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PregNut survey: knowledge, attitude, and practices of midwives regarding plant-based diets during pregnancy

Stephanie C. McLeod[1,2,4], Jessica C. McCormack[1], Jade Wratten[3], Lorna Davies[3], Yvonne Mosley-Martin[3], Indrawati Oey[1,2], Tamlin S. Conner[4] and Mei Peng[1,2*]

Abstract

Background Plant-based diets (PBD) are gaining global popularity, yet there is limited research on the experiences of pregnant women adhering to these diets. This study employed the knowledge, attitudes, and practices (KAP) framework to assess midwives' readiness in managing the growing plant-based trend in Aotearoa New Zealand (NZ).

Methods A cross-sectional, online-administered survey was developed in collaboration with midwifery academics, and was presented in three sections: knowledge, attitudes, and practices towards nutrition in general, towards PBD during pregnancy, and practice information. Questions included Likert-style, free text responses, and check boxes. Currently practising lead maternity carer midwives in NZ were invited to participate, primarily via an email newsletter disseminated by the New Zealand College of Midwives. Descriptive statistics, chi-square tests, and content analysis were used to interpret data.

Results The study received 133 valid responses from a total of 1246 registered midwives in NZ, reflecting a demographic profile similar to the current midwifery workforce. Although respondents demonstrated foundational knowledge of plant-based nutrition, midwives reported feeling significantly less prepared to advise clients following PBD, compared with omnivorous diets (96% vs. 72%, X^2 (1, $n = 133$) = 29.03, $p < .001$)). While attitudes towards PBD appeared positive, midwives reported higher expectations of knowledge from plant-based clients, compared with omnivore-based clients. Midwives' practices towards their PBD clients varied considerably, with some inconsistencies attributable to reported barriers including lack of time or feeling unqualified. Respondents' personal dietary patterns were correlated with preparedness, knowledge of emerging concepts, and the belief that PBD are better for mothers and infant development.

Conclusion This study, conducted within NZ innovative midwifery care system, reveals discrepancies between midwives reported levels of preparedness to manage clients following PBD compared with omnivorous diets, despite a strong foundation of general and plant-based nutrition knowledge. The reported desire to expand midwives understanding of PBD nutrition and improve practices reiterates the importance of access to current research,

*Correspondence:
Mei Peng
mei.peng@otago.ac.nz

Full list of author information is available at the end of the article

evidence-based practice protocols, and support avenues to enhance midwives' preparedness in advising the growing number of individuals following PBD.

Keywords Pregnancy, Plant-based, Midwives, Knowledge, Attitudes, Practices, Maternal diet, Nutrition

Background

Aotearoa New Zealand (NZ) adopts a unique maternity care system, where the community-based midwife acts as the lead maternity care provider (LMC) [1] for the majority (94%) of pregnancies [2]. This model is highly regarded globally, with women less likely to receive intervention during birth, and more likely to report satisfaction with their antenatal care [3]. Midwives play a critical role in the health and wellbeing of women during their pregnancy, and are regarded as an influential source of information on a variety of health and lifestyle topics [4, 5]. Although resources developed by The New Zealand Ministry of Health| Manatū Hauora (MOH) recommend pregnant individuals following plant-based diets (PBD) to seek advice from a dietitian [6], it is midwives, not dietitians, who are most accessible for dietary advice during pregnancy in NZ. Pregnant individuals view midwives as an influential source of nutrition information [7–9], a view similarly held by other health professionals [10], and midwives themselves [11].

Despite the role of midwives in disseminating normal dietary advice as a routine part of their practise, midwives have previously reported their nutrition education regarding PBD and pregnancy as being insufficient [10]. This is particularly concerning, considering one key source for nutrition knowledge is undergraduate midwifery education [10, 11]. This apparent misalignment between roles and responsibilities, and the resources available to a workforce under numerous pressures, leaves room for a potential gap in nutrition advice provided during pregnancy. This gap could disproportionately affect women requiring additional nutrition advice, such as followers of PBD. It is also plausible that this gap, or shortfall in evidence-based information, may leave PBD followers susceptible to misinformation. Drummond and colleagues [12] recent paper regarding pregnancy nutrition information available on social media, reveals a concerning prevalence of false or misleading information. The importance of accessibility is reiterated by Diekman and colleagues [13], who present social media as both a challenge and an opportunity for accredited health professionals to communicate evidence-based information.

PBD can be broadly defined as a spectrum of diets restricting the intake of animal products [14]. Globally, interest in plant-based dietary patterns and products are increasing among consumers and public health organisations (e.g., The National Heart Foundation of New Zealand [15]), predominantly driven by growing awareness of the benefits of PBD for health and sustainability (e.g., the EAT-Lancet diet). It is widely acknowledged that shifting towards PBD can improve the sustainability of food systems by decreasing reliance on resource-heavy animal proteins [16, 17]. This is becoming an important motivator for individuals adopting PBD [18–20] and may be particularly salient during pregnancy when women are highly motivated to make lifestyle changes [21]. While PBD present a number of health benefits for adults, such as reduced risk of cardiovascular mortality [22, 23], concerns have been raised regarding their adequacy for meeting the nutritional needs of a healthy pregnancy diet [24, 25].

