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Indonesian antenatal nutrition education: A qualitative study of healthcare professional views

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Abstract

Background: Early lifestyle intervention, including antenatal nutrition education, is required to reduce the triple burden of malnutrition. Understanding healthcare professionals' views and experiences is essential for improving future nutrition education programmes for Indonesian pregnant women. This study aimed to investigate the views of Indonesian antenatal healthcare professionals regarding nutrition education for pregnant women and the improvements required to provide more effective antenatal nutrition education.

Methods: A descriptive qualitative study involved semi-structured interviews was conducted with 24 healthcare professionals, including nutritionists ($n = 10$), midwives ($n = 9$) and obstetricians ($n = 5$) in Malang, Indonesia, between December 2018 and January 2019. Data were analysed using thematic analysis.

Results: The study identified four main themes. First, healthcare professionals were aware of the importance of providing antenatal nutrition education, which included supporting its targeted delivery. Second, there were differing views on who should provide nutrition education. Most midwives and obstetricians viewed nutritionists as the prime nutrition education provider. Nutritionists were confident in their capability to provide nutrition education. However, some nutritionists reported that only a few women visited primary health centres and received nutrition counselling via this pathway. Third, healthcare professionals revealed some barriers in providing education for women. These barriers included a limited number of nutritionists, lack of consistent guidelines, lack of healthcare professionals' nutrition knowledge and lack of time during antenatal care services. Fourth, participants expressed the need to strengthen some system elements, including reinforcing collaboration, developing guidelines, and enhancing capacity building to improve future antenatal nutrition education.

Conclusions: Healthcare professionals play a central role in the provision of antenatal nutrition education. This study highlighted the importance of educational models that incorporate various antenatal nutrition education delivery strategies. These methods include maximizing referral systems and optimizing education through multiple delivery methods, from digital modes to traditional face-to-face nutrition education in pregnancy classes and community-based health services.

Keywords

antenatal nutrition education, healthcare professionals, midwives, nutritionists, obstetricians

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Introduction

Indonesia is a country experiencing a triple burden of malnutrition (TBM) and the consequential adverse health outcomes among its population.[1] TBM is defined as the coexistence of overweight/obesity, undernutrition, and micronutrient deficiencies.[2] These three nutritional problems in pregnant women, either singly or together, increase the risk of numerous health issues.[3] Maternal overweight or obesity during pregnancy has been correlated with negative pregnancy outcomes, including gestational diabetes,[4] pre-eclampsia,[5] preterm birth,[6] high birth weight,[4] low birth weight,[7] congenital malformations,[8] prolonged overweight/obesity,[9] and obesity-related morbidities.[10] Maternal antenatal undernutrition is associated with intrauterine growth restriction,[11] preterm birth,[12] low birth weight,[13] and maternal mortality.[3] Micronutrient deficiency, including iron, calcium, iodine, and zinc, is associated with the disturbance of foetal growth and development,[14] cognitive development,[15] immune functions,[3,16] and increases the risk of infant and maternal mortality.[3,17]

Recent and consecutive national surveys in Indonesia have shown the high prevalence of maternal and childhood TBM.[1,18] In 2018, the Indonesian national survey reported that the prevalence of obesity in women of reproductive age was 44.4%, and chronic energy malnutrition in pregnant women was 17.3%.[1] Furthermore, anaemia in more than one-third of pregnant women (37.1%) was reported in a national survey in 2013.[18] The prevalence of malnutrition in children under 5 years includes stunting (30.8%), wasting (10.2%), overweight (8%)[1] and anaemia (28.1%).[18] Therefore, addressing the TBM among pregnant women should be an urgent priority for public health interventions in Indonesia.

Studies have shown that pregnant women's sub-optimal nutrition status significantly contributes to their offspring's nutritional problems.[19,20] Nutrition education has been shown to alter nutrition status in pregnancy and reduce the risk of low birth weight,[21] sub-optimal gestational weight gain[22] and maternal postpartum weight retention.[23] Therefore, providing nutrition education across the antenatal period is essential to optimize maternal pregnancy health outcomes and minimize the initial risk for the development of TBM,[24] including the risk of childhood stunting and maternal obesity.

The Indonesian Ministry of Health recommends comprehensive and integrated antenatal care (ANC), including nutrition education, to obtain optimal health status for both the mother and child.[25] ANC in Indonesia is provided through multiple health channels, including public and private hospitals, primary health centres, and a number of maternal focused clinics, village clinics, and private midwives clinics.[25,26] Figure 1 illustrates the health system structure in Indonesia.[25,26] Within integrated ANC services in primary health centres, multidisciplinary healthcare professionals, including midwives, nutritionists, general practitioners, dentists, laboratory assistants and pharmacists, provide care.[27] The flow of the integrated ANC process in primary health centres[25–27] is illustrated in Figure 2.

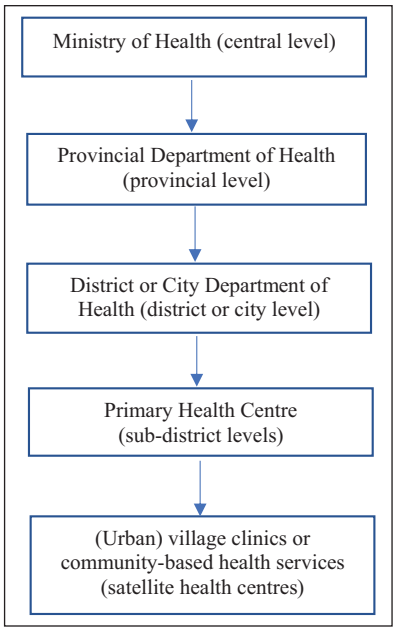

Figure 1. The diagram of health system organization in Indonesia.[25,26]

The delivery of ANC through multiple local systems may impact the consistency of antenatal health care and education for pregnant women.[28,29] Across Indonesia, local governments are frequently ill-equipped to support maternal and child health services adequately.[29] This condition places added pressure on the antenatal system and reduces opportunities for pregnant women to receive the ANC programme and optimal nutrition education.[29–31] Nutritionists or dietitians, who provide primary services, including nutrition education to pregnant women in the general population, work in primary health centres. Given the fragmented provision of ANC across the Indonesian community, these and other key health professionals potentially have a role in providing antenatal nutrition education.

