

Identifiable Dietary Patterns of Pregnant Women: A Canadian Sample

LYDIA TEGWYN MOSHER, MScFN, RD^a; JAMIE A. SEABROOK, PhD^{a,b,c,d,e,f}; JASNA TWYNSTRA, PhD^{a,g}

^aSchool of Food and Nutritional Sciences, Brescia University College, London, ON; ^bDepartment of Paediatrics, Western University, London, ON; ^cDepartment of Epidemiology and Biostatistics, Western University, London, ON; ^dChildren's Health Research Institute, London, ON; ^eLawson Health Research Institute, London, ON; ^fHuman Environments Analysis Laboratory, Western University, London, ON; ^gDepartment of Medical Biophysics, Western University, London, ON

ABSTRACT

Purpose: To estimate the percentage of a sample of pregnant women in Canada following a vegetarian, vegan, low-carbohydrate, gluten-free, Mediterranean, or well-balanced diet, before and during pregnancy and to explore if pregnant women received and were satisfied with nutrition information received from health care providers (HCPs).

Methods: Participants were conveniently sampled through Facebook and Twitter. An online survey collected data on sociodemographic characteristics, maternal diet, and whether women received and were satisfied with nutrition information from their HCPs. The McNemar test assessed changes in the proportion of diets followed before and during pregnancy.

Results: Of 226 women, most followed a well-balanced diet before (76.9%) and during (72.9%) pregnancy ($p = 0.26$). Vegetarian, gluten-free, vegan, and low-carbohydrate diets were the least followed diets before and during pregnancy (vegetarian: 7.6% vs 5.3%; gluten-free: 4.9% vs 4.0%; vegan: 2.7% vs 2.2%; low-carbohydrate: 4.0% vs 0.4%). Overall, the number of women following restrictive diets before pregnancy was significantly reduced throughout pregnancy (19.1% vs 12.0%, $p < 0.001$). Only 52.0% of women received nutrition information from their primary HCP, and 35.6% were satisfied with the nutrition information received.

Conclusions: Most women followed a well-balanced diet before and during pregnancy and approximately one-third were satisfied with the information received from HCPs.

Key words: pregnancy, diet, vegan, vegetarian, low-carbohydrate, Mediterranean, gluten-free, well-balanced, nutrition, prenatal.

(Can J Diet Pract Res. 2022;83:104–111)

(DOI: 10.3148/cjdpr-2021-040)

Published at dcjournal.ca on 11 January 2022

RÉSUMÉ

Objectif. Estimer le pourcentage d'un échantillon de femmes enceintes au Canada qui suivent un régime végétarien, végétalien, à faible teneur en glucides, sans gluten, méditerranéen ou équilibré, avant et pendant la grossesse, et déterminer si les femmes enceintes ont reçu de l'information nutritionnelle de la part de professionnels de la santé (PS) et si elles en étaient satisfaites.

Méthodes. L'échantillonnage des participantes s'est fait par l'entremise de Facebook et de Twitter. Un sondage en ligne a permis de recueillir des données sur les caractéristiques sociodémographiques et le régime alimentaire de la mère, et de savoir si les femmes ont reçu de l'information nutritionnelle de la part de leur PS et si elles en étaient satisfaites. Le test McNemar a permis d'évaluer les changements quant à la proportion des régimes alimentaires suivis avant et pendant la grossesse.

Résultats. Sur 226 femmes, la plupart avaient suivi un régime alimentaire équilibré avant (76,9 %) et pendant (72,9 %) la grossesse ($p = 0,26$). Les régimes végétariens, sans gluten, végétaliens et à faible teneur en glucides étaient les régimes les moins suivis avant et pendant la grossesse (végétarien : 7,6 % vs 5,3 %; sans gluten : 4,9 % vs 4,0 %; végétalien : 2,7 % vs 2,2 %; à faible teneur en glucides : 4,0 % vs 0,4 %). Dans l'ensemble, le nombre de femmes qui suivaient un régime restrictif avant la grossesse a été significativement réduit pendant la grossesse (19,1 % vs 12,0 %, $p < 0,001$). Seulement 52,0 % des femmes ont reçu de l'information nutritionnelle de la part de leur PS primaire, et 35,6 % étaient satisfaites de l'information reçue.

Conclusions. La plupart des femmes avaient une alimentation équilibrée avant et pendant la grossesse et environ un tiers d'entre elles étaient satisfaites de l'information reçue par des PS.

Mots-clés : grossesse, régime alimentaire, végétalien, végétarien, faible teneur en glucides, méditerranéen, sans gluten, bien équilibré, nutrition, prénatal.

