Effective Health Communication Strategies for Nutrition-Related Behaviours during Pregnancy: A Review of the Evidence

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Alberta Health Services

Table of Contents

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This report has been prepared by Nutrition Services, Alberta Health Services

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Executive Summary

Purpose

This report summarizes the findings of the research on the effectiveness of health communication strategies for pregnant women. Specifically:

- What are the most effective strategies that engage pregnant women to change nutrition-related behaviour?
- What are the key elements of an effective communication strategy for pregnant women and their families?
- How effective is social media for nutrition-related messaging for pregnant women and their families?

Methods

- A multi-step, systematic process was used for article search, retrieval, selection, critical appraisal, and synthesis.
- There were 2811 potential articles from the database search and 9 additional articles from the hand search. A total of 153 full-text articles were considered for final review and critical appraisal from which 32 articles met the inclusion criteria.
- A situational analysis was then undertaken to describe the current state of key indicators of Albertans and Canadians related to maternal and infant health outcomes. This data added context to the literature review findings, conclusions and recommendations in this report.

Search Results:

- Four systematic reviews
- 28 primary research articles: 16 quantitative; 12 qualitative.
- Country source: primarily the U.S. (n=14) and Australia (n=7). One Canadian study.

Key Findings

Findings by Specific Strategies

- **Print Materials:** Tailored and focused print materials were more effective in positively changing prenatal nutrition-related behaviours than untailored materials with general messages.
- **Nutrition Education/Counselling:** Nutrition education/counselling combined with nutrient or food supplementation had the greatest effect on maternal/infant outcomes.
- **Multimedia Technologies:** Some studies demonstrated small improvements in nutrition knowledge, self-efficacy, and behaviour change for multimedia programs (e.g. computer-based programs with interactive features such as audio, video, graphics).
- **Text Messaging:** Receiving text messages influenced pregnant women's beliefs about prenatal vitamins and helped them remember to take prenatal vitamins and consume more nutritious foods.
- **Internet, Smartphone Apps, Text Messaging and Social Media and other Mobile Health Technologies** are being used by pregnant women. The internet is frequently used to search for pregnancy-related nutrition information and smartphone pregnancy Apps are being used. Pregnant women have positive views about mobile health technologies whereas health care providers have mixed views about their use as a health communication tool.

Across-Strategy Findings

- Approaches that included multiple strategies were more effective than single interventions.
- Limited research available on effectiveness of online or computer-based nutrition education approaches.
- Interventions that incorporated tailored messages (appealing to the unique characteristics of an individual or group) were effective for influencing nutrition and other health outcomes.
- Women most frequently search for information and desire a conversation with their HCP early in pregnancy.
- Nutrition information received from HCPs or recognized health care settings or websites are considered trustworthy by pregnant women. Women wanted assistance in navigating online information.
- Messages that are simple and focus on a specific topic have greater uptake than more complex and general messages.

Relevance of Findings to Nutrition Services and Implications for Practice

- Health communication strategies are more effective for impacting health and nutrition behaviour when provided as multiple strategies or combined with other interventions. This approach was supported in the qualitative research with both pregnant women and health care providers.
- Nutrition education/counselling emerged as an effective strategy, with effectiveness enhanced by focused (tailored) counselling and the use of simple messages. In low socio-economic status populations, whose ability to apply nutrition recommendations is directly impacted by their economic access to nutritious food, the effect of nutrition education/counselling was greatest when combined with nutrient and/or food supplement strategies. This finding supports an emphasis on nutrition counselling, aligning with current practice in Nutrition Services.
- Print materials, a key health communication approach used in Nutrition Services, were found to be more effective if focused on a specific topic and tailored to the personal practices and attitudes of participants. The effectiveness of print resources and other approaches, such as e-based interventions, were enhanced when a health care provider used them and incorporated them into nutrition education. The health care provider has a critical role in influencing the trustworthiness, uptake and utilization of nutrition information.
- Evidence of effectiveness of “newer” forms of health communication strategies were lacking in the literature. This was particularly the case for internet and mobile health technologies delivered on phones or tablets such as smartphone apps, text messages and social media. This does not mean they are not effective; any use of mobile health communication technologies in Nutrition Services provides an opportunity for effectiveness evaluation.

Summary and Recommendations

The findings highlight the importance of incorporating the following elements into nutritional health communication strategies during pregnancy:

- For all women during pregnancy, use multiple health communication strategies.
- Develop messages for the early pregnancy period and share with pregnant women and their families during this timeframe. Develop messages that are simple and action-oriented. Tailor to the woman's individual needs where possible.
- For populations vulnerable to poor health outcomes, provide individualized, tailored prenatal nutrition education, combined with prenatal supplements.
- Use resources such as print materials as an adjunct to, not a replacement for, individualized counselling or group education. They need to be easy to read, attractive and provide practical, "how to" information that can support tailored messages by care providers and client conversations.
- Explore the use of technologies such as smartphone Apps and text messaging. They are already being used by women to access nutrition information and may readily support current health behaviour goals for pregnancy. Pregnancy Apps can track and provide feedback on pregnancy weight gain and text messaging can remind, motivate or engage women in health behaviours, such as taking a daily multivitamin.
- Involve the input of client consultants in all phases of planning (e.g. conceptual to final product pilot) and development of prenatal nutrition products.

Abbreviations

AHS (Alberta Health Services)
APRON (Alberta Pregnancy Outcomes and Nutrition Study)
BMI (body mass index)
BW (birthweight)
CASP (Critical Appraisal Skills Program Qualitative Checklist)
EPHPP (Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies)
GDM (gestational diabetes mellitus)
GPs (general practitioners)
GWG (gestational weight gain)
HCP (healthcare provider)
HIC (high income countries)
KRS (Knowledge Resource Services)
LBW (low birth weight)
LGA (large for gestational age)
mHealth (Mobile Health)
NEdC (Nutrition Education/Counselling)
NS (Nutrition Services)
NS PPH (Nutrition Services Population and Public Health)
NTD (neural tube defect)
PPH (Population and Public Health)
RCT (randomized-controlled trial)
SGA (small for gestational age)
SMS (short message service)
SR (systematic review)
US (United States)
V/F (vegetables/fruits)
WIC (Special Supplemental Nutrition Program for Women, Infants, and Children)

Introduction

Background

In 2010, Nutrition Services, Population and Public Health (NS PPH) dietitians undertook a review of the literature to summarize the evidence regarding the key public health nutrition-related issues across Alberta including the effectiveness of various strategies with which to address them.[1] The purpose of the 2010 review was to contribute to NS strategic planning through issue prioritization and by better understanding best and promising practices. The document was positively received by provincial PPH groups, as they undertook planning of topics where nutrition was involved. It was also used by NS PPH, to help understand the evidence around effectiveness of various strategies and programs to address public health issues. Then in 2014, this review was updated, with a focus on specific questions pertaining to nutrition communications during pregnancy from a population and public health perspective. The following report represents this update.

Scope

The purpose of this evidence review is to understand the evidence on effective health communication strategies for pregnant women.

Core questions asked:

- What are the most effective health communication-related strategies that engage pregnant women to change nutrition-related behaviour?
- What are the elements of an effective nutrition-related health communication strategy for pregnant women and their families?
- How effective is social media as a health communication strategy for nutrition-related messaging among pregnant women and their families?

Methodology

A multi-step, systematic process was used for article search, retrieval, selection, critical appraisal and synthesis (*Appendix A*).

Search Strategy

Knowledge Resource Services (KRS) was consulted to help define the question and scope and develop the search planning tool. The search planning tool identified keywords, synonyms for each keyword, and twelve distinct keyword search strings. Keyword search strings were developed for searching in the identified databases.

Searches were completed by project group members and the KRS librarian between January and December 2015 and annotated bibliographies were generated in RefWorks/Proquest. In addition, hand search articles were identified from systematic review reference lists, Google Scholar Alerts and Health Evidence Registry Updates, covering 2016 to end of 2019. An extensive grey literature search was not conducted due to capacity and the determination that it would not further inform the question. Details of the search planning process, databases searched and criteria are provided in *Appendix A*.

Eligibility Criteria and Study Selection

Articles were reviewed for inclusion/exclusion at the title, abstract and full-text reading stages, using defined criteria noted in *Appendix B*. A minimum of two reviewers screened and determined the articles for inclusion at each step in the process. At the full text reading step systematic review article references were reviewed for any relevant citations not retrieved through the database search.

A total of 2811 potential articles were retrieved from the database search. An additional 9 articles were identified through hand search strategies. A total of 153 full-text articles were considered for final review and critical appraisal with a final 32 articles meeting the inclusion criteria. (Figure 1)

Quality Appraisal

Articles were critically appraised using standard public health practice evidence appraisal tools based on the information provided in the study article. A minimum of two reviewers independently appraised each article. Differences in appraisals were discussed, with a third reviewer included if necessary. Final appraisal rating was determined by consensus for each article.

- Review articles (e.g. Systematic reviews (SR) and reviews with a systematic search strategy) were appraised with the *Health Evidence Quality Assessment Tool – Review Articles.*[2]
- Primary research articles were appraised using the *Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies* (EPHPP).[3]
- Qualitative Studies were reviewed using the *Critical Appraisal Skills Program (CASP) Qualitative Checklist.*[4]

While all SR articles appraised as strong, in most cases only select sections answered the question of interest. In addition, there were few high-quality primary research articles. However, all critically appraised articles meeting the inclusion criteria, regardless of rating, were included in this evidence review to identify potential strategies applicable to the Alberta context.

Data Extraction

Data extraction was completed for all articles selected for full-text review using an instrument developed by NS. Data captured in the data extraction tables for each full-text article included: author, year of publication, country, study design, objective, intervention description, methods, outcome, and limitations.

Synthesis

Articles were grouped according to common themes by intervention or strategy. Data extraction tables for the final set of included articles were simplified in order to summarize key findings and highlight effectiveness of the strategy and interventions (*Appendix C*). Table 1 outlines these themes and where applicable, subthemes which were further synthesized and presented in the findings section of this report. Using key findings, *recommendations*, and implications for practice were developed to inform strategic planning for NS.

Situational Analysis

A situational analysis was undertaken to describe the current state of key indicators of Albertans and Canadians related to maternal and infant health outcomes. This data adds context to the literature review findings, conclusions and recommendations in this report. Key data included are grouped under the areas of demographics, social determinants of health, birth outcomes, maternal pregnancy outcomes, and nutrition-related health behaviours. (*Appendix D*)

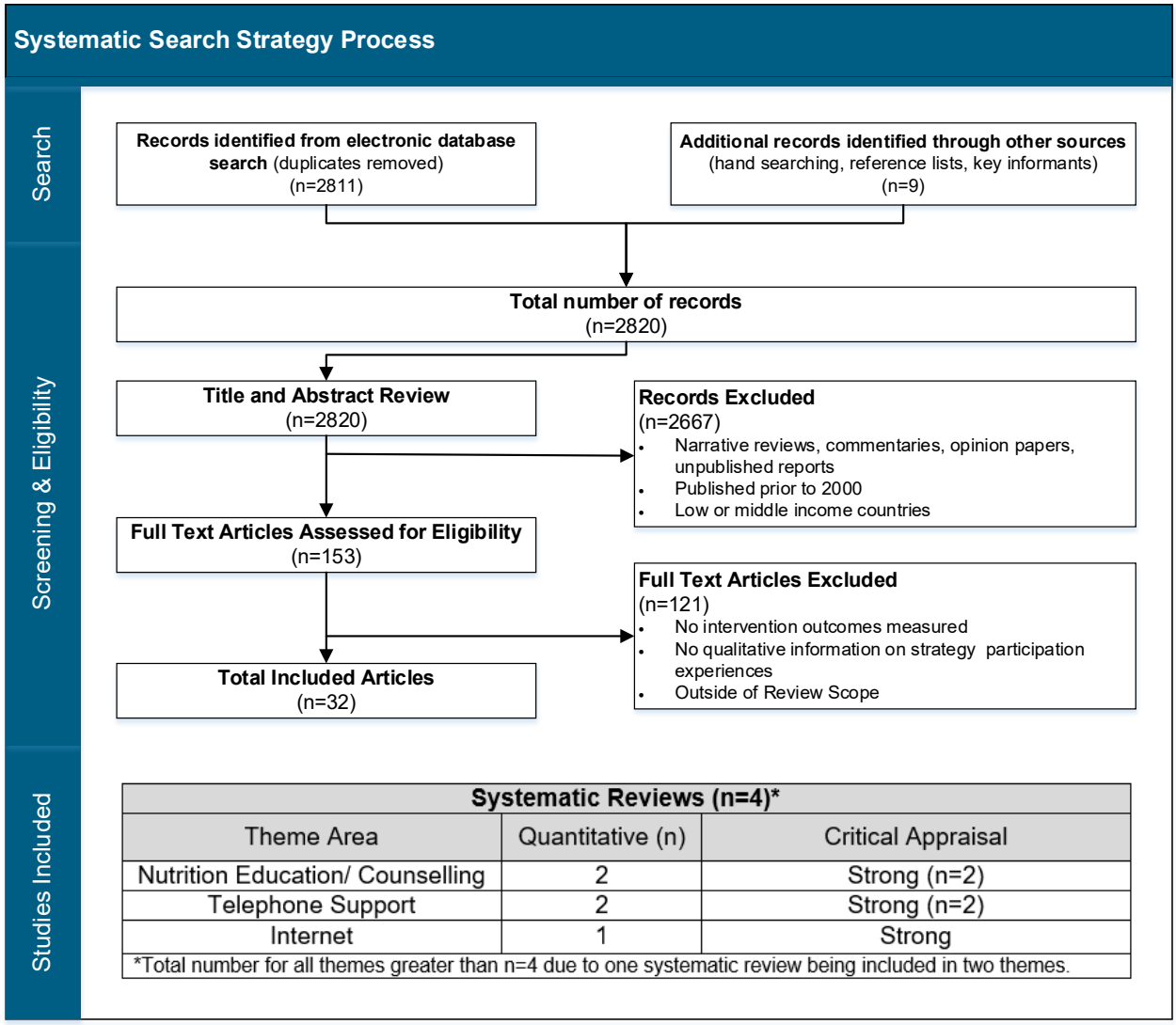
Of particular interest is the data that women in the 25-34 year age grouping represent almost two-thirds (64.7%) of females giving birth in Alberta.[5] Based on 2016 census data, among women aged 25-34 in Alberta, 23.0% identified as immigrants, and of these, almost half (10.3%) came to Canada between the years 2011-2016.[6]

Regarding provincial versus Canadian comparisons for infant health outcomes, Alberta has slightly higher rates for low birth weight (LBW), small for gestational age (SGA) and pre-term birth when compared to national data.[7]

The prevalence of negative outcomes is significantly higher for Indigenous populations compared to non-Indigenous populations, with almost a two-fold increase in the prevalence of large for gestational age (LGA) infants and infant death, higher rates of pre-term birth and almost a five-fold increase in the prevalence of post-neonatal death.[8] In 2013, 72% of Indigenous women in Alberta were not able to access prenatal care in the first trimester.[9]

It is estimated that more than half of Albertan adults have insufficient fruit and vegetable consumption. Consumption is influenced by socio-economic factors, with approximately two-thirds of those considered the “most deprived” reporting insufficient intake, although on average, women are less likely than men to have an insufficient intake.[10]

Figure 1: Systematic Search Strategy Process



Systematic Reviews (n=4)*		
Theme Area	Quantitative (n)	Critical Appraisal
Nutrition Education/ Counselling	2	Strong (n=2)
Telephone Support	2	Strong (n=2)
Internet	1	Strong

*Total number for all themes greater than n=4 due to one systematic review being included in two themes.

Primary Research (n= 28)*									
Theme Area	Total (n)	Quantitative				Qualitative			
		Total (n)	Critical Appraisal			Total (n)	Critical Appraisal		
			Strong	Moderate	Weak		Strong	Moderate	Weak
Print Materials	10	3			3	7	4	3	
Nutrition Education/Counselling	6	5		3	2	1	1		
Multimedia	5	5		3	2				
Mobile Health	8	3		1	2	5	1	3	1
Internet	8	0				8	4	3	1

*Total number for all themes greater than n=28 due to primary research being included in more than one theme.

Limitations

In general, most studies suffered bias from a variety of sources including small sample sizes,[11–18] concerns with drop-outs,[19] losses to follow-up,[13,16,20–23] low response rates,[24–26] homogenous sub-populations,[25] differences in participant baseline demographics, differences between intervention and control groups,[23] greater representation of women with higher incomes,[27] or who were well educated.[11,18,20,28–30] Bias was also introduced through participant self-selection[15,31] or volunteer bias,[32] sampling single-centres,[31] and exclusion of non-English speaking women. This limits the global generalizability of the findings. Of note, only one Canadian study met inclusion criteria.[16]

Several studies also had weak appraisal ratings.[12,13,21,23,24,26,33–35] (*Figure 1*) Two studies relied on non-validated data collection tools.[24,36] Other studies may not be transferable to other jurisdictions.[26,34,37]

Although included SRs[17,20,38,39] had strong appraisal ratings, the studies within some SRs differed substantially with respect to target population,[17] design and delivery of nutrition education/counselling (NEdC)[20] and in measurement of the outcome.

A complete representation of the effectiveness of certain strategies (integrated mobile Health [mHealth] programs, text messages, social media, and videos) was affected by the limited number of studies and the rapidly changing capabilities and use of these communication technologies since this review began. Furthermore, the generalizability of mHealth studies to a wider pregnant population was limited by a lack of focus on pregnant women.[19] Studies focusing on multimedia technologies (e.g. CD-ROM) were also dated and likely no longer relevant.[22,24]

Another limitation was the exclusion of articles that focused on healthy pregnancy weight gain. These articles were seen as not necessary to include as previous projects that involved Alberta Health Services (AHS) teams (i.e. the ENRICH project and Healthy Pregnancy Weight Gain) had already focused on this topic. It is possible that the exclusion of this topic resulted in missing some important evidence related to communications for this review.

It is also not known how applicable this evidence is for Indigenous population contexts and if strategies and interventions/approaches would be appropriate for Indigenous women during pregnancy.

Findings

A total of thirty-two articles were included in the findings. This included sixteen articles with quantitative study designs, nine qualitative study designs, four SRs and three cross-sectional studies. Primary research included one Canadian study, fourteen American, seven Australian, two from the Netherlands, one from Finland, two from Sweden, and one from Ireland. SRs included one each from the United States, United Kingdom, Singapore and Australia. Quality ratings deemed eleven articles were strong, eleven were moderate and ten were weak (*Figure 1*).

Strategies identified in the literature were grouped under common themes (Table 1). Six single-strategy interventions were identified and included: *print materials*, *NEdC*, *multimedia technologies*, *internet*, *mHealth*, and *telephone support*. *across-strategy sub-themes* were also identified. Summary statements and key findings from SRs and individual qualitative and quantitative studies are summarized below. More detailed information of each study can be found in the simplified data extraction tables (*Appendix C*).

Table 1: Nutrition Related Themes and Strategies Represented

	Intervention	Subthemes
Single Strategies	Print Materials	• Print materials (all types)
	Nutrition Education and Counselling	• One-to-one counselling • Group education (classes, workshops)
	Multimedia Technologies	• Multimedia Technologies (all types)
	Internet	• Internet
	Mobile Health	• Multiple mobile health strategies • Smartphone Apps • Text Messaging • Social Media • Video
	Telephone support	• Telephone support (all types)
Across-Strategies		• Combination strategies • Individualized and tailored approaches • Early pregnancy period • Trusted sources • Simple messages • Considerations for vulnerable populations

Single Strategies

Print Materials

Print materials included books, booklets, pamphlets, leaflets, brochures, and other printed tools for public and patient education.

Key Findings

Quantitative studies found:

- Tailored and focused print materials were more effective in positively changing prenatal nutrition-related behaviours than untailored print materials with general nutrition messages.[12,33]

Qualitative studies found:

- Print materials distributed by healthcare providers (HCPs) were considered trusted sources of health promotion education;[15,28] however, their effectiveness at influencing behaviour change was low unless referred to or provided in conjunction with counselling.[40]
- Women and HCPs preferred easy to read and attractive print materials.[11,14]
- Providing practical (the "how") information was also important to pregnant women.[28]
- Print materials used in prenatal practice, including uptake and adoption of recommendations, was enhanced by the HCP specifically highlighting information in the resource;[40] and discussing the print material in conjunction with counselling.[18]
- Women preferred to receive print materials, especially food safety information, at the beginning of pregnancy.[11]

Quantitative studies:

- The delivery of a general information pregnancy book by midwives did not improve the percentage of women meeting vegetable/fruit (V/F) recommendations.[27]
- A United States (US) state-level fish advisory brochure with balanced risk/benefit communication successfully influenced a change in fish consumption behaviours (from riskier to less risky) among women who read the brochure.[33]
- A tailored nutrition education brochure based on the personal practices/attitudes of participants successfully increased consumption of targeted (nutrient-rich) foods compared to a brochure with general messages.[12]

Qualitative studies:

- Women saw the provision of nutrition education an important role of the general practitioner (GP), even if it was in the form of printed materials.[28]
- Print material distributed through hospitals was one form of education that was trusted by clients.[15]
- The effectiveness of a nutrition brochure in influencing behaviour change was low unless discussed with women.[40] Women wanted brochures to be discussed in conjunction with counselling.[18]

- Women prefer to receive food safety information in a written format (pamphlets, booklets, brochures), at doctor's offices and at the beginning of pregnancy.[11]
- Written materials that are attractive and attention-grabbing are preferred by pregnant women.[11]
- HCPs working in settings with vulnerable pregnant women prefer to provide food safety education in the form of simple, easy to read, attractive handouts; however, few reported they would review them with clients.[14]
- Some pregnant women[28] and HCPs[14] are concerned about the lack of detail provided in print resources.[28]

Nutrition Education/Counselling (NEdC)

NEdC included in-person one-to-one counselling, classes, and workshops delivered by a dietitian or care provider trained to deliver nutrition education.

