

Nutrition Advice During Pregnancy: Do Women Receive it and Can Health Professionals Provide it?

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Abstract A healthy diet during pregnancy is essential for normal growth and development of the foetus. Pregnant women may obtain nutrition information from a number of sources but evidence regarding the adequacy and extent of this information is sparse. A systematic literature review was conducted to identify sources of nutrition information accessed by pregnant women, their perceived needs for nutrition education, the perceptions of healthcare providers about nutrition education in pregnancy, and to assess the effectiveness of public health programs that aim to improve nutritional practices. The Scopus data base was searched during January, 2013 and in February 2014 to access both qualitative and quantitative studies published between 2002 and 2014 which focused on healthy pregnant women and their healthcare providers in developed countries. Articles were excluded if they focused on the needs of women with medical conditions, including obesity, gestational diabetes or malnutrition. Of 506 articles identified by the search terms, 25 articles were deemed to be eligible for inclusion. Generally, women were not receiving adequate nutrition education during pregnancy. Although healthcare practitioners perceived nutrition education to be important, barriers to providing education to clients included lack of time, lack of resources and lack of relevant training.

Further well designed studies are needed to identify the most effective nutrition education strategies to improve nutrition knowledge and dietary behaviours for women during antenatal care.

Keywords Antenatal care · Nutrition advice · Nutrition education · Nutrition information · Pregnancy

Introduction

A healthy diet during pregnancy is essential for normal growth and development of the foetus. The American Dietetic Association recommends a safe, healthy and balanced diet and highlights the key nutrients folate, iron, calcium and vitamin D as particularly important considerations during pregnancy [1]. Long chain omega 3 polyunsaturated fatty acids (LCn3PUFA) are additionally required for optimal neural, visual and cognitive development [2, 3] and Iodine is required in greater amounts during pregnancy for brain development. Adequate Iodine intake is of particular concern for countries with soils deficient in iodine without a universal salt iodisation program that accesses over 90 % of the population [4]. This includes Australia where iodine supplementation is recommended during pregnancy [5].

The World Health Organisation has specific guidelines for healthcare providers to ensure the nutrition education of pregnant women [6]. Many countries have developed their own antenatal clinical guidelines, including Australia [7], Canada [8] and Britain [9] which include nutritional advice related to healthy eating, as well as specific advice for single nutrients (e.g. folic acid supplementation, vitamin D supplementation, avoidance of vitamin A-containing supplements and products). Other nutrition-related topics included

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in the guidelines are management of conditions commonly experienced during pregnancy (e.g. heartburn, constipation and haemorrhoids), as well as food safety information, particularly about listeriosis. In Australia, the guidelines additionally cover iodine supplementation, and include separate guidelines for the culturally appropriate care of Aboriginal and Torres Strait Islander women [10]. Despite the existence of such guidelines, the extent to which healthcare professionals adhere to them is currently unknown. In Australia and New Zealand, nutrition education is not required to be taught as part of midwifery degrees [11], and the nutrition education needs of midwives is under researched [12]. Furthermore, recent Australian research indicates that pregnant women have poor knowledge, at least for some areas of nutrition, and that women perceive advice provided by their healthcare providers, either written or verbal, to be insufficient [13, 14]. This limits women's ability to plan an optimal diet to meet their needs during pregnancy.

Due to the broad scope of research available regarding the nutritional care of healthy pregnant women, four key objectives were developed: (1) Identify nutrition information and sources of such received by pregnant women; (2) Explore women's perceived needs for nutrition education during pregnancy; (3) Explore perceptions of healthcare providers of delivering nutrition education; and (4) Identify effective methods of providing nutrition advice to pregnant women.

Methods

Studies published in peer-reviewed journals between 2002 and February 2014, including quantitative and qualitative studies were eligible for inclusion. Studies were selected if they addressed one or more of the following topics:

- What nutrition information women received during pregnancy
- Women's perceptions on nutrition information received during pregnancy
- Healthcare providers perceptions on nutrition information required during pregnancy
- Health promotion interventions

Scopus was searched using combinations of three sets of search terms: (1) *pregnan**, antenatal care and prenatal care; (2) nutrition, diet, supplement; and (3) advice, education, *inform**, media, nutrition education material and behaviour change. Additional searches were conducted using Proquest and Medline using the same search strategy. Only studies that focused on nutrition advice for healthy, pregnant women were included. Studies from developed countries were eligible for inclusion, namely Australia, New Zealand, United States of America, Canada, the United Kingdom and European countries.