Non-compliance with national dietary guidelines during pregnancy remains a public health challenge. A prospective cohort study involving 5,664 pregnant individuals in NZ revealed only 3% adhered to all Ministry of Health food intake guidelines [26]. These findings reflect a global trend of low adherence to dietary guidelines during pregnancy (e.g., [27, 28]) as reviewed by Caut and colleagues [29], yet evidence specific to PBD populations is scarce and primarily focuses on the risks or shortcomings of following these dietary patterns during pregnancy. However, there are also plausible mechanisms through which PBD may promote healthy pregnancies. PBD have been associated with lower dietary zinc intake among pregnant NZ adults [30], while a longitudinal study in Germany found up to 39% of vegetarians experience vitamin B_{12} deficiency in at least one trimester [31]. Hedegaard and colleagues [32] reported individuals following PBD during their pregnancy had significantly lower dietary intakes of protein, vitamin B_{12}, and vitamin D compared with omnivores, based on data from the Danish National Birth Cohort ($n = 91{,}381$), yet these disparities were no longer observed when dietary supplements were included in their analysis, resulting in the median intakes of each micronutrient among all dietary groups exceeding the Nordic Nutrition Recommendations [32]. Hedegaard and colleagues [32] also reported significantly increased fibre intake among the PBD participants compared with omnivores, which has been associated with a reduced risk of preeclampsia [33] and gestational diabetes mellitus [34]. More broadly, research into excess gestational weight gain has found PBD may have a protective effect [35]. In contrast to the German Nutrition Society [36], The American and Canadian Dietetic Association maintain PBD can be appropriate for pregnancy provided they are well-planned [37],

acknowledging the need for targeted supplementation with vitamins B_{12} and D, iron, and docosahexanoic acid.

A small number of studies have investigated general nutrition knowledge and attitudes of midwives (e.g., 11, 38, 39), yet few have focused specifically on PBD, with the exception of Meulenbroeks and colleagues' [10] cross-sectional survey of Dutch midwives, dietitians, and obstetricians. This same study is also one of the few to investigate practices relating to PBD, revealing little consistency, and conflicting views regarding health professional responsibility [10]. A recent scoping review [40] identified a significant research gap regarding health professionals' practices, and revealed health professionals' knowledge of plant-based nutrition in pregnancy was reported to be limited and frequently attributed to a lack of nutrition training. In addition to this, respondents' personal dietary patterns and work-specialisations were closely associated with their knowledge, attitudes, and practices [41, 42], suggesting variability within clinical disciplines. Research from 2007 found midwives in NZ possess high levels of confidence and knowledge in supporting general nutrition during pregnancy [11]. However, the interim 18 years since Elias and Green Elias and Green [11] published their findings have seen NZ midwifery practices fraught with numerous challenges and external pressures, including workforce shortages [43], increasing workloads, and pay disparity [44]. These represent potential barriers to adapting practices to accommodate shifting dietary trends, such as the growing number of individuals following PBD. This study seeks to investigate midwives' knowledge, attitudes, and practices in relation to PBD, enabling an efficient pathway to address any relevant disparities within these three domains.

Methods

Study design and population

This current study was based on the knowledge, attitudes, and practices (KAP) framework, an approach used in public health research to give broad insights into a current phenomenon [45], in this case, PBD during pregnancy. Lead maternity carer (LMC) midwives in New Zealand were eligible to participate, provided they held a current Te Tatau o te Whare Kahu Midwifery Council practicing certificate. The survey was disseminated as part of an email newsletter sent to LMC midwives registered with the New Zealand College of Midwives ($n = 1246$), with a second email sent one month later, and a final reminder two weeks before survey closure. In addition, the survey was distributed via targeted groups on social media, social media advertisements, and posters. It was expected the majority of eligible participants would have had access to the survey. Potential participants were able to access the survey by contacting the research team via email, scanning a quick response (QR) code, or using a hyperlink to go directly to the participant information sheet, consent form, screening questionnaire, optional prize-draw entry (5 x NZD $100, 1 x NZD $500), and survey, all managed via REDCap (Research Electronic Data Capture) online software. Ethical approval was granted by the University of Otago Human Ethics Committee (reference 22/072), and all participants supplied informed, written consent prior to commencing the survey.

Survey

The research team, consisting of experts in behaviour research (MP, TSC, JM), health psychology (TSC), public health (JM), midwifery (JW, LD, YMM), food chemistry (IO), and an associate registered nutritionist (SCM), created questions based on previously conducted surveys of health professionals' nutrition knowledge [10, 11, 38, 39], and selected and modified existing questions to meet the objectives of the present study. Questions included Likert-style and free text responses, and check boxes. An initial survey was drafted and reviewed by a group of academic and practicing midwives. Once the survey had been refined, it was piloted by a small group of practicing midwives ($n = 3$). A minor change included adding an option to select 'no barriers' for a question regarding barriers to discussing nutrition with clients.