Key Findings

Overall, NEdC combined with nutrient or food supplementation was found to have the greatest effect on maternal/infant outcomes.[20] No studies were found that compared effectiveness of one-to-on nutrition counselling to group education approaches.

Systematic reviews found:

- NEdC positively influenced infant birthweight (BW),[20] gestational weight gain (GWG)[17,20] and reduced the risk of preterm delivery.[20]
- NEdC has the greatest effect for influencing maternal/infant outcomes when combined with other interventions, particularly nutrient or food supplementation.[20]
- E-based interventions are also more effective when combined with NEdC.[17]

Quantitative studies found:

- Pregnant women receiving focused NEdC and simpler messages (in group or one-to-one settings) had positive: message recognition,[35] movement through the stages of change[35] and dietary improvements.[21,27,35,41]
- Frequent one-to-one nutrition counselling visits by a nutritionist positively influenced some dietary behaviours and infant outcomes; however, there was risk in participants dropping out due to the time constraints of intensive counselling.[13]
- Focused one-to-one dietary counselling by a nutritionist combined with provision of specific food products had a positive impact on vulnerable women's targeted dietary behaviours.[41]

Qualitative studies found:

- Personal discussion groups, with an opportunity for food safety information to be provided in a verbal format, was preferred over written form by some women. This was particularly important for non-Caucasian vulnerable pregnant women participating in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) program.[11]

Systematic Reviews:

- In high-income (HI) countries, receiving NEdC (compared to no receipt of NEdC) significantly increased mean infant birthweight (BW) and GWG (as desired).[20]
- NEdC reduced the risk of preterm delivery and was associated with a greater proportion of women reporting dietary changes (regardless of the country's income level).[20]
- NEdC was most effective for influencing maternal/infant outcomes when it was combined with nutrient supplementation or a 'food basket'.[20]
- E-based interventions were more effective when combined with in-person interventions for changing GWG outcomes.[17]

Quantitative Studies:

- One-to-one nutrition counselling
  - An intensive nutrition assessment/counselling program (6 visits) delivered by a nutritionist* led to improvements in iron consumption and infant BWs; however, there were concerns with dropout rates.[13]

* Wording used in study. Understood to be a regulated nutrition professional in the country the study was conducted

  - Women who received group exercise and a one-time personalized dietary plan developed by a dietitian did not have significant differences in kcal intake, GWG, incidence of gestational diabetes mellitus (GDM), birth procedures and infant BW, compared to women who received a prenatal nutrition informational package from Health Canada.[16]
  - Focused dietary counselling by a nutritionist at each trimester of pregnancy combined with provision of specific food products had a small positive impact on vulnerable women's targeted dietary behaviours (change in type of fat, ↑ fibre).[41]
- Group education or workshops
  - In WIC settings, nutrition education (delivered by a dietitian or WIC educator in group and one-to-one settings) using focused topics led to some small improvements in dietary patterns (↓ juice intake, ↑ whole grain intake, replacement of whole milk with lower fat milk), better message recognition and movement in stages of change.[35]
  - Simpler messages (e.g. "switch to lower-fat milk") had greater uptake than more complex messages ("eat more whole grains").[35]
  - A 60-minute workshop delivered by maternity dietitians designed with the 5 A's of Pregnancy and extended booklet information, led to small improvements in dietary behaviours (e.g., ↑½ svg V/F per day) compared to receiving an informational resource alone. Women who attended the workshop also had slightly more awareness of GWG guidelines compared to those who only received the booklet.[21] Attendance at the workshop was lower than ideal (48.3%).

Qualitative studies:

- Group education or workshops
  - One qualitative study found personal discussion groups, with an opportunity for food safety information to be provided in a verbal format, was preferred over written form by some women. This was particularly important for non-Caucasian vulnerable pregnant women participating in a WIC program.[11]

Multimedia Technologies

Multimedia technologies were computer-based programs that often included varying interactive features (e.g., audio, video, graphics, and tailored components, etc.).

Key Findings

Quantitative studies found:

- Multimedia programs were found to support small improvements in nutrition knowledge,[36,42] self-efficacy,[42] and behaviour changes;[25,36] however, this was not consistent across all studies.
  Acceptability of multimedia programs was high;[22,36] however, the time commitment was a concern reported across most studies.[36,42]

Quantitative studies:

- Nutrition education delivered via an interactive CD-ROM program led to small improvements in specific nutrition knowledge components and a short-term increase in self-efficacy. No impact on participants' stages of change or dietary behaviours was found. Many participants felt a 30-40-minute program was "too long".[42]
- The addition of a DVD to regular prenatal nutrition care led to a small improvement in diet quality.[25]
- No obvious benefits were observed for a multimedia program approach versus written material for improving self-reported food handling practices. The multimedia intervention was well received and liked by almost all participants.[22]
- A counselling video, cuing sheet for clinicians and take-home educational worksheet significantly: increased participants' knowledge of some nutrition topics, improved many dietary behaviours, and increased the number of discussions with clinicians. The entire program was well liked, with the most popular component being the Educational Worksheet. The length of the program was a concern for some participants.[36]
- Completion of a computer-tailored program was associated with participant self-reported intention to eat more V/F. The program component most frequently reported as beneficial was knowledge acquisition (new and useful information).[26]

Internet

The Internet involved looking for information via search engines (e.g. Google, Yahoo) or accessing information on specific websites.

Key Findings

One systematic review found:

- Although study reports varied, many women found information online to be reliable and useful.[39]
- Nutrition was a popular topic of interest for women who searched the Internet for pregnancy-related information.[39]

Qualitative studies found:

- Pregnant women frequently used the internet to search for pregnancy-related information,[15,29,30,37] including nutrition information.[30,39]
- The early pregnancy period was a time when women searched more frequently.[32]
- Although the sites women stated preferring were commercial (e.g. BabyCenter),[15,31] they placed more trust in government or health professional websites.[29]
- A common finding was the need to search multiple websites for certain information; women wanted assistance with navigating online health information (e.g. recommended online resources, direct links, etc.).[18,37,43]
- Various reasons women accessed the internet included: to fill information gaps,[32] to answer immediate questions,[(29,37)] to supplement information received from their HCP or to increase their confidence when speaking to an HCP.[29]
- Most women did not discuss the information they found on the internet with their HCP.[30]

Systematic review:

- Women were using the internet as a source of information about pregnancy and the majority of women found internet sources of health information to be reliable and useful.[39]
- Nutrition was a popular topic of interest for women who searched the Internet for pregnancy-related information.[39]

Qualitative studies:

- When asked about their use of the internet, a majority of women reported accessing the internet (e.g. Google search engine) for pregnancy-related information.[15,29,30,37] Women reported searching multiple websites and accessing the internet multiple times per day.[29]
- The early pregnancy period was a time where women were frequently searching the internet.[30] Nutrition-related information was included in internet searches for pregnancy-related information.[29,30]

- More trust was placed in information from government or HCP websites (e.g. Mayo clinic),[29] compared to general Google searches or commercial websites; however, some women reported a higher use for commercial sites and few reported using local health department websites.[15,29,31]
- Various reasons women reported using the internet during pregnancy included: to supplement information received from their HCP; find information to answer immediate questions, and to increase their confidence when speaking to a HCP.[29] However, women disclosed not discussing the information they found on the internet with their midwife.[30]
- Women primarily searched online to find quick factual answers to immediate questions.[37] Women viewed the internet as having a large depth of information (compared to other platforms); however, extensive searching was often required and direct links were preferable.[43]
- Women were accessing the internet (e.g. Google search) in part because the structure of prenatal care didn't meet their needs for information, especially in early pregnancy.[32] Women sought online information to fill gaps.[32]
- Components of preferred online resources included: "parent-focused", evidence-based, consistent information, and a one-stop-shop.[37] Both pregnant women and HCPs wanted information with multiple and integrated technology elements (e.g., different platforms and mediums).[43]
- Women were more likely to access commercial sites than government websites (e.g. BabyCenter).[15] Access to international websites (where nutrition recommendations differ) created confusion for pregnant women.[18]
- Overall, women had concerns about the reliability of information accessed online.[15] Women could recognize limitations in online information and many searched multiple sites to find specific information.[32] Women wanted assistance navigating online information (e.g. HCPs to recommend online resources).[18,37]

Mobile Health

To date, no standardized definition of mHealth has been established.[44] For the purposes of this report, mHealth was defined as the delivery of health services via mobile phones and tablets. Individual elements of mHealth technologies included smartphone apps, text messages, social media, and videos. Although in some cases the internet may be a component of mHealth, due to its prevalence as a medium for sharing health information, studies investigating the internet were presented in a separate section. The majority of studies included in this review examined single elements of mobile technologies, and are discussed separately below.

Key Findings

Views of mHealth

A small qualitative study[43] found that pregnant/post-partum women had positive views about mHealth including:

- potential to reach a wider audience;
  - opportunity as an adjunct to prenatal care;
  - supported individual learning styles and needs

HCPs had a wider variety of views towards mHealth and identified specific potential risks and barriers to its use in antenatal care including:

- accessibility to the technology;
- privacy, intellectual property;
- harmful information;
- stress arising from program's expectations;
- a compromised patient relationship;
- uncertainty of overall ownership/responsibility for high-quality mHealth interventions

Smartphone Apps

Smartphone apps were computer applications that ran on a mobile device (e.g. phone, tablet).

Key Findings

Qualitative studies found:

- When asked about their use of smartphone apps, over 80% of surveyed pregnant women reported using online pregnancy apps.[15,31]
- Women reported using apps to track pregnancy and nutrition-related progress (e.g. weight gain),[32,43] and utilized the self-assessment tools/features,[37] with usage highest in early pregnancy.[37]
- Limitations were noted with tracking features, particularly the inability to deal with progress outside the normal range (e.g. weight above recommended range).[32]
- Other interesting findings from qualitative research included: downloading an app was not equivalent to using an app (Wilcox found that pregnant women had many apps they never utilized);[43] consensus did not exist among women about their usefulness and relevancy as a source of health communication[15] and there was a general lack of awareness of pregnancy-related apps among HCPs.[43]

Qualitative studies:

- Many pregnant women reported using online pregnancy apps.[31]
- Popular apps Irish pregnant women were using included: What to Expect When You're Expecting and BabyCenter.[31]
- Women were using apps to help keep track of pregnancy progress (e.g. weight gain); however, when progress was not within normal range, the app could not provide further assistance.[32]
- Some women were using self-assessment tools on apps. Self-assessment usage was highest in early pregnancy.[37]
- Weight and nutrition self-assessments were used most.[37]
- Pregnant women saw some benefits with apps, mainly the ability to track nutrition-related progress.[43]
- Some women had many apps that they never used.[43]
- There was a lack of awareness of pregnancy-related apps among HCPs.[43]
- Many women reported using pregnancy-related apps; however, consensus did not exist among women about their usefulness and relevancy as a source of health communication.[15]

Text Messaging

Text messages included short message services (SMS) and involved the creation of real-time exchanges of messages of 160 characters or fewer.[45]

Key Findings

Quantitative studies found:

- Pregnant women reported that receiving text messages influenced their beliefs about prenatal vitamins[23] and helped them remember to take prenatal vitamins and to consume more nutritious foods.[34]

Qualitative studies found:

- Text messages were found to have the ability to remind and motivate women to engage in nutrition-related health behaviours.[43]
- Text messages were viewed as an avenue to connect with pregnant women directly and they had attributes that may remind, motivate and engage women.[43] HCPs expressed a wide variation in attitudes towards text messaging use in antenatal care.[43]

Quantitative studies:

- Pregnant women reported that receiving encouraging text messages helped them to take prenatal vitamins and to consume more nutritious foods.[34]
- The Text4baby program influenced pregnant women's beliefs about the importance of taking prenatal vitamins; however, women's preventive health behaviours were not influenced in the short term.[23]

Qualitative studies:

- Qualitative studies found text messages were viewed as an avenue to connect with pregnant women directly and they had attributes that may remind, motivate, and engage women.[43] HCPs expressed a wide variation in attitudes towards text messaging use in antenatal care.[43]

Social Media

Social media included platforms or forums like Facebook, Twitter, Instagram, etc. Social media was often used to connect and network with people that have similar interests and to share information.

Key Findings

Small qualitative studies found:

- Pregnant women (and HCPs) wanted information with multiple technology elements and social media was one element.[43]
- Social media platforms offered opportunities for pregnant women to connect and share pregnancy-related information;[32,43] however women were also apprehensive with the information shared on these platforms.[32,43]
  Facebook was a popular platform used by many pregnant women.[15,32]

Qualitative Studies:
Small qualitative studies with pregnant women[15,32] and HCPs[43] found:

- Social media was one way pregnant women sought information.[32]
- Facebook was a popular social media platform used by many pregnant women.[15]
- Twitter did not appear to be a popular social media platform used by women for pregnancy-related information in Australia in 2012.[15]
- Social media (e.g. Facebook, Instagram, and blogs) offered opportunities for women to share pregnancy-related symptoms and obtain information from women with similar experiences; however, women were also cautious about what was shared.[32]
- Both HCPs and pregnant women saw value and challenges with information sharing using social media.[43]
- Pregnant women (and HCPs) wanted information with multiple technology elements.[43]
- Social media platforms were seen as a method to create communities of people with common interests; however, perinatal women had apprehensions about unsupportive comments and multiple opinions. Some women felt social media platforms should be moderated by HCPs.[43]

Video

Videos included the recording of images either digitally or on a videotape.

Key Findings

One qualitative study found video messages were seen to aid visual learning; however, there were concerns by some women that there are financial costs associated with video messages and some women preferred reading to video messages.[43]

Multiple and Integrated mHealth Strategies

Multiple and integrated mHealth strategies were programs that offered information through various mHealth elements.

Key Findings

One quantitative study found:

- A pilot project for a tailored web-based coaching program that used various mHealth elements (e.g. text messages, email, apps, etc.) saw some positive nutrition behaviour changes (i.e., vegetable, fruit, and folic acid supplement use) among participants in preconception and pregnancy.[19]

One qualitative study found:

- Pregnant/post-partum women had positive views about mHealth and wanted programs with multiple technological elements.[43]

Telephone Support

Telephone support was the use of verbal telephone communication as a means of providing support in health care. Support may have been either passive (only available when requested), or proactively offered.[38]

Key Findings

Systematic reviews found:

- Women reported higher levels of satisfaction with support during pregnancy when receiving telephone support; however, the effect of telephone support on nutrition-related behaviours was unclear.[38]

Systematic reviews:

- Women receiving telephone support had higher levels of satisfaction with support during pregnancy and postpartum compared to women who received routine care.[38]
- Telephone support had no significant effect on participant's self-reported alcohol consumption compared to routine prenatal care.[38]
- E-based interventions were more effective when combined with phone interventions for reducing GWG.[17]

Across-Strategy Themes

Across-strategy themes were higher-level sub-themes that emerged from more than one strategy. Six themes appeared across interventions including combination strategies, individualized and tailored approaches, the early pregnancy period, trusted sources, simple messages, and considerations for vulnerable populations.

Combination Strategies

Combination strategies were interventions with multiple strategies.

Key Findings

Approaches that included multiple strategies were found to be more effective than single interventions.[17,20,25]

Applicable studies:

- Girard[20] found NEdC was most effective for influencing maternal/infant outcomes when it was combined with micronutrient supplements or food provision.
- When e-based interventions were combined with phone or in-person interventions, there was an effect on reducing GWG.[17]
- A randomized controlled trial (RCT) study found the addition of a DVD to routine prenatal nutrition care, which included dietary consultations and print materials, also led to a small improvement in dietary quality.[25]
- A prospective cohort study found focused dietary counselling combined with provision of specific food products that supported dietary changes, had a small positive impact on targeted dietary behaviours.[41]

Individualized and Tailored Approaches

Individualized and tailored approaches included interventions designed to appeal to the unique characteristics of an individual or group including personal preferences, attitudes, readiness for behaviour change, stage of change, stage of pregnancy, etc.

Key Findings

Interventions that incorporated tailored messages were effective for influencing nutrition and other health outcomes.[12,23–26,36] Qualitative research also supported a tailored approach.[43]

Applicable studies:

- When comparing two different forms of nutrition education brochures, a tailored brochure with messages reflecting the practices/attitudes of the subjects was more effective for increasing consumption of targeted foods, compared to a brochure with general messages.[12]
- In Jackson et al,[36] counselling video clips were matched to the patient's body mass index (BMI), eating and exercise habits and readiness for change. The intervention increased women's knowledge of some nutrition topics and improved many dietary behaviours.
- The above approach was similar for a text messaging intervention where content was designed for a particular stage of pregnancy, which influenced women's beliefs about the importance of taking prenatal vitamins.[23]
- A pilot test of a computer-tailored program found that low-income pregnant women reported planning to eat more V/F.[26]
- In a RCT design study, nutrition education delivered via an interactive CD-ROM (including tailored dietary feedback) program led to small improvements in nutrition knowledge components and a short-term increase in self-efficacy but no impact on dietary behaviours.[24]
- One study[22] did not find a positive result of a tailored approach. When content was tailored to a specific ethnic group and delivered on a computer kiosk, this RCT study found no obvious benefits when the computer-tailored content was compared to written materials for improving self-reported safe food handling practices.[22]
- Willcox et al[43] found participants' ideas for maximizing engagement of mHealth programs included the tailoring and personalizing of messages with the baby's development, women's interests, and technology platform.

The Early Pregnancy Period

The first 13 weeks or first trimester of pregnancy is the timeframe most often referred to as the early pregnancy period. It is a time period frequently noted when pregnant women search for pregnancy and nutrition-related information.

Key Findings

Early pregnancy (including the first trimester) appeared to be the time when women most frequently searched for information[30,39] and desired a conversation with their HCP.[40]

Applicable studies:

- In Szwajcer et al,[40] findings suggested there was a window of opportunity for nutrition communication between a pregnant woman and HCP. In this qualitative study, women felt the late-early pregnancy period was too late for nutrition communication as other topics (e.g. “hearing the baby’s heartbeat”) took precedence.[40]
- The early pregnancy period was also a theme in Kraschnewski et al[32] where too few prenatal visits in the first trimester of pregnancy, was identified by women as a key barrier to meeting their information needs.
- The early pregnancy period was a time where women were frequently searching the internet.[30]

Trusted Sources

Women are exposed during pregnancy to nutrition information from a variety of sources. The trustworthiness of information sources was a theme that arose in the research. Pregnant women discussed their view of the trustworthiness of information based on who provided it and how they accessed it.

Key Findings

Overall, qualitative research revealed that nutrition information received from HCPs or recognized health care settings or websites are considered trustworthy by pregnant women.[11,15,29,37]

Applicable studies:

- In a cross-sectional study with a California WIC program, nutrition education using focused topics led to some small improvements in dietary patterns and better message recognition.[35]
- Ritchie et al[35] also found simple straight-forward messages (e.g. “switch to lower-fat milk”) had greater uptake than more complex messages or messages where there is more difficulty in identifying desired foods (e.g. “eat whole grains”).
- A US state-level fish advisory brochure with simple fish messages relevant to pregnancy (e.g. switch from higher to lower mercury-containing fish) successfully influenced a change in fish consumption behaviours.[33]

Considerations for Vulnerable Populations

Strategies that included studies with vulnerable populations (e.g. WIC participants, women attending “welfare” clinics) include tailored NEdC, simple messaging, and online/computer-based nutrition education. Key findings and considerations are presented below.

- Tailored Nutrition Education
  - Tailored NEdC included one or more ways in which the nutrition information was customized to the individual. The modes of delivery included in-person education/counselling with a HCP, print resources or computer-based programs. Approaches that incorporated tailored messages and/or used a "stages of change" and personalized approaches to education led to small, positive changes in nutrition behaviours.

Key Findings

- An intensive in-home, individualized prenatal nutrition assessment/counselling program was associated with improvements in iron consumption among low-income African-American women.[13]
- A tailored nutrition education brochure based on the personal dietary practices of WIC participants successfully increased consumption of targeted (nutrient-rich) foods compared to a brochure with general messages.[12]
- Nutrition education to WIC clients using focused topics led to small improvements in dietary patterns (↓ juice intake, ↑ whole grain intake, replacement of whole milk with lower fat milk) and better message recognition. In addition, simpler messages, such as "switch to lower-fat milk", had greater uptake than more complex messages ("eat more whole grains").[35]
- A personalized education approach that included matched video, clinician cueing sheet and take-home educational worksheet to ethnically diverse, low-income women, significantly increased participants' knowledge of some nutrition topics, and dietary behaviours.[36]
- Intention to eat more V/F was reported by pregnant women who completed a pilot test of a tailored computer program. The program was designed for low-income, socially and financially disadvantaged pregnant women, with intervention feedback tailored to stages of change.[26]
- In a prospective cohort study, dietary counselling that focused on the amount and type of certain foods and was supported by provision of specific food products had a positive impact on some targeted dietary behaviours.[41]

Simple Messaging

Simpler messages (e.g. "switch to lower-fat milk") had greater uptake and message recognition than complex messages (e.g. "eat more whole grain").