Search Methods

A total of ten separate searches using Scopus were conducted during January 2013, using varied combinations of the terms described above. No new relevant articles were found after search four. Only English language articles were included. Further searches were conducted using Scopus in February 2014 with the four key word combinations listed in Fig. 1. The Proquest and Medline databases also were searched to ensure no relevant papers were missed.

Exclusion criteria included: Studies focused solely on obesity or weight gain during pregnancy; malnourished or underweight women; gestational diabetes; other clinical outcomes, including allergies and birth defects; lifestyle choices including smoking, alcohol and substance abuse; accessibility and equity of healthcare; breastfeeding; consumer and social research; broad public health campaigns that did not focus on pregnancy; and studies on non-pregnant women. Exclusions were made using database functions to remove irrelevant subjects and key words which did not relate to studies on healthy, pregnant women. An abstract search was conducted to remove articles which did not meet the inclusion criteria, leaving the total relevant articles for each search. A citation search was conducted on these articles and relevant articles that were published between 2002 and 2014 were also included.

Results

The full papers of 31 articles were included in the final review, as shown in Fig. 1. These papers were divided into three categories based on the four key objectives for further analysis: pregnant women, healthcare professionals and public health interventions. One article examined both healthcare providers and pregnant women and was therefore included in both sections.

Pregnant Women: Type, Sources and Perceptions of Information Received

Sixteen articles were related to the type, sources and perceptions of the nutrition advice women received during their pregnancy (see Table 1).

What Type of Information Do Pregnant Women Receive?

These articles highlighted that nutrition education for pregnant women in primary healthcare was lacking. One Australian study by Sinikovic et al. [15] explored what advice pregnant women received from their healthcare