While the Indonesian Government guidelines recommend nutrition education in all ANC services,[25] few studies have investigated the provision of Indonesian nutrition education and healthcare providers' experiences and views of antenatal nutrition education delivery. Similarly, limited research exists in other developing countries. Studies in rural India[32] and Tanzania[33] have found that lack of guidelines, training and limited consultation times prevents healthcare professionals from providing nutrition education. The only Indonesian study by Widyawati et al.[34] revealed that lack of midwives' capacity, insufficient facilities, cultural beliefs and low participation of families in antenatal programmes prohibited them from providing adequate antenatal nutrition education. Similar findings have also been seen in developed countries. Some studies

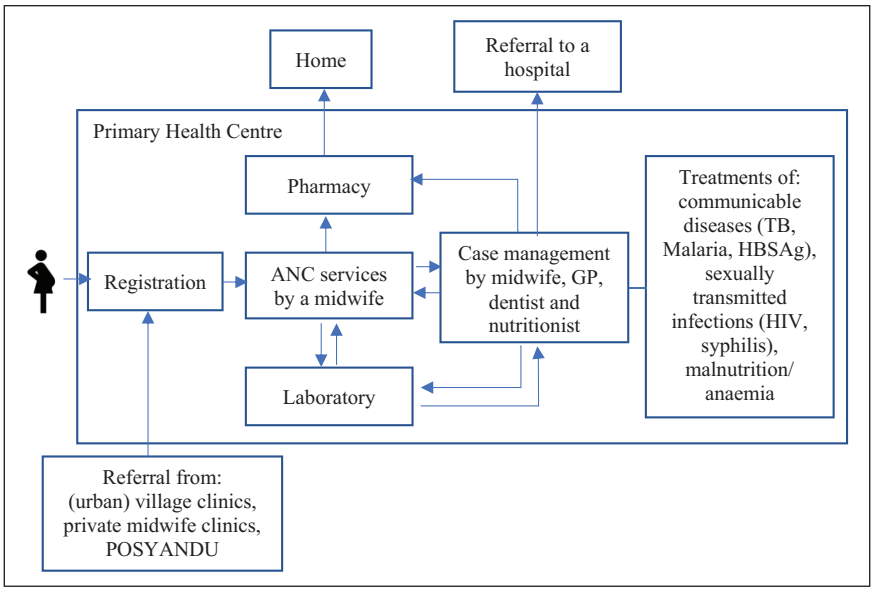

Figure 2. Flow chart of the integrated antenatal care process in primary health centres.[25–27]

in Australia[35–38] and the United States[39] have shown that health professionals are aware of the importance of antenatal nutrition, but many do not provide antenatal education.

The reported barriers to providing nutrition education include limited consultation time,[39] financial barriers,[36,37] lack of organizational structure,[36] lack of pregnancy advocacy groups,[37] limited knowledge and training,[35] lack guidance,[35] and lack of women's interest in the education provided.[38] These studies demonstrate that while guidelines may be in place, antenatal nutrition education may require examination and improvement to be effective and meet the needs of women.

This study aimed to investigate Indonesian antenatal healthcare professionals' views regarding the provision of antenatal nutrition education and the improvements required to provide effective antenatal nutrition education. Understanding healthcare professionals' views of existing antenatal nutrition education is one element required to facilitate the development of effective antenatal nutrition education programmes that aim to alleviate the TBM for both mothers and their offspring.

Methods

Study design

The qualitative study reported in this article is part of a mixed-methods investigation of Indonesian women's need for antenatal nutrition education in Malang, Indonesia.[40–43] Descriptive qualitative research,[44] using face-to-face semi-structured interviews,[45] was conducted with healthcare professionals (nutritionists, midwives and obstetricians) in Malang City, Indonesia, between 21 December 2018 and 20 January 2019. Malang City is one of the increasingly urbanised[46] cities in Indonesia, with a moderate population density and a range of people across Indonesian socio-economic strata.[47]

The Consolidated Reporting Criteria for Qualitative (COREQ) studies were used to design and report this study (Supplemental file 2).[48] This study was conducted according to the guidelines laid down in the Declaration of Helsinki. All procedures involving human subjects were approved by the Deakin University Faculty of Health Ethics Advisory Group (Reference HEAG-H 196_2018).

Participants and recruitment

Healthcare professionals who provide ANC services in Malang City, Indonesia, including midwives, nutritionists and obstetricians, were purposively selected. In 2015, the number of midwives, nutritionists and obstetricians who provide service, including ANC, in Malang City were estimated to be 733, 177 and 48, respectively.[49] ANC health care facilities include 16 primary health centres, 25 hospitals and multiple public and private clinics.[49] The sampling selection was based on a maximum variation sampling strategy. Therefore, the researcher selected healthcare professionals who provide services across the Department of Health, primary health centres, urban-village clinics, as well as government and private healthcare facilities based on the recommendation from the Malang City Department of Health or snowballing techniques from healthcare professionals.

Figure 3 illustrates the ANC system in the study area and the position of healthcare professionals who were sampled in this study. The three groups of healthcare professionals were chosen because of their role in providing ANC or nutrition education to pregnant women in Malang.

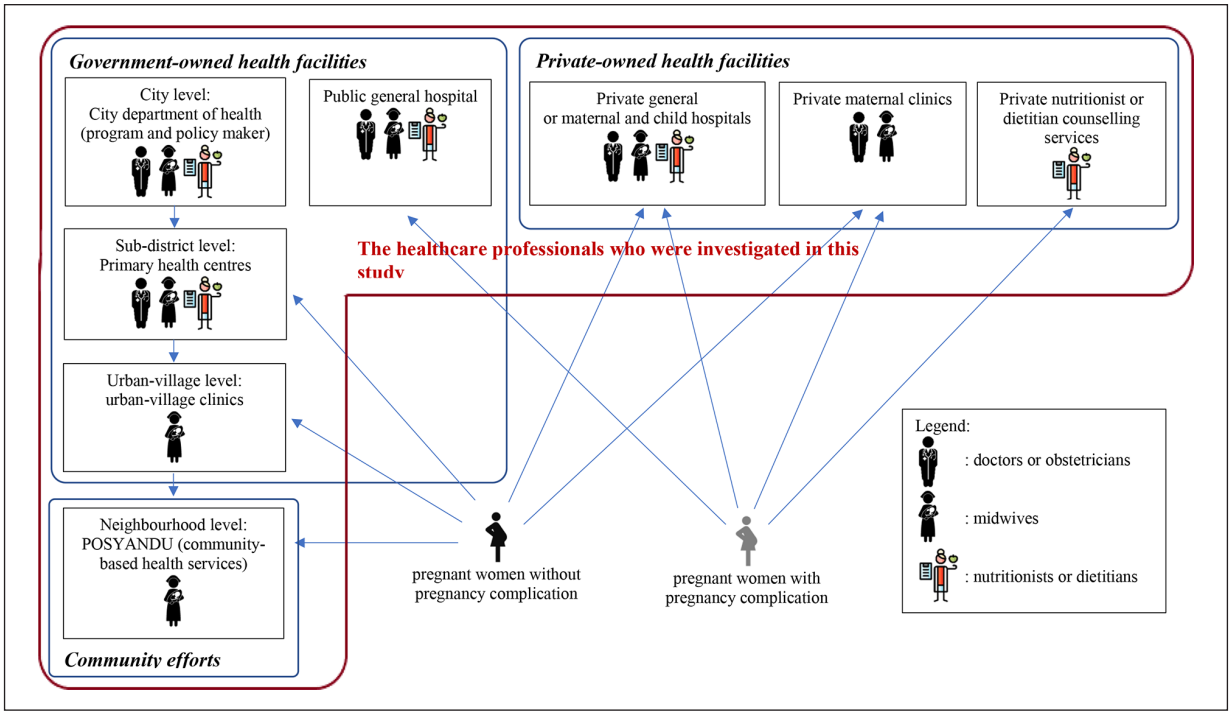

Figure 3. The contextual position of healthcare professionals in the antenatal care system.