Key Findings

- Nutrition education to WIC clients using focused topics led to small improvements in dietary patterns (↓ juice intake, ↑ whole grain intake, replacement of whole milk with lower fat milk) and better message recognition. In addition, simpler messages, such as "switch to lower-fat milk", had greater uptake than more complex messages ("eat more whole grains").[35]

Online and Computer-based Nutrition Education

Limited research was available on the effectiveness of online or computer-based nutrition education approaches for vulnerable populations.

Key Findings

- Nutrition education delivered to WIC clients via an interactive CD-ROM program led to small improvements in specific nutrition knowledge components and a short-term increase in self-efficacy. No impact on participants' stages of change or dietary behaviours was found.[24]
- No obvious benefits were observed for a multimedia program approach versus written material for improving self-reported food handling practices of WIC clients.[22]

Discussion/Conclusion

This review focused on the effectiveness of various health communication strategies for pregnant women, including best approaches for impacting nutrition-related behaviours and infant and maternal health outcomes, specific elements of effective communication strategies, and whether social media was an effective communication strategy to influence pregnant women's nutrition behaviours.

Best approaches for impact on health and nutrition-related behaviour

NEdC consistently emerged as an effective strategy for impacting health and nutrition-related behaviours of women during pregnancy. The effectiveness of other approaches, such as e-based interventions[17] and print resources,[40] were enhanced when incorporated into nutrition education.

When considering the impact of NEdC on prenatal nutrition health outcomes, including infant BW, GWG, and preterm delivery, NEdC had the greatest effect when combined with nutrient and or food supplementation strategies. This finding was of particular importance for low socio-economic status populations, whose ability to apply nutrition recommendations was directly impacted by their economic access to nutritious food.

Elements of effective nutrition-related health communications strategy

Nutrition-related health communication strategies reported in the literature included: counselling, print resources, multimedia technologies (computer-based programs), internet (including websites), smartphone apps, text messaging and social media (Twitter, Facebook, Instagram, etc). Regardless of the type of health communication strategy employed, a common theme expressed in the qualitative evidence was that women wanted assistance in navigating the information presented[18,37,43] and in applying

the information to their situation. This aligned with the AHS *Patient and Family Centred Care Strategy*. There was an expressed desire (by both pregnant women and health care providers) for nutrition-related health information to be accessible and delivered through multiple and integrated strategies.[43]

Elements that influenced the effectiveness of nutrition-related health communication strategies are outlined below, organized by strategy category.

- NEdC
  - Emerged as effective for impacting health and nutrition-related behaviour,[17,20] with greater effect when combined with other interventions.[17,20]
  - More effective if the counselling was focused (tailored)[35] and used simpler messages.[35]
- Print materials
  - More effective if they were tailored to personal practices and attitudes of participants.[12]
  - More effective if they were focused on a specific topic.[33]
- Multimedia technologies
  - Effectiveness of computer-based programs that often included varying interactive features was unclear. Effectiveness ranged from no obvious benefits[22] to small improvements in knowledge,[24,26,36] reported diet quality,[24,26] and behaviours.[36]
- Internet
  - No evidence assessing the effectiveness of the internet for accessing, receiving and utilization of nutrition information was found.
- Smartphone apps
  - No evidence assessing the effectiveness of smartphone apps for accessing, receiving and utilization of nutrition information was found.
- Text messaging
  - Text messaging had features that could remind, motivate and engage pregnant women.[43]
  - May be effective to influence specific behaviours such as taking multivitamins[22,34] and consuming more nutritious foods.[34]
- Social media
  - No evidence assessing the effectiveness of social media for accessing, receiving and utilization of nutrition information was found.
- Telephone support
  - The effect of telephone support on nutrition behaviour was not clear. Phone support has been shown to impact level of satisfaction with care during pregnancy.[38] Phone support combined with other interventions demonstrates effectiveness in reducing GWG.[17]

Audience Perspectives

The qualitative research with pregnant women revealed that the HCP has a critical role in influencing the trustworthiness, uptake and utilization of nutrition information. The early pregnancy period also emerged as an important time for information provision. This evidence highlighted the importance of the following elements of a nutrition-related health communications strategy:

- The timing of offering nutrition information for pregnancy is important. The early pregnancy period is an important time that women seek for this information.[39]
- The HCP has an important role in provision and facilitation of nutrition information for pregnant women.[28,40] The physician was seen as a trusted and important HCP for this role.[28]
- Pregnant women seek out resources, but it is critical that they are not used as a replacement to individualized counselling and discussion. Resources need to be:
  - provided, referred to and used in conjunction with counselling.[18,40]
  - easy to read and attractive.[11,14]
  - provide practical, “how to” information
- The internet is being accessed by pregnant women to search for and use information and seek out answers to their more detailed questions.[15,29,30,38,39] The effective use of the internet needs to be supported by:
  - having information accessible for the early pregnancy period.[32]
  - guidelines/assistance for navigation of online resources; providing clarity on “trustworthiness” of the various sites.[18,37,43]
  - ensuring information is “parent-focused”, evidence-based and consistent.[43]
  - features that enable women to get factual answers to their questions.[37]
- Smartphone apps are being used by pregnant women.[15,31] They may have particular appeal for pregnancy tracking applications, such as tracking pregnancy weight gain,[32,43] and self-assessment features.[37] It is important that a distinction is made between evidence of downloading an App and using an App.
- Text messaging may be helpful as a medium to connect directly with pregnant women and have features that can remind, motivate and engage them. The views of health care providers vary greatly with regards to the use of text messaging.[43]

Effectiveness of Social Media as a Health Communication Strategy For Nutrition Related Messaging

No evidence assessing the effectiveness of social media for accessing, receiving and utilization of nutrition information was found.

Qualitative research revealed that both pregnant women and HCPs want information with multiple and integrated technology elements and social media was one element.[43] Concern about the trustworthiness of social media platforms and a potential role for health professionals in moderating the information shared on these platforms were expressed in qualitative research.[32,43]

Recommendations/Potential Examples for PPH Nutrition Practice

The Population Health Model[46] outlines an approach to maintain and improve the health status of the entire population, reduce the incidence of disease and injury, and to eliminate inequities in health status between population groups. The majority of interventions that emerged from this review represented *Personal Health Practices* and *Reorienting Health Services,* two of the five strategies in this model. Influencing Personal Health Practices involves different forms of health education and focuses on enhancing the knowledge, attitudes and beliefs of individuals.[46] Reorienting Health Services recognizes that health promotion in health services is a shared responsibility among individuals, health professionals, community groups, health institutions and governments.[46] It also recognizes the health sector must not be limited to providing clinical and curative services, but move towards increasing capacity for health promotion. Multiple population health strategies also have a greater impact on health outcomes at the population level, versus solely health education.[47] This was a key across-strategy theme that emerged from the evidence in this report.

The following recommendations and potential examples represent actionable measures adapted from the research evidence included in this report, with special consideration given to the local Alberta prenatal population context.

Table 2. Recommendations and Potential Examples for PPH Nutrition Practice

Recommendations	Potential Examples
Explore opportunities to leverage NEdC (specifically identifying and focusing on where gaps exist).	• Undertake a current state analysis of NEdC activities in prenatal programs provided by HCPs in AB. Include information about location and whether and when nutrition information is provided to pregnant women. • Where dietitians in prenatal programs exist, support clients in accessing NEdC. • Continue to work with AHS internal and external prenatal programs, primary care providers (e.g., physicians, midwives) to promote nutrition education and conversations with pregnant women (e.g. PreNut Tool and low English literacy products, physician newsletters).
Share the evidence that a combined approach (prenatal supplements plus NEdC) was most effective for influencing outcomes. Rationale: The effect of NEdC was greater when combined with nutrition support, e.g. food provision; micronutrient supplements, especially in areas where food insecurity may limit women's capacity to adhere to NEdC messages.	• Provide guidance that enables care providers to assist clients in accessing all available short and long-term income and nutrition supports (e.g. prenatal diet funding, health benefit programs, CPNP projects, free prenatal supplements, food/grocery store coupons, other food provision programs)

Recommendations	Potential Examples
Support the addition of mHealth technology as an adjunct strategy to prenatal NEdC Rationale: Multiple strategies were more effective than single strategies	• Explore opportunities to use mHealth technology within existing NEdC programs (provincial and zone) • Develop NS supported guidelines and practical strategies for use of mHealth • Identify mHealth opportunities within Connect Care
Recommend a combination of technology elements based on evidence Rationale: Pregnant women (and HCP) wanted information with multiple and integrated technology elements.	• Leverage opportunities with other AHS programs that currently use multiple technology elements (e.g. Facebook, Instagram, text messages, etc.)
Develop communication approaches that tailor/individualize prenatal nutrition education, specifically for socio-economically vulnerable populations. Rationale: Interventions that incorporated tailored messages are more effective for influencing nutrition and other health outcomes compared to those with untailored or universal messaging.	• Identify at-risk groups that require tailored approaches to nutrition education • Assist with the development of nutrition products that tailor prenatal nutrition education messages to at-risk populations (e.g. Indigenous populations)
Encourage the facilitation of prenatal nutrition information in the early pregnant period Rationale: Early pregnancy was a key time period when pregnant women had nutrition-related questions and frequently searched the internet for nutrition information.	• Identify stakeholders and explore opportunities for sharing of nutrition information in the early pregnancy period • Seek opportunities to raise awareness among care providers and programs of the importance of nutrition conversations with pregnant women in the early pregnancy period • Seek unconventional opportunities to target pregnant women in early pregnancy • Conduct an environmental scan of programs and services in other jurisdictions that may be using an approach that leverages NEdC in early pregnancy
Develop nutrition education messages that are simple and action-oriented. Rationale: Simpler messages (e.g. “switch to lower-fat milk”) had greater uptake and message recognition than complex messages (e.g. “eat more whole grain”).	• Identify complex prenatal nutrition messages that would benefit from greater clarity (e.g. fish and mercury, safe cheeses) • Utilize the NS, Product Development Process to ensure end-user involvement • Ensure use across all applicable communication avenues and programs • Align with patient-centred care initiatives that focus on small goal centred behaviour change approaches

Recommendations	Potential Examples
Raise awareness with care providers around the benefit and effectiveness of combining print materials with opportunities for conversation Rationale: Print materials in prenatal practice, uptake and adoption of recommendations were enhanced by: the HCP specifically highlighting information in the resource; discussing the print material in conjunction with counselling	• Where educational approaches rely on print materials, explore options for supporting interactive conversations with pregnant women
Support the navigation of evidence-based online prenatal nutrition information Rationale: Women wanted assistance with navigating online health information (e.g. recommended online resources, direct links, etc.)	• Build awareness that clients want support with online nutrition information • Look for opportunities to improve navigation of online prenatal nutrition information (e.g. direct links in products) • Encourage providers and programs to promote existing (e.g., ReadyOrNot, Healthy Parents Healthy Children) internet-based resources as reliable nutrition information with clients
Establish or support a client consultant group that can advise and inform prenatal nutrition work Rationale: Qualitative evidence was a valuable component of this evidence review. Products and processes need to ensure the client voice is reflective of the Albertan population	• Explore opportunity to consult with Maternal Newborn Child & Youth Strategic Clinical Network client advisory group • Continue to work with Indigenous Services Canada and the Alberta CPNP/CAPC Coalition to ensure there is appropriate consultation with populations identified as higher risk of poor maternal and infant outcomes

References

1. Nutrition Services. The population and public health evidence summary: A backgrounder to inform public health nutrition planning in Alberta. Alberta: Alberta Health Services, Nutrition & Food Services; 2010.
2. McMaster University. Health Evidence. Quality assessment tool - review articles [Internet]. Vol. 2020. 2020. Available from: https://healthevidence.org/documents/our-appraisal-tools/quality-assessment-tool-dictionary-en.pdf
3. McMaster University. Effective Public Healthcare Panacea Project (EPHPP). Quality assessment tool for quantitative studies [Internet]. Vol. 2020. 2020. Available from: https://www.ephpp.ca/quality-assessment-tool-for-quantitative-studies/
4. Critical Appraisal Skills Program. CASP qualitative checklist: 10 questions to help you make sense of a qualitative research [Internet]. Vol. 2020. 2018. Available from: https://casp-uk.net/casp-tools-checklists/
5. Government of Canada SC. Table 13-10-0416-01. Live births, by age of mother [Internet]. Vol. 2020. 2020. Available from: https://doi.org/10.25318/1310041601-eng
6. Government of Canada SC. Gender, diversity and inclusion statistics [Internet]. Vol. 2020. 2019. Available from: https://www.statcan.gc.ca/eng/topics-start/gender_diversity_and_inclusion
7. Bushnik T, Yang S, Kaufman JS, Kramer MS, Wilkins R. Socioeconomic disparities in small-for-gestational-age birth and preterm birth. Heal reports [Internet]. 2017 Nov 15;28(11):3–10. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29140535
8. Sheppard AJ, Shapiro GD, Bushnik T, Wilkins R, Perry S, Kaufman JS, et al. Birth outcomes among First Nations, Inuit and Métis populations. Heal reports [Internet]. 2017 Nov 15;28(11):11–6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29140536
9. Alberta Health Services. Maternal Newborn Child and Youth Strategic. The Alberta Antenatal Pathway. 2019;(Version 1.3).
10. Alberta Health Services. Healthier Together. Risk Factors in Alberta [Internet]. 2020 [cited 2021 Sep 27]. Available from: https://www.healthiertogether.ca/prevention-data/alberta-community-health-dashboard/community-cancer-prevention-screening-dashboard/
11. Athearn PN, Kendall PA, Hillers V, Schroeder M, Bergmann V, Chen G, et al. Awareness and acceptance of current food safety recommendations during pregnancy. Matern Child Heal J [Internet]. 2004;8(3):149–62. Available from: http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2005016530&site=ehost-live
12. Brinberg B, Axelson ML. Improving the dietary status of low-income pregnant women at nutritional risk. J Public Policy Mark [Internet]. 2002 Apr 1;21(1):100–4. Available from: https://www.jstor.org/stable/30000712
13. Briley C, Flanagan NL, Lewis NM. In-home prenatal nutrition intervention increased dietary iron intakes and reduced low birthweight in low-income African-American women. J Am Diet Assoc [Internet]. 2002 Jul;102(7):984–7. Available from: https://www.sciencedirect.com/science/article/pii/S0002822302902257
14. Morales S, Kendall PA, Medeiros LC, Hillers V, Schroeder M. Health care providers' attitudes toward current food safety recommendations for pregnant women. Appl Nurs Res [Internet]. 2004;17(3):178–86. Available from: https://www.sciencedirect.com/science/article/pii/S0897189704000527

15. Rodger D, Skuse A, Wilmore M, Humphreys S, Dalton J, Flabouris M, et al. Pregnant women's use of information and communications technologies to access pregnancy-related health information in South Australia. Aust J Prim Health [Internet]. 2013;19(4):308–12. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24004661

16. Hui AL, Ludwig S, Gardiner P, Sevenhuysen G, Murray R, Morris M, et al. Community-based exercise and dietary intervention during pregnancy:A pilot study. Can J Diabetes [Internet]. 2006;30(2):1–7. Available from: https://www.sciencedirect.com/science/article/pii/S1499267106020107

17. Lau Y, Klainin-Yobas P, Htun TP, Wong SN, Tan KL, Ho-Lim ST, et al. Electronic-based lifestyle interventions in overweight or obese perinatal women: a systematic review and meta-analysis. Obes Rev. 2017 Sep;18(9):1071–87.

18. Wennberg AL, Lundqvist A, Hogberg U, Sandstrom H, Hamberg K. Women's experiences of dietary advice and dietary changes during pregnancy. Midwifery. 2013 Sep;29(9):1027–34.

19. Van Dijk MR, Huijgen NA, Willemsen SP, Laven JS, Steegers EA, Steegers-Theunissen RP. Impact of an mHealth platform for pregnancy on nutrition and lifestyle of the reproductive population: A survey. JMIR mHealth uHealth [Internet]. 2016 May 27;4(2):e53. Available from: https://www.ncbi.nlm.nih.gov/pubmed/27234926

20. Girard Webb A, Olude O. Nutrition education and counselling provided during pregnancy: effects on maternal, neonatal and child health outcomes. Paediatr Perinat Epidemiol [Internet]. 2012;26:191–204. Available from: http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2011740603&site=ehost-live

21. Wilkinson SA, McIntyre HD. Evaluation of the "healthy start to pregnancy" early antenatal health promotion workshop: a randomized controlled trial. BMC Pregnancy Childbirth [Internet]. 2012;12:131. Available from: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=cctr&AN=CN-00864412
http://sfxhosted.exlibrisgroup.com/hinc?sid=OVID:cctrdb&id=pmid:23157894&id=doi:&issn=1471-2393&isbn=&volume=12&issue=&spage=131&pages=131&date=2012&title=BMC+pregnan

22. Trepka MJ, Newman FL, Davila EP, Matthew KJ, Dixon Z, Huffman FG. Randomized controlled trial to determine the effectiveness of an interactive multimedia food safety education program for clients of the Special Supplemental Nutrition Program for Women, Infants, and Children. J Am Diet Assoc [Internet]. 2008;108(6):978–84. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S0002822308003209

23. Douglas Evans W, Wallace Bihm J, Szekely D, Nielsen P, Murray E, Abroms L, et al. Initial outcomes from a 4-Week follow-up study of the Text4baby Program in the military women's population: randomized controlled trial. J Med Internet Res [Internet]. 2014 May 20;16(5):e131. Available from: https://www.openaire.eu/search/publication?articleId=od_____267::7fd96dea399d04572940b5bdbb91823c

24. Campbell MK, Carbone E, Honess-Morreale L, Heisler-MacKinnon J, Demissie S, Farrell D. Randomized trial of a tailored nutrition education CD-ROM program for women receiving food assistance. J Nutr Educ Behav [Internet]. 2004;36(2):58–66. Available from: https://www.sciencedirect.com/science/article/pii/S1499404606601346

25. Szmeja MA, Cramp C, Grivell RM, Deussen AR, Yelland LN, Dodd JM. Use of a DVD to provide dietary and lifestyle information to pregnant women who are overweight or obese: a nested randomised trial. BMC Pregnancy Childbirth [Internet]. 2014 Dec 12;14(1):409. Available from: https://www.ncbi.nlm.nih.gov/pubmed/25495459

26. Mauriello L, Dyment S, Prochaska J, Gagliardi A, Weingrad-Smith J. Acceptability and Feasibility of a Multiple-Behavior, Computer-Tailored Intervention for Underserved Pregnant Women. J Midwifery Womens Health [Internet]. 2011;56(1):75–80. Available from: http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2011252770&site=ehost-live

27. Wilkinson SA, Miller YD, Watson B. The Effects of a Woman-Focused, Woman-Held Resource on Preventive Health Behaviors During Pregnancy: The Pregnancy Pocketbook. Women Health [Internet]. 2010;50(4):342–58. Available from: http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2010760813&site=ehost-live

28. Begley A. Barriers to good nutrient intakes during pregnancy: a qualitative analysis. Nutr Diet. 2002 Sep;59(3):175.

29. Huberty J, Huberty J, Dinkel D, Dinkel D, Beets M, Beets M, et al. Describing the Use of the Internet for Health, Physical Activity, and Nutrition Information in Pregnant Women. Matern Child Health J [Internet]. 2013 Oct;17(8):1363–72. Available from: https://www.ncbi.nlm.nih.gov/pubmed/23090284

30. Larsson M. A descriptive study of the use of the Internet by women seeking pregnancy-related information. Midwifery [Internet]. 2009;25(1):14–20. Available from: https://www.sciencedirect.com/science/article/pii/S0266613807000186

31. Kennedy RAK, Mullaney L, Reynolds CME, Cawley S, McCartney DMA, Turner MJ. Preferences of women for web-based nutritional information in pregnancy. Public Health [Internet]. 2017 Feb 1;143:71. Available from: https://search.proquest.com/docview/2050624423

32. Kraschnewski JL, Chuang CH, Poole ES, Peyton T, Blubaugh I, Pauli J, et al. Paging “Dr. Google”: Does technology fill the gap created by the prenatal care visit structure? Qualitative focus group study with pregnant women. J Med Internet Res [Internet]. 2014 Jun 3;16(6):e147. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24892583

33. Teisl MF, Fromberg E, Smith AE, Boyle KJ, Engelberth HM. Awake at the switch: Improving fish consumption advisories for at-risk women. Sci Total Environ [Internet]. 2011 Aug 15;409(18):3257–66. Available from: https://www.sciencedirect.com/science/article/pii/S0048969711004803

34. Moniz MH, Meyn LA, Beigi RH. Text messaging to improve preventive health attitudes and behaviors during pregnancy: A prospective cohort analysis. J Reprod Med [Internet]. 2015 Sep;60(9–10):378. Available from: https://www.ncbi.nlm.nih.gov/pubmed/26592061

35. Ritchie LD, Whaley SE, Spector P, Gomez J, Crawford PB. Favorable impact of nutrition education on California WIC families. J Nutr Educ Behav [Internet]. 2010 May 1;42(3S):S2. Available from: https://search.proquest.com/docview/356865872

36. Jackson RA, Stotland NE, Caughey AB, Gerbert B. Improving diet and exercise in pregnancy with Video Doctor counseling: A randomized trial. Patient Educ Couns [Internet]. 2011;83(2):203–9. Available from: http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2010998898&site=ehost-live

37. Hearn L, Miller M, Lester L. Reaching perinatal women online: the Healthy You, Healthy Baby website and app. J Obes [Internet]. 2014;2014:573928. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24872891

38. Lavender T, Richens Y, Milan SJ, Smyth R, Dowswell T. Telephone support for women during pregnancy and the first six weeks postpartum. Cochrane Database Syst Rev [Internet]. 2013;7. Available from: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=coch&AN=00075320-100000000-07788 http://sfxhosted.exlibrisgroup.com/hinc?sid=OVID:cochdb&id=pmid:&id=doi:&issn=&isbn=&volume

=&issue=7&spage=&pages=&date=2013&title=Cochrane+Database+of+S

39. Sayakhot P, Carolan-Olah M. Internet use by pregnant women seeking pregnancy-related information: a systematic review. BMC Pregnancy Childbirth [Internet]. 2016 Mar 28;16(1):65. Available from: https://www.ncbi.nlm.nih.gov/pubmed/27021727

40. Szwajcer EM, Hiddink GJ, Koelen MA, van Woerkum CMJ. Written nutrition communication in midwifery practice: What purpose does it serve? Midwifery [Internet]. 2009;25(5):509–17. Available from: https://www.sciencedirect.com/science/article/pii/S0266613807001210

41. Piirainen T, Isolauri E, Lagström H, Laitinen K. Impact of dietary counselling on nutrient intake during pregnancy: a prospective cohort study. Br J Nutr [Internet]. 2006 Dec 1;96(6):1095–104. Available from: http://journals.cambridge.org/abstract_S000711450723613X

42. Campbell F, Johnson M, Messina J, Guillaume L, Goyder E. Behavioural interventions for weight management in pregnancy: A systematic review of quantitative and qualitative data. BMC Public Health [Internet]. 2011 Jun 22;11(1):491. Available from: https://www.ncbi.nlm.nih.gov/pubmed/21696589

43. Willcox JC, van der Pligt P, Ball K, Wilkinson SA, Lappas M, McCarthy EA, et al. Views of women and health professionals on mHealth lifestyle interventions in pregnancy: A qualitative investigation. JMIR mHealth uHealth [Internet]. 2015 Oct 28;3(4):e99. Available from: https://www.ncbi.nlm.nih.gov/pubmed/26510886

44. World Health Organization. mHealth: New horizons for health through mobile technologies: second global survey on eHealth. WHO Press; 2011.