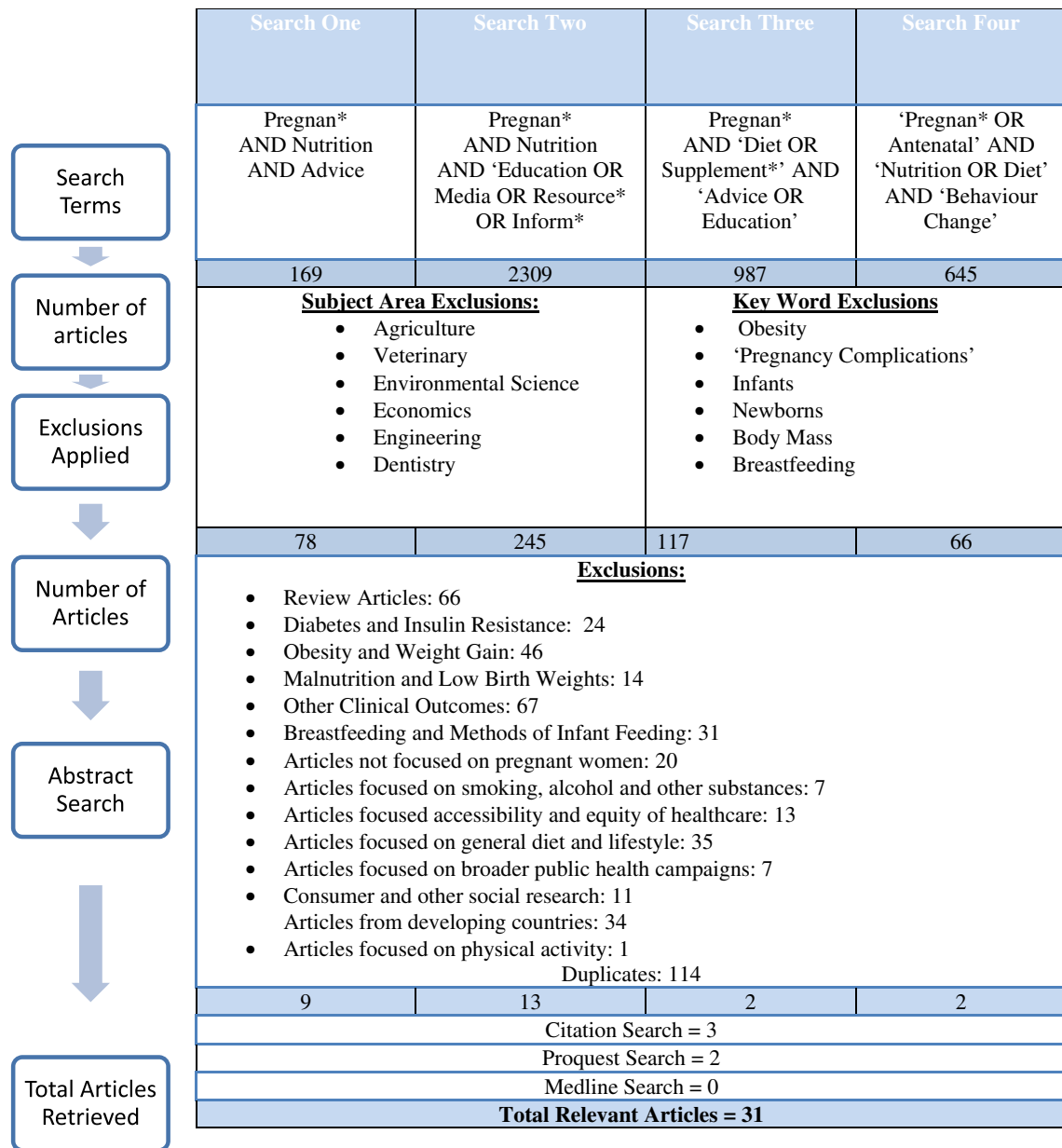


Fig. 1 Flow chart following the search process using Scopus

practitioner. The study was focused on advice related to long chain omega 3 polyunsaturated fatty acids (LCn3PUFA). Twenty-three percent of women reported receiving advice on LCn3PUFA, which was similar to related topics, including mercury contamination (19 %) and listeriosis (27 %); however was much lower than advice received about folate (74 %), iron (71 %) and calcium (50 %). Charlton et al. [16] (Australia) found that 48 % of pregnant women had received written advice from a healthcare practitioner on food poisoning and listeria, and 48–63 % had received written information about iron,

calcium, folate and healthy eating. Only 15.8 % received written information about iodine.

Barbour et al. [17] (Scotland) explored the decision-making process of pregnant women with regard to their uptake of folic acid supplements. In this sample only 31 % of women were taking folic acid supplements. Themes that emerged from the focus groups indicated women did not receive the nutrition information pack until their 12 week ANC appointment, which is too late to commence folic acid supplementation for the prevention of neural tube defects [18]. The women also reported feelings of

Table 1 Summary of observational studies involving pregnant women

Reference	Country	n	Participants	Methods	Key findings	NHMRC level of evidence [42]
Athearn et al. [23]	USA	69	Pregnant women	Focus groups	Most women received food safety advice from friends and family, but were more likely to comply with advice from a healthcare professional Women were more likely to comply with food safety advice which was specific and answered why certain foods should be avoided	IV
Barbour et al. [17]	Scotland	211 (focus group = 24)	Pregnant women	Self-administered written surveys and focus groups	2 out of 24 women had received advice about folate from their GP preconception All women received an education book at 12 weeks, the large amount of information received at the first ANC visit made women feel anxious	IV
Bermosky De Flores [49]	USA	11	Pregnant Mexican migrants	Focus groups	31 % were taking folic acid supplements 9 women could accurately describe folic acids role in pregnancy and the amount recommended 1 participant took folic acid preconception Women who did not consume supplements did so due to gastrointestinal discomfort and costs	IV
Bloomingdale et al. [20]	USA	22	Pregnant women who consumed less than 2 serves of fish per week	Focus groups	Most women received verbal advice to limit fish intake without an adequate explanation as to why Confusion about which fish were safe resulted in women avoiding all fish Women were distrusting of sources outside of healthcare professionals Women did not take folic acid supplements due to unplanned pregnancies and nausea	IV
Charlton et al. [16]	Australia	139	Pregnant women	Self-administered written survey	Women reported receiving less advice about iodine then other key nutrients and nutrition topics	IV
De Jersey et al. [24]	Australia	58	Pregnant women	Self-administered semi-quantitative written questionnaire	80 % of women reported they would have liked to receive education about nutrition, physical activity and weight gain early in their pregnancy Less than 50 % were given appropriate advice regarding healthy eating and physical activity	IV
Ferrari et al. [26]	USA	58	Pregnant women	Focus groups	Women commonly reported overwhelming and confusing dietary advice, not tailored to individual needs	IV
Graham et al. [22]	Canada	15	Pregnant women in their third trimester	Semi-structured interviews	Women's perceived barriers to achieving a diet low in added sugar were physical symptoms, lack of nutritional guidance and social pressures. Implementing dietary strategies guided by nutritional knowledge was a facilitator	IV