(Rev can prat rech diétét. 2022;83:104–111)

(DOI: 10.3148/cjdpr-2021-040)

Publié au dcjournal.ca le 11 janvier 2022

INTRODUCTION

The dietary choices women make prior to and throughout pregnancy can impact maternal health and fetal development [1–4]. While certain foods are recommended to be avoided during pregnancy to reduce the risk of food poisoning (e.g., raw or lightly cooked eggs, raw seafood) [5], following dietary patterns that are restrictive can result in nutritional deficiencies and potential adverse birth outcomes [4, 6]. Restrictive dietary patterns can include diets that omit or limit the consumption of certain foods. Examples of these dietary patterns include vegan or vegetarian, which limit the intake of animal products [7]; low-carbohydrate, which restricts carbohydrates to varying degrees [8]; or gluten-free, which

excludes gluten, the protein found in rye, barley, and wheat [9]. Improperly following restrictive dietary patterns prior to and throughout pregnancy can lead to a lower intake of essential nutrients for fertility, gestation, critical fetal development, and can significantly impact pregnancy outcomes [8, 10–13]. If the fetus is not well nourished it can program itself to re-allocate nutrients for development, such as an increased apportionment to brain growth and a reduction to tissue repair, that can lead to an increased risk of developing chronic diseases in adulthood, such as coronary heart disease, type 2 diabetes, and hypertension [14–16].

The vegan, vegetarian, low-carbohydrate, and gluten-free dietary patterns are current trending diets [17, 18]. More than

6.4 million Canadians adhere to a dietary pattern that restricts the intake of meat products, such as veganism or vegetarianism [19], approximately 10 million Canadians are consumers of gluten-free items [20], and the longstanding popularity and variations of the low-carbohydrate diet (e.g., Atkins, ketogenic) demonstrates the ongoing societal interest in this dietary pattern [21]. Expectant mothers consuming plant-based diets are at risk of developing deficiencies in vitamins B₁₂, D, iron, zinc, calcium, and (or) iodine [11]. Consumers of the gluten-free diet are at risk for insufficient intakes of vitamin B₁₂, folate, iron, and (or) zinc [13]. The nutrient deficiencies that may result from low-carbohydrate diets include iron [22] and (or) folate [22, 23]. More restrictive lower-carbohydrate diets can cause a reduction in maternal glucose levels, the preferred energy substrate for fetal development [8, 24]. The nutrient deficiencies outlined above can result in adverse birth and health outcomes including increased risk for small for gestational age [25], pre-eclampsia, and higher risk for autoimmune diseases [26].

A less restrictive dietary pattern that has gained interest as being beneficial during pregnancy is the Mediterranean diet [27, 28]. This diet, which has been modified for pregnancy with the omission of red wine recommendations, is rich in fruits, vegetables, unrefined cereals, nuts, seeds, olive oil, whole grains, and legumes, with a limited intake of dairy and poultry, and a rare consumption of red meat [29]. The Mediterranean diet also includes moderate to high consumption of fish, although some fish are not recommended in high consumption for pregnant women, such as bigeye tuna (found in sushi), swordfish, and king mackerel [30]. The nutrient composition of the Mediterranean diet increases the likelihood that an expectant mother will consume essential nutrients, such as vitamin B₁₂ and zinc, both of which are important for fetal neurological development [11]. The Mediterranean diet has been found to be protective against many adverse outcomes including premature birth, cardiometabolic and congenital defects, gestational diabetes mellitus, and pre-eclampsia [29].

Health care providers (HCPs) are often relied upon for nutrition advice and support [31, 32]. However, the time HCPs spend on prenatal nutrition in Canada is limited, and some HCPs have reported a lack of training in providing nutrition counseling [33]. The objectives of this study were to estimate the percentage of a sample of pregnant women in Canada following a vegan, vegetarian, low-carbohydrate, gluten-free, Mediterranean, or well-balanced diet prior to and throughout the gestational period and to explore if pregnant women received and were satisfied with the nutrition care recommendations from their HCPs.

METHODS

Study design

This cross-sectional, descriptive study used an online survey for data collection. Participants were conveniently sampled

through Facebook and Twitter between May and August 2019. On Facebook, study recruitment messages were posted on the personal pages of study investigators and shared on pages that were relevant to Canadian women, including Public Health Units and YMCA institutions across Canada who agreed to post the message. On Twitter, recruitment messages were shared on the study investigators' personal pages and included pertinent hashtags to the target population (i.e., #pregnancy, #dieting, #diet). The sample was restricted to women who were either currently pregnant or pregnant within the last 12 months at the time of survey completion and had resided in Canada for the entire duration of their pregnancy. The study received approval from the Health Sciences Research Ethics Board at Western University.

Data collection

Data were collected through an anonymous, online survey developed on the Qualtrics platform (Qualtrics, Provo, Utah, USA 2015) and was completed by participants at the time of study recruitment (Supplementary Figure 1¹). Implied consent was provided when participants submitted the survey. Prior to data collection, the 26-item original questionnaire was pre-tested on 10 Canadian women who had been pregnant 2–5 years prior to ensure clarity of survey questions. The survey asked questions about sociodemographic characteristics (e.g., age, ethnicity, education, employment status, annual household income, and geographical residence by province or territory), if women were primigravida or multigravida, nutrition information received by HCPs, and dietary patterns followed prior to and throughout pregnancy. Average annual household income was calculated based on the midpoint of 10 income categories provided in the survey (categories ranged from less than \$20 000 to greater than \$100 000, with \$10 000 increments between categories).