45. Hall AK, Cole-Lewis H, Bernhardt JM. Mobile text messaging for health: A systematic review of reviews. Annu Rev Public Health [Internet]. 2015 Mar 18;36(1):393–415. Available from: https://www.ncbi.nlm.nih.gov/pubmed/25785892

46. World Health Organization. Health promotion: The Ottawa charter for health promotion [Internet]. Vol. 2020. 1986. Available from: https://www.who.int/healthpromotion/conferences/previous/ottawa/en/

47. Government of Canada. Population health promotion: An integrated model of population health and health promotion [Internet]. Vol. 2020. 2001. Available from: https://www.canada.ca/en/public-health/services/health-promotion/population-health/population-health-promotion-integrated-model-population-health-health-promotion/developing-population-health-promotion-model.html

48. Government of Canada SC. Table 13-10-0428-01 Live births and fetal deaths (stillbirths), by type of birth (single or multiple) [Internet]. Vol. 2020. 2020. Available from: https://doi.org/10.25318/1310042801-eng

49. Government of Canada SC. Table 13-10-0418-01. Crude birth rate, age-specific fertility rates and total fertility rate (live births) [Internet]. Vol. 2020. 2020. Available from: https://doi.org/10.25318/1310041801-eng

50. Arriagada P. Women in Canada: A Gender-based Statistical Report. First Nations, Métis and Inuit Women [Internet]. Statistics Canada. Catalogue no. 89-503-X; 2016. Available from: https://www150.statcan.gc.ca/n1/en/pub/89-503-x/2015001/article/14313-eng.pdf?st=1IDZGro8

51. Government of Canada SC. Income of men and women, sub-provincial regions, T1 Family File: Interactive tool [Internet]. Vol. 2020. 2019. Available from: https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2019006-eng.htm

52. Government of Canada SC. Immigration and Ethnocultural Diversity Highlight Tables. Immigrant status and period of immigration, % distribution 2016, female, age (25 to 34), Canada, provinces and territories, 2016 Census – 25% Sample data [Internet]. 2019. Available from:

https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hlt-fst/imm/Table.cfm?Lang=E&T=11&Geo=00&SP=1&view=2&age=6&sex=3

53. Public Health Agency of Canada. Congenital anomalies in Canada 2013: A perinatal health surveillance report [Internet]. Vol. 2019. Ottawa; 2014. Available from: https://www.canada.ca/en/public-health/services/health-promotion/what-is-ccasn/congenital-anomalies-canada-2013-a-perinatal-health-surveillance-report.html

54. Begum F, Colman I, McCargar LJ, Bell RC, Team on behalf of the APO and N (APrON) S. Gestational weight gain and early postpartum weight retention in a prospective cohort of Alberta women. J Obstet Gynaecol Canada [Internet]. 2012;34(7):637–47. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S1701216316353166

55. Public Health Agency of Canada. Maternal Diabetes in Canada. Cat.: HP35-47/2014E-PDF [Internet]. Vol. 2019. 2014. Available from: https://www.canada.ca/en/public-health/services/publications/healthy-living/maternal-diabetes-canada.html

56. Public Health Agency of Canada. Maternal Hypertension in Canada. Cat.: HP35-49/2014E-PDF [Internet]. 2014. Available from: https://www.canada.ca/en/public-health/services/publications/healthy-living/maternal-hypertension-canada.html

57. World Health Organization. Global Health Observatory Data Repository/World Health Statistics. Prevalence of anemia among pregnant women (%) [Internet]. 2019. Available from: https://data.worldbank.org/indicator/SH.PRG.ANEM

58. World Health Organization. The global prevalence of anaemia in 2011. [Internet] [Internet]. 2015. Available from: https://apps.who.int/iris/bitstream/handle/10665/177094/9789241564960_eng.pdf

59. Canadian Foundation for Dietetic Research. Tracking nutrition trends report. Toronto, Ontario: Leger; 2018.

60. Public Health Agency of Canada. Folic acid: Are they getting enough? [Internet]. Vol. 2020. 2018. Available from: https://www.canada.ca/en/public-health/services/publications/healthy-living/folic-acid-are-you-getting-enough-factsheet.html

61. Han A, Rotermann M, Fuller-Thomson E, Ray JG. Pre-conceptional folic acid supplement use according to maternal country of birth. J Obstet Gynaecol Canada [Internet]. 2009;31(3):222–6. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S1701216316341202

62. Health Canada. Prenatal Nutrition Guidelines for Health Professionals - Folate contributes to a healthy pregnancy. [Internet] [Internet]. Vol. 2018. 2009. Available from: https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/fn-an/alt_formats/hpfb-dgpsa/pdf/pubs/folate-eng.pdf

Appendix A: Search Planning Tool

What is the appropriate timing and framing of maternal health nutrition messages, including who are effective gate keepers, formats and avenues to deliver messages?*
1. What are the most effective health communication-related strategies that engage pregnant women to change nutrition-related behaviour? 2. What are the elements of an effective nutrition-related health communication strategy for pregnant women and their families? 3. How effective is social media as a health communication strategy for nutrition-related messaging among pregnant women and their families? *Consideration given to settings, methods and targeted messages
Limits
Age: Child 6-12 years Adolescent 13-18 years Publication date for database search: 2000 to 2015 Hand search: 2015-2019 Geography: Canada, U.S., European Countries (e.g. U.K., Italy, Germany, Holland, etc), Australia, New Zealand, and Scandinavian countries (e.g. Denmark, Norway, Sweden, Finland) Language: English
Databases**
Business Source Complete, Business Source Elite, CAB Abstracts, CINAHL, Communication Abstracts, Communication and Mass Media Complete, Education Research Complete. EBSCO Interface, EMBASE, ERIC, Evidence-Based Medicine (EBM Reviews-includes Cochrane Database of Systematic Reviews), Family & Society Studies Worldwide, Family Studies Abstracts, Health Source (Consumer and Nursing/Academic Edition), MEDLINE, OVID Interface, PsychINFO, Psychology & Behavioral Sciences Collection, PubMed, PubMed Central, Scopus, Social Work Abstracts, SocINDEX with Full Text, Web of Science. Grey literature site searched included: Dietitians of Canada (including Practice-based Evidence in Nutrition®[PEN] and Health Evidence. Grey Literature databases were not extensively searched due to capacity and determination that it would inform the question further.

Concept	Synonym
Pregnant[1] women (and family support)[2] [1] For this project, pregnancy/pregnant women, etc. were used as the core keywords; a specific stage of pregnancy was not identified at the search stage [2] Individuals that could be considered family support for the pregnant woman	Pregnancy [Keyword, MeSH]; pregnant [Keyword]; pregnan* [Keyword]; "pregnant women" [Keyword, MeSH]; expectant [Keyword]; "expectant mothers" [Keyword, CINAHL heading]; multiparous [Keyword]; primiparous [Keyword]; nulliparous [Keyword]; gravid [Keyword]; antepartum [Keyword] prenatal; perinatal "family support" [Keyword, CINAHL heading]; spouses [Keyword, MeSH]; support* [Keyword]; family [Keyword, MeSH]; "parental support" [Keyword]; parent* [Keyword]; parents [MeSH]; sibling* [Keyword]; siblings [MeSH]; partner* [Keyword]; "extended family" [Keyword]
Maternal Health	"maternal health" [Keyword]; "maternal welfare" [Keyword, MeSH]
Social Risk	"social risk" [Keyword]; "social risks" [Keyword]; "socioeconomic status" [Keyword]; "socioeconomic factors" [Keyword, MeSH, CINAHL heading]; "social environment" [Keyword, MeSH, CINAHL heading]; "risk factor" [Keyword]; "risk factors" [Keyword, MeSH, CINAHL heading]; "social class" [Keyword, MeSH, CINAHL heading]; "risk assessment" [Keyword, MeSH]

Concept	Synonym
Health Communication[4] [4]Several synonyms included for health communication; did not include more general keywords, such as intervention, strategy, forum, channel to reduce irrelevant hits.	"health communication" [Keyword, MeSH]; campaign [Keyword]; "mass media" [Keyword, MeSH]; "communications media" [CINAHL heading]; "social marketing" [Keyword, MeSH, CINAHL heading]; "social media" [Keyword, MeSH]; message [Keyword]; "health message" [Keyword]; "health education" [Keyword, MeSH, CINAHL heading]; "risk communication" [Keyword]; "health marketing" [Keyword]; "health promotion" [Keyword, MeSH, CINAHL heading]; "health fair" [Keyword]; "health fairs" [MeSH]"mobile health units" [Keyword, MeSH, CINAHL heading]; "health literacy"
Behaviour Change[5] [5]Note the spelling variations for behaviour/behavior	"behavior change" [Keyword]; "behavioral changes" [CINAHL heading]; "behavior changes" [Keyword]; "behaviour change" [Keyword]; "behaviour changes" [Keyword]; "behaviour therapy" [Keyword]; "behavior therapy" [Keyword, MeSH]; "behaviour modification" [Keyword]; "behavior modification" [Keyword, CINAHL heading]
Healthy Eating Behaviour	"healthy eating" [Keyword]; feeding behavior [MeSH]; "feeding behavior" [Keyword]; "feeding behaviors" [Keyword]; "feeding behaviour" [Keyword]; "feeding behaviours" [Keyword]; food habits [MeSH]; "food habit" [Keyword]; "food habits" [Keyword, MeSH]]; "healthy diet" [Keyword]; "eating behavior" [Keyword]; "eating behaviour" [Keyword]; "eating behaviors" [Keyword]; "eating behaviours" [Keyword]
Adolescents (13-18)/Adults (19-44)[6] [6]Most databases have comprehensive age limiters, which is the recommend way to search. The keyword/MeSH terms for available age groupings are listed for reference.	adolescen* [Keyword]; adolescent [MeSH]; youth* [Keyword]; teen* [Keyword]; adult* [Keyword];
Optimum Nutrition/Healthy Growth	"optimum nutrition" [Keyword]; nutrition [Keyword]; "healthy growth" [Keyword]; "healthy weight" [Keyword]; "obesity prevention" [Keyword
[3] Prenatal and perinatal not included as keyword synonyms since these 2 concepts are most often associated with medical risks, and the subsequent care required to alleviate these risks.	

Keyword Search Strings
1. (pregnancy OR pregnant OR pregnan* OR "pregnant women" OR expectant OR "expectant mothers" OR multiparous OR primiparous OR nulliparous or gravid OR antepartum OR prenatal OR perinatal) AND ("health communication" OR "health message" OR "health education" OR "health marketing" OR "health promotion" OR "health fairs" OR "mobile health units" OR "health literacy") AND ("behavior change" OR "behaviour change" OR "behavior changes" OR "behaviour changes" OR "behavioral changes" OR "behaviour therapy" OR "behavior therapy" OR "behaviour modification" OR "behavior modification") AND ("healthy eating" OR "feeding behavior" OR "feeding behaviors" OR "feeding behaviour" OR "feeding behaviours" OR "food habit" OR "food habits" OR "healthy diet" OR "eating behavior" OR "eating behaviors" OR "eating behaviour" OR "eating behaviours" OR "diet" OR "food choice"
2. (pregnancy OR pregnant OR pregnan* OR "pregnant women" OR expectant OR "expectant mothers" OR multiparous OR primiparous OR nulliparous or gravid OR antepartum OR prenatal OR perinatal) AND ("health communication" OR "health message" OR "health education" OR "health marketing" OR "health promotion" OR "health fairs" OR "mobile health units" OR "health literacy") AND ("behavior change" OR "behaviour change" OR "behavior changes" OR "behaviour changes" OR "behavioral changes" OR "behaviour therapy" OR "behavior therapy" OR "behaviour modification" OR "behavior modification") AND ("optimum nutrition" OR nutrition OR "healthy growth" OR "healthy weight" OR "obesity prevention")
3. (pregnancy OR pregnant OR pregnan* OR "pregnant women" OR expectant OR "expectant mothers" OR multiparous OR primiparous OR nulliparous or gravid OR antepartum OR prenatal OR perinatal) AND ("family support" OR "parental support") AND ("health communication" OR "health message" OR "health education" OR "health marketing" OR "health promotion" OR "health fairs" OR "mobile health units" OR "health literacy") AND ("optimum nutrition" OR nutrition OR "healthy growth" OR "healthy weight" OR "obesity prevention")

Keyword Search Strings	
4.	(pregnancy OR pregnant OR pregnan* OR “pregnant women” OR expectant OR “expectant mothers” OR multiparous OR primiparous OR nulliparous or gravid OR antepartum OR prenatal OR perinatal) AND support* AND (spouses OR family OR parent* OR sibling* OR partner OR “extended family”) AND (“health communication” OR “health message” OR “health education” OR “health marketing” OR “health promotion” OR “health fairs” OR “mobile health units” OR “health literacy”) AND (“optimum nutrition” OR nutrition OR “healthy growth” OR “healthy weight” OR “obesity prevention”)
5.	(pregnancy OR pregnant OR pregnan* OR “pregnant women” OR expectant OR “expectant mothers” OR multiparous OR primiparous OR nulliparous or gravid OR antepartum OR prenatal OR perinatal) AND (“social risk” OR “social risks” OR “socioeconomic status” OR “socioeconomic factors” OR “social environment” OR “risk factor” OR “risk factors” OR “social class” OR “risk assessment”) AND (“health communication” OR “health message” OR “health education” OR “health marketing” OR “health promotion” OR “health fairs” OR “mobile health units” OR “health literacy”) AND (“behavior change” OR “behaviour change” OR “behavior changes” OR “behaviour changes” OR “behavioral changes” OR “behaviour therapy” OR “behavior therapy” OR “behaviour modification” OR “behavior modification”) AND (“healthy eating” OR “feeding behavior” OR “feeding behaviors” OR “feeding behaviour” OR “feeding behaviours” OR “food habit” OR “food habits” OR “healthy diet” OR “eating behavior” OR “eating behaviors” OR “eating behaviour” OR “eating behaviours” OR “diet” OR “food choice”)
6.	(pregnancy OR pregnant OR pregnan* OR “pregnant women” OR expectant OR “expectant mothers” OR multiparous OR primiparous OR nulliparous or gravid OR antepartum OR perinatal OR prenatal) AND (“social risk” OR “social risks” OR “socioeconomic status” OR “socioeconomic factors” OR “social environment” OR “risk factor” OR “risk factors” OR “social class” OR “risk assessment”) AND (“health communication” OR “health message” OR “health education” OR “health marketing” OR “health promotion” OR “health fairs” OR “mobile health units” OR “health literacy”) AND (“behavior change” OR “behaviour change” OR “behavior changes” OR “behaviour changes” OR “behavioral changes” OR “behaviour therapy” OR “behavior therapy” OR “behaviour modification” OR “behavior modification”) AND (“optimum nutrition” OR nutrition OR “healthy growth” OR “healthy weight” OR “obesity prevention”)
7.	pregnancy OR pregnant OR pregnan* OR “pregnant women” OR expectant OR “expectant mothers” OR multiparous OR primiparous OR nulliparous or gravid OR antepartum OR prenatal OR perinatal) AND (“health communication” OR “health message” OR “health education” OR “health marketing” OR “health promotion” OR “health fairs” OR “mobile health units” OR “health literacy”) AND (“social marketing” OR “social media” OR “mass media” OR “communications media”) AND (“optimum nutrition” OR nutrition OR “healthy growth” OR “healthy weight” OR “obesity prevention”
8.	(pregnancy OR pregnant OR pregnan* OR “pregnant women” OR expectant OR “expectant mothers” OR multiparous OR primiparous OR nulliparous or gravid OR antepartum OR prenatal OR perinatal) AND (“family support” OR “parental support”) AND (“health communication” OR “health message” OR “health education” OR “health marketing” OR “health promotion” OR “health fairs” OR “mobile health units” OR “health literacy”) AND (“social marketing” OR “social media” OR “mass media” OR “communications media”) AND (“optimum nutrition” OR nutrition OR “healthy growth” OR “healthy weight” OR “obesity prevention”)
9.	(pregnancy OR pregnant OR pregnan* OR “pregnant women” OR expectant OR “expectant mothers” OR multiparous OR primiparous OR nulliparous or gravid OR antepartum OR perinatal OR prenatal) AND support* AND (spouses OR family OR parent* OR sibling* OR partner OR “extended family”) AND (“health communication” OR “health message” OR “health education” OR “health marketing” OR “health promotion” OR “health fairs” OR “mobile health units” OR “health literacy”) AND (“social marketing” OR “social media” OR “mass media” OR “communications media”) AND (“optimum nutrition” OR nutrition OR “healthy growth” OR “healthy weight” OR “obesity prevention”)
10.	(pregnancy OR pregnant OR pregnan* OR “pregnant women” OR expectant OR “expectant mothers” OR multiparous OR primiparous OR nulliparous or gravid OR antepartum OR prenatal OR perinatal) AND (“maternal health” OR “maternal welfare”) AND (“optimum nutrition” OR nutrition)
11.	pregnancy OR pregnant OR pregnan* OR “pregnant women” OR expectant OR “expectant mothers” OR multiparous OR primiparous OR nulliparous or gravid OR antepartum OR prenatal OR perinatal) AND (“maternal health” OR “maternal welfare”) AND (“health communication” OR “health message” OR “health education” OR “health marketing” OR “health promotion” OR “health fairs” OR “mobile health units” OR “health literacy”) AND (“optimum nutrition” OR nutrition)
12.	(“health communication” OR “health message” OR “health education” OR “health marketing” OR “health promotion” OR “health fairs” OR “mobile health units” OR “health literacy”) AND (“maternal health” OR “maternal welfare”) AND (“optimum nutrition” OR nutrition)

Appendix B: Inclusion/Exclusion Criteria

Component	Inclusion Criteria	Exclusion Criteria
Language	English	Non-English
Publication Date	2000-2015 Note: Systematic reviews and primary research hand search/reference list reviews to January 2020	Prior to 2000
Population	Women, Pregnant, Post-partum; individuals providing support to pregnant women	Adolescent pregnancy
Geography	High-income countries (previously termed developed countries). Included: Canada, U.S., European countries (e.g. U.K., Italy, Germany, Holland, etc), Australia, New Zealand, Scandinavian countries (e.g. Denmark, Norway, Sweden, Finland).	Low income and middle-income countries.
Health status	Healthy population, non-disease, obesity-prevention strategy (E.g. healthy living messages)	Those outside of "healthy" category; Primary focus on health conditions (e.g. gestational hypertension, gestational diabetes, eating disorders, obesity treatment
Setting	Community, home, school/university	Institutionalized, hospital
Strategy	Articles that evaluate the nutrition or health outcomes as a result of a policy, strategy, program or program. Articles that describe the facilitators and barriers of participating in the strategy.	Articles that postulate/ recommend a strategy that is unrelated to the outcomes the article actually measures.
Study Type	Articles published in a peer-reviewed journal. Quantitative articles that include a method to compare impact of a policy/strategy/ program/project (e.g. randomized control trial, cohort, quasi-experimental design, cross-sectional- analytic, etc). Qualitative or mixed methods articles that report on food-related knowledge, attitude and behaviours of prenatal populations.	Narratives, opinion papers, conference proceedings, books, magazine articles, poster presentations.
Other		Exclude if we cannot locate the full article via google scholar or KRS