Table 1 continued

Reference	Country	n	Participants	Methods	Key findings	NHMRC level of evidence [42]
House and Coveney et al. [21]	Australia	13	Pregnant women	Focus groups	Most women indicated that they distrusted the internet, however commonly used it to answer food related queries	IV
Šiniković et al. [15]	Australia	190	Pregnant women	Self-administered written survey	Women reported receiving less advice on long chain omega 3 polyunsaturated fatty acids, mercury and listeriosis than folate, iron and calcium	IV
Szwajcer et al. [50]	The Netherlands	442	Pregnant women and women trying to conceive	Interviews	Women were most interested in nutrition during the first trimester	IV
Szwajcer et al. [19]	The Netherlands	12	Pregnant Women	Recorded the first midwife consultation and conducted interviews	Main sources of nutrition advice were the internet (33 %), midwives (23 %) and books (12 %) 5 out of 35 min was focused on nutrition Majority felt 12 weeks was too late to receive nutrition information	IV
Troxell et al. [47]	USA	47	Pregnant women enrolled in the Women, infants and children's (WIC) program	Focus groups	Women were more likely to refer to written information provided by midwives if midwives verbally referred to it and if women perceived midwives to believe the information to be important	IV
Tuffrey and Scriven [51]	United Kingdom	37	Pregnant and post natal women	Interview administered questionnaires	Women indicated that they wanted adequate advice to enable them to understand the role of different nutrients in pregnancy. Barriers to consuming DHA rich foods were identified as lack of familiarity with these foods, lack of preparation skills and affordability 82 % of participants were taking folic acid supplements 41 % of participants had received folic acid supplementation advice from their GP 24 % were avoiding foods on healthcare practitioner advice, mainly soft cheese and pate The most common reason for making dietary changes was the physical effects of pregnancy such as cravings and nausea 10 participants reported making changes on healthcare practitioner advice, mostly increasing sources of dietary iron such as dried apricots and red meat	IV

Table 1 continued

Reference	Country	n	Participants	Methods	Key findings	NHMRC level of evidence [42]
Wise and Arcamon [25]	United Kingdom	49	Pregnant adolescents	Self-administered written questionnaires	One-third recalled receiving pregnancy nutrition information in school 51 % stated that their GP was their main source of information 6 % obtained most of their information from magazines Majority felt teachers and healthcare professionals were the best nutrition learning sources compared to reading educational material, watching videos and media, and group cooking classes	IV
Wulf and Ekstrom [27]	Sweden	901	Postnatal women	Self-administered written survey	47 % received advice about iron supplementation 64 % of women who had received advice to take iron supplements did so, compared to 19 % of those who did not receive advice The most common reason for not taking supplements was gastrointestinal side effects	IV

anxiousness resulted from ‘bombardment of information’ at the first ANC 12-week visit.

The written and verbal nutrition education practices in Dutch midwifery were explored by Szwajcer et al. [19]. Midwives were found to be often supportive about clients’ weight issues but did not make specific recommendations on how women could prevent gaining too much weight. They provided nutrition information as part of a larger information pack, which they rarely referred to verbally. Most pregnant women identified that receiving advice at 12 weeks came too late to put into practice.

What Sources are Utilised and Are They Perceived to be Reliable?

Four studies identified sources of nutrition information during pregnancy and the perceived reliability of these sources. Women in the study by Bloomingdale et al. [20] (USA) commonly reported referring to outside sources in addition to their healthcare provider, although the majority were “concerned about the reliability” of pregnancy books, magazines and the internet. Women in the study also noted they “didn’t pay much attention” to advice from family and friends. Similarly, House and Coveney [21] reported that although women distrusted the internet, they commonly used it to search for answers to food related queries.

How Does Advice Received Affect Behaviour?

Eight studies examined pregnant women’s accounts of how the advice they received had affected their behaviour.

Babour et al. [17] (Scotland) reported that most women were not taking folic acid supplements due to unplanned pregnancies, being too busy to remember to take them daily and nausea. A common theme found in the focus groups was ‘my mother didn’t take folic acid supplements so why should I’. A qualitative study examining sugar consumption during pregnancy in Canada [22], highlighted that although nutrition education was an enabler for reducing sugar intake during pregnancy, other sociocultural and physical factors were important with regard to being barriers to reducing dietary sugar.