Data on the dietary patterns were obtained from participants selecting the dietary pattern that best described their intake prior to and during pregnancy from the following list: vegan, vegetarian, low-carbohydrate, Mediterranean, gluten-free, I tried to eat a well-balanced diet, or other. Participants who selected the other category were encouraged to describe the diet followed in the provided text box. Changes in dietary patterns followed prior to and throughout pregnancy were first assessed by individual categories, to gain a better understanding of the overall dietary patterns followed by pregnant women. Changes in dietary patterns were then assessed by collapsing all restrictive dietary patterns (vegan, vegetarian, low-carbohydrate, and gluten-free) together and assessing the change in proportion of women following restrictive diets prior to and throughout pregnancy. Participants who indicated they changed their diet during pregnancy were asked if they were advised to follow their specific diet during their pregnancy, and if so why, from the following options: to

¹Supplementary data are available with the article through the journal Web site at <https://dcjournal.ca/doi/suppl/10.3148/cjdpr-2021-040>.

manage weight gain, disease, food allergies, pregnancy discomforts, or for other reasons that they could specify.

Nutrition information received by pregnant women was collected by asking women which HCPs were primarily involved in their antenatal care and if nutrition information was provided by them. The overall satisfaction with the nutrition support received from HCPs and participants' perception of the importance of nutrition during pregnancy were also explored. Maternal satisfaction was rated on a 5-point Likert scale ranging from very unsatisfied to very satisfied. The importance of nutrition was also rated on a 5-point Likert scale ranging from very unimportant to very important. The ordinal categories of maternal satisfaction and importance of nutrition were collapsed to 3-point scales for data analysis. For maternal satisfaction, the very unsatisfied and unsatisfied categories were collapsed into 1 category (unsatisfied), and very satisfied and satisfied into another (satisfied). For importance of nutrition, the very unimportant and unimportant categories were collapsed into 1 category (unimportant), and very important and important were collapsed into another (important). The mid-point of both scales (neither satisfied or unsatisfied, or neither important or unimportant) were left as is.

Statistical analysis

Quantitative data were analyzed using IBM SPSS Statistics, version 25.0 (IBM Corp., Armonk, NK, 2017). Survey questions measured on a continuous scale were summarized using the mean and standard deviation (SD), and categorical variables were reported with percentages. The McNemar test was used to evaluate the change in dietary patterns followed prior to and throughout pregnancy. A p -value < 0.05 was considered statistically significant. Qualitative responses from the "other" categories were independently analyzed for common themes by the study authors and a final list of themes was agreed on by all authors.

Results

Demographics

A total of 226 women participated in this study. The mean age was 30.2 years (SD = 4.3) (Table 1). Most women were Caucasian ($n = 208$; 92.4%), living in Ontario ($n = 179$; 79.2%), and had graduated with a university degree and (or) college diploma ($n = 132$; 58.7%). An additional 45 (20.0%) participants had graduated with a master's or doctoral degree. Approximately half of participants ($n = 108$; 47.8%) were pregnant for the first time. Less than half of the women were employed full-time ($n = 103$; 45.8%), and the average annual household income was CAD \$84,066 (SD = \$24 253) with the median response of "greater than \$100 000". Most women reported that nutrition was important during pregnancy ($n = 204$; 90.7%).

Dietary patterns

Fifty-two (23.1%) participants changed their diet after becoming pregnant (Table 2). Most participants followed a

Table 1. Characteristics of participants (N = 226).

Characteristic	Mean \pm SD or n (%)
Age (years)	30.2 \pm 4.3
Household Income (\$ CAD)	\$84,066 \pm \$24,253
First Pregnancy	
Yes	108 (47.8)
No	118 (52.2)
Education	
High school diploma or less	12 (5.3)
Some university and (or) college	20 (8.9)
University degree and (or) college diploma	132 (58.7)
Master's or doctoral degree	45 (20.0)
Professional degree	16 (7.1)
Ethnic origin	
Aboriginal	3 (1.3)
Arab/West Asian	3 (1.3)
Black	1 (0.4)
Filipino	2 (0.9)
Latin American	1 (0.4)
South Asian	3 (1.3)
South East Asian	1 (0.4)
Caucasian	208 (92.4)
Other	3 (1.3)
Geographic Location	
Alberta	5 (2.2)
British Columbia	6 (2.7)
Manitoba	10 (4.4)
New Brunswick	1 (0.4)
Newfoundland and Labrador	1 (0.4)
Northwest Territories	3 (1.3)
Nova Scotia	18 (8.0)
Ontario	179 (79.2)
Saskatchewan	3 (1.3)
Employment status	
Employed full-time	103 (45.8)
Employed part-time	19 (8.4)
Unemployed	9 (4.0)
Maternal/parental leave	94 (41.8)
Importance of Nutrition^a	
Unimportant	18 (8.0)
Neither important/unimportant	3 (1.3)
Important	204 (90.7)

^aParticipants' perception of the importance of nutrition during pregnancy.

well-balanced diet, both prior to ($n = 173$; 76.9%) and throughout pregnancy ($n = 164$; 72.9%; $p = 0.26$). The number of women adhering to restrictive diets decreased significantly from prior to pregnancy to throughout ($n = 43$; 19.1% vs $n = 27$; 12.0%; $p < 0.001$). More women reported following

Table 2. Dietary patterns followed prior to and throughout pregnancy (N = 226).