The inclusion criteria were: working as a registered midwife, nutritionist or obstetrician, providing antenatal services or nutrition education to pregnant women in the Malang area for at least 3 years, and aged 18 years or older.

Participants were invited to the study by means of a mailed letter consisting of a short description of the proposed study, a plain language statement, and an informed consent form (in Bahasa). Participants who agreed to participate contacted the researcher (W.R.) via phone or WhatsApp, then signed the consent form and returned it to W.R. in person at the time of the interview.

Data collection procedures

The face-to-face, semi-structured interviews were arranged to be held at the most convenient time and place for the participants, such as each participant's workplace. The interviews were audio-recorded with the consent of the individuals. All the interviews were conducted in Bahasa by W.R., who is a local Malang City resident, a nutrition academic and PhD candidate and who had completed a qualitative research unit course prior to the interviews.

The recruitment of the participants was stopped when the data saturation was reached.[50]

Interview guide

Participants were asked several questions around the three key themes of antenatal and food nutrition issues, experiences of antenatal nutrition education and expectations of antenatal nutrition education. The questions for the interview guide were informed by previous research.[35,37] The questions were:

1. What do you think the key antenatal nutrition issues are? What do you think the barriers and enabling factors are for women to eat well in pregnancy?
2. Could you share your general opinions and experiences about antenatal nutrition education for pregnant women in Malang City?
3. Could you please tell me your expectations about antenatal nutrition education? What should be done to improve the effectiveness of nutrition education for pregnant women in Malang City?

Data analysis

All the interviews were conducted by the first author (W.R.) in Bahasa. The transcription process and translation process (from Bahasa to English) were carried out by W.R. or independent local transcribers (nutrition graduates) and independent translators (English linguistics graduates) under the supervision of W.R.

A thematic analysis method, specifically a reflexive thematic analysis, was used[51] which allowed the use of both predefined deductive themes obtained from the literature and inductive themes identified from the interview process.[52] Thematic analysis is a qualitative method that is focused on identifying and describing both explicit and

Table 1. Characteristics of participants.

Characteristics	*n* (%)
Healthcare professionals' specialists	
- Nutritionists	10 (41.7)
- Midwives	9 (37.5)
- Obstetricians	5 (20.8)
Education background	
- Three-year diploma	9 (37.5)
- Bachelor's degree	7 (29.1)
- Postgraduate or specialist	8 (33.3)
The distribution of participants based on their service place	
- Primary health centre	9 (37.5)
- Urban-village clinic	5 (20.8)
- Private healthcare facility	4 (16.7)
- Both government and private healthcare facility	3 (12.5)
- Department of health	2 (8.3)
- Department of health and primary health centre	1 (4.2)
Years of practice (mean ± SD)	13.9 ± 6.9

SD: standard deviation.

implicit ideas, which moves beyond counting explicit words or phrases.[53] The interview transcriptions were read independently by two researchers (W.R. and J.W.) to derive a more nuanced interpretation of the phenomenon[48] and to ensure the emerging themes were consistent.[54] To discover patterns of meaning across data sets, two of the researchers (W.R. and J.W.) used six phases of thematic analysis: (1) familiarizing with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes and (6) producing the report.[55]

Results

Participant characteristics

From 28 healthcare professionals (10 nutritionists, 9 midwives and 9 obstetricians) who were invited to participate in this study, 24 (86%) consented and undertook interviews (10 nutritionists, 9 midwives and 5 obstetricians). Two obstetricians did not respond to the invitation, while two other obstetricians verbally agreed to be interviewed but did not have a suitable time for the interview. The interviews took approximately 34.3 ± 16.6 minutes to complete.

Table 1 presents the characteristics of the 24 participants. Nine participants (37.5%) had a 3-year diploma, eight had postgraduate or specialist qualifications, and seven (29.1%) had a bachelor's degree. The healthcare professionals served in a variety of ANC areas, including primary health centres ($n=9$), urban-village clinics ($n=5$), private ANC ($n=4$), both government hospital and private ANC ($n=3$), the Department of Health ($n=2$) and both the Department of Health and primary health centre ($n=1$). The participants' experience working in their current professions averaged 13.9 years (range: 3–27 years).

Themes from research

The analysis of the participants' responses identified four main themes about the provision of education in the Malang area: (1) healthcare providers were aware of the importance of, and support, nutrition education; (2) there were differing views on who should provide education; (3) healthcare providers revealed some barriers and limitations for them to provide education and for women to access it, and (4) participants expressed the need to strengthen some system elements, including reinforcing collaborations, guidelines and capacity building, to improve future nutrition education.

Theme 1: healthcare professionals were aware of the importance of optimal antenatal nutrition and support, nutrition education

Almost all healthcare professionals were aware of antenatal nutrition issues in the Malang area. Most of them focused on nutrition deficiencies, such as chronic energy deficiency (CED) and anaemia. Some revealed that they saw many cases of anaemia and CED.

> So, many pregnant women are with CED . . . and anaemia. There are a lot of anaemia cases here. (Nutritionist 5)

> In this health centre area, there were some cases of LBW (low birth weight) . . . We need to be concerned when women are pregnant and when they are an adolescent. Many women suffer from anaemia or CED. (Midwife 5)

However, a few healthcare providers, mainly nutritionists and obstetricians, were also aware of the double burden of malnutrition, including overnutrition and excessive gestational weight gain that may have resulted in negative outcomes such as gestational diabetes.

> Gaining too much weight during pregnancy is not good. The pregnant woman has a risk of preeclampsia. Thus, there should be a limit to how much weight she can gain. (Nutritionist 1)

> The nutrition problems of pregnant women that I frequently found were both underweight and overweight. (Nutritionist 9)

> A four-month foetus doesn't need a plate of rice. The extra [calories] would be accumulated in the mother's body, right? . . . Then the risk of obesity in pregnancy is gestational diabetes, hypertension and macrosomia. (Obstetrician 4)

In addition to the adverse health outcomes from poor antenatal nutrition, some of the health professionals reported concern about women's nutrition knowledge and beliefs and the quality of their food intakes. Most of the healthcare professionals cited the limited nutrition knowledge and awareness among the women, their families and

the community about healthy eating. This ranged from poor knowledge of nutrients and food intake to the lack of awareness of the negative outcomes of poor nutrition.

> Overall, pregnant women usually eat a lot of food, but they don't understand the nutrients they need. (Obstetrician 1)

> They didn't know the concept of the dietary requirement for pregnant women. (Nutritionist 9)

> [The cause of the nutrition problems in pregnancy is] the low level of community's knowledge about nutrition status, dietary pattern or caring behaviour. . . . Then, the domination or influence from those people closest to pregnant women. (Nutritionist 2)

A number of healthcare professionals, mostly nutritionists and obstetricians, viewed the misleading beliefs of some women about avoiding certain foods as being due to traditional 'food myths or taboos', personal food preferences or the custom of 'eating for two', which results in sub-optimal intakes.