Seven studies reported on women’s preferred format for receipt of nutrition information. Pregnant women preferred to receive nutrition advice in the form of a written pamphlet from their healthcare professional [15, 20, 23, 24]. In contrast, a study of pregnant adolescents reported that listening to teachers and healthcare professionals was the best way to learn about nutrition [25]. For nutrition counselling, women prefer individual rather than group settings, with nutrition and physical activity advice tailored to meet their individual needs [24, 26]. A qualitative study conducted in the USA assessed pregnant women’s perceived needs for

nutrition education about LCn3PUFA, themes revealed that women want detailed educational materials to enable them to understand the roles of nutrients in pregnancy such as pamphlets, books and calendars.

Healthcare Professionals: Perceptions of Providing Nutrition Education to Pregnant Women

Six articles assessed the beliefs and practices of healthcare professionals working with pregnant women (see Table 2). Elias and Green [11] found that although only 37 % of 370 New Zealand midwives received nutrition education as part of their formal education, 85 % had received nutrition education through nutrition organisations. The study by Wulf and Ekstrom [27] reinforced that recommendations provided in clinical guidelines were not always applied in practice, with 15 % of 134 Swedish midwives not recommending iron supplementation to all pregnant women, despite the recommendations of Swedish antenatal care guidelines.

A survey of 226 Australian healthcare providers [28], 59 of which were GPs, reported that most participants felt that

nutrition (88 %) and physical activity (77 %) were highly important educational areas in pregnancy, although the proportion providing advice was much lower. Only 32 % provided advice on folic acid supplementation (52 % of GPs), while 27 % advised about iron-rich food sources (46 % of GPs), 19 % gave food safety advice (40 % of GPs) and 23 % gave advice on general healthy eating (42 % of GPs). Participants were asked to indicate their need for further training on a 10 points scale (0 = no need, 10 = very high need), with a mean (SD) of 6.3 (2.8). The major barriers to accessing further nutrition training included lack of time, lack of relevant training and cost. These findings were consistent with two earlier studies [29, 30]. The most highly ranked way for healthcare professionals to receive ongoing education was through hard copy resources [28].

Hearn et al. [31] (Australia) conducted focus groups and interviews with perinatal healthcare providers to determine their perceptions about the best strategies to provide nutrition education to pregnant women. Participants indicated that evidence-based, practical information should be presented in an engaging and interactive online format,

Table 2 Summary of observational studies involving healthcare professionals

Reference	Country	n	Participants	Methods	Key findings	NHMRC level of evidence [42]
Elias and Green [11]	New Zealand	370	Midwives	Self-administered questionnaires	Most believed that nutrition education was important for pregnant women. Participants were least knowledgeable about maternal weight gain guidelines	IV
Hearn et al. [31]	Australia	76	Perinatal healthcare providers	Focus groups and interviews	Participants wanted to provide their pregnant clients with practice evidence-based information presented in a simple and engaging interactive form	IV
Heyes et al. [29]	UK	163	Midwives (n = 26), practice nurses (n = 37), GP's (n = 62) and health visitors (n = 38)	Self-administered questionnaire	Lack of resources, time, money and training were barriers to delivering pre-conception care	IV
Hughes et al. [28]	Australia	226	GP's (n = 59), nurses (n = 54), pharmacists (n = 51) and pharmacy assistants (n = 55)	Self-administered questionnaire	Less than half of participants gave pregnant women advice about folic acid supplements, iron rich food sources, food safety and general healthy eating	IV
Morales et al. [30]	USA	23	Healthcare providers including nurses (n = 6), Women's, infants and children (WIC) educators (n = 5), midwives (n = 3), nutritionists (n = 3), social workers (n = 3), obstetricians (n = 2), and GP's (n = 1)	Semi-structured interviews	Most were willing to incorporate key food safety recommendations for pregnant women into their practice if they had further education, however time was identified as a key barrier	IV
Wulf and Ekstrom [27]	Sweden	177	Midwives (n = 134) and obstetricians (n = 43)	Self-administered questionnaire	79 % of obstetricians and 41 % of midwives recommended iron supplements to their pregnant patients	IV

although they also expressed concern that such a resource would marginalise culturally and linguistically diverse (CALD) and rural indigenous Australians.

Interventions: Identifying Effective Methods to Deliver Nutrition Education to Pregnant Women

Ten articles evaluated interventions addressing nutrition during pregnancy (see Table 3).

Supplementary Prenatal Care

Five studies evaluated the provision of supplementary antenatal care to improve nutrition in pregnancy [32–36] (USA; Finland; Canada). These studies suggested that increased counselling could improve nutrition knowledge, women's interest in accessing further nutrition education and compliance with supplementation. Piirainen et al. [33] (Finland) highlighted that dietary behaviour could be improved through a health promotion program which combined dietary counselling with food provision of conventional food products including high fibre pasta, high fibre breakfast cereal and rapeseed oil. Similarly, Hautero et al. [35] (Finland) demonstrated that intake of saturated fats could be lowered, and unsaturated fats could be increased, significantly improving participants blood lipid profile, through dietary counselling and food provision. Furthermore, Oken et al. [36] (USA) showed that food provision in addition to dietary counselling, improves targeted dietary habits more than counselling alone.