Variables	Yes, n (%)	No, n (%)	
Changed pre-pregnancy diet	52 (23.1)	173 (76.9)	
Dietary pattern	Prior to pregnancy, n (%)	Throughout pregnancy, n (%)	p value ^a
Vegetarian	17 (7.6)	12 (5.3)	0.13
Vegan	6 (2.7)	5 (2.2)	1.00
Low-carbohydrate	9 (4.0)	1 (0.4)	0.21
Mediterranean diet	4 (1.8)	6 (2.7)	0.63
Gluten-free	11 (4.9)	9 (4.0)	0.50
Well-balanced	173 (76.9)	164 (72.9)	0.26
Other	5 (2.2)	28 (12.4)	<0.01
Restrictive diets combined	43 (19.1)	27 (12.0)	<0.001

^aMcNemar test was used to assess changes in the proportion of diets followed before and during pregnancy.

the vegetarian, vegan, low-carbohydrate, or gluten-free dietary patterns prior to pregnancy than those throughout (vegetarian: 17 (7.6%) vs 12 (5.3%); vegan: 6 (2.7%) vs 5 (2.2%); low-carbohydrate: 9 (4.0%) vs 1 (0.4%); and gluten-free: 11 (4.9%) vs 9 (4.0%)); however, there were no statistically significant differences in individual dietary patterns followed prior to and throughout pregnancy. The “other” dietary pattern category showed a statistically significant increase from pre-pregnancy to the gestational period ($p < 0.01$). The types of diets that participants ($n = 28$, 12.4%) reported in the “other” dietary pattern category throughout pregnancy pertain to diet modifications they chose due to food tolerance and healthy eating choices (e.g., little/no red meat and pork, decreased tolerance to vegetables, no raw fish (sushi), no cold cuts, no soft cheese, less sugar, more supplements). Of those who changed their diet, 14 women were advised to follow their identified pregnancy diet for the following reasons: to manage disease ($n = 1$; 7.1%), to manage food allergies ($n = 1$; 7.1%), to manage weight gain ($n = 4$; 28.6%), to manage pregnancy discomfort ($n = 3$; 21.4%), and other reasons ($n = 5$; 35.7%), which primarily included changing their diet to maintain healthy eating for pregnancy health.

Health care providers

The most common HCP for women following a Mediterranean, well-balanced, vegetarian, or other dietary pattern during pregnancy was an obstetrician (Mediterranean diet: 5/6 (83.3%); well-balanced: 66/164 (40.2%); vegetarian: 4/12 (33.3%); other: 8/28 (28.6%)) (Table 3). Only 117 (52.0%) women reported receiving nutrition information from their primary HCP. However, most participants following a vegan (4/5; 80.0%), Mediterranean (4/6; 66.7%), vegetarian (7/12; 58.3%) or gluten-free (5/9; 55.6%) dietary pattern received no nutrition information. One-third of women reported feeling satisfied ($n = 80$; 35.6%) with the nutrition support received from their HCP. The Mediterranean diet was the only dietary

pattern that had no participants satisfied with the nutrition support received from their HCP (0/6; 0.0%).

DISCUSSION

Most participants in this study were highly educated and reported following a well-balanced dietary pattern. Fifty-two women reported changing their diet after becoming pregnant, with most women switching to “other” dietary patterns for their pregnancy. Although 52.0% of participants received nutrition information from their HCP, two-thirds (64.4%) reported feeling “unsatisfied” or “neither satisfied or unsatisfied” with the nutrition information provided.

The proportion of women following vegan, vegetarian, and gluten-free diets are higher in this study than nationally reported data which found that 1.3% of Canadians follow a vegetarian diet [34], 0.3% follow a vegan diet [34], and 1.9% follow a gluten-free diet [35]. In contrast, our data are similar to a 2020 study that surveyed 2566 youth and young adults in major Canadian cities and reported that 6.6% of participants followed a vegetarian diet and 2.5% followed a vegan diet [36]. Other studies have found that highly educated women were more likely to consume a prenatal diet that met recommended pregnancy requirements and had a higher consumption of healthier dietary patterns that include fruits [37], vegetables [37], and whole grains [38, 39]. Women with high educational attainment generally have more nutrition knowledge [40] and high socioeconomic status groups disproportionately utilize new knowledge that emerges about health-risks and protective factors [41]. It can be speculated that women with higher education are more aware of the relationship between nutrition, maternal health, and fetal development and are more apt to follow dietary patterns reflective of current prenatal nutrition recommendations.

Fewer women adhered to a restrictive dietary pattern throughout pregnancy compared with those following one prior to pregnancy. According to Lee et al. [42] women are

Table 3. Nutrition support from HCPs regarding dietary patterns followed throughout pregnancy (N = 226).