The survey was presented in three sections: attitudes and practices towards nutrition in general, attitudes and practices towards PBD, and demographic information. The first section asked participants about their own dietary pattern, preparedness to advise on nutrition, ability to refer clients, expectations regarding clients' nutrition knowledge. In addition, participants were asked about frequency of advice given, information sources used, and types of diets followed by their clients. The second section focused on PBD, and asked participants about their practice, including frequency of referrals, and supplements prescribed, and their attitudes and expectations towards PBD during pregnancy. Lastly, the third section collected demographic information, including education and workforce experience. Further detail on item wording is available in Additional file 1.

Analysis

Analysis of quantitative data was performed using IBM SPSS Statistics (Version 29) and was primarily descriptive, using available cases to manage missing data [46]. Likert responses were aggregated from five-point scales (e.g., strongly agree, agree, neutral, disagree, strongly disagree) into response categories providing three-point summaries (e.g., agree, neutral, disagree). To investigate midwife preparedness to advise on PBD nutrition compared with general nutrition, response categories were aggregated to create a dichotomous variable appropriate

for McNemar's chi-square test suitable for within subject comparisons (i.e., prepared versus other). Univariate analysis of variance was used to test whether self-reported dietary pattern predicted frequency of meat consumption. Chi-square test of independence was used to determine associations between dietary pattern and selected variables (e.g., preparedness to advise on PBD). Post-hoc analysis using Bonferroni adjusted residuals were conducted on significant chi-square results to determine where significance occurred [47], and effect size was measured using Cramer's V test. Free text responses were analysed using quantitative and qualitative manifest content analysis [48]. Due to the nature of the questions, for example, asking respondents to "briefly outline", it was decided meaning units could be words or sentence fragments [49]. A coding structure was created with guidance from word frequency analysis and added to throughout the coding process. Finally, codes were aggregated into categories for reporting.

Results

Response

Registered LMC midwives ($n = 1246$) were invited to participate in the survey, predominantly recruited via the New Zealand College of Midwives email register between 2 June and 17 August 2023. Of the 1246 midwives invited, 163 completed consent forms, and 137 (11%) commenced the survey. Twenty-six participants were ineligible to take part, due to them not currently practicing ($n = 1$), not practicing as a LMC midwife ($n = 11$), or not completing the consent form ($n = 14$). Of the 137 midwives who commenced the survey, a small number did not answer any questions ($n = 4$), thus were excluded from any analysis, resulting in 133 valid responses, and a response rate of 10.7%.

Participant characteristics

Almost all (98.3%) respondents identified as women, with a mean age of 44 years (Table 1). The most frequently reported ethnicity was New Zealand European (68.4%), followed by Other (16.5%), and Māori (11.3%).

Table 1 Demographic characteristics of respondents $N = 133$

Demographic Characteristic		*n* (%)	M (SD)
Age			44.0 (11.5)
Gender	Women	116 (98.3)	
	Another gender	2 (1.7)	
Ethnicity	New Zealand European	91 (68.4)	
	Māori	15 (11.3)	
	Asian	3 (2.4)	
	Pacific Peoples	2 (1.6)	
	Other	22 (16.5)	
Highest education qualification	High school qualification	1 (0.8)	
	Trade certificate or diploma	2 (1.5)	
	Bachelor of Midwifery	91 (68.4)	
	Postgraduate education i.e., postgraduate diploma	17 (12.8)	
	Master's degree	10 (7.5)	
	PhD	1 (0.8)	
Nutrition training received	Coursework as part of midwifery education	75 (56.4)	
	Short course outside of midwifery education	19 (14.3)	
	None received	25 (18.8)	
	Other relevant tertiary education	13 (9.8)	
	Other	5 (3.8)	
Country where trained	New Zealand	100 (75.2)	
	Australia	2 (1.5)	
	United Kingdom	14 (10.5)	
	North America	1 (0.8)	
Years practicing as a midwife			12.3 (10)
Practiced outside of NZ	Yes	23 (17.3)	
Years practising overseas			9.3 (5.7)
Personal dietary pattern	Omnivore	78 (58.6)	
	Flexitarian	24 (18.0)	
	Pesco-vegetarian	13 (9.8)	
	Vegetarian	13 (9.8)	
	Vegan	5 (3.8)	

Respondents most frequently trained in NZ (75.2%) and had spent more than 12 years (mean (M) = 12.3, standard deviation (SD) = 10) in professional practice. Most respondents held a Bachelor of Midwifery degree (68.4%), with nutrition training undertaken as part of this education (56.4%). Other avenues of nutrition training included short courses (14.3%) and other tertiary education (9.8%), however 19% ($n = 25$) reported not receiving any. Further demographic data is available in Additional file 2.