Development and Implementation of Resources

Five articles developed and evaluated a pregnancy nutrition resource. DeStephano et al. [37] (USA) explored the acceptability of a health education video for pregnant women, targeting Somali refugees. All women surveyed found the videos to be appropriate and 96 % indicated that it would be their preferred medium for nutrition education. A randomised controlled trial in Ireland, found that an interactive video doctor providing tailored nutrition advice appropriate to a participants body mass index, exercise and dietary habits, and readiness to change, was beneficial [38]. The intervention group had significantly increased physical activity and fruit and vegetable consumption, as well as decreased intake of high sugar foods and fast foods compared to the control group. Emmet et al. [39] (Australia) developed a pamphlet and shopping card about docosahexaenoic acid (DHA), a LCn3PUFA which Australian women do not routinely receive information about as part of ANC. In this trial study, 93 % of participants found the resources useful.

Two articles reported on the development and evaluation of resources in the Australian context. Wilkinson et al. [40] evaluated the 'pregnancy pocket book', a 73 page binder with evidence based information for pregnant women including screening tools, goal setting and monitoring activities. Self-reported surveys were conducted at baseline and 12 weeks post-test with the intervention group (140/103) and the control group (130/90). The most read sections of the pocketbook were reported to be 'Being active' and 'go for 4&5', and the majority of women used the pregnancy weight tracker. Additionally there was a trend for increased physical activity levels in the intervention group by an additional 20 min per week. No significant differences were found between groups for fruit and vegetable intake. Although midwives had been trained to provide and explain the tool, only one in three women reported they had received an explanation. Thus potentially the tool could be more effective at influencing behaviour change if appropriately implemented. Wilkinson and McIntyre [41] evaluated a counselling approach which involved low intensity group learning workshops with a dietitian. Participants were assessed at baseline and 12 weeks following the intervention. The control group (n = 169, per protocol) received usual care and a nutrition information brochure, whilst the intervention group (n = 72, per protocol) received a 1 h group education workshop with a dietitian and a nutrition information brochure. The intervention group had significantly increased fruit (0.4 serves/day, $p = 0.004$) and vegetable (0.4 serves/day, $p = 0.006$) consumption and gestational weight knowledge (8 %, $p = 0.009$).

Discussion

The limited available data in the published literature indicates that pregnant women in developed countries are not receiving adequate nutrition advice from reputable sources, namely healthcare professionals.

The majority of studies were low quality and cross sectional in nature, using both qualitative and quantitative methods. Based on the NHMRC level of evidence hierarchy [42], seven studies were identified as level 2 (randomised control trial) [32–36, 38, 43], one study was level 3–1 (pseudo randomised control trial) [40], while the remainder were level 4 observational studies (cross sectional studies or case series). Out of the randomised control trials, only one study was assessed to have a low risk of bias [36], assessed using The Cochrane collaboration's tool for assessing risk of bias [44].

To ensure women receive adequate nutrition advice in time to make informed decisions regarding pregnancy, further exploration into effective nutrition education during