Nutrition support	Dietary pattern							
	Vegetarian, n (%)	Vegan, n (%)	Low-carbohydrate, n (%)	Mediterranean diet, n (%)	Gluten-free, n (%)	Well-balanced, n (%)	Other, n (%)	Total, n (%)
Primary HCP ^a								
GP	3 (25.0)	2 (40.0)	1 (100.0)	1 (16.7)	2 (22.2)	39 (23.8)	7 (25.0)	55 (24.4)
OB	4 (33.3)	1 (20.0)	0 (0.0)	5 (83.3)	2 (22.2)	66 (40.2)	8 (28.6)	86 (38.2)
MW	3 (25.0)	2 (40.0)	0 (0.0)	0 (0.0)	4 (44.4)	48 (29.3)	8 (28.6)	65 (28.9)
NP	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.6)	2 (7.1)	3 (1.3)
GYN	2 (16.7)	0 (0.0)	0 (0.0)	0 (0.0)	1 (11.1)	6 (3.7)	2 (7.1)	11 (4.9)
Other	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (2.4)	1 (3.6)	5 (2.2)
Received information ^b								
Yes	5 (41.7)	1 (20.0)	1 (100.0)	2 (33.3)	4 (44.4)	90 (54.9)	14 (50.0)	117 (52.0)
No	7 (58.3)	4 (80.0)	0 (0.0)	4 (66.7)	5 (55.6)	74 (45.1)	14 (50.0)	108 (48.0)
Overall satisfaction ^c								
Unsatisfied	2 (16.7)	2 (40.0)	0 (0.0)	3 (50.0)	1 (11.1)	13 (7.9)	7 (25.0)	28 (12.4)
Neither satisfied/ unsatisfied	7 (58.3)	2 (40.0)	0 (0.0)	3 (50.0)	4 (44.4)	86 (52.4)	15 (53.6)	117 (52.0)
Satisfied	3 (25.0)	1 (20.0)	1 (100.0)	0 (0.0)	4 (44.4)	65 (39.6)	6 (21.4)	80 (35.6)

Note: HCP, health care provider; GP, general practitioner; OB, obstetrician; MW, midwife; NP, nurse practitioner; GYN, gynaecologist.

^aPrimary HCP involved with each dietary pattern throughout pregnancy.

^bParticipants received nutrition information from their primary HCP throughout pregnancy.

^cOverall women's satisfaction of nutrition support from HCP.

motivated to make dietary changes throughout the gestational period due to their realization that poor nutrition may have a negative impact on their baby. Pregnant women are particularly interested in healthy eating as they view their diet to be something they can control to protect their own and their baby's health [43]. It is possible that women in this study were knowledgeable about potential health risks of their restrictive diets, which prompted them to change to a more well-balanced diet during pregnancy and mitigate the risk of adverse birth outcomes.

Almost one-quarter of the women in the current study reported changing their diet after becoming pregnant, mostly due to the removal of recommended food items for food tolerance and healthy eating choices. These findings are similar to the Alberta Pregnancy Outcomes and Nutrition study ($n = 379$), where pregnant women reported making changes to their dietary intake for the health of the baby (64.9%), food aversions (26.4%), and nausea (22.7%) [44]. Another study found factors such as nausea, food cravings, and heartburn to influence maternal dietary modifications throughout pregnancy [45]. Although women may perceive adapting their diet to exclude certain recommended foods during pregnancy as a change in diet, it appears that most women do not change their overall diet, but instead, slightly adapt their food intake to accommodate their pregnancy-related needs.

Although 52.0% of women in the current study reported receiving nutrition information from their primary HCP, the majority who followed a restrictive dietary pattern throughout pregnancy, apart from the low-carbohydrate diet, received no nutrition information. HCPs report a lack of education and training in prenatal nutrition and find pregnant women who are vegan [46], vegetarian [46, 47], or have prior medical conditions [42, 47] more challenging to nutritionally counsel. The lack of nutrition information provided to women following a restrictive dietary pattern is concerning because these dietary patterns, if improperly followed, can result in nutritional deficiencies which may impact gestational development [11, 13]. Two-thirds of participants in the current study reported feeling neither satisfied or unsatisfied with the nutrition information provided by HCPs. In a study exploring prenatal nutrition care delivered by Family Health Teams and Community Health Centres in Ontario, HCPs reported spending little time on prenatal nutrition care [33]. Similar findings were reported in an Australian study where HCPs described the nutrition advice they provided to pregnant women as brief [42]. It is possible that low HCP knowledge and (or) limited time devoted to prenatal nutrition in antenatal appointments contributed to the overall lack of nutrition counseling and women's low satisfaction with the counseling in the present study.

Strengths and limitations

This study is the first of its kind to investigate the self-identified dietary patterns followed by a select sample of Canadian women prior to and throughout pregnancy.