> Maybe because of the lack of information about the consumption of food for pregnant women. . . . Then some myths or food taboos. (Nutritionist 6)

> The main cause of being underweight is because they have a lot of dietary restrictions. Many women told me, 'I don't want to eat this or that food'. (Nutritionist 9)

> There are still a lot of women who think that pregnant women need to eat food for two people. They complain, 'Doctor, I can't eat rice [due to nausea], even though I'm supposed to eat for two people'. (Obstetrician 5)

While food insecurity was noted by four nutritionists working in primary health centres, three nutritionists and two obstetricians working in private or public health care reported that while many women were able to afford the food, they did not know how to select healthy foods.

> I don't think [undernutrition] exists because of economic status. They could access WhatsApp and buy a smartphone but were experiencing anaemia or chronic energy malnutrition. (Nutritionist 8)

> Because our clients are middle to upper class, they could afford the food. But they don't know the composition of healthy food and dietary recommendations for pregnant women in detail. (Obstetrician 1)

All the healthcare professionals agreed with the importance of antenatal nutrition education as a vehicle to promote optimal nutrition and impact health outcomes for both the child and the mother. The generational influence of antenatal nutrition was of particular focus.

> When we want to prevent stunting, we can't just solve it now. We have to go much further before. If we can manage nutrition in pregnancy well, we can solve three big problems: maternal mortality, infant mortality and stunting. So, nutritional interventions in pregnancy are essential. (Nutritionist 1)

> Everything in our body comes from food. Dietary interventions during pregnancy matter a lot. I told my clients that they could give their children the best start with good nutrition during the pregnancy period. (Obstetrician 1)

It was acknowledged by two participants that while many women had received nutrition education, the current education models may not be enough to build capacity.

> Some of them already have the knowledge. They already know the information, but they don't know how to apply it. (Nutritionist 5)

> Why do these nutritional problems still exist? The main cause is the lack of knowledge about how to assess anaemia and how to solve it. Although we have educated them, I think we need to improve the educative process again and again. (Nutritionist 3)

Concern was also expressed by 10 participants about the prevalence of unreliable nutrition information either from digital sources, family, friends or other health professionals. The countering of the misinformation from the Internet and the community was seen to be a crucial role in formal nutrition education. Several healthcare professionals discussed the importance of including the women's family in antenatal education and acknowledging digital sources of information.

> They [pregnant women] read social media. The information in social media is not reliable, but it is understood by them as truth. (Obstetrician 1)

> The obstacle is that they are living in one household with their parents or parents-in-law. So, there are a lot of messages, such as 'this food is not allowed'. Sometimes, the messages were not suitable for what women needed. (Obstetrician 5)

> We frequently conducted education and counselling. But they did what they were told to do by their closest persons. Either neighbours, parents or parents-in-law, or their aunt. (Nutritionist 2)

Theme 2: differing views about who should provide antenatal nutrition education

There were several modes of antenatal nutrition education used by or known to the participants. These include nutrition counselling, nutrition education within pregnancy classes, group nutrition education in primary health centres (PUSKESMAS) or community-based health services (POSYANDU) and home visits. Most of the participants viewed the nutritionist as the main nutrition education

provider. There were mixed views of both obstetricians and midwives about their roles in nutrition education.

Mostly, health care professionals supported antenatal nutrition education and preferred collaboration with nutritionists for the integration of care.

> Nutritionists are going to handle the nutrition education program since they learn more about that. (Midwife 8)

> Antenatal care should include medical professionals and nutritionists and must be integrated. (Obstetrician 2)

The nutritionists also perceived themselves as experts in nutrition education and were confident in their capability to provide it. They were, in turn, surprised that nutrition information was not delivered by other antenatal health professionals.

> In the beginning, I thought that when pregnant women saw a healthcare professional, they would get information about nutrition. But, it turned out that nutrition information was not delivered much by colleagues from other professions. (Nutritionist 2)

While four obstetricians stated that they didn't have enough time to provide adequate nutrition advice, two revealed that they still tried to provide nutrition education to pregnant women, despite the limitation of time.

> Frankly, I have never provided adequate education to pregnant women. Because I don't have enough time. (Obstetrician 2)

> I give a lot of advice about nutrition, what food is allowed and not, and to eat more varied foods. . . . Sometimes I educate clients that if they read the information on Google, please check who the writer is. (Obstetrician 4)

Most midwives who oversaw maternally and child health services at urban-village levels reported that they usually tried to provide nutrition education for pregnant women. One midwife reported that she provided only a little nutrition information based on women's questions because of time, or because she perceived the woman to be healthy or that she did not need a lot of nutrition information.

> During early pregnancy, most women are nauseous. I usually educate them, 'Eat a small portion but often, instead of a big portion at once'. (Midwife 2)

> Midwives' clients are numerous, and most of them are healthy. I asked, 'Do you have any questions?'. I gave the information briefly. I usually make sure to ask, 'You are healthy, aren't you?' At least I advised, 'Maintain your meals, drink milk, eat lots of vegetables and get enough rest'. If I explained the information in detail, they would forget it [laughs]. (Midwife 7)

Three of four midwives who provided services at the health centre reported that they usually referred all pregnant women to a nutritionist. One midwife reported that she would only refer pregnant women to a nutritionist if the women had nutritional or pregnancy health issues.

> For more specific advice about nutrition, we were assisted by the nutritionist. . . . Because we have an integrated antenatal care service. (Midwife 1)

> When we found an underweight or anaemic pregnant woman, we would refer her to the nutritionists. . . If a woman did not have any problems, or when nutritionists were on outside service, a midwife would educate her. (Midwife 8)

One obstetrician confessed that by the time women consulted her, malnutrition was often significant.

> Sometimes, I found women with low foetal growth rates or anaemia. . . . [I asked her] 'How was your eating? You should eat good food'. I knew that it was a bit late. (Obstetrician 5)

Theme 3: barriers to the provision of and access to nutrition education

Healthcare professionals identified some barriers to the provision of nutrition education. These included the limited number of nutritionists in health centres and ANC facilities, lack of nutritionists' capacity, lack of national guidelines on nutrition practice during pregnancy, lack of healthcare professionals' nutrition knowledge and lack of time available for the provision of ANC services.

The lack of nutritionists and resourcing in ANC facilities and primary health centres was the most frequently mentioned barrier to the provision of nutrition education. Obstetricians and midwives reported the scarcity of nutritionists in ANC teams and in the community and expressed the need for more nutritionists to work with large numbers of pregnant women.

Three obstetricians recognized that they needed a nutritionist in their ANC team but were currently without one.

> Ideally, to provide antenatal care, there should be a team. I can monitor the overall health of the mother and baby. And there should be a nutritionist in my team. . . . So far, we don't have one yet. (Obstetrician 1)

While healthcare professionals in three health centres reported that they involve a nutritionist in pregnancy classes, nutritionists in one health centre and in private ANC services revealed that pregnancy classes were not conducted regularly or did not involve a nutritionist to provide nutrition education.