Knowledge of plant-based diets during pregnancy

Midwives displayed a good understanding of PBD specific nutrition for pregnancy, identifying possible complications, including increased likelihood of iron deficiency anaemia (77.7%), and Vitamin B_{12} deficiency (74.4%) (Table 2). Respondents were less concerned regarding outcomes such glucose tolerance, gestational weight gain, and hypertensive disorders, most frequently selecting no difference (50.8%, 51.2%, and 68.3%, respectively) followed by less likely (46.7%, 47.9%, and 28.3% respectively). An optional, free text response question asked respondents to outline any other complications they felt plant-based pregnancies were more or less likely to experience. A total of 44 responses were received, most frequently reiterating concerns regarding micronutrient deficiencies, iron ($n = 9$) and calcium ($n = 5$). Low energy or fatigue was also raised as a concern ($n = 6$), along with the hypothesised impact of low protein intake ($n = 4$), such as oedema ($n = 1$) and compromised tissue integrity ($n = 1$). Other comments included concerns regarding health outcomes on infants, lactation, and blood sugar regulation. Respondents also expressed positive attitudes, including the belief their clients following PBD were healthier ($n = 6$), and displayed higher health literacy compared with omnivorous clients. Although most respondents felt prepared to advise on general nutrition, significantly fewer felt prepared to advise on plant-based nutrition (96% vs. 72%, X^2 (1, $n = 133$) = 29.03, $p < .001$).

Attitudes towards PBD during pregnancy

Almost all respondents agreed nutrition is important during pregnancy (99.2%), and that midwives are instrumental in providing this advice to their clients (98.5%), yet 69.2% also reported believing their clients were responsible for educating themselves about nutrition. Nearly two thirds (63.9%) agreed midwives can refer to nutrition specialists when needed (i.e., a dietitian). While only half of midwives agreed their clients were knowledgeable about their own nutrition needs (52.6%), three quarters (76.2%) expected their clients following PBD to have a good knowledge of their nutritional requirements. Few midwives agreed with statements suggesting PBD are 'better' for mothers or babies' development, with most respondents choosing to remain neutral, or disagreeing (30.9%, and 28.5% respectively) (see Additional file 3 for further information).

Midwifery practices towards omnivore and PBD

Most midwives reported having clients following PBD, most frequently vegetarian (89.5%), followed by vegan (63%). In addition to PBD, other diets frequently reported include medically restricted (e.g., glucose monitored for diabetes) (88%), gluten- or dairy-free without allergies or intolerances (74.4%), religious or cultural diets (66.2%), and ketogenic diets (14.3%). Self-reported differences in practices towards clients following PBD and omnivorous diets were observed (Fig. 1). Between 50 and 60% of midwives reported increased frequency of discussions regarding nutrition, screening for nutritional deficiency, and prescribing supplements compared with their omnivorous clients. The exception was dietitian referrals, with the majority (71.6%) reporting no difference in referral frequency.

Table 2 Midwives' knowledge of plant-based nutrition for pregnancy

Survey items	Response, *n* (%)				
	N	**Less likely**	**No difference**	**More likely**	***p*-value**
Expected likelihood of the following complications during plant-based pregnancy compared with omnivore					
Vitamin B12 deficiency	121	6 (5)	25 (20.7)	90 (74.4)	
Iron deficiency / iron deficiency anaemia	121	5 (4.1)	22 (18.2)	94 (77.7)	
Glucose intolerance / gestational diabetes	120	56 (46.7)	61 (50.8)	3 (2.5)	
Increased gestational weight gain	121	58 (47.9)	62 (51.2)	1 (0.8)	
Hypertensive disorders of pregnancy	120	34 (28.3)	82 (68.3)	4 (3.3)	
Small for gestational age / low birth weight	121	8 (6.6)	92 (76)	21 (17.4)	
Preparedness to advise on nutrition during pregnancy					
		Prepared	Neutral[a]	Unprepared[a]	
Level of preparedness to advise on general nutrition	133	127 (95.5)	2 (1.5)	4 (3.0)	
Level of preparedness to advise on plant-based nutrition	133	96 (72.2)	18 (13.5)	19 (14.3)	< 0.001