Whereas other studies have assessed changes in maternal dietary intake by evaluating the inclusion or omission of individual foods and (or) food groups [37–39], the current study assessed whether women changed their entire dietary patterns once becoming pregnant. The present study also offers information on the level of nutrition support provided by HCPs, particularly with respect to each identifiable dietary pattern, as well as the overall satisfaction that participants felt towards the nutrition support delivered. These strengths aside, the data collected relied on participant self-reporting and may reflect reporting bias. Participants were also conveniently sampled and are not representative of all pregnant women in Canada. For example, the study sample had a higher median household income [48], higher educational attainment, and was less diverse than the Canadian population [49]. The data were collected on women who were currently pregnant or had been pregnant in the last year, thus it is possible that some women had to recall dietary patterns from over a year ago which may have resulted in recall bias. As the survey was available in English only, it may have also excluded Canadian pregnant women speaking other languages, particularly French. No participants were recruited from Quebec, which is the second largest province by population, representing approximately 22% of the Canadian population [50]. Last, dietary patterns explored were open to participant interpretation, which may have resulted in inconsistent definitions between survey participants. Specifically, participants may have self-selected to follow a well-balanced diet even when following one of the other diet options, which may have overstated the responses in the well-balanced diet category. Similarly, it is possible for all other diet categories to be well-balanced in terms of nutritional intake. Future studies could provide more explicit definitions of each dietary pattern and include a larger, more representative sample to make findings more generalizable to the Canadian population.

RELEVANCE TO PRACTICE

As restrictive dietary patterns may result in maternal nutritional deficiencies, thereby impacting gestational outcomes [11, 23], women following these dietary patterns may require expert advice to ensure optimal nutrition throughout pregnancy. While many prenatal HCPs report a lack of education and training in nutrition [42, 46, 47], registered dietitians could be utilized to provide prenatal nutrition advice. Better integration of dietetic services in the antenatal care of pregnant women could be beneficial for the health of mother and baby. Alternatively, increased nutrition training could be provided to antenatal HCPs to ensure their understanding of nutrition requirements for all pregnant women, regardless of the women's preferred dietary patterns. Future work should focus on identifying differences in dietary changes and satisfaction of nutrition advice received based on parity of women and how HCPs can be provided with adequate nutrition training to ensure pregnant women are receiving the best care for their pregnancy.

Financial Support: This study was not funded.

Conflict of Interest: Authors have no conflicts to declare.