Table 3 Summary of intervention studies

Reference	Country	n	Participants	Methods	Intervention	Outcome	NHMRC level of evidence [42] and bias risk [44]
Boyd and Windsor [32]	USA	240	Pregnant women enrolled in the WIC program	Formative pilot intervention evaluation. Randomised control trial design using pre and post intervention self-administered surveys and focus groups (n = 16)	Intervention group (n = 120) received 8 peer educator lessons, control group (n = 120) received usual ANC	48 women enrolled in the intervention and 65 women in the control group completed the study. The intervention group had a significant improvement in nutrition knowledge and dietary behavior. Themes from focus groups indicate that the high time demand for participants was a potential cause of the high attrition rate	II High risk of bias
DeStephano et al. [37]	USA	22	Pregnant Somali refugee women	Post-test case series. Post intervention self-administered surveys	Pre-natal education videos developed for Somalian refugees were shown to participants	All women thought the videos were appropriate and 96 % indicated that they preferred this format for health education	IV
Emmett et al. [39]	Australia	74	Pregnant women	Case series with pre-test/post test outcomes using a questionnaire. Self-administered and interview-administered surveys were used	Provision of a DHA pamphlet and shopping card	93 % found the materials useful. There was a significant increase in reported average fish consumption per month and a significant increase in the number of participants who actively shopped for DHA enriched products	IV
Hautero et al. [35]	Finland	90	Women in their first trimester with a family history of allergy (sub-sample of participants enrolled in the Mother-infant diet and probiotic intervention study)	Randomised control trial using 3 day food records and blood sample at baseline, in the third trimester and 1 month post intervention	Women in the intervention group (n = 45) received individual dietary counseling advocating food low in saturated fat and high in unsaturated fat. Appropriate food products were provided. Control group (n = 45) received usual antenatal care	Women in the intervention group had significantly lower intakes of saturated fat and significantly higher intakes of unsaturated fat. Blood levels of polyunsaturated fatty acids were significantly higher in the intervention group	II High risk of bias
Jackson et al. [38]	Ireland	321	Pregnant women who did not report smoking, alcohol or drug use	Randomised control trial. Self-administered survey at baseline and 4 weeks post intervention	Women in the intervention group (n = 158) received individually tailored messages about diet, exercise and weight gain through a 'video doctor'. Control group (n = 166) received usual ANC	Women in the intervention group had significantly increased physical activity, fruit and vegetable intake, intake of wholegrains and decreased intake of sugary foods and fast food	II High risk of bias

Table 3 continued

Reference	Country	n	Participants	Methods	Intervention	Outcome	NHMRC level of evidence [42] and bias risk [44]
Oken et al. [36]	USA	55	Pregnant women between 12–22 weeks gestation who consumed ≤ 2 servings of fish per month and no contraindications of fish consumption	Three armed randomised control trial. Food frequency questionnaire, plasma DHA and hair mercury measured at baseline and 12 weeks post intervention	The first intervention group (n = 18) received advice on consuming low mercury high DHA fish and the second intervention group (n = 17) received grocery store gift cards to purchase fish in addition to the same advice. The control group received usual ANC	There was no difference in plasma mercury or hair DHA between the three groups. Intake of fish significantly increased in both intervention groups. At follow up no women in the control group consumed at least 200 mg/day of DHA, compared to 33 % of women in the advice arm and 53 % of women in the advice and gift card arm	II Low risk of bias
Piirainen et al. [33]	Finland	218	Pregnant women attending their first ANC visit with no chronic or metabolic disease	Randomised control trial. 3 day food records were collected in each trimester	Women in the intervention group (n = 140) received dietary counseling and food products targeted towards increasing intake of polyunsaturated fatty acids and decreasing saturated fat, in addition to usual care. Control group (n = 69) received usual care	Women in the intervention group had a significantly higher intake (% energy) of polyunsaturated fatty acids and lower intake of saturated fatty acids	II High risk of bias
Tough et al. [34]	Canada	1737	Pregnant women prior to their first prenatal appointment	Three armed randomised control trial using telephone interviews and self-administered questionnaires in the first trimester, third trimester and 8 weeks post delivery	The first intervention group (n = 578) received usual care plus an additional consultation with a prenatal support nurse and the second intervention group (n = 577) received usual care, prenatal nurse support and non-medical prenatal support with a trained home visitor. The control group (n = 582) received usual care	For women in the nurse and home visit intervention group, there was a significant increase in participants accessing nutrition counseling, which was higher in women who practiced risk behaviors	II High risk of bias
Wilkinson et al. [40]	Australia	270	Pregnant women prior to first ANC appointment	Pseudo-randomised control trial. Self-reported data was collected at baseline and 12 and 24 weeks post intervention	Intervention group (n = 140) received a pregnancy pocket book which included information and recording activities, in addition to usual care. Control group (n = 130) received usual care	There was a significant increase in smoking cessation in the intervention group; however there were no other significant differences	III-1

