may, in part, be because of a lack of reporting by many studies and broad range of measurements, which emphasizes the need for standardization in the reporting of measures of CVD risk in studies focused on women post-HDP.

The differences in study methodology and interventions merit attention in understanding the nonsignificant effects of nutrition on CVD health outcomes. First, the current literature used interventions of varying durations and follow-up times, which might have resulted in the different effects reported across studies, limiting the ability to pool results. Second, 4 studies focused on healthy diet as part of a comprehensive health behaviour intervention. The nutrition components of the interventions differed in implementation approaches: evidence-based recommendations,[16] counselling and education by a dietician,[18-20] individualized goal setting,[8-20] audiovisual modules on healthy eating,[18] and personalized health-behaviour coaching.[18] Although this may limit ability to statistically pool the results, this narrative review provides health care providers with a range of dietary interventions to individualize nutritional counselling in women after HDP.

Strengths and limitations

An important strength this review is that the large variety of nutrition interventions represented in the studies, which provides clinically useful information to health care providers on a range of nutritional interventions that can be individualized, based upon the needs and preferences of their patients. A second key strength of this study is the comprehensive search methodology involving the systematic search of all relevant peer-reviewed literature from 4 databases and the screening of 8741 abstracts, which limits the possibility of missing studies. Further, rigourous quality assessments were conducted for the 6 included studies to ensure the inclusion of high-quality research.

Although the range of nutritional interventions is a potential strength for clinicians, the heterogeneity of the interventions (the nutritional intervention itself and the range of additional health behaviours addressed) among studies limited statistical pooling of results. Further, the type and measurements of cardiovascular-related health outcomes varied among studies, limiting meaningful pooling of results. This identifies a need for standardized outcomes (type and measurement) to advance the research in this emerging field more rapidly.

From a methodologic perspective, all 6 studies were conducted in high-income countries with primarily Caucasian participants, limiting the generalizability of the results and uptake of the interventions globally. This is important, as HDP is one of the leading causes of maternal mortality and morbidity worldwide, particularly among low- and middle-income countries, which are in need of long-term CVD prevention studies.[36] In addition, the study findings are unable to address the impact of social determinants of health and gender roles on study participation, adherence to the nutritional interventions, and impact on CVD outcomes. This knowledge is instrumental in advancing personalized medicine for this high-risk population of women.

Conclusions

Although health-behaviour modifications are recommended by international groups as first-line therapies for the reduction of cardiovascular risk and prevention of cardiovascular risk factors for women after HDP, this review found statistically nonsignificant yet clinically important improvements in measures of cardiovascular risk across a range of nutritional interventions in women after HDP. Further high-quality evidence is needed to inform the design and implementation of nutritional preventive cardiovascular care targeting this high CVD-risk population of women post-HDP.

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Ethics Statement

This is a systematic review article; therefore, the authors confirm that ethics approval and patient consent are not applicable to this article.

Patient Consent

This is a systematic review article; therefore, patient consent is not applicable to this article.

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Disclosures

The authors have no conflicts of interest to disclose.

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Supplementary Material

To access the supplementary material accompanying this article, visit *CJC Open* at https://www.cjcopen.ca/and at https://doi.org/10.1016/j.cjco.2023.10.018.