Appendix C: Simplified Data Extraction Tables

Intervention: Print Materials
Total articles: 10
Quantitative articles: 3

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Quasi-experimental	Wilkinson et al 2010 Australia, universal population Appraisal: weak **Pregnancy Pocketbook (PP):** 73 page interactive health promotion resource with evidence-based information, screening tools, goal setting, self-monitoring activities, and referral information. The resource included symbols to highlight activities for women or if they should seek assistance from their HCPs. • Readability score: 3.7-14.6. • Average week of gestation upon which it was received = 14.8 wks. • PP training delivered to 50 midwives and dissemination relied on midwives **Usual Obstetric Care (UC):** no additional detail	**Design** Control • usual obstetric care (UC) (*site 1*), n=140 Intervention • UC+ pregnancy pocketbook (PP) presented at booking visit (*site 2*), n=130 **Date collection** Self-reported data at baseline, 12 weeks, and 24 weeks with computer-assisted telephone interviewing	No significant differences observed in the percentage of women meeting V/F guidelines for pregnancy between the intervention and control sites 12 weeks after initial booking visit: *Fruit intake:* • PP: 2.3 ± 1.2 svg/day • UC: 2.1 ± 0.9 svg/day *Vegetable intake:* • PP: 2.5 ± 1.3 svg/day • UC: 2.1 ± 0.9 svg/day • No data available for 24 weeks after initial booking visit	Greater representation of women with a high income Poorer retention in intervention group at 12 and 24 weeks Authors report effects may be conservative estimates due to ineffective dissemination of PP: • Dissemination relied on midwives. • Only ~ 63% of intervention group reported receiving PP. • Only ~ 1/3 of women reported having the PP explained to them • ~ ¼ of women reported reading only the main sections	There were no differences in the percentage of women meeting V/F guidelines between those who received usual care compared to those who received the intervention (UC + PP).
Observational	Teisl et al 2011 United States, universal population • Appraisal: weak **Fish advisory brochure**: State-level program that informed pregnant women about the benefits and risks of fish consumption (balanced communication). They were designed for lower literacy abilities and extensively tested with the target population. The brochure was distributed to pregnant women through Maine's WIC Nutrition Program (~40% of pregnant women) and offices of HCPs providing prenatal care. In HCP offices, brochures were given as part of a packet at the first prenatal visit, and were placed on display for all patients to take.	**Design** 1250 women randomly drawn from Maine's birth certificate registry (who had given birth in last 3 mths). Mail survey assessed awareness of fish advisory, receipt of fish advisory brochure and change in fish consumption behaviour– 3 communication occurrences resulted in 769 women completing the 80 question survey (62% response rate)	Women who read the fish advisory brochure: • Were more likely than nonreaders to switch the kinds of fish they ate as they became pregnant (significant coefficient: 0.937). • Significantly ↑ their consumption of light tuna (0.260 avg. # monthly meals) and ↓ their consumption of white tuna (-0.282 avg. # monthly meals)	Women who read the guidelines were more likely to be older, more educated, dual parent, higher income. >96% of Maine citizens are Caucasian	Women who read a fish advisory brochure were more likely to "switch" from highly-contaminated fish to less-contaminated fish during pregnancy, compared to women who did not read the brochure

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Cohort-analytic	Brinberg et al 2002 United States, vulnerable population (WIC setting) Appraisal: • weak	**Design** All participants received dietary assessment and counselling based on food consumption deficits, a 15-minute video on nutrition and its role in prenatal health, and a Q&A period with a HCP. The main difference between the two groups was the type of brochure that was distributed. Control • General information brochure about diet and health, n=7 Intervention • Targeted nutrition education brochure, n=5 **Data collection** FFQ Pre-test and Post-test at 6-8 weeks after intervention	Consumption of targeted (high nutrient) foods: • changed significantly more in the + direction for women in the intervention group than for women in the control group [48.3% vs. 25.5%; Z=2.25, p<0.02] Less women in the intervention reported no changes compared to the control group [51.7% vs. 74.5%; Z=2.45, p<0.01].	Small scale evaluation High attrition rate Predominantly Caucasian women (82%)	When comparing two different forms of nutrition education brochures, a tailored brochure with messages reflecting the practices/attitudes of the subjects was more effective for ↑ consumption of targeted foods, compared to a brochure with general messages

Tailored nutrition education brochure: derived from an analysis of each participant's food practices and attitudes. If a participant's diet was deficient in a nutrient, messages focused on promoting foods already consumed with some frequency that were high in that nutrient. 8 foods were selected from the participant's FFQ and 4 additional foods high in the nutrient were also included Participants were provided with a calendar to track daily intake as a tangible reminder of daily goals. Readability: 5th grade reading level

Intervention: Print Materials
Total articles: 10
Qualitative articles: 7

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Focus groups	Begley 2002 Australia, universal population • Appraisal: moderate	16 focus groups (n=90) • 10 questions asked to understand barriers to dietary changes during pregnancy **Focus group topic: barriers to initiating and maintaining dietary change for pregnancy** Relevant Focus Group Questions: 1) When did you first get information about nutrition for pregnancy? 2) Did you want to make changes but you couldn't find information? 3) Who should be providing information on nutrition in pregnancy? 4) What would be the best way to get nutrition information to pregnant women? Focus groups lasted 60 minutes.	**Who:** • Women saw provision of education as an important role of GPs **What:** • Printed educational materials (e.g. pamphlets) received from GPs was seen as an acceptable and useful way to obtain nutrition information **Preferred content/design:** • Pamphlets were seen as easy to read and free • Concerns raised about insufficient practical information to implement recommendations • Women were unlikely to have purchased books	Subjects self-selected 55.6% of participants had undertaken some or completed tertiary-level education Authors noted data saturation not reached	• Women saw the provision of nutrition education an important role of the GP, even if it is in the form of printed materials. Pamphlets were viewed as easy to read and accessible but there was concern expressed about a lack of sufficient/practical detail
Focus groups	Athearn 2004 United States, mainly universal population Appraisal: strong	• 11 focus groups across three states (n=69) **Focus group topic: pregnant women's food safety attitudes and beliefs** Focus group sessions included a discussion about participants' food safety information needs. Relevant Questions: 1) How would you like to get this information? 2) Whose advice on food safety are you most likely to follow? Focus groups lasted 90 minutes	**Women's food safety communication needs:** **Who/Where:** • Information received (or endorsed) by doctors was 'trusted' • Preference for information to be received at doctor's offices or clinics; however Spanish speaking participants preferred information through WIC clinic **What:** • Food safety information in written form (e.g. pamphlets, brochures, booklets) • Spanish speaking participants preferred verbal discussion over written information **Content/design:** • Written materials that are colorful, easy to read, and pictorial • Reasons why recommendations are made **When:** • Receiving food safety information in preconception or early pregnancy	Most women were Caucasian and well educated; one exclusively Hispanic focus group Conducted in three states with diverse population samples, across-state differences not described Recruitment methods varied, volunteer subjects, and limited sample size •	Women within the universal population preferred to receive food safety information in written form at doctor's offices. Women in a WIC setting preferred to receive information verbally from WIC clinic. Food safety information should be received at the beginning of pregnancy. • Written materials should be attractive, easy to read, and attention grabbing.

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Semi-structured interviews **Interview topic: Pregnant women's use of information and communications technologies.** Interviews were designed to elicit understanding of information that was sought, and where and why it was accessed.	Rodger 2013 Australia, mainly vulnerable population • Appraisal: moderate	• 35 interviews	**Communication preferences:** **Who:** Interpersonal communication with HCPs and print materials distributed by hospitals were information sources most 'trusted' by clients	Small sample size Participants self-selected, mostly Anglo-Australian	Print materials distributed through hospitals were 'trusted'
Recording of initial antenatal consultation with midwives followed by 2 semi-structured interviews	Szwajcer 2009 Netherlands, universal population Appraisal: strong	Antenatal consultations occurred during the 12th week of pregnancy. Interviews took place the day after the consultation and two weeks later (n=12)	**Communication preferences:** **How:** • Women reflected that receiving a nutrition brochure as part of a package of materials did not encourage nutrition communication with their midwife • Women who were advised to read a particular brochure by their midwife followed through on this advice; women who were not told to read a particular brochure did not read any **When:** • Nutrition communication took place relatively late in pregnancy (when the first trimester was almost over) and at a point when other topics (e.g. "hearing the baby's heart beat") took precedence	Observation bias - observations of midwives may have overestimated quality of care • Small sample size	Unless women were directed to a particular brochure , there was no purpose of a nutrition brochure in practice when it was part of a package of materials • Nutrition education should take place as early in pregnancy as possible
Focus groups **Focus group topic: women's experiences of dietary information and change of habits during pregnancy** An interview guide covered sources of information about diet during pregnancy, reactions to dietary advice, and coping with dietary advice. Interviews lasted 45 minutes	Wennberg 2013 Sweden, universal population Appraisal: strong	6 focus groups (n=23) Women were in mid-pregnancy and attending antenatal classes	The distribution of brochures did not occur in conjunction with deeper counselling and women related that they had to read information by themselves	• Most women were well educated	• Women preferred brochures to be discussed in conjunction with counselling

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Semi-structured in-depth interviews with HCPs **Focus group topic: HCP attitudes toward food safety recommendations for pregnant women and interest in education and patient materials on food safety during pregnancy** 31 questions explored attitudes of HCP about food safety, their food safety information needs, and types of educational materials they would be interested in providing to clients Interviews lasted 45 minutes	Morales 2004 United States, vulnerable population • Appraisal: strong	HCPs working with WIC programs (n=23)	**Preferences of WIC HCPs:** **What:** • Food safety handouts were preferred by a majority of HCPs; however only a few reported verbally reviewing handouts with clients ***Content/Design:*** • Handouts that are 1-2 pages, simple, easy to read, attractive, include a list of sources for further information, and related specifically to pregnant women • Some HCPs reported that clients would want to know why recommendations are being made, and risks involved	• Small sample size and limited numbers of each HCP specialty	HCPs in WIC settings preferred to provide food safety education in the form of simple, easy to read, attractive handouts; however few report they would review these materials with clients
Qualitative assessment of print materials provided in Control group **Intervention:** Informational DVD + written materials + series of standard consultations. The DVD educational tool contained information about healthy eating during pregnancy, serving sizes, and exercise during pregnancy. The information content of the DVD was the same as that presented to women in the intervention sessions and written materials. **Control:** Standard written materials + series of standard consultations. Women were between 10-20 weeks gestation at the time of their first prenatal visit.	Szmeja, 2014 Australia/New Zealand, universal population, overweight/obese Appraisal: moderate	• 568 women provided feedback in relation to the provided written study materials.	Quantitative results presented in Multimedia Technologies The majority of women liked the nutrition in pregnancy book (78.3%) and found the information easy to follow (87.3%), only 21.3% reported referring to the book “sometimes” or “often” during pregnancy or in the postpartum period (9.9%).	• Participants were mainly Caucasian	• Although women reported liking a pregnancy book and finding information easy to follow, this didn’t translate to frequent use during pregnancy or postpartum.

Intervention: Nutrition Education/Counselilng (NEdC)
Total articles: 8
Systematic reviews: 2

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
Systematic Review	Girard et al 2012 Combined studies from high, middle and low-income countries • Appraisal: strong	Of 34 studies,16 were RCTs Category 1: n=15 studies Category 2: n=6 studies Category 3: n=13 studies	Results presented for different types of NEdC and High-income Country (HIC) stratification. Results for low-income and middle-income stratifications not applicable to Canadian context. NEdC effectiveness results for HIC specifically not available. **Increased GWG** (as study goal) (n=13 studies) Significant improvements observed for intervention group with Category 3 interventions (+0.15 kg [95% CI 0.00, 0.29]). NEdC studies conducted in HIC also showed significant improvements for intervention groups (+0.76 kg [95% CI 0.20, 1.31]) **Risk of anemia** (n=11 studies) NEdC did not significantly reduce risk of anemia in HIC (0.91[95% CI 0.61, 1.36]). Category 3 NEdC (usually combined with micronutrient supplementation) as more effective for reducing risk of anemia (0.58 [95% CI 0.44, 0.76]) compared to Category 1 NEdC (0.84 [95% CI 0.7, 1.0]) **Risk of LBW** (n=12 studies) No significant effect **Mean infant BW** (n=13 studies) In HIC, NEdC significantly increased mean BW (64.8 g [95% CI 1.65, 128.03]). Category 3 NEdC interventions were more effective for increasing mean BW (297.2 g [95%	Overall quality of evidence low – many studies had small sample sizes , inadequate power to detect differences in outcomes Studies differed substantially with respect to design, population, NEdC delivery Many studies suffered from losses to follow-up Women who attended NEdC were older, more educated NEdC effectiveness results for HIC specifically not available.	In HIC, NEdC significantly increased mean infant BW and GWG. Overall, NEdC reduced the risk of preterm delivery and was associated with a greater proportion of women reporting dietary changes. NEdC is most effective for influencing maternal/infant outcomes when combined with supplementation or a 'food basket'.

Nutrition Education/Counselling: NEdC interventions focused on improving maternal diet and nutritional status during pregnancy
Types of NEdC:
Category 1: strategies providing NEdC during pregnancy as sole intervention
Category 2: strategies tested the effect of a package of health education messages that included a NEdC component
Category 3: combined NEdC with nutrition support (e.g. food baskets, food supplements or micronutrient supplements)

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
			CI 226.8, 367.6]) compared to NEdC 1 (-8.1g [95% CI -86.7, 69.6]) and NEdC 2 (0.14g [95% CI -0.04, 0.32]) interventions. **Risk of preterm delivery** (n=10 studies) Pooled analysis revealed that overall, NEdC significantly reduced preterm birth (0.81 [95%CI 0.66, 0.99]). There were no significant stratified effects by NEdC type. **Dietary behaviours** (n=20 studies) • Generally, NEdC improved maternal diets (dietary practices, consumption of specific macro and micronutrients) • Impact of NEdC on other dietary-related outcomes (e.g. energy intake) is mixed **Category 2 NEdC:** NEdC as part of a package (Category 2) of other health messages consistently reported null effects for outcomes.		
Systematic Review **Intervention:** E-based lifestyle interventions comprising at least one component of dietary control, physical activity and weight management that were delivered through at least one of the following means: website, Internet, Apps, SMS, email, computer or video player. The study does not provide a complete picture of the effectiveness of NEdC interventions alone.	Lau et al 2017 HIC, universal, overweight/obese Appraisal: strong	Only 2/7 trials assessing the effectiveness of e-based interventions on GWG incorporated NEdC	**Gestational weight gain** • Interventions that combined e-based and in-person delivery formats were more effective at reducing GWG (z=2.02, P=0.04) compared to e-based lifestyle interventions alone.	Variable intervention methods Majority of studies conducted with white perinatal women in developed countries • Small sample sizes	• E-based interventions are more effective when combined with in-person interventions for reducing GWG

Intervention: Nutrition Education/Counselling (NEdC)
Total articles: 8
Quantitative articles: 5

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
Controlled clinical trial	Briley et al 2002 United States, vulnerable population Appraisal: weak **Intervention:** 6 individualized in-home nutrition assessment/counselling visits. Visits were scheduled weekly for the first 4 weeks, and then monthly for 2 more visits. Topics of visits included: 1) Introduction to intervention and initial dietary Ax; 2) Basic nutrition, weight gain during pregnancy; 3) Special nutrient needs during pregnancy; 4) How to make it work?; 5) Is it working?; 6) Healthy habits as a new mom; 6) Review (optional) Women were at 24 weeks gestation or less **Control:** 2 visits, same topics as 1st and 5th visits in intervention	**Design:** Random assignment to intervention or control Intervention (n=10): • minimum of 6 individualized in-home nutrition assessment and counselling visits Control (n=10): • 2 visits **Data Collection:** • 3 24-hour recalls before and after intervention	Infant Outcomes: Infant BW • significantly higher in the intervention group (3.54 ±0.4 kg) compared to the control (3.06±0.5 kg) (P<0.05) Maternal Outcomes: Nutrient Intakes (Energy, Iron, Vitamin B6, Calcium, Folate, Zinc) • Dietary iron consumption - significant increase in the intervention group (Before: 12.6±3.7 mg, after: 19.4±8.2 mg, P<0.01). • Non-significant differences in energy, vitamin B6, calcium, folate, and zinc intake before and after the intervention.	Very small study. Authors note it was not possible to evaluate the independent influence of dietary improvements or nutrition intervention – potential confounders not assessed • Time constraints prevented some women from scheduling appointments. 7/27 (26%) women dropped out (5 or 71% were from intervention group).	• An intensive nutrition assessment/counselling program (6 individualized in-home nutrition assessment and counselling visits) was associated with improvements in iron consumption and infant BWs; however there were concerns with dropout rates.
Controlled clinical trial	Hui et al 2004 Canada, vulnerable population • Appraisal: moderate **Intervention:** Dietitians provided a personalized plan for participants, including recommended changes in food choice, frequency, portion size and pattern of intake, if required. Assessment information was obtained using the Food Choice Map (FCM) interview program. FCM is a tool for both assessment and intervention. During the interview, participants recalled usual food intake (1 week). RDs placed magnets with food images and bar codes on a board for meals and snacks, based on information received in interview. Bar codes represented food items and portion sizes. These were scanned into a computer and analyzed total kcal and daily macronutrient intake, as well as gestation-related weight gain information. Add physical activity info. Women were ~ 26 weeks gestation when recruited	**Design:** Intervention (n=24): • Computer-assisted dietary interviews and counselling (FCM) + home and group-based physical activity Control (n=21):	No differences between intervention and control groups in: **Infant Outcomes:** • Incidence of macrosomia • BW • Incidence of weight related birth procedures **Maternal Outcomes:** • GWG • Pregnancy duration • Incidence of excessive weight gain • Incidence of GDM • Total kcal and macronutrient intake • Physical activity-related outcomes not discussed	Pilot study Study had poor power so unable to detect differences although authors note trends 7 women dropped out. Those who dropped out were lower income.	Women who received an exercise and personalized dietary plan did not see significant differences in kcal intake, GWG, incidence of GDM, birth procedures and infant BW compared to women who received a prenatal nutrition informational package from Health Canada • A one-time personalized plan did not appear to have an advantage over an informational package from Health Canada

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
Prospective cohort study	Piirainen et al 2006 Finland, vulnerable population Appraisal: moderate	**Design:** Intervention (n=140): • Detailed dietary counselling + food products Control (n=69): • *No detail provided* **Data Collection:** Food records	**Maternal Outcomes: Food and nutrient intakes** Compared to the control group, women in the intervention group significantly: • ↑Vegetables (+23 g, 95% CI +1.4, +44.7, P<0.05) • ↑Fruits (+59 g, 95% CI +28.1, +89.9, P<0.05) • ↑Soft margarines (+2.9 g, 95% CI +1.0, +4.7, P<0.05) • ↑Vegetables oils (+2.0 g, 95% CI +0.9, +4.3, P<0.05) • ↑Fibre (+1.8 g, 95% CI +0.1, +3.4) • ↓Butter (-3.0 g, 95% CI, -4.0, -2.0, P<0.05) • ↑Dietary intake of Vit E (+1.4 mg, 95% CI +0.6, 2.2, P<0.001) • ↑Dietary intake of Folate (+20.9 µg, 95% CI, 0.8, 41.0, P<0.05) • ↑Dietary intake of Vit C (+19.8 mg, 95% CI 3.5, 36.0, P<0.01) • ↑Intake of PUFA (+1.3 g, 95% CI 0.2, 2.4, P<0.01) No significant differences were observed in consumption of grain products, milk products, meat products, fish products, cheese and sugar/sweets between the intervention and control groups	Reliance on food records for analysis of dietary intake Long duration of study. Authors note this may have affected women's motivation to maintain recommended diet and consumption of food products Pregnant women may have received dietary counselling by nurses, and may have already altered dietary habits before entry to the study Women in the control group also received feedback on their food records Although statistically significant, dietary changes were extremely small	Focused dietary counselling combined with provision of specific food products had a small positive impact on some targeted dietary behaviours (change in type of fat, ↑ fibre)

Detailed dietary counselling: modifications to amount/type of fat and amount of fibre + food products with favourable fat (rapeseed oil-based spread and salad dressings) and fibre (fibre enriched pasta, breakfast muesli, porridge cereal). Women were also encouraged to increase vegetables, fruits and wholegrain bread and cereals, leaner meats, low fat cheese/milk, fish 2x week.

Consumption of specific amounts of food products was advised.