> In a pregnancy class, we have four meetings. We usually invite a nutritionist to provide nutrition education in one meeting. She would provide education about nutrition for pregnancy, after delivery and breastfeeding. (Midwife 6)

> In the past few years, we conducted pregnancy classes regularly. We [nutritionists] were invited by midwives [to provide nutrition education]. But now, I am not invited anymore. (Nutritionist 5)

> At this [private] hospital, we have pregnancy classes. But they don't involve a nutritionist there. Only midwives provide education. (Nutritionist 10)

By contrast, three of four health centres ran an 'integrated ANC services' programme which included nutrition counselling by a nutritionist for all pregnant women who attended the health centres at least once in their pregnancy. If a pregnant woman has pregnancy or nutrition issues, she can be referred again to the nutritionist until her problem is solved.

> In this health centre, every pregnant woman who visits the health centre must be referred to a nutritionist, both women with or without nutrition problems". (Midwife 3)

> All pregnant women have to consult with a nutritionist, even if they don't have any nutrition problems. . . . A healthy pregnant woman will meet a nutritionist on their first visit. If they are at risk, they will meet the nutritionist at every visit. (Nutritionist 6)

The lack of nutritionists to allow servicing of the large numbers of pregnant women and health professionals' lack of familiarity with nutritionist services was noted by many.

> Well, the problem is the number of nutritionists in Malang. How come I don't know them [nutritionists], other than those in the hospital! (Obstetrician 4)

This scarcity of service meant that many women who required a nutritionist consultation missed out, or health professionals only referred those with the most urgent nutrition issues.

> Our nutritionists are two, but now there is only one because one nutritionist is on maternity leave. The pregnant woman who really needs to see a nutritionist sometimes leaves without seeing one. (Midwife 3)

> A pregnant woman will be referred to nutrition counselling if she has anaemia, chronic energy deficiency or high-risk pregnancy issues . . . such as low gestational weight gain, preeclampsia or high blood pressure. (Nutritionist 2)

The nutritionists noted their lack of capacity to provide nutrition education for everyone. The limited-time available to cover large numbers of pregnant women in the community and the extensive number of responsibilities reduced their ability to provide adequate education to pregnant women.

> I wish we could ask for one nutritionist in every urban village, like an urban village midwife. . . . So, I could understand our area and pregnant women well. . . . Now, there are so many people that I need to tackle. (Nutritionist 6)

> Because we don't just care for pregnant women, we take care of a lot of tasks. . . .. We also have a lot of nutrition programs. From toddlers, infants, . . . and the elderly too! (Nutritionist 5)

Nutritionists commented that they sometimes did not receive referrals from the ANC midwives at the health centre. Some tried to reach pregnant women when they visited POSYANDU (community-based health services); however, women rarely visited those services.

> We usually missed pregnant women who the midwives did not refer. We usually tried to reach out to them at the POSYANDU, but there were not many pregnant women there. . . . So, most of them just have contact with a midwife. (Nutritionist 2)

The lack of clearly articulated nutrition guidelines for pregnancy was mentioned as a barrier by nutritionists. This was seen to cause conflict between health professionals and was a cause of concern for the nutritionists, particularly.

> Sometimes, I advised a pregnant woman to reduce her consumption because the food she needs is not as much as the amount she eats now. . . . But, when the women see the OBGYN [Obstetric and Gynaecologist] again, the OBGYN asked, 'why did you reduce your meals?' Indeed, I arranged her diet based on her needs! (Nutritionist 9)

> Sometimes, the person who prohibits the consumption of seafood is their midwives . . . because of mercury content. I think it is an old reason. (Obstetrician 4)

Furthermore, the lack of models of care or implementation guidelines for antenatal nutrition education to allow consistency of education was mentioned by all health professionals. Integrated ANC and pregnancy classes, including nutrition education, were not carried out consistently among healthcare facilities. The lack of adequate and up to date nutrition knowledge was an obstacle expressed by five midwives. Three midwives disclosed that their nutrition knowledge was based on information they received during midwifery education or that they had sought it themselves. One midwife revealed that she relied on the information provided in the Maternal and Child Health (MCH) books.

> For us as midwives, we just understand the outer layer of nutrition science. My nutrition knowledge is as much as that I received from midwifery education, reading books or searching the Internet. . . . There is no nutrition training for midwives. (Midwife 5)

> As midwives, our knowledge about nutrition for pregnant women is limited to what is written in the MCH [Mother and Child Health] book. . . . For more detailed information, it is

better if nutrition education be provided by a nutritionist. (Midwife 3)

Two midwives also expressed their misunderstandings about nutrition principles on topics such as the quantity of food and energy required during pregnancy. One midwife reported that she usually advised pregnant women to eat twice as much food as non-pregnant women. Another midwife reported that she wanted pregnant women in their area to be fat to prevent low-birth-weight babies.

My advice to them [pregnant women] is they have to eat twice as much food as women who are not pregnant. (Midwife 4)

I want all pregnant women in my working area to be fat [laughs]. The problem is if there is a case of LBW [low birth weight], right? If there is a case of LBW (low birth weight), it has more adverse effects on the baby after birth. (Midwife 6)

The lack of awareness among women about the importance of antenatal nutrition education and the key antenatal nutrition principles was noted as a concern by some healthcare professionals. A few healthcare professionals regretted that not many women attended pregnancy classes and nutrition education sessions.

From our observation, the pregnancy classes were not optimal. We expected one group to be attended by 15 pregnant women. However, only seven or fewer women attended it. A lot of pregnant women did not attend. (Nutritionist 2)

Some women were reluctant to attend ANC classes and education. One nutritionist reported that there were some women who trusted traditional birth attendants and refused the services of healthcare professionals who approached them.

There are some groups of people that are . . . hard to approach. . . . They didn't allow health professionals to check their pregnancy. Some of them still trusted traditional birth attendees. (Nutritionist 8)

The reluctance of women to attend education was also reported by nutritionists from private and public antenatal services who worked with higher socio-economic women who refused nutrition care. They appeared to be unaware of the importance of antenatal and nutrition education, even though they were well educated and were from higher socioeconomic strata.

Sometimes, from the women's faces, I could see that they actually rejected what I explained to them. Back again, to personal awareness. Sometimes, they think that nutritional knowledge is not very important. (Nutritionist 10)

We are very difficult to access women from middle-to-high [socio-economic strata]. . . . When we [health workers] visited their house [for a health program], we were not welcomed. (Midwife 5)

However, one private nutritionist believed that women from high socio-economic levels mostly have a good awareness of nutrition, and they could search for their nutrition information themselves.

I think pregnant women from middle-to-high socioeconomic levels already have good health awareness. They report their pregnancy to a doctor or midwife every month. . . . I am not worried about them. (Nutritionist 9)

A few healthcare professionals from primary health centres also expressed regret that pregnant women from higher economic strata did not want to access her primary health centre, where they could help to monitor their condition. Previously there had been a case of maternal mortality in one of these centres because the woman did not report her pregnancy to the primary health centre but to a private health facility. Therefore, the health centre officers could not monitor the woman's pregnancy health. The midwife perceived that although private health facilities have good services, however, not all conduct monitoring as recommended by the Indonesian government.