Note. [a] Categories 'Neutral' and 'Unprepared' were aggregated for analysis

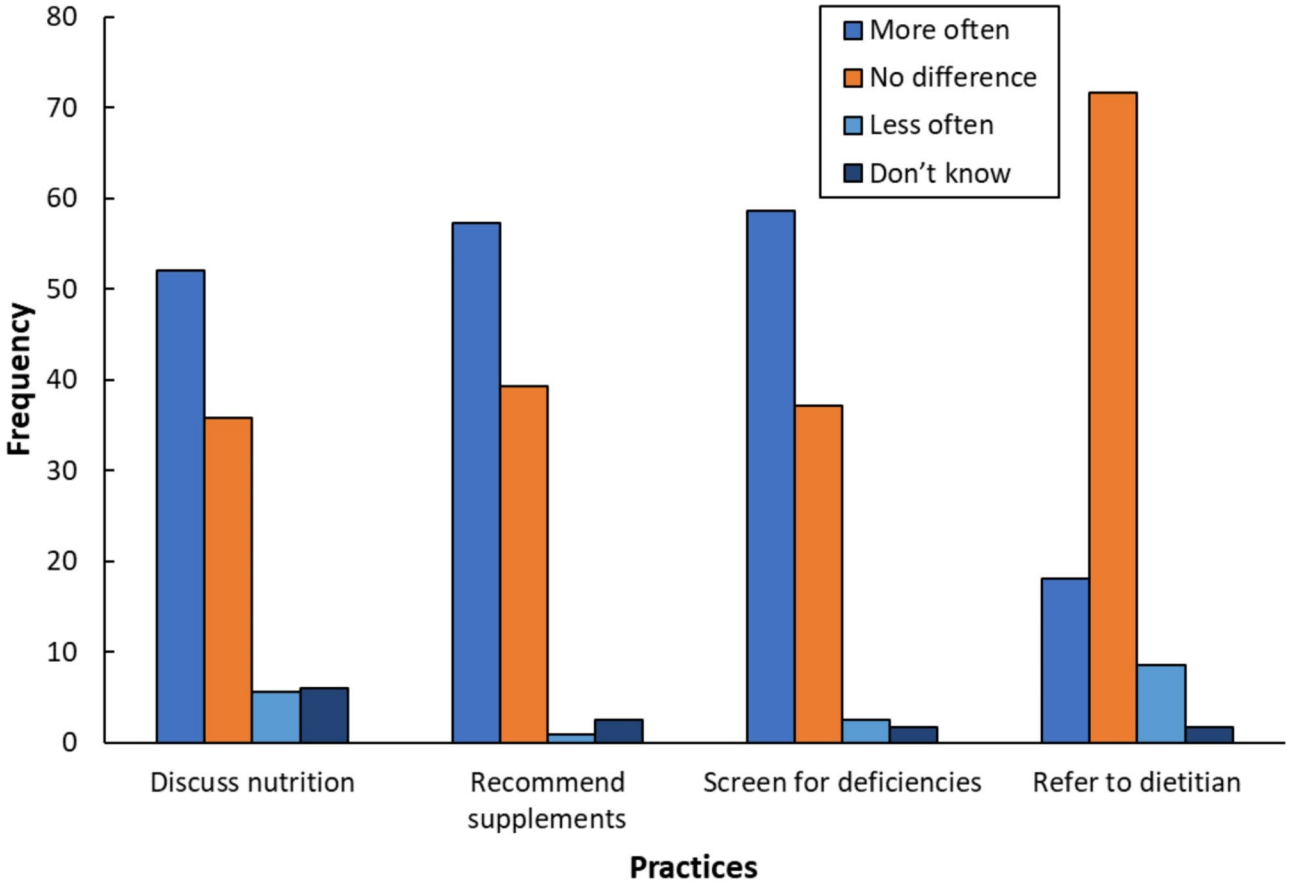

Fig. 1 Midwives' practices towards clients following plant-based diets compared with omnivorous diets

Midwives were asked to briefly outline the dietary advice given to their PBD clients (Table 3). Of the 105 responses received, midwives frequently discussed micro- and macro-nutrient intakes, and supplementation e.g., *"Importance of ensuring adequate levels of iron, B12, Vit D, calcium, protein, and plant-based foods / supplements which can help meet these needs".* Fourteen responses mentioned recommending vitamin B12, and iron supplements, and $n=7$ reported recommending multi-vitamins. General advice, such as eating a variety of nutritious foods was also given frequently, e.g., *"eat a wide variety of vegetables, lentils, nuts and fruit".* Some responses included insights into specific practices, such as screening for nutritional deficiencies, though this was reported less frequently than prescribing or recommending supplements. Specifically, a small number of responses illustrated an assumption that clients following PBD would be more knowledgeable, or were responsible for researching their own unique requirements, for example, midwives noted, "*someone on plant based nutrition often already knows more about protein and iron sources than those on more mainstream meals*", and "*I encourage them to do additional reading/listening seek out information and support that meet the needs of themselves for their pregnancies*".

Barriers to providing nutrition advice

Lack of time and feeling unqualified were frequently identified as barriers to discussing nutrition with their clients (36.1% and 30.1%, respectively), although 45.1% reported that they did not experience any barriers to discussing nutrition. In addition, twenty respondents used the free text option to identify other barriers, mentioning client disinterest, concerns regarding how advice may be perceived by clients as judgement of lifestyle choices, lack of knowledge regarding plant-based nutrition and traditional or cultural diets, and the challenge of keeping up to date with changing advice. Evidence-based information sources, such as government or official websites, and midwifery education comprised the majority of sources used to help advise clients (69.9% and 57.9% respectively), although 10.5% ($n=14$) reported using social media. An open comment response option outlined some concerns regarding a lack of resources or information, including the challenge of accessing dietitian referrals ($n=4$), and expressing the desire for more information ($n=7$). One midwife summarised the challenges faced, and some

Table 3 Qualitative content analysis of dietary advice given by midwives to clients following plant-based diets (PBD)