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
Pre-post, cross-sectional comparison of results **Coordinated state-wide nutrition education program:** 6-month curriculum (*Health Habits Every Day*) was delivered in 3 2-month blocks, each with a different nutrition focus: 1) Fruits and Vegetables; 2) Lower-fat milk; 3) Whole Grains. Curriculum designed specifically for the California WIC population (>75% Latino). Key messages were piloted with WIC families during development phase. Examples of activities for sessions included card sorts, taste tests, and label reading. All local WIC agency programs in California were mandated to participate in the program.	Ritchie et al 2010 United States, vulnerable population Appraisal: weak	**Design:** Random sample of 9000 participants receiving WIC services were sent surveys Time 1 (Jan 2009): • Pre-nutrition education (n=3015) Time 2 (July 2009): • Post-nutrition education (n=3004)	**Maternal Outcomes:** food message recognition, intention to change food behaviour, food behaviours **Dietary Behaviours** • ↓Juice intake – mean frequency of daily juice ↓ between Time 1 (0.93±1.02) & Time 2 (0.83±0.91), p<0.001) • No differences in frequency of intake for other V/F • ↑ Whole grain intake for respondents and family between Time 1 (30.4%) & Time 2 (34.2%), p=0.002 • No difference in proportion of respondents looking at ingredient labels for whole grain foods • ↑ Proportion of participants consuming lower-fat milk (Time 1: 62.8%% vs. Time 2: 69.4%) and ↓ in whole milk consumption (Time 1: 34.3% vs. Time 2: 27.5%) **Dietary Message Recognition** • ↑ V/F message recognition (Time 1 recognition ranged from 43.3-86.1%; time 2 recognition ranged from 64.1-89.5%) • Some ↑ in message recognition for eating more whole grain foods between time 1 & time 2 • Message recognition – between time 1 & time 2, increases were observed in recognizing importance of lower-fat milk (time 1: 68.8% vs. time 2: 81.1%) **Intention to Change Behaviours** • Stages of change - less participants were in the precontemplation stage for some dietary behaviours at time 2	Potential for over-reporting Majority of participants were Latino • ~ 9% were pregnant	Nutrition education using focused topics led to some small improvements in dietary patterns (↓ juice intake, ↑ whole grain intake, replacement of whole milk with lower fat milk) and better message recognition Simpler messages (e.g. “switch to lower-fat milk”) had greater uptake than more complex messages (“eat more whole grains”)

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions

Randomized controlled trial	Wilkinson & McIntyre 2012
	
	Australia, universal population
	
	Appraisal: moderate
	
	Healthy Start to Pregnancy workshop (HSP): 60-minute session designed according to the 5A's of Pregnancy and delivered by maternity dietitians. Delivered with PowerPoint slides to facilitate information sharing, discussion and activities to extend booklet information (see below).
	
	Usual nutrition care (UC): 12 page pregnancy booklet distributed by midwives at booking visit. Contained literature regarding behaviours that influence maternal and infant outcomes (e.g. V/F intake, healthy GWG, physical activity) and screening tools, goal setting, self-monitoring activities. Reading score = 7.9
		Design:
		
		Intervention (n=178):
		• HSP workshop delivered by RDs
		Control (n=182):
		• Usual nutrition care
		
		Data Collection:
		Survey methods
		Time 1: booking visit (~14 wks. gestation)
		Time 2: ~26 weeks gestation (12 weeks after workshop)
			Maternal Outcomes: Food intake; GWG awareness
			Women attending the HSP workshop had:
			V/F intake at Time 2 (PP analysis):
			• ↑Fruit [0.4 (0.1-0.6, p=0.004)]
			  ○ HSP:2.4±1.0
			  ○ UC:1.9±0.9
			• ↑Vegetables [0.4 (0.1-0.7), p=0.006]
			  ○ HSP: 3.3±1.3
			  ○ UC: 2.4±1.2
			
			Diet Quality Score (PP analysis):
			• ↑0.09 (0.009-0.2, p=0.027)
			  ○ HSP:2.5±0.4
			  ○ UC:2.1±0.4
			
			GWG Awareness:
			• 8% more women in HSP workshop could report correct GWG goals [rounded] (significant in PP analysis)
				Only 46.5% of women who were recruited attended the intervention (87/178)
				
				63.5% of the HSP and 70.9% of the UC women returned Time 2 surveys
				
				Women who attended had higher education levels
					A 60 minute workshop designed with 5 A's of Pregnancy and that extended booklet information, led to some small improvements in dietary behaviours (e.g., ↑½ svg V/F per day) compared to receiving an informational resource alone. Women who attended also had slightly more awareness of GWG guidelines compared to those who only received the booklet.

Intervention: Nutrition Education/Counselling (NEdC)

Total articles: 8
Qualitative articles: 1

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Focus groups	Athearn et al 2004 United States, universal population Appraisal: strong **Focus group topic: pregnant women's food safety attitudes and beliefs** Focus group sessions included a discussion about participants' food safety information needs. Relevant Questions: 1) How would you like to get this information? 2) Whose advice on food safety are you most likely to follow? Focus groups lasted 90 minutes	• 11 focus groups across three states (n=69)	**Women's food safety communication needs:** **Who/Where:** • Some women preferred that food safety information be provided verbally, in personal discussion groups. In particular, the Spanish-speaking focus group preferred receiving information through their WIC clinic discussion group and placed more value on the spoken over the written word		• Personal discussion groups, with an opportunity for food safety information to be provided in a verbal format, was preferred over written form by some women. This was particularly important for non-Caucasian vulnerable pregnant women participating in a WIC program.

Intervention: Multimedia Technologies
Total articles: 5
Quantitative articles: 5

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
Randomized trial	Campbell et al 2004 United States, vulnerable population Appraisal: weak	**Design:** Intervention: • Interactive CD-ROM program (n=141) Control : • No interactive CD-ROM program until 1-2 month f/up (n=166) **Data Collection:** Surveys @ baseline, immediately post program, 1-2 month f/up **Intervention:** Interactive CD-ROM with 4 components: 1) Targeted video soap opera (*Baby Oh Baby)* – prenatal nutrition incorporated into plot 2) infomercials – designed to assess nutrition knowledge and skills and provide tailored feedback. Topics included: infant feeding, low-fat foods, healthy menu choices, meal planning, and using the Food Guide Pyramid 3) Tailored dietary feedback – based on results of baseline FFQ. Large focus on dietary fat for women in preconception and on V/F and calcium-rich foods for pregnant and breastfeeding women. 4) Take-home print materials Participants completed baseline survey, received the intervention program, and answered interactive feedback components. Survey questions took 15 minutes and intervention took ~20-25 minutes to complete. **Control:** Completed surveys but did not receive intervention until after follow-up	**Knowledge:** • ↑Low-fat knowledge (mean follow-up scores: Intervention (2.76) vs. Control (2.63), P=0.02 • ↑Infant-feeding knowledge (mean follow-up scores: Intervention (2.62) vs. Control (2.40) P<0.01 **Self-efficacy for healthy eating:** • ↑Self-efficacy from baseline to immediate f/up for participants receiving intervention (Total scores: Intervention [19.51] vs. Control [17.89]) but no difference at 1-2 month f/up (Total scores: Intervention [18.93] vs. Control [18.48]) **Stages of change:** • No difference between intervention and control groups on movement through stages of change between baseline and f/up **Dietary behaviour:** • No difference between the intervention and control groups in any dietary behaviours between baseline and f/up **Process measures:** Participant feedback: • 63.7% of intervention participants felt the program was “very helpful” or “helpful” • 88.6% reported being very or somewhat interested in using a similar program in the future • 51.3% indicated that the 30-40 minute program was “too long”	Differences in baseline demographics Original response rate was low (15.6%). Telephone interviews were added to obtain an adequate total response rate of 74.8%. Data collection methods not validated Participants may have been exposed to other nutrition education Limited to English speaking participants Inclusion of all WIC participants (~ 20% pregnant)	Nutrition education delivered via an interactive CD-ROM program led to small significant improvements in specific nutrition knowledge components and a short-term increase in self-efficacy. No impact was found on participants’ stages of change or dietary behaviours. Many participants felt a 30-40 minute program was “too long”.

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
Nested randomized trial	Szmeja et al 2014 Australia/New Zealand, universal population (Overweight/Obese) • Appraisal: moderate **Intervention:** Informational DVD + written materials + series of standard consultations. The DVD educational tool contained information about healthy eating during pregnancy, serving sizes, and exercise during pregnancy. The information content of the DVD was the same as that presented to women in the intervention sessions and written materials. **Control:** Standard written materials + series of standard consultations. Women were between 10-20 weeks gestation at the time of their first prenatal visit.	**Design:** Intervention (n=543): • Informational DVD + written materials + series of standard consultations Control(n=565): • No informational DVD but subjects received written materials + series of standard consultations **Data Collection:** • FFQ @ 28, 36 weeks gestation	Women who received the DVD intervention had: • ↑Mean **Healthy Eating Index** at 36 weeks gestation (73.6 vs 72.3; adjusted mean difference 1.2; 95% CI 0.2 to 2.3;p=0.02) • No statistically significant differences for mean Healthy Eating index at 28 weeks gestation No statistically significant differences between the DVD intervention and the control at either 28 or 36 weeks for: • Total GWG • Women's self-reported knowledge of healthy food choices • Women's sense of improved health Qualitative assessment of study materials discussed in Printed Materials	Frequency of utilizing materials was poor Low response rate Participants were mainly Caucasian	• The addition of a DVD to prenatal nutrition care led to a small improvement in diet quality
Randomized controlled trial	Trepka 2008 United States, vulnerable population Appraisal: moderate **Intervention:** Interactive multimedia food safety education program completed on a computer kiosk. Contained video, audio and graphics. Modules were followed by questions and participants were given immediate feedback after submitting answers. Narration was provided during program, so reading was not necessary. Content tailored to African Americans. Average amount of time to complete program was 35 minutes. **Control:** 3 food safety pamphlets designed to convey the same information in written form as the multimedia program.	**Design:** Intervention • Multimedia food safety education program (n=195;f/u n=119) Control • 3 food safety pamphlets (n=199;f/u n=136) **Data Collection:** Self-reported surveys pre- and post-intervention (>2 months)	**Changes in food-handling practices:** • Improvements were seen for subjects in both the intervention and control (P<0.001; partial n^2=0.200, a strong effect size) • Overall, no difference between participants receiving pamphlets and those receiving interactive multimedia in food-handling practices (P=0.072; partial n^2=0.013); Significant **Satisfaction with interactive Multimedia:** • 93.9% of participants agreed or strongly agreed with the statement "enjoyed using the computer kiosk"	Only 64.7% of participants completed the f/up questionnaire Self-reported practices may promote reporting bias	No obvious benefits were observed for a multimedia program approach versus written materials for improving self-reported safe food handling practices. The multimedia intervention was well received and liked by almost all participants.

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
			• 95% agreed or strongly agreed with the statement "learned a lot from the program" • Participants who had less education were more likely to state that they enjoyed using the kiosk compared to those who had more education (98.2% vs 87.0%; P=0.002) and that they preferred learning with the kiosk compared to reading pamphlets (90.8% vs 78.3%; P=0.01), and that they would like to learn more about health and nutrition topics using interactive multimedia (95.4% vs 86.6%; P=0.04)		

Randomized controlled trial	Jackson 2011
	
	United States, mainly vulnerable population
	
	• Appraisal: moderate
		Design:
		Intervention (n=158):
		• Video Doctor Counselling + Cueing Sheet + Educational Worksheet
		Control (n=163):
		• Video Doctor assessment
		Data Collection:
		Self-reported survey @ baseline and f/up
		
		Intervention: Video Doctor Counselling – computer program with voiceover audio, delivered on laptop in a clinic setting. 3 parts 1) Video Doctor Counselling - An actor-portrayed Video Doctor offered education on exercise, nutrition and weight gain based on principles of Motivational Interviewing. Simulated an ideal conversation with a HCP and matched counselling video clips to participant's BMI, eating and exercise habits, and readiness to change 2) Cueing Sheet – received at conclusion of the program and was printed for the clinician. Offered the Clinician a summary of patient's risk profile and suggested counselling statements; 3) Educational Worksheet for patient to take home
		
		Control: Usual care. Control participants received the Video Doctor Ax but did not receive the tailored counselling messages.
			After receiving the Video Doctor Counselling program, women in the intervention had:
			
			Knowledge:
			• ↑Knowledge for 3/6 knowledge-related outcomes
			  ○ Total correct answers (+1.5 (2.4) vs +0.7 (2.4), p<0.009)
			  ○ Fat knowledge (+1.1 (1.6) vs +0.38 (1.3), p<0.0001)
			  ○ Knew correct weight gain per IOM recommendations (65% vs 44%, p<0.001)
			
			Dietary-related behaviour changes:
			• ↑V/F (0.4 svgs/day, p<0.05)
			• ↑Whole grains (0.7 svgs/day, p<0.05)
			• ↑Fish/Avocado/Nuts (0.7 svgs/day, p<0.05)
			• ↓Sugary foods (-0.4 svgs/day, p<0.05)
				Women were enrolled later in pregnancy (~19 weeks gestation)
				
				Sample size may have limited ability to detect differences for some outcomes
				
				Survey was not validated
					A counselling video, cuing sheet for clinicians and take-home educational worksheet significantly: increased women's knowledge of some nutrition topics, improved many dietary behaviours, and increased the number of discussions with clinicians.
					
					Although the entire program well-liked, the most popular component of the intervention was the Educational Worksheet.
					
					• Some women felt the program was too long.

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
			• ↓White grains (-0.05 svgs/day, p<0.05) • ↓high fat meats (-0.7 svgs/week, p<0.05) • ↓Fried foods (-0.07 svgs/week, p<0.05) • ↓Solid fats (-0.6 svgs/week, p<0.05) • ↓Fast food (-0.5 svgs/week, p<0.05) No differences from baseline to follow-up for any of the above outcomes in the control group. **Discussions with Clinicians:** • ↑Discussions with clinicians about weight, nutrition and exercise immediately after Video Doctor intervention (range:76-81% vs. 55-59%) and at follow-up (range:79-89% vs 53-62% - all significant p values) **Weight gain:** No difference between groups in: • proportion of women gaining above IOM guidelines • mean weight gain • weekly weight gain **Satisfaction:** • 98% of women in intervention reported they liked the program, found it was easy to use • 94% found it to be private • 97% liked the Educational Worksheet • 82% liked the Video Doctor program • 27% felt the Video Doctor intervention was too long		

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
Pilot test of a program	Mauriello 2011 United States, vulnerable population Appraisal: weak	**Design:** Evaluation of the *Healthy Pregnancy: Step by Step* program (n=87) **Data Collection:** 16-item evaluation questionnaire to gauge acceptability of the program	**Qualitative Comments:** **Likes (68% [n=59] of participants provided comments):** • Learning new and/or useful information (35/59) • Tailored/personalized feedback (9/59) • Easy to use (6/59) **Dislikes (28% [n=24] provided comments):** • Repetition of questions (9/24) • Too long (6/24) **Precursors to Behaviour Change:** Prior to completing the V/F module, 86% subjects were in a "pre-action" stage for change. • Participants who completed the V/F module reported intending to eat 1.7 more servings of V/F each day, compared to the amount they reported at the start of the intervention	Pilot study Pilot only available in English • Qualitative comments based on low response rate	After completing a computer-tailored program, pregnant women reported planning to eat more V/F. Women liked learning new and useful information, tailored feedback; however some didn't like repetition or the length of the program. • The program component most frequently reported as beneficial was knowledge acquisition (new and useful information).

Intervention: Computer-tailored program (**Healthy Pregnancy: Step by Step**) designed to promote positive health behaviours during pregnancy. Designed for low-income, socially and financially disadvantaged population. One of the targeted behaviours was V/F consumption (eating at least 5 cups of fruits and vegetables per day). Intervention feedback is tailored to stage of readiness for each behaviour. Participants received stage-matched and tailored messages. During intervention, participants receive 2 modules addressing 2/3 targeted behaviours. They receive a longer module including messages on stage of change, decisional balance, self-efficacy, and the most important process of change for their particular stage for 1 behaviour. They received a shorter module for the secondary behaviour. Which behaviour for a participant receives as primary and secondary is determined by a priority order programmed in the software. 20.7% received V/F consumption module. The program was self-directed and took ~ 25 minutes to complete.

Intervention: Internet
Total articles: 9
Systematic reviews: 1

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
Systematic review	Sayakhot et al 2016 Mixed country setting, universal population • Appraisal: strong	N= 7 studies (samples sizes ranged from 182-1347)	**Characteristics of women who searched the internet** • All studies reported that the majority of women selected the Internet as a source of information about their pregnancy **Frequency of internet searching** • The number of times women reported using the Internet for specific reasons varied widely (once per month to 62 times per month) • One study found women most often searched for information during the early stages of pregnancy **Type of information sought** • The most often mentioned topics of interest included fetal development, nutrition in pregnancy, medications in pregnancy, pregnancy complications and antenatal care **Women's perceptions of the reliability and usefulness of retrieved health information** • Four studies reported women's perceptions of health information on the internet as reliable and useful	• Excluded qualitative articles	Nutrition is a topic of interest for pregnant women who searched online • The majority of women found health information on the Internet to be reliable and useful

Purpose: to investigate ways in which pregnant women used the internet to retrieve pregnancy-related information

Intervention: Internet
Total articles: 9
Cross-sectional studies: 3

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions

Cross-sectional study	Larsson 2009
	
	Sweden, universal population
	
	Appraisal: strong
		N=182
		
		Data collection: Questionnaires in antenatal clinic waiting rooms
		
		Questionnaire contained 14 questions, 13 multiple-choice and one open-ended. Six questions explored the extent of internet use. The open-ended question asked for elaboration on the kind of information searched for on the internet. Two questions explored women's perceptions of the reliability of information. Two questions investigated women's interactions with their midwife. Women were 32-41 weeks pregnant
			Internet use (n=153):
			• 84% of women had used the internet on one or more occasions to access pregnancy-related information
			• Frequency of internet searches varied from 1-62 times/month
			• 54% searched for information more often in the beginning of their pregnancy
			What kind of information did the women look for? (n=149)
			• 18% of women reported searching for prenatal nutrition information
			• Fetal development was the most popular topic women reported searching for (59%, n=88)
			Women's perceptions of the reliability of health information from the internet (n=153):
			• In general, women reported higher reliability of information when:
			  ○ Information corresponded with facts from other sources (51%)
			  ○ References were provided (42%)
			  ○ Reviewed by experts (33%)
			  ○ Information was continuously updated (33%)
			  ○ Government institution responsible for information (32%)
			Interaction with the midwife (n=151):
			• 70% women did not discuss the health information they had retrieved from the internet with their midwife
			• Many women had searched for information on topics brought up by the midwife (55%)
				Data collected in 2004
				
				Women who did not understand Swedish were excluded
				
				Women were highly educated
					Women frequently used the internet for pregnancy-related information, especially in early pregnancy. Some women searched for nutrition-related information.
					
					Most women did not discuss the information they find on the internet with their midwife
					
					Almost half of the women had searched for internet on topics initiated by the midwife.

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions

Cross-sectional	Huberty et al 2013
	
	United States, universal population
	
	Appraisal: Strong
		N=312 (completed at least one question)
		
		N=293 (completed entire survey)
		
		41.8% were pregnant (61.7% in 3rd trimester); 58.2% were 1 year postpartum
		
		Survey had 7 sections: 1) Reasons pregnant women might look for information on the internet 2) Selection of the internet as a source for information during pregnancy 3) Searches for specific information on the internet 4) Collection of information from the internet 5) Evaluation of information retrieved on the internet 6) Use of information found on the internet and the role it played in decision making 7) Impact of internet use on behaviours
			Use of the internet:
			• 94% (n=312) of women reported using the internet for pregnancy-related information.
			• Women used the internet to:
			  ○ Supplement information they received from their HCP (87.6%, n=241/275)
			  ○ Find information on own (98.5%, n=269/273)
			  ○ Increase confidence when speaking to their HCP (55.7%, n=151/271)
			Sources of information:
			• 97.8% (n=269) of women reported using Google or Yahoo search engines – 51.9% trusted this information
			• 57% reported using sites run by HCPs (i.e., Mayo Clinic) – 80% trusted this information
			• 13.8% (n=261) used local county health department websites – 67.4% trusted this information
			• 33.7% (n=262) women used government websites – 67.4% trusted this information
			• 94.4% of women felt HCPs should suggest suitable internet sites for pregnancy information (n=270)
			• 86.3% of women reported visiting multiple websites (n=270)
			Collecting information online and evaluation of online information:
			• Women reported using the internet 6-10 times for general health information about their pregnancy
			• 90% of respondents reported they found the information they needed most of the time or always
			• 76.2% looked to see who was providing the information, ¾ felt that the quality of the information was good
				70.6% of participants were from white neighborhoods
				
				Women had higher education levels
				
				Cross-sectional design
				
				No data on race/ethnicity therefore only able to control for age, income and parity
				• Targeted mid-west US population
					A majority of pregnant women access the internet (e.g. Google search engines) for pregnancy-related information and many access different sites and search multiple times per day. Most women reported accessing the internet for nutrition information to some extent.
					
					Some women accessed pregnancy-related information from HCP sites (e.g. Mayo Clinic); however few report using local health department websites. Women placed more 'trust' in information from government or HCP sites compared to Google searches.
					