After ten years of no case or maternal mortality, then we have it one this year – that who is reporting her pregnancy to a private hospital. . . . People think that a private hospital is better. It is indeed good, but we also need monitoring. We [primary health centres workers] have monitoring standards imposed by the government. . . . Not all hospitals follow that. (Midwife 5)

Theme 4: various system elements for system improvement

All of the health professionals were able to identify areas of the ANC system where nutrition education could be strengthened. These included several strategies: (1) the strengthening of nutrition implementation via upgrading guidelines and collaboration between healthcare professionals, (2) the development of digital delivery systems, (3) recruitment of community volunteers and (4) nutrition education training for healthcare professionals.

Improved guidelines for the implementation of nutrition education. One key element identified by many participants was the need for explicit and consistent regional specific nutrition education implementation guidelines, models of care and education resources.

Some healthcare professionals viewed the importance of collaboration between healthcare professionals as a crucial element for these implementation guidelines to provide optimal antenatal nutrition education.

> A doctor does not have enough time to provide nutritional counselling. So, there must be another health worker [a nutritionist] to provide nutrition education. (Obstetrician 2)

> It could be cooperation between some OBGYN doctors and a nutritionist. So, pregnant women can be consulted by a nutritionist or included in WhatsApp groups organised by a nutritionist. (Obstetrician 4)

Several healthcare professionals suggested the more resourcing of public nutritionists with clear treatment models, such as integrated ANC and pregnancy classes. For example, three of the primary health centres had implemented the integrated ANC where the midwife screened and referred all women to receive nutrition counselling.

> All pregnant women in this health centre must be consulted with a nutritionist, even though they do not have any nutrition problems. . . . A healthy pregnant woman will meet a nutritionist once. If they have a risk, they would be referred to meet a nutritionist in every ANC visit. (Nutritionist 6)

> In the 'integrated antenatal care' procedure, every pregnant woman will be referred to a nutritionist in their first visit. We will refer them again in the following visit when women still have a risk of anaemia or chronic energy deficiency. (Midwife 1)

One of the healthcare professionals wanted the development of nutrition education guidelines that can be used by all healthcare professionals in the field to improve outcomes for women.

> I hope there is a standard for all health centres, in the form of short and simple written material about pregnancy health problems including nutrition, that can be delivered by all urban-village midwives or health workers who provide services in POSYANDU [community-based health services]. (Midwife 3)

A review of the way education was delivered was recommended by a few healthcare professionals to aid in improving the uptake of education programmes and making the programmes more engaging.

> Even though it [nutritional counselling] is an old method and not interesting, maybe we can make it interesting. Yes, nutritional counselling or lecture. They can conduct those activities on certain days. (Obstetrician 4)

Five nutritionists expressed the view that new models need to be developed to maximize the capacity building of women in the short amount of time provided for education. The nutrition information they provided during nutrition counselling sessions and pregnancy classes was not perceived as adequate to help women gain the required information and make behaviour change. Some reported that they tend to give as much information in one session of nutrition counselling or pregnancy classes because that is the only opportunity they have.

> The topics delivered to a healthy pregnant woman during nutrition counselling is healthy nutrition for pregnant women, the first 1000 days of life and exclusive breastfeeding. . . . Nutrition advice for women who have nutrition problems is almost the same. (Nutritionist 6)

> I attended one session of four pregnancy class meetings to deliver nutrition information. . . . I provided complete information, from nutrition in pregnancy, breastfeeding and nutrition for lactation. Because they [midwives] only gave me one session. (Nutritionist 8)

Reviewing and creating new models of education was seen to be required to access women across the community and across the pre-pregnancy, antenatal and postnatal time frames. Some nutritionists disclosed that they expect they could provide more nutrition education sessions.

> I think our nutrition education was not adequate. If possible, once a month, when pregnant women visit the health centre would be preferred. Then we also have a 'health volunteers accompanying program' to monitor pregnant women's food and supplement intake. (Nutritionist 4)

> Because it is difficult to handle if the problem has been suffered by pregnant women, such as anaemia. It takes a long time to overcome. In fact, we have to prepare for it before pregnancy and involve their family. (Nutritionist 8)

Given the influence of the women's families and communities on their nutrition information and food intake, several health professionals recommended designing education to incorporate the women's family.

> Women's family influence is quite big, right? So, our target is not only pregnant women but also their husbands and parents. If I educated a pregnant woman, but their husband did not know about what I said, that was useless. (Nutritionist 8)

> I think it ought to be better to approach pregnant women and their families. . . . Typically, grandmothers play an important role. They said, 'you are not allowed to eat that food because it will cause something bad'. (Midwife 9)

Increased promotion and communication about the role and services of nutritionists and other healthcare professionals do was seen to be important to ensure that the community is aware of the benefits of contacting and consulting with nutritionists and health centres.

> Nutritionists need to improve their performance and promote their profession so that other professions and communities are aware of their roles. (Nutritionist 9)

> We have to improve the brand image of our health centre. Not only by staff of the health centre but we also ask the assistance

> of cross-sector institutions to advertise that our health centres now have much improved. (Nutritionist 4)

Digital delivery. The creation of digital delivery systems for antenatal nutrition education and information for women, health professionals and the community were seen to be important by many participants. Digital delivery could augment current education and care and potentially reach women who did not traditionally access education. The need to use the digital channels that women frequently used was emphasized.

> Young mothers frequently access Instagram, WhatsApp, or Facebook. Yes, it [nutrition education] can be socialised through social media. (Obstetrician 3)

> Because we are living in a city, pregnant women on average will access the Internet. . . . If [information provided via] billboard or leaflets, ah, women wouldn't read it. (Nutritionist 4)

While several healthcare professionals acknowledged that some information provided via the Internet and social media was unreliable, they saw these channels as an opportunity for healthcare professionals to provide reliable and easily accessible nutrition education. It was also seen as an opportunity to be able to educate and guide women about how to assess online health information.

> Many people who didn't have a nutrition education background explained about nutrition for pregnancy on Instagram. . . . If we [nutritionists] have the capabilities to create interesting messages, we can educate people via social media. (Nutritionist 10)

> The nutritionist association might conduct webinars or develop a website for pregnant women. Or maybe the WhatsApp group is organised by nutritionists. (Obstetrician 4)

Four nutritionists reported establishing WhatsApp groups or providing women with their personal WhatsApp contacts to give women opportunities to discuss nutrition outside the education sessions. This was seen to increase the connectivity with and engagement of women.

> I have created a WhatsApp group after a pregnancy class meeting. The members were 15—thirteen pregnant women, one midwife and myself (a nutritionist). . . . So, they can ask freely via the WhatsApp group. (Nutritionist 8)

> After nutrition counselling, I provided my WhatsApp number. They usually contact me again to ask some questions. 'Ma'am if I eat like this, is this suitable with your advice yesterday?' (Nutritionist 9)

Two participants reported that the Malang Department of Health and its associated community health centres have a website and social media accounts such as Instagram and Facebook. Malang Department of Health collaborated with several mass media outlets to share their activities and programmes.