References

- Jarman M, Mathe N, Ramazani F, Pakseresht M, Robson PJ, Johnson ST, et al. Dietary patterns prior to pregnancy and associations with pregnancy complications. *Nutrients*. 2018;10(7). doi: [10.3390/nu10070914](#).
- Barker DJ, Gluckman PD, Godfrey KM, Harding JE, Owens JA, Robinson JS. Fetal nutrition and cardiovascular disease in adult life. *Lancet*. 1993;341(8850):938–941. PMID: [8096277](#). doi: [10.1016/0140-6736\(93\)91224-A](#).
- Gresham E, Bisquera A, Byles JE, Hure AJ. Effects of dietary interventions on pregnancy outcomes: a systematic review and meta-analysis. *Matern Child Nutr*. 2016;12(1):5–23. PMID: [25048387](#). doi: [10.1111/mcn.12142](#).
- Charbonneau KD, Seabrook JA. Adverse birth outcomes associated with types of eating disorders: A review. *Can J Diet Pract Res*. 2019;80(3):131–136. PMID: [30724093](#). doi: [10.3148/cjdp-2018-044](#).
- Health Canada. Safe food handling for pregnant women. Government of Canada; 2015.
- Purandare CN. Maternal nutritional deficiencies and interventions. *J Obstet Gynaecol India*. 2012;62(6):621–623. PMID: [24293835](#). doi: [10.1007/s13224-013-0347-9](#).
- Melina V, Craig W, Levin S. Position of the Academy of Nutrition and Dietetics: Vegetarian Diets. *J Acad Nutr Diet*. 2016;116(12):1970–1980. PMID: [27886704](#). doi: [10.1016/j.jand.2016.09.025](#).
- Rodrigues N, Judge M. Nutrition and Health. In: Lammi-Keefe C, Couch S, Philipson E, editors. *Handbook of Nutrition and Pregnancy*. Humana Press; 2008. p. 177–89.
- Melini V, Melini F. Gluten-free diet: Gaps and needs for a healthier diet. *Nutrients*. 2019;11(1). doi: [10.3390/nu11010170](#).
- Cetin I, Berti C, Calabrese S. Role of micronutrients in the periconceptional period. *Hum Reprod Update*. 2010;16(1):80–95. PMID: [19567449](#). doi: [10.1093/humupd/dmp025](#).
- Sebastiani G, Herranz Barbero A, Borrás-Novell C, Alsina Casanova M, Aldecoa-Bilbao V, Andreu-Fernandez V, et al. The effects of vegetarian and vegan diet during pregnancy on the health of mothers and offspring. *Nutrients*. 2019;11(3). doi: [10.3390/nu11030557](#).
- Piccoli GB, Clari R, Vigotti FN, Leone F, Attini R, Cabiddu G, et al. Vegan-vegetarian diets in pregnancy: danger or panacea? A systematic narrative review. *BJOG*. 2015;122(5):623–633. PMID: [25600902](#). doi: [10.1111/1471-0528.13280](#).
- Newberry C, McKnight L, Sarav M, Pickett-Blakely O. Going gluten free: the history and nutritional implications of today's most popular diet. *Curr Gastroenterol Rep*. 2017;19(11):54.
- Woods N, Gilliland J, Seabrook JA. The influence of the built environment on adverse birth outcomes. *J Neonatal Perinatal Med*. 2017;10(3):233–248. PMID: [28854508](#). doi: [10.3233/NPM-161112](#).
- Barker DJ. The developmental origins of adult disease. *J Am Coll Nutr*. 2004;23(sup6):588S–595S. doi: [10.1080/07315724.2004.10719428](#).
- de Boo HA, Harding JE. The developmental origins of adult disease (Barker) hypothesis. *Aust N Z J Obstet Gynaecol*. 2006;46(1):4–14. PMID: [16441686](#). doi: [10.1111/j.1479-828X.2006.00506.x](#).
- Freire R. Scientific evidence of diets for weight loss: Different macronutrient composition, intermittent fasting, and popular diets. *Nutrition*. 2020;69:110549. PMID: [31525701](#). doi: [10.1016/j.nut.2019.07.001](#).
- Kaminski M, Skonieczna-Zydecka K, Nowak JK, Stachowska E. Global and local diet popularity rankings, their secular trends, and seasonal variation in Google Trends data. *Nutrition*. 2020;79–80:110759.
- Charlebois S, Somogyi S, Music J, Caron L, Planet, Ethics, health and the new world order in proteins. *J Agri Stud*. 2020;8(3):171–92. doi: [10.5296/jas.v8i3.16535](#).
- Agriculture and Agri-Food Canada. "Gluten Free" Claims in the Marketplace. 2014.
- Malik VS, Hu FB. Popular weight-loss diets: from evidence to practice. *Nat Clin Pract Cardiovasc Med*. 2007;4(1):34–41. PMID: [17180148](#). doi: [10.1038/ncpcardio0726](#).
- Freedman MR, King J, Kennedy E. Popular diets: a scientific review. *Obesity research*. 2001;9(1):1s–5s. doi: [10.1038/oby.2001.113](#).
- Desrosiers TA, Siega-Riz AM, Mosley BS, Meyer RE, National Birth Defects Prevention S. Low carbohydrate diets may increase risk of neural tube defects. *Birth Defects Res*. 2018;110(11):901–909. PMID: [29368448](#). doi: [10.1002/bdr2.1198](#).
- Bronisz A, Ozorowski M, Hagner-Derengowska M. Pregnancy ketonemia and development of the fetal central nervous system. *Int J Endocrinol*. 2018;2018:1. PMID: [29971100](#). doi: [10.1155/2018/1242901](#).
- Avnon T, Paz Dubinsky E, Lavie I, Ben-Mayor Bashi T, Anbar R, Yogev Y. The impact of a vegan diet on pregnancy outcomes. *J Perinatol*. 2021;41(5):1129–1133. PMID: [32873905](#). doi: [10.1038/s41372-020-00804-x](#).
- Mulligan ML, Felton SK, Riek AE, Bernal-Mizrachi C. Implications of vitamin D deficiency in pregnancy and lactation. *Am J Obstet Gynecol*. 2010;202(5):429.e1–9. PMID: [19846050](#). doi: [10.1016/j.ajog.2009.09.002](#).
- Al Wattar B, Dodds J, Placzek A, Beresford L, Spyrelli E, Moore A, et al. Mediterranean-style diet in pregnant women with metabolic risk factors (ESTEEM): A pragmatic multicentre randomised trial. *PLoS Med*. 2019;16(7):e1002857. doi: [10.1371/journal.pmed.1002857](#).
- Fernandez-Barres S, Vrijheid M, Manzano-Salgado CB, Valvi D, Martinez D, Iniguez C, et al. The association of Mediterranean diet during pregnancy with longitudinal body mass index trajectories and cardio-metabolic risk in early childhood. *J Pediatr*. 2019;206:119–27 e6.
- Amati F, Hassounah S, Swaka A. The impact of Mediterranean dietary patterns during pregnancy on maternal and offspring health. *Nutrients*. 2019;11(5). doi: [10.3390/nu11051098](#).
- Forsyth DS, Casey V, Dabeka RW, McKenzie A. Methylmercury levels in predatory fish species marketed in Canada. *Food additives and contaminants*. 2004;21(9):849–856. PMID: [15666978](#). doi: [10.1080/02652030400004259](#).
- Health Canada. Prenatal nutrition guidelines for health professionals: Background of Canada's food guide. Ottawa: Health Canada; 2009.
- de Seymour J, Beck K, Conlon C. Nutrition in pregnancy. *Obstet Gynaecol Reprod Med*. 2019;29(8):219–224. doi: [10.1016/j.ogrm.2019.04.009](#).
- Town M, Smoliak O, Brauer P, Forbes L. Prenatal nutrition in team-based care: Current practices and opportunities for optimization of care. *Can J Diet Pract Res*. 2019;80(3):96–103. PMID: [30724090](#). doi: [10.3148/cjdp-2018-043](#).
- Valdes M, Conklin A, Veenstra G, Black JL. Plant-based dietary practices in Canada: examining definitions, prevalence and correlates of animal source food exclusions using nationally representative data from the 2015 Canadian Community Health Survey-Nutrition. *Public Health Nutr*. 2021;24(5):777–786. PMID: [33106204](#). doi: [10.1017/S1368890020003444](#).
- Mudryj A, Waugh A, Slater J, Duerksen DR, Bernstein CN, Riediger ND. Dietary gluten avoidance in Canada: a cross-sectional study using survey data. *CMAJ Open*. 2021;9(2):E317–E23. PMID: [33795221](#). doi: [10.9778/cmajo.20200082](#).
- Vergeer L, Vanderlee L, White CM, Rynard VL, Hammond D. Vegetarianism and other eating practices among youth and young adults in major Canadian cities. *Public Health Nutr*. 2020;23(4):609–619. PMID: [31603064](#). doi: [10.1017/S136898001900288X](#).
- Skreden M, Bere E, Sagedal LR, Vistad I, Overby NC. Changes in fruit and vegetable consumption habits from pre-pregnancy to early pregnancy among Norwegian women. *BMC Pregnancy Childbirth*. 2017;17(1):107. PMID: [28376732](#). doi: [10.1186/s12884-017-1291-y](#).
- Wesolowska E, Jankowska A, Trafalska E, Kaluzny P, Grzesiak M, Dominowska J, et al. Sociodemographic, lifestyle, environmental and pregnancy-related determinants of dietary patterns during pregnancy. *Int J Environ Res Public Health*. 2019;16(5).
- Northstone K, Emmett P, Rogers I. Dietary patterns in pregnancy and associations with socio-demographic and lifestyle factors. *Eur J Clin Nutr*. 2008;62(4):471–479. PMID: [17375108](#). doi: [10.1038/sj.ejcn.1602741](#).
- Lee A, Belski R, Radcliffe J, Newton M. What do pregnant women know about the healthy eating guidelines for pregnancy? A web-based questionnaire. *Matern Child Health J*. 2016;20(10):2179–2188. PMID: [27395383](#). doi: [10.1007/s10995-016-2071-4](#).
- Seabrook JA, Avison WR. Socioeconomic status and cumulative disadvantage processes across the life course: implications for health outcomes. *Can Rev Sociol*. 2012;49(1):50–68. PMID: [22586837](#). doi: [10.1111/j.1755-618X.2011.01280.x](#).
- Lee A, Newton M, Radcliffe J, Belski R. Pregnancy nutrition knowledge and experiences of pregnant women and antenatal care clinicians: A mixed methods approach. *Women Birth*. 2018;31(4):269–277. PMID: [29126796](#). doi: [10.1016/j.wombi.2017.10.010](#).
- Szwajcer EM, Hiddink GJ, Koelen MA, van Woerkum CM. Nutrition-related information-seeking behaviours before and throughout the course of pregnancy: consequences for nutrition communication. *Eur J Clin Nutr*. 2005;59(Suppl1):S57–S65. doi: [10.1038/sj.ejcn.1602175](#).