Categories *n* = 16	Sub-categories *n* = 67	Number of references *n* = 339
Discuss vitamin / mineral intake	Iron; Calcium; Absorption; Vitamin $B_{12;}$ Vitamin D; Choline; Folate; Iodine; Potassium; Choline	90
Recommend supplementation	Iron; Vitamin B_{12}; Not specific; Multi-vitamin; Calcium; Vitamin D; Iodine; Folic acid; Omega 3;	58
Discuss macronutrient intake	Protein; Fibre; Healthy fats; Energy intake	47
Eat a variety of nutritious foods		32
Screen for nutritional deficiencies	Iron; Vitamin B_{12}; Vitamin D; Discuss symptoms; Folate	27
Give tailored advice	Assess knowledge; Explain increased needs; Cultural awareness	24
Refer to resources	Nutrition specialist, Ministry of Health; Recipes; Vegan Society	21
Recommend foods to avoid	Less nutritious foods; Food safety	20
Client responsibility	Assume prior knowledge; Encourage own research	7
Encourage healthy eating behaviours	Encourage healthy eating behaviours	5
Encourage intake of animal protein	Seafood; Dairy; Eggs	3
Same as omnivore		3
Unsure		1

Note. Omega 3 = omega-3 polyunsaturated fatty acid

ideas for useful resources disseminated via a central governing body:

> *"...on NZCOM [New Zealand College of Midwives] website in practice statements etc. to remove the burden of the research side of it from frontline midwives".*

Impact of self-reported diet

Respondents were asked about their personal dietary patterns, revealing a high prevalence of plant-based diet followers (Table 1). Participants who self-identified as omnivores reported the highest meat intake frequency on a 10-point scale (1 = never eat meat, 10 = eat meat every day) with a mean of 7.5 (SD = 2). This was followed by flexitarians (M = 4.0, SD = 2), pesco-vegetarians (M = 1.7, SD = 0.6), vegetarians (M = 1.2, SD = 0.8), and vegans (M = 1.0, SD = 0.0). Significant differences were observed between mean scores of self-reported meat-intakes based on self-reported dietary pattern ($F_{4,126}$ = 69.52, p <.001), enabling the cohort to be grouped into three categories for further analysis: OMNI, FLEX and PLBD (consisting of pesco-vegetarian, vegetarian, and vegan dietary patterns). Chi-square test of independence revealed a significant, though moderate, relationship between level of preparedness to advise on PBD and the diet groups (X^2 (4, N = 133) = 12.7, p <.05, V = 0.22), with midwives in the PLBD group significantly more likely to report feeling prepared, compared with the OMNI group.

Significant relationships between dietary pattern and knowledge of PBD during pregnancy were observed; participants in the OMNI group were more likely to believe individuals following PBD during pregnancy were at the same or heightened risk of iron deficiency (X^2 (4, N = 133) = 17.91, p <.001, V = 0.27), and less likely to believe PBD were protective against hypertensive disorders (X^2 (4, N = 133) = 11.13, p <.05, V = 0.22). Personal dietary patterns were also correlated with attitudes towards PBD during pregnancy, including the belief that, compared with omnivorous diets, PBD are better for mothers (X^2 (4, N = 133) = 19.61, p <.001, V = 0.27), and better for babies' development (X^2 (4, N = 133) = 22.65, p <.001, V = 0.30), with the PLBD group significantly more likely to agree with the above statements. No other risks or concerns were significant.

Discussion

This study sought to understand the knowledge, attitudes, and practices of midwives in relation to PBD during pregnancy. Our results suggested a high prevalence of fundamental knowledge of, and positive attitudes towards PBD, though inconsistent practices with limited resources restricting the dissemination of more individualised advice. In addition, knowledge and attitudes were associated with midwives own dietary patterns; midwives following PBD displayed more positive attitudes towards PBD during pregnancy, and higher levels of preparedness to advise on plant-based nutrition. Our results also highlight some current needs and barriers to providing effective advice, and provide possible solutions to these, including physical resources that can be distributed to clients, and clear practice guidelines disseminated from a governing body, enabling a more consistent approach across the maternal health-care sector.

Nutrition knowledge requires continued professional development

Although the number of midwives reporting receiving formal nutrition training as part of their midwifery education is relatively low (56%), this represents an improvement compared to the 37% reported by Elias and Green in 2007 [11]. This is possibly due to a change in standard of midwifery education, overseen by the regulating body (Te Tatau o te Whare Kahu Midwifery Council), which outlines the requirement to provide education regarding nutrition for pregnancy, birth, and lactation [50]. Despite different reported experience of nutrition education, almost all midwives reported feeling prepared to advise their clients on general nutrition in pregnancy.

However, significantly fewer felt prepared to advise on plant-based nutrition. Previous research suggests this is a frequently occurring phenomenon with little improvement over 28 years of research, with midwives reporting feeling unprepared to advise on PBD [39] attributed to a lack of knowledge [10], and feeling least confident regarding advising vegetarian clients, compared with other common nutrition-related conditions [11]. Preparedness to advise on general nutrition and plant-based diets was higher than previous studies on midwives' confidence in providing nutrition advice. For example, Arrish and colleagues [38] found 87.2% of midwives reported moderate to high confidence in providing general nutrition advice and only 40.8% in providing vegetarian dietary advice. Although the prevalence of formal nutrition training appears to have increased, it is possible the education standards regarding nutrition require more PBD-focused content, or recent curriculum changes are yet to be reflected within the workforce. Crucially, nearly 60% of midwives reported basing their nutrition knowledge and advice on their midwifery nutrition education, therefore it is critical to ensure this information is comprehensive and up to date.