> Malang Department of Health has a website, Instagram and Facebook. . . . We also collaborate with five local newspapers, . . . seven television stations . . . and four radio stations around Malang. . . . They help us to deliver information and share our programs and experiences. (Nutritionist 7)

One participant was concerned about resources and updating digital tools to maintain relevant information and reach. Another participant reported the importance of collaboration to manage and digital delivery.

> Our health centre has an Instagram account, a website and Facebook. But we don't update them often [laughs]. The information may not be up to date. Because our resources are not good enough to do that. (Nutritionist 3)

> If we have developed digital messages, I wonder where we should put the message. Should we put in blogs or how? I think we need to cooperate with others. (Nutritionist 4)

A third participant proposed a combination of approaches for delivering nutrition education: a user-friendly digital nutrition education platform to reach women from middle-to-upper socio-economic levels and a strengthening monitoring system for women from middle-to-lower socio-economic levels.

> I think we need user-friendly education via smartphones. Everything such as web-based information can be accessed easily by the community. . . . For medium-to-low socio-economic levels, I think the Department of Health Office has a monitoring system, such as a smartphone-based undernutrition monitoring system. (Nutritionist 9)

Volunteers. The Indonesian system for using health volunteers (cadres) to visit women was viewed as an important method for screening women for malnutrition and an opportunity for strengthening and broadening the reach of education. Cadres were often relied on by healthcare professionals as the first line to educate women in the community. Similarly, visiting community midwives were considered as having opportunities for screening, education and referral to nutritionists.

> If midwives find undernutrition cases, please let me know, and I will handle it because I need to stay in the health centre for nutrition counselling every day. We only have two nutritionists here. (Nutritionist 8)

> In the accompanying process, health volunteers monitor pregnant women four times in one month. Once a month, they refer the pregnant women to the nutritionist and the midwife for further analysis. . . . Then, we educate the women. (Nutritionist 2)

Cadres were viewed as being a close and trusted conduit between the women and health professionals if there was a problem and when women lacked the resources to contact health professionals.

> If a pregnant woman who does not have a contact number suffers from a pregnancy issue, often the cadres contact me, 'Ma'am, Mrs X, who doesn't have a cell phone, feels like this'. Then I advised the cadres to convey a direction to the woman. (Midwife 2)

One nutritionist was confident that she could train health volunteers (cadres) as the first line of nutrition educators to increase the reach of education.

> For now, I can't reach all pregnant women or focus on one urban village. But I can train health volunteers to educate pregnant women. . . . So, if health volunteers meet pregnant women who didn't want to eat or drink milk, they can advise the women. (Nutritionist 8)

However, one obstetrician expressed concern about nutrition education being provided by health volunteers.

> We used to have a few healthcare professionals, so we recruited non-health professionals to help us with monitoring health programs in the community. We had to train them. . . . I think the training is not adequate. (Obstetrician 4)

Training for health professionals. The Malang Department of Health and other health professional training associations were viewed as important enablers of evidence-based care by four healthcare professionals.

> We carry out the training about improving maternal and child health services. . . . We also facilitated midwives or nutritionists from health centres to attend training at the provincial level. (Nutritionist 1)

> Four seminars per year are held by the Nutritionist Association. . . . Our PPN [National Priority Project] is now tackling stunting. There will be more material about nutrition for pregnant women related to stunting prevention, malnutrition and anaemia. (Nutritionist 4)

Four participants wanted more frequent and up-to-date training. Others sought more involvement of health professionals in the training and more engaging and locally relevant information, such as continuing education for health professionals. This extra training was seen to be essential for the delivery of current evidence-based care. The lack of training opportunities drove some to extend their self-learning.

> I confess that I need information updates and nutrition science updates. If I didn't learn by myself, I would be stuck here. . . . So, I am happy if there is some training because I need to update my nutrition knowledge. (Nutritionist 8)

One midwife expected training about nutrition for pregnancy could be delivered to all midwives, with 'easy to understand' materials and complete explanations.

> In our last training about pregnancy nutrition, the handout was written in English. There were some questions that were not answered. . . . Then, only the midwife coordinators were invited. I can't explain the training materials to other midwives in the detail that the speaker explained. (Midwife 3)

Discussion

This is the first study in Indonesia to investigate the perspectives of three types of healthcare professionals: nutritionists, midwives and obstetricians, regarding the provision of antenatal nutrition education. This study found that most healthcare professionals acknowledge the importance of antenatal nutrition education and support the provision of antenatal nutrition education. The healthcare professionals in this study held varied views about their role in nutrition education, including being key providers, providing general advice or referring women to receive further advice. Most of the healthcare professionals reported barriers in delivering nutrition education, including lack of time, guidelines and training. Finally, the healthcare professionals identified a number of elements likely to improve antenatal nutrition education, such as the development of guidelines, more and better training, stronger collaboration and new forms of digital delivery. These findings will support recommendations for the improvement of the antenatal nutrition education system in Indonesia.

All healthcare professionals in this study acknowledged the importance of antenatal nutrition education. They expressed concern about the maternal malnutrition that they observed in the community and the lack of adequate services to rectify these concerns. These findings are consistent with other studies in the United States[39] and Australia.[35] These studies found that healthcare professionals were aware of the importance of nutrition education for pregnant women. However, healthcare professionals may not provide adequate nutrition education themselves.[35,39] Healthcare professionals have an important role to play in providing evidence-based nutrition education because they are trusted by, and in frequent contact with, pregnant women.[56] The transdisciplinary team approach, involving multidisciplinary health professionals, including nutritionists, midwives and obstetricians, has been shown to strengthen the provision of lifestyle education.[57]

Indonesia exhibits unique tiers of ANC care and health-related contact where nutrition education can be provided or reinforced (Figure 1) (Indonesian Integrated Antenatal Care Guidelines).[25,26] The findings of this study offer a unique opportunity for frequent visits across a range of

practitioners. Our study found that pregnant women may see different types of healthcare professionals if they visit different types of health facilities. Depending on women's geographic location and socio-economic status, women may have contact with a midwife and a nutritionist in a primary health centre, an obstetrician or a midwife at a private maternal clinic or hospital, a private nutritionist or dietitian based on a referral from ANC professionals, or a midwife and health volunteer at the neighbourhood level during pregnancy (See Supplemental File 1). This is because Indonesia offers a range of ANC facilities, from government-financed health facilities, non-profit charity-owned health facilities, and for-profit privately-owned health facilities.[58]

Our study also found the opportunity for community health volunteers or cadres to act as mediators between healthcare professionals and the community, including pregnant women and their families. Community health volunteers are community members who have high social sensibility and actively support the people in their neighbourhood area.[59] Several studies have achieved success with volunteers in other developing countries.[60–62] For example, successful models have been seen in tackling child survival in sub-Saharan Africa,[60] adolescent pregnancy health in Thailand[61] and maternity care in Nepal.[62] As part of their job description, health volunteers in this study are able to refer pregnant women to report their pregnancies to healthcare professionals, including nutritionists at health centres, to receive nutrition counselling. Improving the role of cadres in referring pregnant women in their neighbourhood area to the health centres and nutritionists might increase the reach of the antenatal nutrition education programmes. Therefore, we recommend further work to map the potential opportunities to increase the reach of antenatal nutrition education for more women from wider communities from different socio-economic backgrounds.