					Various reasons women used the internet during pregnancy included: to supplement information received from their HCP; find information to answer immediate questions; and to increase their confidence when speaking to a HCP.
					• Women felt HCPs should suggest suitable internet websites for pregnancy information

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
			Confidence in decision making and sharing of health information: • On average, women used the internet 6-10 times to prepare for their prenatal visit, find general information for their next visit or to be involved in decision-making • Women had greater confidence in making a decision after accessing the internet • Many women discussed the information they found with their HCP, family, friends **Nutrition and the internet (n=242):** **Women reported using the internet:** • "Not at all" (19%) or "very little" (21%) • 37% of women reported using the internet "only somewhat" • 19% of women reported using the internet "quite a bit" and 5% reported "a great deal" • Women reported an increased level of confidence in healthy eating after using the internet ($p<.001$); however no association was found between confidence from using the internet for healthy eating and reported changes in a variety of specific dietary behaviours (non-significant p-values)		

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Cross-sectional design Survey had 3 sections: 1) Participant characteristics 2) Use of web-based technologies and preferences 3) Socioeconomic status	Kennedy et al 2017 Ireland, universal population • Appraisal: strong	**Design:** **N=101** **Data Collection:** Self-administered questionnaire	When asked about their access and use of the internet for pregnancy information, women reported: • Using online pregnancy forums, websites or apps (82.2%) • Using multiple web-based resources for pregnancy-related nutrition advice (65.6%) • Intention to use a nutrition app or website during pregnancy (87.1%) • The primary reason for use of a pregnancy-related nutrition website/app was to obtain information on what is safe & healthy (34.7%) Online resources used by participants: • 24.7% reported using general Google searches to obtain information, followed by *What to expect when you're expecting* (15%), and the *Babycenter* website (12.9%) • Features study participants would have most like to see include: o Recipes (88%, n=88) o Exercise advice (71%, n=71) o Personalized dietary feedback (37%, n=37) o Social features (35%, n=35) o Videos (24%, n=24) • Cooking demonstrations (23%, n=23)	Women who did not understand English were excluded Single-centre convenience sampling Cross-sectional Self-selection bias 97% of participants had internet access so limits generalizability	Most women reporting using an online pregnancy website or app. A variety of online resources were accessed and most women reported using more than one web-based resource for pregnancy-related nutrition advice. Women had a preference for commercial or unregulated websites. • Women's content preferences varied, indicating the need to design web-based resources to allow women to customize information according to their need.

Intervention: Internet
Total articles: 9
Qualitative articles: 5

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
Interviews and focus groups	Hearn et al 2014 Australia, universal population Appraisal: weak	**Design:** 1) Interviews with 53 pregnant women attending hospital antenatal clinics 2) 12 Focus groups (n=67 postnatal mothers) 3) Interviews with 76 HCPs – *results not discussed*	**Results from focus groups with pregnant women:** **Key reasons for accessing online information:** • Considered online resources their primary source of lifestyle information • Searched for prenatal and early childhood information • Searched online to find short, quick factual answers to immediate questions, both to confirm current knowledge and/or to provide reassurance that issues were normal, without having to visit the doctor for nonmedical reasons Key Lifestyle topics searched: • Nutrition and diet, • Exercise, • Managing weight gain, • Sleeping, • Emotions, • Allergies, • Breastfeeding, and • GDM Key components women want from online information: • Credible, evidence-based information • There was dissatisfaction with current resources and Google search terms led women to international websites with no local information	• Focused on the development of a local Australian website and app	For many women, online resources were a primary source of lifestyle information. Women primarily searched online to find quick factual answers to immediate questions. Preferences for online resources included: evidence-based, consistent information across sites, one-stop-shop. Women wanted their HCPs to recommend online resources. Women wanted trustworthy online information.

Healthy You, Healthy Baby Website and App: A needs assessment identified online needs and preferences for mothers and HCPs and led to the development of a specific website and app.

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
			Other key findings about women's beliefs and use of online information: • Government or university websites were trusted; questioned trustworthiness of commercial websites, • Commercial sites were more accessible and user-friendly/attractive • Information from numerous sites was checked & compared; clarification sought from family or friends and not HCPs • Would appreciate recommendations for online resource from their HCP • Wanted information in one place and which they could trust • Wanted information relevant to their individual issues • Suggestions how to improve relevancy:, user self-assessment tools, ongoing tracking of progress, smartphone apps, instructional video clips, monthly updates on local events/ activities **Website Content Usage:** • Antenatal ○ Nutrition content (40% of views) • Weight (33% of views)		

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
Focus groups and in-depth interviews	Willcox et al 2015 Australian, universal population and HCPs Appraisal: moderate	Design: Focus groups and in-depth interviews with pregnant women or postpartum women (n=15) and in-depth interviews with HCPs (n=12)	**Results from focus groups (findings specific to website technology):** **Overall:** Both women and HCPs reported that programs or interventions with multiple technology elements would better serve needs. • Websites seen to have greater depth of information than other platforms such as apps or text messages **HCP** • Websites were most familiar technology to most HCPs; **Women:** • Saw websites as a back-up for alternate platforms including text messages, apps, and social media (e.g. some searching required for websites, direct link to website preferable)	mHealth issues specifically related to HCPs were not explored. Lack of focus group interaction with HCPs may have lacked depth in understanding. Regional nature of sampling may have placed some limits on generalizability of outcomes.	Pregnant women (and HCPs) want information with multiple technology elements. • Women view the internet as having a large depth of information (compared to other platforms); however, searching was often required to find the desired information and direct links would be preferable.
	Purpose: aimed to explore women's and HCPs views regarding mHealth information sources and interventions to assist women to eat well, be physically active, and gain healthy amounts of weight in pregnancy.				
Focus groups	Kraschnewski et al 2014 United States, vulnerable population • Appraisal: moderate	**Design:** • Four focus groups with pregnant women at WIC clinics (n=17)	**Results from focus groups (findings specific to technology use during pregnancy)** • Technology use, including internet or smartphone apps was the standard • Women sought the Internet and smartphone apps, in part to fill a gap and address unmet needs for information in early pregnancy • Google was used to answer pregnancy-related questions Limitations of Technology was recognized – particularly with respect to accessing inaccurate information and challenges in finding the specific information they were looking for.	Convenience sample of volunteer pregnant women – volunteer bias likely	Women sought online information to fill gaps and address unmet needs for information, especially in early pregnancy Women could recognized online information may be inaccurate and may not meet their specific question needs.
	Purpose: to understand how women use technology during pregnancy. Women were asked where they sought information prior to their first prenatal care visit. The focus group also included questions about the positive experiences and challenges they were having during their current pregnancy and how they had been using their smartphones and other sources of technology during their pregnancy.				

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
			Smartphone app discussion located in Smartphone apps. Other important findings related to communication: Prenatal Care Structure was not patient-centred • Women reported that the structure of prenatal care did not meet their needs and led participants to turn to internet resources to provide them with pregnancy-related information. Barriers relating to prenatal visits included: • Timing o Visits did not reflect when women wanted to see their provider ▪ Women commented that the first visit occurred too late and that there were too few visits early in pregnancy when women had the most questions o Supplemental information not useful – package of pamphlets not reviewed and difficult to navigate • Visits felt routine & inconvenient		

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
Focus groups **Purpose**: to describe women's experiences of dietary information and the change of dietary habits during pregnancy	Wennberg et al (2013) Sweden, universal population • Appraisal: strong	Design: • 6 focus groups (n=23)	**Results from focus groups with women:** • The internet was a key source of information when women searched for information on their own. Diet and avoidance of inappropriate food was described as highly prioritized. • Referral to online dietary guidance was provided, but questions were not answered by the midwife **Accuracy of information and discrepancies between information found in different information sources was confusing and stressful for women:** • Women found information from international sources [websites implied] and felt confused by the fact that dietary advice differed from country to country • Other results in printed materials	•	The internet was seen as a source of information, particularly to fill gaps in information or to access more detailed advice. Women wanted help navigating online information. Access to international websites (where nutrition recommendations differ) created some confusion for pregnant women.

Semi-structured interviews
 	
Purpose: explored pregnant women's use of information and communication technologies, principally internet and mobile phones, to access pregnancy-related information. The interviews were designed to elicit detailed understanding of the information that women sought during pregnancy, where they accessed it and why.
	Rodger et al 2013
	
	Australia, mainly vulnerable
	
	• Appraisal: moderate
		Design:
		
		Semi-structured interviews with pregnant women (n=35)
			Internet-specific information
			Sources of technology women reported using included:
			• 89% internet
			• 40% pregnancy related apps
			• 20% YouTube
			• 0% Twitter
			• Women reported more likely to use a popular commercial website (51%) than an Australian government website (28%).
			  ○ Only 11% of women could identify the specific Australian government website by name
			  ○ Very few women could identify government websites listed in their regional pregnancy resource
			  ○ Women were rarely directed to government websites by hospital staff
			• Women placed a very low level of 'trust' in websites and online information
				Small sample size
				
				• Participants self-selected, mostly Anglo-Australian
					The internet was a primary source of pregnancy-related information.
					
					Women were more likely to use commercial sites than government websites
					
					• Women had concerns about the reliability of information accessed online and placed a very low level of trust in online information

Intervention: Smartphone Apps
Total articles: 5
Cross-Sectional articles: 1

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Cross-sectional design	Kennedy et al 2017 Ireland, universal population Appraisal: strong	**Population:** Pregnant women (n=101) **Data Collection:** Self-administered questionnaire **Questionnaire:** The questionnaire collected information on women's use of web-based technologies and their preferences in this area. Participants were asked if they sought nutritional advice and if so, the sources they used. They were also asked: their general use of downloadable pregnancy applications for mobile devices (apps), and websites to source nutritional advice and whether or not they would use an online resource for nutrition advice during their pregnancy.	**Women's use of pregnancy apps:** • 82.2% of women reported using online pregnancy websites or apps **Women's intended use of nutrition apps:** • 87.1% reported they would use a nutrition app or website during pregnancy **Women's reason for using pregnancy or nutrition apps:** • To obtain accurate information on what is safe and healthy during pregnancy (34.7%) **Pregnancy apps used by participants** (n=94): • What to expect when you're expecting (26.6%) • BabyCenter (23.4%) • Eumom (12.8%) • Rollercoster (9.6%) • The Bump (2.1%) • Other (21.3%) **Most favoured features in apps currently used by participants** (n=101): • Social features (e.g. group discussion fora) (17.8%) • Informative (12.9%) • Information on pregnancy (11.9%) • Ease of use/convenience (9.9%) • Ability to track fetal development (5%)	Women who did not understand English were excluded Single-centre convenience sampling Cross-sectional Self-selection bias	Many pregnant women reported using online pregnancy apps Popular apps pregnant women were using include: What to Expect When You're Expecting and BabyCenter • The most favoured components of an app were social features.

Intervention: Smartphone Apps
Total articles: 5
Qualitative articles: 4

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Focus groups	Kraschnewski et al 2014 United States, vulnerable population • Appraisal: moderate **Purpose**: to understand how women use technology during pregnancy. Women were asked where they sought information prior to their first prenatal care visit. The focus group also included questions about the positive experiences and challenges they were having during their current pregnancy and how they had been using their smartphones and other sources of technology during their pregnancy.	**Design:** 4 focus groups with pregnant women at WIC clinics (n=17)	Overview covered in Internet • Most women reported using a smartphone app to help keep track of their pregnancy progress, but limitations were noted (e.g. some women tracked their weight gain during pregnancy through an app, but when they found that they were gaining too much weight, there was no specific advice to help women achieve weight gain goals)	Convenience sample of volunteer pregnant women – volunteer bias likely	• Women were using apps to help keep track of pregnancy progress (e.g. weight gain); however, when progress was not within normal range, the app could not provide further assistance
Interviews and focus groups	Hearn et al 2014 Australia, universal population Appraisal: weak *Healthy You, Healthy Baby* Website and App: A needs assessment identified online needs and preferences for mothers and HCPs and led to the development of a specific website and app.	**Design:** Interviews with 53 pregnant women attending hospital antenatal clinics 12 Focus groups (n=67 postnatal mothers) Interviews with 76 HCPs	**Mothers and HCPs Online Needs and Preferences –** reported in Internet **App self-assessment content usage:** • The highest app self-assessment usage was in the first two trimesters of pregnancy • The most popular app self-assessments completed over the year were weight (25%) and sleep (18%), followed by nutrition (15%), physical activity (15%), emotions (13%), and social life (13%).	• Focused on the development of a local Australian website/app	Some women were using self-assessment tools on apps. Self-assessment usage was highest in early pregnancy. • Weight and nutrition self-assessments were used the most.
Focus groups and in-depth interviews	Willcox et al 2015 Australian, universal population and HCPs Appraisal: moderate **Focus groups/interviews:** questions aimed to explore women's and HCP views regarding mHealth information sources and interventions to assist women to eat well, be physically active, and gain healthy amounts of weight in pregnancy	**Design:** Focus groups and in-depth interviews with pregnant women or postpartum women (n=15) and in-depth interviews with HCPs (n=12)	**Views of smartphone apps:** • Some women commented that in general they had many apps that were never used • Some participants familiar with apps saw benefits with ease of access and providing food, exercise, and weight tracking features. • No HCPs were aware of health promotion apps focused on pregnancy		Pregnant women saw some benefits with apps, mainly the ability to track nutrition-related progress. Some women downloaded apps that they never utilize. • There was a lack of awareness of pregnancy-related apps among HCP

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Semi-structured interviews	Rodger et al 2013 Australia, mainly vulnerable Appraisal: moderate	**Design:** Semi-structured interviews with pregnant women (n=35)	**Smartphone app usage:** • 40% of women reported the use of at least one pregnancy-related app There were mixed feelings about apps. Some participants saw apps as being more relevant and useful to them than other forms of health communication and others reported disliking them		Many women reported using pregnancy-related apps; There was not a consensus about their usefulness and relevancy as a source of health communication.

Purpose: explored pregnant women's use of information and communication technologies, principally internet and mobile phones, to access pregnancy-related information. The interviews were designed to elicit detailed understanding of the information that women sought during pregnancy, where they accessed it and why.

Intervention: Text Messages

Total articles: 3

Quantitative articles: 2

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions

Randomized controlled trial	Douglas Evans et al 2014
	
	United States, military women's population
	
	• Appraisal: weak
		Design:
		Intervention: Text4baby + usual prenatal care (n=470)
		
		Control: usual prenatal care alone (n=473)
		
		Data Collection:
		Baseline assessment with 24-item self-administered online survey of attitudes and behaviours related to Text4baby message content.
		Follow-up survey at 4 weeks after baseline survey
			Behaviours:
			• No effects of the Text4baby intervention on any measured behaviour (nutrition, smoking, alcohol) at 4 weeks post enrollment follow-up
			• Measured nutrition behaviours;
			  ○ 3 or more servings of fruits/day
			  ○ 3 or more servings Vegetables/day
			
			Beliefs/Attitudes:
			• ↑Agreement with beliefs in the importance of prenatal vitamins (OR 1.91, 95% CI 1.08-3.34, P=0.024) – adjusted model
			• ↑Belief in the importance of:
			• Visiting a health care provider to be a healthy new mother (OR 1.52, 95% CI 1.01-2.31, P-0.046) unadjusted model
			• Health risks of alcohol during pregnancy (OR 2.06, 95% CI 1.00-4.31, P=0.05) – unadjusted model
				Loss to follow-up - only 48.7% of participants completed follow-up survey.
				
				Participants who completed the follow-up survey were more likely to be married and not working or attending school.
				
				There were baseline differences between health behaviours of control and intervention participants - more participants in the control group reported smoking in the last 30 days and consuming 3 or more vegetables per day.
				
				Additional follow-up surveys were conducted but not reported on in this article.
					The Text4baby program influenced pregnant women's beliefs about the importance of taking prenatal vitamins. Attitudes and beliefs in other areas (alcohol and the importance of health care provider visits) were also impacted.
					
					• In the short-term (4 week period) the Text4baby program did not appear to influence women's preventive health behaviours.

Intervention: Text4baby program consisted of 135 (3 per week) distinct prenatal text messages delivered on a schedule timed to mothers' enrollment in the program and due date of the baby. In this way, messages were tied to the information most needed during a particular stage of pregnancy. Text messages related to nutrition, smoking, taking vitamins, alcohol use, flu shots, health care appointments, health information seeking, and related risk prevention behaviours

Control: usual prenatal care

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
Prospective cohort analysis	Moniz et al 2015 United States, vulnerable population • Appraisal: weak	**Design:** • Pregnant women (n=171) received 12 weekly text messages **Data Collection:** • Pre- and post-intervention surveys **Intervention:** Pregnant women received 12 weekly text messages encouraging preventive health behaviours (tobacco cessation, condom use for disease prevention, nutrition optimization [prenatal vitamin use and intake of healthy food], seat belt use, breastfeeding). Messages were written using direct non-formal language. Text messages were designed to build accurate knowledge about susceptibility and serve as cues to action to avoid risky behaviours. Messages also emphasized that healthy choices during pregnancy benefit both mother and infant. Study messages were also designed to encourage participants to discuss target behaviours with prenatal professionals.	**Self-reported changes in beliefs at post-intervention:** • 83% of participants reported text messages helped "a lot" or helped "a little" with regards to taking prenatal vitamins • 84% of participants reported text messages helped "a little" or "a lot" with higher frequency of nutritious food intake **Self-reported behaviours at post-intervention:** • 32% of participants reported taking a prenatal vitamin on more days in the past 7 days • 41% of participants reported a higher frequency of healthy food intake **Attribution of behaviour change to receipt of text messaging** • 86% of participants attributed taking a daily prenatal vitamin more often • 83% attributed a higher frequency of nutritious food intake	The study was a secondary analysis of a RCT designed to explore text messaging to influence influenza vaccination rates in pregnancy Results may not be generalizable to pregnant women who are amenable to vaccination in pregnancy • Participants who reported not receiving text messages were excluded from analysis.	• Some pregnant women report that receiving encouraging text messages helped them to take prenatal vitamins and to consume more nutritious foods. Among these women, the majority attributed the behaviour improvement to receipt of text messaging.

Intervention: Text Messages

Total articles: 3
Qualitative articles: 1

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Focus groups and in-depth interviews	Willcox et al 2015 Australian, universal population and HCPs Appraisal: moderate	**Design:** Focus groups and in-depth interviews with pregnant women or postpartum women (n=15) and in-depth interviews with HCPs (n=12)	**Views on Texts:** • Text messages were seen by both pregnant women and HCPs to be an avenue to communicate with women directly. • Texting attributes noted included the ability to remind, motivate, and engage. • Barriers for use expressed by HCP included lack of familiarity and limited comprehension of the capacity of new technologies to support care.	Study conducted in a specific region. There may be limits on the generalizability of the findings. • Study explored mHealth views of which text messaging is only one component therefore deeper analysis of text messages was not possible.	Text messages may have the ability to remind, motivate, and engage pregnant women. • HCP express a wide variation in attitudes towards text messaging use in antenatal care.

Focus groups/interviews: questions aimed to explore women's and HCP views regarding mHealth information sources and interventions to assist women to eat well, be physically active, and gain healthy amounts of weight in pregnancy. mHealth included text messaging, handheld computers, apps, video messaging, voice calls and audio packages.

Intervention: Social Media

Total articles: 3
Qualitative articles: 3

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions

Semi-structured interview	Rodger et al 2013
	
	Australia, mainly vulnerable
	
	• Appraisal: moderate
		Design:
		
		Semi-structured interviews with pregnant women (n=35)
			Social media-specific information
			• Social media use was highly dependent on the particular platform.
			  ○ 89% of participants used Facebook (percentage of women using Facebook for pregnancy-related information is unknown)
			  ○ 32% used YouTube (20% used it for pregnancy-related information)
			• 6% used Twitter (0% used it for pregnancy-related information)
				Small sample size
				
				Participants self-selected, mostly Anglo-Australian
					Facebook is a popular social media platform used by many pregnant women; however it is unknown whether they used it for nutrition-related information.
					
					In a 2012 Australia study, twitter did not appear to be a popular social media platform used by women for pregnancy-related information.

Purpose: To explore pregnant women's use of information and communication technologies, principally internet and mobile phones, to access pregnancy-related information. The interviews were designed to elicit detailed understanding of the information that women sought during pregnancy, where they accessed it and why.

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Focus groups and in-depth interviews	Willcox et al 2015 Australian, universal population and HCPs Appraisal: moderate **Purpose**: Aimed to explore women's and HCP's views regarding mHealth information sources and interventions to assist women to eat well, be physically active, and gain healthy amounts of weight in pregnancy.	**Design:** Focus groups and in-depth interviews with pregnant women or postpartum women (n=15) and in-depth interviews with HCPs (n=12)	**Pregnant women and HCPs Views of mHealth:** • Both women and HCPs reported that programs or interventions with multiple technology elements would better serve needs Specific to social media (Results combined HCP and women's views): • Social networks or forums were seen as a convenient way to create communities where common interests could be explored • Some women were apprehensive that other women may be unsupportive • The multiple opinions on current social networks were seen to be overwhelming for some • Many articulated a need for HCP moderation of social networks	mHealth issues specifically related to HCP were not explored. Lack of focus group interaction with HCPs may have lacked depth in understanding. Regional nature of sampling may have placed some limits on generalizability of outcomes.	Pregnant women (and HCPs) want information with multiple technology elements. Social media platforms were seen as a method to create communities of people with common interests; however perinatal women had apprehensions about unsupportive comments and multiple opinions. Some women felt that social media platforms should be moderated by HCPs.

Focus groups	Kraschnewski et al 2014
	
	United States, vulnerable population
	
	Appraisal: moderate
	
	Purpose: to understand how women use technology during pregnancy. Women were asked where they sought information prior to their first prenatal care visit. The focus group also included questions about the positive experiences and challenges they were having during their current pregnancy and how they had been using their smartphones and other sources of technology during their pregnancy.
		Design:
		4 focus groups with pregnant women at WIC clinics (n=17)
			• Social media (Facebook, Instagram, and Blogs) offered opportunities to:
			  ○ Learn about and share symptoms of pregnancy
			  ○ Obtain information from other women who had similar experiences.
			  ○ Share their personal pregnancy updates.
			• Many women reported being cautious about how much they shared on Facebook.
			• Social media was one way women sought information.
				Convenience sample of volunteer pregnant women – volunteer bias likely	Social media was one way pregnant women sought information.
					