Table 3 continued

Reference	Country	n	Participants	Methods	Intervention	Outcome	NHMRC level of evidence [42] and bias risk [44]
Wilkinson and McIntyre [43]	Australia	360	Pregnant women prior to first ANC appointment	Randomised control trial using a self-administered survey at baseline and 12 weeks post intervention	Intervention group (n = 72) attended a 1 h group education workshop with a dietitian and the control group (n = 169) received usual care	Intervention group had significantly increased intake of fruit and vegetables, and knowledge on gestational weight gain	II High risk of bias

preconception and antenatal care and is warranted. Pregnant women’s experiences indicate that nutrition information received at 12 weeks is too late to be useful [17, 19, 24]. This is particularly true for folic acid supplementation, which is required 1 month preconception and for the first 12 weeks of pregnancy to prevent neural tube defects [18]. Pre-conception and inter-natal care would also reduce feelings of being overwhelmed by large amounts of information provided at the first ANC visit [17]. For increased compliance with dietary recommendations, healthcare providers need to be mindful about explaining reasons for recommendations [23], as well as providing written material for future reference such as a list of reputable evidence-based websites. More research is needed to explore strategies to ensure that health professionals provide pregnant women with the nutritional advice recommended in ANC guidelines. The effectiveness of public health campaigns, including peer education campaigns [32], and campaigns which include healthy food provision for low socio-economic women [33, 35], warrant further investigation.

Sub-sectors of populations who are at greater risk of poor birth outcomes include indigenous groups and migrants [45, 46]. These women may have different cultural needs, as well as language barriers, which require different approaches in health education. More research is needed on how to provide effective pregnancy nutrition education to these women.

The studies indicated that healthcare providers had a low level of engagement with pregnancy nutrition issues, in particular the provision of advice on LCn3PUFA, fish consumption, food safety and iodine. Healthcare providers reported requiring ongoing support to overcome barriers such as time, cost and lack of training. Midwives, GPs and other healthcare practitioners may benefit from continuing education about nutrition in pregnancy and further research in Australia in relation to nutrition within midwifery education and programs appears warranted. GPs are often the first point of call for women trying to conceive and during early pregnancy prior to women’s visits with the ANC clinic. It is imperative that GPs receive support to enable them to provide nutrition advice for women during prenatal visits and during the first trimester.

Studies found that women were more likely to comply with advice from healthcare professionals when it is specific and provides explanations as to why the recommendation is important. The preferred medium was an easy-to-read bullet point pamphlet, with some women recommending it contain links to websites containing more information [15, 20, 23, 24, 47]. Such a resource would ease women’s concerns about the reliability of information online and from other sources. Women were more likely to read pamphlets if they perceived that the healthcare

practitioners felt the information they contained was important [19]. Women were also more likely to take pregnancy supplements if it was verbally recommended by healthcare providers and women received counselling on supplement use on subsequent ANC visits [32, 33].

An area identified in the literature as having potential in the Australian context is the use of pharmacists to provide pregnancy advice. An Australian study of Hughes et al. [28] reported that 43 % of pharmacists and 53 % of pharmacy assistants served pregnant women at least once per day. Despite this, most did not feel confident providing nutrition advice. These professionals may see women prior to the first ANC visit and thus provide timely recommendations for supplementation, as well as providing advice to women trying to conceive.

Although both international [6] and country specific [8–10, 48] antenatal care guidelines exist, the findings of the present systematic review have identified that translating the nutritional aspects of these guidelines into clinical practice is a challenge. Further support is required to assist healthcare practitioners to provide this information to pregnant women to optimise pregnancy outcomes.

As with all reviews of this nature, there are limitations. Firstly, not all articles may have been retrieved despite best efforts, including conducting ten searches during the initial search period with key terms, despite no new papers being identified after the fourth search. Secondly, retrieved papers were analysed by a single reviewer, which may have introduced bias. Thirdly, nutrition advice received by women prior to conception fell outside the scope of this paper and this is an important group to target, particularly with regard to folic acid supplementation. Due to the nature of the recruitment process in many of the studies and the types of study designs, most of the cited studies included non-representative samples, thus generalisability was limited. Since volunteers in the studies may have been more interested in nutrition than the general population, information on practices related to supplementation by women and provision of nutrition advice by healthcare providers probably overestimates the true situation. Lastly, the studies targeted different population subgroups, limiting the generalisability of the results for more broadly based recommendations about nutrition education during pregnancy.

Conclusion

The important public health issue of assisting women with healthy food choices during pregnancy is not well explored in the literature. The needs of pregnant Indigenous and migrant women are particularly under-reported. The limited available studies suggest that women are not receiving adequate nutrition education to make informed decisions

during their pregnancy. Nutrition counselling was identified as potentially an effective tool in increasing adherence to a healthy diet and supplementation within some population groups. However, the small number of studies available show that healthcare providers are not routinely assisting pregnant women to make informed decisions.

The extent and type of nutrition advice received by pregnant women across different models of antenatal care has not been examined, and the effectiveness of different health promotion initiatives requires further and systematic evaluation. This lack of research on nutrition education during pregnancy does not reflect the importance of this issue for the future health of mother and baby.

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