Healthcare professionals have varied views about their roles in nutrition education. Perceived roles ranged from being the primary educator, providing general nutrition advice, identifying malnutrition, providing a nutritionist referral or, due to limited time, not providing nutrition education at all. Uniformly, nutritionists were regarded by themselves and others as the primary providers of comprehensive antenatal nutrition education within the integrated ANC services at health centres. Despite nutritionists providing nutrition counselling services as a part of integrated ANC services at primary health centres, few women were reported to consult them due to low utilization of ANC services at primary health centres, low referral rates and other health professionals' lack of awareness about nutritionist services. Our study found a limited number of nutritionists and a lack of nutritionists' capacity to provide nutrition education to all pregnant women in their working areas. Based on the Malang Health Profile in 2018, 66.7% of health centres in Malang have two nutritionists, and 33.3% of health centres only have one nutritionist.[49] This was consistent with our previous research in Malang, Indonesia, where pregnant women reported that they frequently found conflicting information from different healthcare professionals.[43] A lack of antenatal dietitians or nutritionists is a problem in other countries, with reports of relatively few women being able to access nutrition or dietetics services.[63–65] The lack of nutrition education services highlights the further work required to equip ANC professionals with adequate knowledge and skills to improve current nutrition education programmes.[64,65] Further adequate knowledge and skills would strengthen the capacity of nutritionists by providing multiple ways of disseminating nutritional information to the wider community. For example, by improving healthcare professionals in disseminating nutrition information via several digital platforms.[66]

This study highlighted health professionals' concerns about pregnant women receiving inconsistent, and sometimes contradictory, nutrition information from healthcare professionals. This finding is in line with our previous work with pregnant women in Malang where women reported frustration with receiving varying nutrition information from healthcare professionals, which contributed to eroding the trust in the information that they received.[43] Similarly, Saronga et al.[33] in Tanzania found that healthcare professionals provided inconsistent nutrition education to pregnant women. This inconsistent information, along with the need for more health professional training for the knowledge and skills to provide education, underscored the lack of antenatal nutrition guidelines to guide evidence-based practise and shared knowledge and language. This confirms our previous research in which Indonesian pregnant women reported receiving inconsistent information from health professionals, which in turn eroded confidence and trust and reduced the likelihood of them following recommendations.[43]

One of the key aspects identified by health professionals contributing to fragmented information was the lack of mapped systems across the health network with clinical guidelines, care pathways and different platforms for information. While antenatal nutrition guidelines are currently issued by The Ministry of Health, they potentially lack sufficient detail and implementation strategies. For example, more practical nutritional guidelines for pregnant women and detailed antenatal nutrition education strategies for specific groups of healthcare professionals in specific ANC service facilities. More research is required in Indonesia which addresses the best way to develop antenatal nutrition guidelines and training for healthcare professionals to improve the consistency and evidence base of nutritional advice provided by them. Paralleling the need for detailed antenatal nutrition guidelines, further work is required to map all the opportunities for nutrition education to be incorporated into ANC pathways, including

referral pathways to nutritionists. The mapping of care pathways, including referral pathways, is supported by Stockton and Nield's[67] review of 20 studies in the United Kingdom, showing that the implementation of referral pathways between healthcare professionals was essential to optimize antenatal nutrition education.

Given the wide-ranging ANC services and lack of access to nutrition education in Malang, our findings suggest the importance of developing alternatives for nutrition education delivery, including digital delivery, to augment current systems and provide maximum reach to all pregnant women. Digital delivery is a feasible delivery mode in Indonesia, with 191.6 million people (65.6% of the total population) possessing smartphones.[68] A small study in Malang found that accessing WhatsApp and WhatsApp groups was a new daily habit for women, exceeding daily television viewing frequency.[69] Our previous research also found that women in Malang accessed the Internet and digital tools frequently and are using digital tools to access information to supplement or augment information from health professionals.[40,43] The women expressed the need for more evidence-based knowledge and trusted sources of digital information and education, which is mirrored in other countries.[37]

Opportunities exist for health professionals to improve communication through hosting and promoting nutrition guidelines for pregnancy via dedicated health professionals and host referral pathways. Community-oriented digital platforms, including social media, could enable pregnant women to access reliable and up-to-date nutrition information at any time. Our study showed that pregnant women, nutritionists and midwives were currently using WhatsApp to discuss pregnancy and nutrition-related information easily, and this practice could be expanded to increase the reach to a greater number of women in a cost-effective manner. The development of digital nutrition education might provide the opportunity for women who cannot access health centres to receive nutrition counselling or supplement information that they receive from health professionals. Further research is required to understand the ways digital delivery platforms might maximize women's and health professionals' engagement within the Department of Health and primary care structures.

Strengths and limitations

Our study provides a comprehensive description of the provision of antenatal nutrition education from the perspectives of three healthcare professional groups: nutritionists, midwives and obstetricians. The views and experiences of participants revealed the current state of the provision of antenatal nutrition education, indicating that improvement is needed to strengthen delivery for pregnant women. The one-on-one semi-structured interviews allowed participants to share their views and experience freely. This was the first study of its kind reporting the three types of healthcare professional views about antenatal nutrition education in Indonesia.

There are several limitations in this study, including the number of healthcare professionals who were willing to participate in the study, although data saturation was reached, suggesting that this number was sufficient. While this study was conducted in Malang City, which might not be representative of Indonesia as a whole, the results were consistent with a number of studies in other countries.[32–35,39] Therefore, this may reflect the common issues that health professionals face within Indonesia and in many other countries. This study also focused on healthcare professionals' viewpoints and did not include women's views on the provision of antenatal nutrition education, which would limit the scope of this study. Finally, this study was conducted in the Malang City area and may not necessarily be reflective of health professionals elsewhere in Indonesia.

Conclusions

Healthcare professionals play a central role in the provision of education in Indonesia. This study highlighted the importance of the incorporation of widespread educational models within various antenatal nutrition education delivery strategies, including optimisation of referral systems, digital deliveries and traditional nutrition education deliveries in pregnancy classes and in POSYANDU (community-based health services). Educational guidelines are essential to ensure the consistent nutrition information delivered by each healthcare professional. Further research involving healthcare professionals from broader populations is required to obtain more understanding of healthcare professionals' views in different regions of Indonesia.

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Author contributions

All authors conceptualized and designed the methodology and research questions. W.R. carried out the investigations. W.R. and J.W. conducted formal analysis and prepared the original draft of the article. All authors read, reviewed, edited and approved the final version of the article.

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Supplemental material

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