According to our results, midwives displayed a good foundation of plant-based nutrition knowledge. However, knowledge of emerging evidence correlating PBD and pregnancy outcomes such as decreased risk of gestational diabetes mellitus [51], hypertensive disorders of pregnancy [52], gestational weight gain [53, 54], and birth weight [53, 55, 56], was less robust. Although these are emerging concepts, they offer useful opportunities for midwives to tailor advice and clinical practice for their PBD clients, illustrating the importance of access to academic journals and professional development. Currently, Te Tatau o te Whare Kahu Midwifery Council requires midwives to undertake a minimum of eight hours per year of continued education. While this presents a convenient opportunity to improve nutrition knowledge, for example encouraging participation in a nutrition education programme [57], the requirements are significantly less compared with similar health professionals, such as nurses, who complete 60 h of training every three years [58]. Facilitating nutrition-focused continued education may be an effective way to curb the practice of gaining nutrition knowledge from social media, as reported by a small number of respondents.

Attitudes and practices

Despite the acknowledgement midwives are instrumental in providing nutrition advice, echoing findings of previous studies [10, 11, 26], more than two thirds of respondents reported believing clients are responsible for educating themselves about nutrition during pregnancy. This contrasts with findings published by Meulenbroeks and colleagues [10], where only 12% of midwives placed this responsibility with the client. This shift of responsibility to the mother may be reflective of concerns regarding time and ability to advise clients, frequently reported barriers to discussing nutrition. It may also reflect a core principle of midwifery practise, to provide support for pregnant women to make informed choices [59]. The higher expectation of knowledge placed on plant-based compared with omnivorous individuals could be viewed similarly. While research has shown general nutrition knowledge between these groups to be similar [60] or better (plant-based individuals) [61], there is little evidence to support the assumption that followers of PBD have an increased understanding of their unique pregnancy-nutrition needs. Certainly, pregnant women have been shown to be highly health-motivated, and driven to achieve positive health and developmental outcomes for themselves and their infants [62, 63], yet healthy eating intention is a poor predictor of actual dietary intake [64, 65], and studies frequently demonstrate poor adherence to pregnancy dietary guidelines [26–29, 66], and minimal dietary changes during pregnancy [67]. The effect of highly accessible, non-evidence-based sources such as social media [13] may promote an appearance of knowledge from clients, yet may be grounded in misinformation, and underscores the importance of the midwife as an influential knowledge source [4].

Despite the well-documented health benefits of PBD among the general population (e.g [68])..,, few midwives agreed PBD were better for mothers during pregnancy. It is widely believed by most nutrition societies that a carefully planned PBD can be safe during pregnancy [37], with health outcomes comparable to individuals following omnivorous diets [69]. Yet midwives' responses reflect a more cautious attitude towards them, with the high frequency of 'neutral' responses possibly a result of attitudinal ambivalence- the recognition of both advantages and disadvantages of PBD compared with omnivorous diets [70] during pregnancy.

Discussing intake of vitamins and minerals, and recommending dietary supplements were the most frequently reported practices when working with PBD clients. Individual and multi micronutrient supplementation is common in pregnancy [71]. In the current study, it appears to be a pragmatic, preventative approach to "fill gaps in [their] diet", echoing the views of pregnant individuals, who see dietary supplementation during pregnancy as an assurance their needs are being met [72]. However, recent research from Sauder and colleagues [73] highlighted that very few supplements meet the optimum requirements for key nutrients during pregnancy. In addition, the risks associated with excessive intakes are significant. Gallo and colleagues [74] found going beyond recommended intake levels for folic acid and iron was more common among those taking both multi micronutrient and individual supplements, correlating with higher, and occasionally excessive plasma levels of these nutrients. Many plant-based alternatives, especially plant-based milks, are fortified with critical micronutrients such as vitamin B_{12}, calcium, iron, folate, and iodine, therefore, midwives should consider the inclusion of fortified products in women's diets when recommending supplements to ensure optimal nutrition intake and avoid consumption beyond the recommended intake. Results from the current survey reiterate the importance of a targeted approach, with screening and monitoring throughout gestation.

The influence of personal dietary patterns

Knowledge of plant-based nutrition during pregnancy appeared to be influenced by midwives' personal dietary patterns- notably, midwives following PBD were significantly more likely to feel confident advising on them, affirming findings of previous studies among health professionals [41, 42]. However, this positive attitude also appeared to influence beliefs about PBD, for example, midwives following PBD were less likely to believe PBD during pregnancy heightens the risk of iron deficiency. Although research shows followers of PBD frequently have dietary intakes of iron at or above levels reported in omnivorous populations [75–77], they are still more likely to have low iron stores [77–79], often due to factors related to absorption (e.g. reduced bioavailability [80], and presence of inhibitors in plant-based foods [81]).

Similarly, positive attitudes towards PBD in pregnancy were also associated with personal plant-based dietary patterns, consistent with findings of previous studies [42, 82–84]. While it can be speculated this attitudinal influence is beneficial- facilitating a better understanding of client needs, it also reiterates the need for an objective understanding to ensure consistency across practices. Given the influence of midwives' own diets on their attitudes and beliefs about PBD, it is important midwives have access to reliable evidence-based information to inform their own diet choices. This highlights the importance of ensuring that accurate information about diet and nutrition is readily available to the general public and the increasing problem of health misinformation on social media [85].