					Social media (e.g. Facebook, Instagram, and blogs) offered opportunities for women to share pregnancy-related symptoms and obtain information from women with similar experiences; however, women were also cautious about what they shared.

Intervention: Video
Total articles: 1
Qualitative articles: 1

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Focus groups and in-depth interviews	Willcox et al 2015 Australian, universal population and HCPs Appraisal: moderate	**Design:** Focus groups and in-depth interviews with pregnant women or postpartum women (n=15) and -depth interviews with HCPs (n-12)	**Views:** • Both women and HCPs reported that programs or interventions with multiple technology elements would better serve needs Specific to videos: • Video messages were seen by both women and HCPs to aid visual learning, but there were concerns from some women that there may be an incurred financial cost. • Some women commented that they would prefer reading to video messages.	Study conducted in a specific region and with a limited number of HCP from different disciplines. There may be limits on the generalizability of the findings. • Study explored mHealth views of which video is only one component therefore deeper analysis of video was not possible.	Pregnant women (and HCPs) want information with multiple technology elements. Video messages were seen to aid visual learning. There were concerns by some women that there are costs associated with video messages and some women preferred reading to video messages •

Focus groups/interviews: questions aimed to explore women's and HCPs' views regarding mHealth information sources and interventions to assist women to eat well, be physically active, and gain healthy amounts of weight in pregnancy

Intervention: Mobile Health Coaching Program – Multiple Technology Elements
Total articles: 2
Quantitative articles: 1

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
Pilot program	Van Dijk et al 2016 The Netherlands, universal population Appraisal: moderate	**Design:** Smarter Pregnancy program (mHealth coaching program) provided to couples contemplating pregnancy (n=1275) or pregnant (n=603) **Data Collection:** Surveys completed at baseline, 6, 12, 18, and 24 weeks of the program. **Smarter Pregnancy program:** A free subscription to the mHealth platform, Smarter Pregnancy, was provided to couples contemplating pregnancy or already pregnant. Coaching included a maximum of three interventions per week - comprised of text messaging and email messages (contained tips, recommendations, vouchers, seasonal recipes, and additional questions addressing behaviour, pregnancy status, BMI, and adequacy of the diet). Topics focused on the most prevalent inadequate nutrition and lifestyle behaviours (i.e., vegetable, fruit, and alcohol intake) or the most strongly demonstrated associations of behaviours with fertility and pregnancy course and outcome (i.e., tobacco and folic acid supplement use). Starting at baseline and then every 6 weeks of the program (until 24 weeks), participants were invited to complete a follow-up screening survey to monitor change in their inadequate nutrition and lifestyle behaviours. Results from the screening session compared to the previous screening sessions were shown on their personal page. A summary of individual results were available at any point by the participant, and to be sent to the HCP for further evaluation and support of preconceptional and antenatal care.	**Compliance and Usability** • 64.9% of participants who activated the program completed the program (n= 1218/1878) • Completion rate for women who were pregnant at baseline was 69.0% (n=416) • 54.7% of participants who completed the evaluation (n=357) rated the program usability as positive or very positive. This ranged from 39.2% (content and coaching) to 73.4% (design and interface). **Improvements for pregnant women (who identified having inadequate intakes at baseline) over 24 weeks** • *Vegetable Intake (n=364):* range of improvement between 22.2% (95% CI 16.7-29.0) and 24.7% (95% CI 18.9-31.7 • *Fruit Intake (n=145):* range of improvement between 35.7% (95% CI 24.2-49.0) and 38.1% (95% CI 30.1-46.8) • *Folic Acid Supplement Use (n=10):* range of improvement between 52.7% (95% CI 7.6-93.8) and 58.0% (95% CI 3.0-98.4)	35.1% of participants resigned by 24 weeks of the program Only 41.5% of women were pregnant Self-reported intake Highly educated women The nature of the study would have excluded populations with less access to the internet	A pilot project for a web-based coaching platform saw improvements in vegetables, fruits, and folic acid supplement use among pregnant women who had inadequate intakes before starting the program. • The design and interface features were rated positively by most participants.

Intervention: Mobile Health Coaching Program – Multiple Technology Elements
Total articles: 2
Qualitative articles: 1

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
Focus groups and in-depth interviews	Willcox et al 2015 Australian, universal population and HCPs Appraisal: moderate	**Design:** Focus groups and in-depth interviews with pregnant women or postpartum women (n=15) and in-depth interviews with HCPs (n-12) **Focus groups/interviews:** questions aimed to explore women's and HCPs' views regarding mHealth information sources and interventions to assist women to eat well, be physically active, and gain healthy amounts of weight in pregnancy	**Relevant Findings for mHealth Overall:** **1. Engagement and Access** • mHealth interventions were seen by women and HCPs as accessible • Women wanted mHealth products to use • Some women saw mHealth as an adjunct to traditional medical care • Some HCPs disliked or were unfamiliar with mHeath. This limited engagement/understanding of capacity of technology to support care • HCPs had some concern for women who did not have mobile or internet access • Mobile phones or tablet functions were seen to reach wider audience than traditional methods **2. Perceived Risk** • Many women perceived themselves to have the ability to sift through noncredible information • Many HCPs and a few women had concerns about privacy, intellectual property, harmful information • Some HCPs and a few women worried that an intervention program would create stress for women • A small number of HCPs and women were concerned about an mHealth program's expectations creating stress for women • Some HCPs had concerns about a compromised health	Study conducted in a specific region and with a limited number of pregnant women and HCP from different disciplines There may be limits on the generalizability of the findings.	Women reported wanting mHealth products to use mHealth has the potential to reach a wider audience. Concerns with mHealth included privacy, intellectual property, harmful information, stress arising from program's expectations, a compromised patient relationship and overall ownership/responsibility for high quality mHealth interventions Women saw value in mHealth as an adjunct to prenatal care

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
			professional-patient relationship with mHealth technology **3. Responsibility for mHealth** • Uncertainly among HCPs and women about who should be responsible for ensuring high quality interventions via mHealth • Key challenges included: absence of key pregnancy or women's advocacy group, lack of health funds for technologies, and perceived inability of maternity hospitals and governments to embrace technology **4. Functionality** • Women identified the functionality of technology as adding value to antenatal care models **Role in Antenatal Care** • Women could envision mHealth included in traditional prenatal care whereas only some HCPs viewed mHealth as adding value to a consultation • Many HCPs felt mHealth programs needed to be introduced by HCPs and be an adjunct to HCP care. **Multiple Technology Elements** • Women and HCPs stated that individual requirements of women are best served by programs or interventions that integrated multiple technology elements (also seen to serve needs of different learning styles) Discussion of individual elements (e.g. text messages, apps) presented elsewhere **Optimizing User Engagement and Experience** • Ease of access and use was valued by both HCPs and women • Ideas for maximizing engagement included tailoring and		Multiple technology elements were seen by women and HCPs to better serve individual needs/learning styles • Engagement could be maximized by tailoring and personalizing content

Study Design	Study, Population, Critical Appraisal Rating	Methods	Effectiveness	Considerations/Limitations	Conclusions
			personalizing the interventions with messages concerning the baby's development, content related to women's interests, and presentation tailored to the technology platform • No ideal frequency of contact		

Intervention: Telephone support
Total articles: 2
Systemic Reviews: 2

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Systematic review	Lavender et al 2013 High-income countries, universal population Appraisal: strong	**Design:** Included RCTs (n=27) comparing telephone support with routine care (no additional telephone support) during pregnancy and up to six weeks after the birth.	No specific nutrition outcomes measured Noteworthy findings: **Maternal satisfaction with telephone support during pregnancy and the first six months postpartum** • Compared with those receiving telephone support, women in the control group had lower mean levels of satisfaction (SMD 1.16, 95%CI 0.79-1.54; two studies with 132 women) **Anxiety during pregnancy** • No consistent evidence that telephone support reduces anxiety during pregnancy **Alcohol consumption** • There were no clear differences between the intervention and control groups in the number of pregnant women who reported that they had not consumed any alcohol in the last month (RR 0.95, 95%CI 0.75 to 1.20, one study with 122 women)	All but one trial were conducted in high resource settings Most of the results are derived from one or two studies	Women receiving telephone support had higher levels of satisfaction with support during pregnancy and postpartum compared to women who received routine care. • Telephone support had no significant effect on participant's self-reported alcohol consumption compared to routine prenatal care.

Intervention(s): All interventions aimed at supporting women by using telephones, whether for general support/information or for a specific medical/social reason (e.g. diabetes). Two studies noted under maternal satisfaction: 1) Influence of telephonic nursing care coordination on patient satisfaction; 2) Satisfaction of healthy pregnant women receiving SMS via mobile phone for prenatal support.

Study Design	Study, Population, Critical Appraisal Rating	Methods	Relevant Findings	Considerations/Limitations	Conclusions
Systematic review	Lau et al 2017 High-income countries, universal, overweight/obese Appraisal: strong	**Topic:** effectiveness of e-based lifestyle interventions. It does not provide a complete picture of the effectiveness of telephone interventions alone; 3 trials **Intervention(s):** Two studies combined e-based lifestyle interventions, in-person, and phone delivery formats. The phone intervention included brief phone calls (15 minutes) for weight gain and extra phone calls for abnormal weight gain. **Control:** Minimal care (brief 15 minute in-person session and newsletters)	• E-based lifestyle interventions incorporating in-person (*discussed in NEC*), phone (z=2.07, P=0.04, one study with 66 women) or a combination of in-person and phone delivery formats (z=2.07, P=0.04, two studies with 1956 women) were found to be more effective for reducing GWG in comparison with solely e-based platforms (z=1.10, P=0.27).	Variable intervention methods The majority of studies were conducted with white perinatal women Small sample sizes	• E-based interventions were more effective when combined with phone interventions for reducing GWG

Appendix D: Situational Analysis

The situational analysis describes key indicators of Albertans and Canadians related to maternal and infant health outcomes. This data adds context to the literature review findings, conclusions and recommendations. Key data included are grouped under the areas of: demographics, social determinants of health, birth outcomes, maternal pregnancy outcomes, nutrition-related health behaviours and sources of nutrition information (*Table 2*).

Demographics:
In 2018, there were 52,518 live births in Alberta. The majority of these births, over 99% (n=50,748) were singleton births. A total of 1,770 multiple births were reported in Alberta in 2018.[48]

The age groups of women with the highest pregnancy rate were in the 30-34 and 25-29 age group categories respectively, representing 36.8% and 27.9% of all mothers in Alberta. The proportion of teenage mothers (ages 15-19) in both Alberta and Canada, continues to decline. In 2018, 1.8% of births in Alberta and 1.9% in Canada were reported for mothers in the 15-19 year age grouping, with 7 births for mothers in the under 15 years of age group in Alberta.[5]

The fertility rate in Alberta remained slightly higher than for the rest of Canada with a crude birth rate (live births per 1,000 population) of 12.2 in Alberta compared to 10.1 in Canada.[49]

Fertility rates for Indigenous people vary from one group to another, although as a group they remain higher than rates for the non-Indigenous population. A 2016 Statistics Canada report utilizing 2011 data cited a fertility rate of 2.2 children per woman for Indigenous women compared to a Canadian rate of 1.6.[50]

Social Determinants of Health:
Women in the 25-34 year age grouping represent almost two-thirds (64.7%) of females giving birth in Alberta.[5] In 2016, for this age grouping, the highest level of education obtained was a university diploma or bachelor's degree (37.8%). Close to half had either a college/non-university certificate/diploma (23.4%) or a high school diploma (22.9%). A little less than 4% reported their highest level of education as university below the bachelor level, 4% had an apprenticeship or trades diploma, and 8.1% reported not having a certificate, diploma or degree.[50]

Based on 2017 income data, the average total and net income for females in the 24-34 age group category is $42,070 and $36,810 respectively, slightly higher than the Canadian averages for this age and sex group.[51]

Based on 2016 census data, among women aged 25-34 in Alberta, 23.0% identified as immigrants. Of these women, almost half (10.3%) came between the years 2011-2016.[6]

Using national statistics collected in 2016 for immigration and ethnocultural diversity, 61.8% of new immigrants were born in Asia (including the Middle East), and 13.4% were born in Africa (including Nigeria, Algeria, Egypt, Morocco and Cameroon). In addition, 37.5% of all Canadian children under the age of 15 were foreign born or had at least one foreign-born parent (the majority were from Asia, Africa, Caribbean and Bermuda, Central and South America).[52]

Birth Outcomes:
Key birth outcomes monitored in Canada, for which provincial and national data is available through Statistics Canada for the infant include LBW (less than 2.500 grams), SGA, pre-term birth, high birth weight (4,500 grams or more) and LGA. Additional national data is available for select birth and infant outcomes by indigenous identity. This data also includes the indicators of infant death, neonatal death and post-neonatal death (*Table 2*).

Regarding provincial versus Canadian comparison, Alberta has slightly higher rates of LBW, SGA, and pre-term birth when compared to national data.[7]

There is a significant gap in healthy birth and infant outcomes between Indigenous and Non-Indigenous populations. In 2013, 72% of Indigenous women in Alberta were not able to access prenatal care in the first trimester.[9]

The prevalence of negative outcomes for Indigenous populations compared to non-Indigenous populations is significantly higher, with almost a two-fold increase in the prevalence of LGA infants and infant death, higher rates of pre-term birth and almost a five-fold increase in the prevalence of post-neonatal death (*Table 2*)

The neural tube defect (NTD) rate significantly declined in Canada immediately following the introduction of folic acid-fortified flour in 1996.[53]

Maternal Pregnancy Outcomes:
Key maternal pregnancy outcomes include GWG, maternal hypertension and GDM. The Alberta Pregnancy Outcomes and Nutrition (APrON) study collected weight gain data from a prospective cohort of pregnant women. In this study, weight gain data was available for 472 women: 71% gained in the above recommended category, 18% gained within, and 11% gained less weight than recommended.[54]

In 2010/2011, the rate of GDM in Canada was 54.5 per 1000 deliveries, a rate that has increased steadily since 2004/2005. Rates are highest among the older age groups, with a rate of 40.7 and 60.4 in the 25-29 year and 30-34 year age groups respectively (in 2010/2011).[55] The prevalence of GDM in Alberta is estimated to affect 7.7% of all women who gave birth in Alberta in 2016.[9]

Gestational hypertension rates in Canada for the same seven-year time period (2004/05 to 2010/2011) remained relatively stable for pre-existing hypertension and pre-eclampsia and decreased for eclampsia. The rate of gestational hypertension without proteinuria in Canada was 46.3 per 1,000 deliveries in 2011. The Alberta rate was higher than the national average at 50.7 per 1,000 deliveries. Rates were highest for the age groups over 40, with rates slightly lower than the national average for the 25-29 and 30-35 year age groups (44.98 and 44.77 respectively in 2010/2011).[56]

The prevalence of anemia among pregnant women in Canada has remained relatively stable since 2002, after seeing a large decline from 1990 to 2002. The lowest reported rates over the past 15 years were in 2008-2011 at 16.6%, gradually increasing during 2011-2016 with a rate of 17.4% in 2016.[57] In 2011, as per the World Health Organization, anemia in pregnant women aged 15-29 years was the highest in South-East Asian regions (prevalence was 48.7%), and African regions (46.3%), and Eastern Mediterranean Regions (38.9%), whereas the global average is 38.2%.[58] No provincial-level data exists for anemia among pregnant women, although some Alberta programs and clinics have flagged high rates among vulnerable populations.*

Nutrition-Related Health Behaviours:
In Alberta, more than half of the population is estimated to have insufficient V/F consumption. Consumption is influenced by socio-economic factors, with approximately two-thirds of those considered the “most deprived” reporting insufficient intake, although on average, women are less likely than men to have an insufficient intake.[10] Among Canadians who have made changes to their eating habits in the page year, eight in ten (84%) state they have made an effort to consume more V/F and less sugar.[59] Younger Canadians (18-34 vs. 35 and older) are significantly more likely to say they have given up dairy or become vegetarian/vegan in the past year. This age group is also least likely to report following Canada’s Food Guide.[59]

Pre-conceptual folic acid supplementation behaviours are captured in the Canadian Community Heath Survey. According to the Public Health Agency of Canada, in the 2015 survey, 60% of women aged 15-45 years who had given birth in the past five years reported taking folic acid in the three months prior to conception and 98% of these women took it daily or almost daily.[60] This is a slight increase from the 2005 rate of 57.8%, which was a substantial increase over the 27.2% reported in 2001.[53]

In Canada, the use of folic acid supplements was lowest among women in lower-income households, women under 25 years of age, women with less than high school graduation, and among immigrant women.[61,62]

* Personal Communication, Best Beginning Program Consultant, January 15, 2020

Sources of Nutrition Information

2018 nutrition trend data indicates that Canadians do not necessarily use the sources they believe are credible to seek out information about food and nutrition. Government, family physicians, dietitians and other health professionals are viewed as credible sources of nutrition information; however, internet, social media, friends/relatives/ colleagues are used when looking for information.[59]

Situational Analysis Table

Indicator	Alberta	Canada	Alberta Rate Vs. Canadian Rate	Reference Period
Demographics				
Total fertility rate (per 100 females)	1.6	1.5	↑	2018
Crude birth rate (live births per 1,000 population)	10.1	12.2	↑	
Fertility rate - Indigenous women (no Alberta data available)	N/A	2.2 (Indigenous) vs. 1.6 (non-indigenous)	↑ for Indigenous (National rate)	2011
Pregnancy Rate (by Age)				
Largest age group of mothers	27.9% were 25-29 years	28.0% were 25-29 years	=	2018
	36.8% were 30-34 years	36.1% were 30-34 years	=	2018
Fertility Rate	6.6	6.6	=	2018
Pregnancy Rate	1.8% of women	1.9% of women	=	2018
Infant Births (Live Births) [singletons and multiples]	52,518	376,291	Not applicable	2018
Multiple Births (Live Births)				
Total	1,770	11,524	Not applicable	2018
Rate of total births	3.4%	3.1%	=	2018
Social Determinents of Health				
Highest Level of Education [For women ages 25-34]				
No certificate/diploma/degree	8.1%	7.0%	=	2016
High school diploma	22.9%	18.8%	↑	2016
College/non-university diploma	23.4%	24.0%	=	2016
University Education (at or above bachelor's degree)	37.8%	40.7%	↓	2016
Income				
Average before-tax income [women ages 25-34]	$42,070	$39,220	↑	2017
Average after-tax income [women ages 25-34	$36,810	$34,650	↑	2017

Indicator	Alberta	Canada	Alberta Rate Vs. Canadian Rate	Reference Period
Language [mother tongue]				
English	70.6%	54.1%	↑	2016
French	1.8%	18.9%	↓	2016
Non-official language	25.1%	24.3%	=	2016
Most common mother tongue [non-English]	Tagalog, German, French,Punjabi,Cantonese	Not applicable	Not applicable	2016
Most common sole home languages [non-English]	Tagalog, Punjabi, Cantonese	Not applicable	Not applicable	2016
Most common Aboriginal languages	Cree-Montagnais	Not applicable	Not applicable	2016
Maternal Pregnancy Outcomes				
Gestational diabetes [per 1000 deliveries]	44.3	47.1	↓	2004/2005-2010/2011
Gestational hypertension (without proteinuria) [per 1000 deliveries]	50.7	46.3	↑	2004/2005-2010/2011

Birth Related Outcomes				
Indicator	**Rate of Adverse Birth Outcomes Provincial/National [a]**		**Rate of Adverse Birth Outcomes By Indigenous Identity [b]**	
	Alberta % 2015 to 2017	**Canada (%) 2015 to 2017**	**Non-Indigenous % 2004 to 2006**	**Indigenous % 2004 to 2006**
Low Birth Weight (Maternal <2,500 grams)	7.1	6.4	-	-
Small for Gestational Age (per 100)	10.1	9.1	8.6	6.6
Preterm Birth (per 100)	8.6	7.8	6.7	8.7
High Birth Weight (≥ 4,500 grams)	1.2	1.5	-	-
Large for Gestational Age (per 100)	8.5	9.5	10.6	18.8
Still Birth (per 1,000)			5.6	9.0
	2018[c]	2018[c]		
Infant Death (per 1,000 live births)	Not Available	4.7	4.4	9.6
Neonatal death (per 1,000 live births)	Not Available	3.5	3.4	4.9
Post-neonatal death (per 1,000 surviving births)	Not Available	1.2	1.1	4.8

Source: a) Percent Application. Table: 13-10-0746-01 (formerly CANSIM 102-4318) How to cite: Statistics Canada. Table 13-10-0746-01 Birth-related indicators (low and high birth weight, small and large for gestational age, pre-term births), by sex, three-year period, Canada, provinces, territories, census metropolitan areas and metropolitan influence zoneshttps://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1310074601&pickMembers%5B0%5D=1.46&pickMembers%5B1%5D=2.1&pickMembers%5B2%5D=4.4
b) 2006 Canadian Birth-Census Cohort database [https://www150.statcan.gc.ca/n1/pub/82-003-x/2017011/article/54886/tbl/tbl02-eng.htm]
c) Table: 13-10-0712-01 (formerly CANSIM 102-0506) Geography: Canada