44. Forbes LE, Graham JE, Berglund C, Bell RC. Dietary change during pregnancy and women's reasons for change. *Nutrients*. 2018;10(8). doi: [10.3390/nu10081032](https://doi.org/10.3390/nu10081032).
45. Tuffery O, Scriven A. Factors influencing antenatal and postnatal diets of primigravid women. *J R Soc Promot Health*. 2005;125(5):227–231. PMID: [16220737](https://pubmed.ncbi.nlm.nih.gov/16220737/). doi: [10.1177/146642400512500515](https://doi.org/10.1177/146642400512500515).
46. Wennberg AL, Hamberg K, Hornsten A. Midwives' strategies in challenging dietary and weight counselling situations. *Sex Reprod Healthc*. 2014;5(3):107–112. PMID: [25200970](https://pubmed.ncbi.nlm.nih.gov/25200970/). doi: [10.1016/j.srhc.2014.07.001](https://doi.org/10.1016/j.srhc.2014.07.001).
47. Mulliner CM, Spiby H, Fraser RB. A study exploring midwives' education in, knowledge of and attitudes to nutrition in pregnancy. *Midwifery*. 1995;11(1):37–41. PMID: [7731375](https://pubmed.ncbi.nlm.nih.gov/7731375/). doi: [10.1016/0266-6138\(95\)90055-1](https://doi.org/10.1016/0266-6138(95)90055-1).
48. Statistics Canada. Table 11-10-0191-01 Income statistics by economic family type and income source. doi: [10.25318/1110019101-eng](https://doi.org/10.25318/1110019101-eng).
49. Statistics Canada. Canada [Country] and Canada [Country] (table). Census Profile. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. 2017 [cited 2017 November 29]. Available from: <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E>.
50. Statistics Canada. Table 17-10-0009-01 Population estimates, quarterly. doi: [10.25318/1710000901-eng](https://doi.org/10.25318/1710000901-eng).