Barriers and resources

Although midwives can refer clients to a dietitian, respondents also mentioned their struggle to do this within the public health system. Therefore, similar levels of referrals between plant-based and omnivorous clients may be reflective of limited resources rather than need. Ministry of Health resources frequently encourage PBD followers to request a dietitian referral from their midwife (e.g., Safe and Healthy Eating in Pregnancy [6]), possibly conflicting with the reality of midwives' practice. General Practitioners were infrequently mentioned in the responses, indicating a possible avenue for supporting PBD clients both before and during pregnancy.

Lack of time and feeling unqualified were frequently reported barriers to discussion nutrition with clients. While appointment time may be fixed, simple and effective resources could be developed and distributed, and knowledge could be built to counter this. Almost two thirds of midwives regularly use government or official websites, and always, or most of the time refer to MOH publications to gain evidence-based nutrition information. Yet gaining relatively specialised knowledge from general public-health resources is challenging, and there remains a significant information gap in terms of PBD. There is a clear need for an evidence-based, public-health resource specifically for PBD during pregnancy, to minimise midwife burden and ensure clients can easily access relevant information. Other resources could include practice protocols based on recommendations from a central governing body, including a basic form of dietary assessment, the most effective procedures for screening and monitoring for nutritional deficiencies, how to target supplementation, and ways to ensure dietary intake is adequate. The current system of continued professional development could be utilised to improve knowledge and confidence, particularly in areas of practical skills, such as dietary assessment. Due to inequitable maternal health outcomes prevalent in NZ, with Māori disproportionately affected [86], any initiatives or resources must be appropriate for the unique cultural needs of Māori, including considering Māori nutrition knowledge, holistic needs, and worldview [87], and use framework such as Atua Matua [88] or Te Whare Tapa Wha [89].

Ensuring PBD followers have access to evidence-based dietary information during their pregnancy should be a primary objective of maternal care, and midwives are frequently recognised as important sources of dietary

information during pregnancy [7–9]. The current findings suggest a potential gap in maternity support for PBD followers, which may be addressed by developing evidence based public-health resources accessible for both health practitioners and PBD followers [9], and developing practice guidelines to support health professionals working in this space.

Study strengths and limitations

The response rate of this study represents 10.7% of the LMC midwifery workforce, a lower response rate compared with KAP questionnaires in other workforces [e.g., 90, 91]. This may reflect the workload challenges faced by LMC midwives in NZ, as highlighted in previous research [44], and raises the risk of potential bias. Despite this, the demographic profile of respondents is comparable with a recent national workforce survey, notably, age, years practising, education, and ethnicity (Māori) [92], minimising the risk of selection bias. The rigorous consultation, piloting, and relationships with collaborators ensure the survey instrument is valid, relevant, and contributes to the midwifery workforce in NZ, as well as provides insights into maternity support in light of the global trend of adopting PBD. The unique structure of the midwifery workforce in NZ means midwives are highly skilled and frequently work autonomously. While this is a great advantage for maternity care, it may limit the generalisability of these findings in different settings.

Conclusion

The results of this novel study conducted within the unique midwifery care system of NZ suggest the need for additional support and training regarding PBD during pregnancy, and align with evidence from. The discrepancy between Ministry of Health recommendations to refer PBD clients to dietitians and midwives' perceived ability to do so, underscores the importance of addressing systemic challenges. Midwives play a crucial role in supporting PBD during pregnancy, yet they require better access to evidence-based knowledge and resources, and collaboration with other healthcare professionals. This study suggests existing challenges but also presents opportunities to improve care for PBD followers. Developing evidence-based information and practice guidelines are essential to bridge this gap, ensuring midwives and clinical practitioners are equipped to effectively support the growing population adhering to PBD during this critical stage of development.

Abbreviations

PBD	Plant-based diet
KAP	Knowledge, attitudes, practices
NZ	Aotearoa new zealand
MOH	The new zealand ministry of health| manatū hauora
LMC	Lead maternity carer

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

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Data availability

The datasets generated and/or analysed during the current study are not publicly available due to participant privacy but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The current study was reviewed and approved by the University of Otago Human Ethics Committee, reference 22/072. Informed, written consent was obtained from all participants via REDCap online data management software prior to data collection.

Consent for publication

Not applicable.

Competing interests

TSC has received grants from Zespri International, the Meat Industry Association Limited, and Beef+Lamb New Zealand Incorporated. TSC serves on the Health & Nutrition Science Advisory Group for Zespri International. All other authors have nothing to declare.

Author details

[1]Sensory Neuroscience and Nutrition Lab, Department of Food Science, University of Otago, Leith Street, Dunedin 9054, New Zealand
[2]Riddet Institute, Private Bag 11 222, Palmerston North 4442, New Zealand
[3]School of Midwifery, Otago Polytechnic, Forth Street, Dunedin 9016, New Zealand
[4]Department of Psychology, University of Otago, Leith Street, Dunedin 9054, New Zealand

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