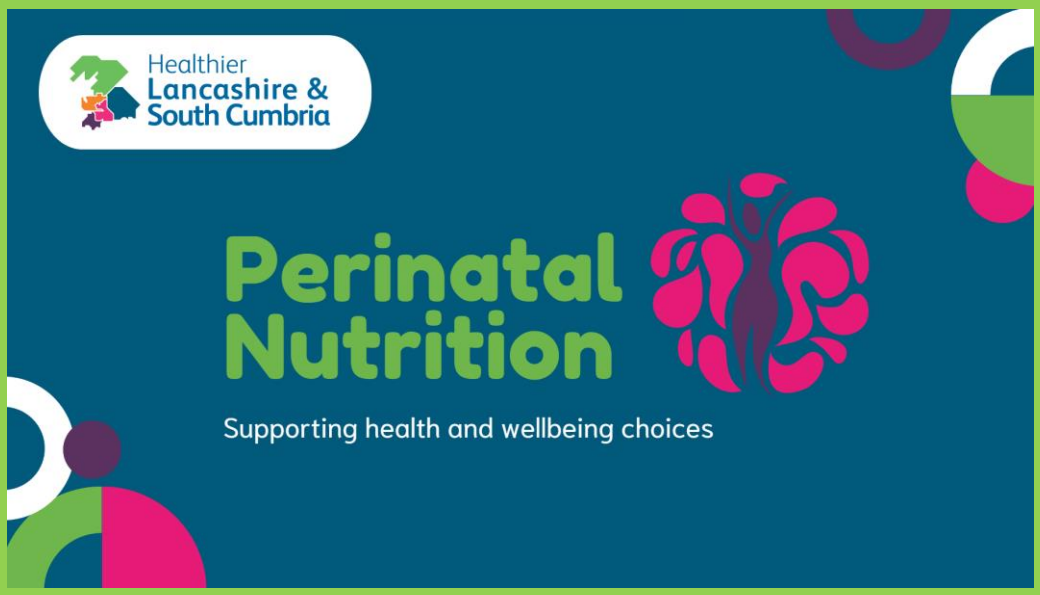
MATERNAL NUTRITION EDUCATION INTERVENTION

Executive report

By Byrom, A; Stewart, L.; Feltham, C.; Moran, V.



Maternal nutrition education intervention

Background context

Maternal nutrition matters

Optimal maternal nutrition during pregnancy is essential for the health of both the mother and the developing fetus (Blumfield et al., 2013; Milman et al., 2016; Procter & Campbell, 2014; National Institutes of Health, 2010). Poor maternal nutrition has been linked to adverse pregnancy outcomes, including low birth weight, preterm birth, congenital anomalies, gestational diabetes, and pre-eclampsia (Barker & Thornburg, 2013; World Health Organization [WHO], 2020). Despite the importance of optimal maternal nutrition during pregnancy, achieving it is challenging. Challenges include poverty, food insecurity, unhealthy dietary patterns, and lack of access to healthcare services (Bambra et al., 2016).

Poor nutrition is associated with increased morbidity and mortality of both mother and infant (WHO, 2024; Watts et al., 2023). In relation to weight, the most recent MBRRACE report, published in October 2024, found that 37% of the women who died in the United Kingdom and Ireland between 2020-2022 had a BMI over 30 (clinically obese), and 27% were overweight (Felker et al., 2024). This represents a significant increase from previous MBRRACE reports.

Local system-context

The latest National Health Service (NHS) statistics in Lancashire and South Cumbria found that nearly one in five pregnant women are classified as obese (NHS England, 2020). Moreover, food poverty and insecurity remain major challenges (Department of Environment, Food and Rural Affairs, 2024). Over a third of residents in this locality live in the most deprived areas in England, with many families struggling to afford healthy, nutritious food (Lancashire and South Cumbria Integrated Care Board, n.d.).

Health inequities and injustice in focus

Food poverty and insecurity, as well as other environmental factors such as mental health, wellbeing, and biological characteristics, may lead to inadequate intake of essential nutrients and increase the risk of complications during pregnancy. Additionally, cultural beliefs and practices around food may also impact the dietary choices women and birthing people make. These challenges are compounded by a lack of access to healthcare, including antenatal care and education, with some women receiving little or delayed antenatal care, which can lead to missed opportunities for interventions to improve maternal nutrition (Public Health England, 2018).

Women from minoritised ethnic communities and those from the most deprived backgrounds are at increased risk of poor maternal and infant health outcomes (Thomson et al., 2022). The National Maternity and Perinatal Audit (NMPA) Sprint Report (2021) reports that women from South Asian and Black ethnic groups, as well as women and birthing people from the most deprived backgrounds, have increased rates of hypertension

and diabetes compared to White ethnic groups and those living in the least deprived areas.

Health professional maternal nutrition education context

To overcome these identified challenges, a multi-faceted, multidisciplinary approach is needed. Health professional education should ensure meaningful, personalised conversations are held with families, and professionals need knowledge of referral pathways and signposting to ensure timely support. A recent review exploring midwives' role in providing nutritional education during pregnancy highlighted gaps in midwives' nutrition knowledge, mainly due to insufficient training in midwifery programmes (Olloqui-Mundet et al 2023). Despite recognising the importance of nutrition for maternal and fetal health and considering nutrition education to be part of their role (Soltani et al 2017; McCann et al 2018), many midwives in the UK feel unprepared to offer comprehensive guidance. A survey of midwives found that only 47% felt confident in providing nutritional advice, with many citing a lack of training as a barrier to effective practice (Higgins et al 2016). Similarly, a survey of obstetricians found that only 27% felt adequately trained to provide nutritional advice to pregnant women (Jones et al 2013).

These findings suggest that there is a need for increased and ongoing training and support for health professionals to provide effective maternal nutrition care. Providing training and resources on topics such as healthy eating during pregnancy, managing gestational weight gain, and identifying nutrient deficiencies can help to ensure that health professionals have the knowledge and confidence necessary to provide high-quality care to pregnant women. Our education programme plan aimed to address these gaps and respond to the identified training needs analysis completed by Lancashire and South Cumbria integrated care system maternal and newborn alliance project lead.

The Local Maternity and Neonatal Systems (LMNS) action plan, devised to move forward the priorities of the 2021 Equity and Equality Guidance for LMNS (Priority 4), commissioned UCLan and All4Maternity to undertake a package of work (Prioritising and addressing equality and equity needs in the Lancashire & South Cumbria LMNS footprint [PAN project]) that draws on quality improvement principles to help achieve clinical effectiveness and encourage collaboration. Maternal nutrition was identified in stage one of the PAN project as a key area to focus on to improve outcomes for women, birthing people, and families. This report evaluates the work undertaken, how it was implemented, and offers recommendations for future action.

METHODS

In order to address the barrier to service improvement that a lack of training for health professionals can create (Higgins et al, 2016; Jones & Jomeen, 2017; Saw et al, 2021) the project group created a learning package to be delivered to student midwives across Lancashire and Cumbria.

The learning package aimed to cover topics identified as essential in improving outcomes including healthy eating during pregnancy, nutrient deficiency, the microbiome, physical

exercise, and the causes and effects of gestational weight gain. Guidance in delivering personalised conversations was provided and food poverty and alternative diets were briefly covered.

Lesson plans, presentations and activity resources were stored in an accessible Padlet allowing training providers the freedom to focus on individual elements as required.
The first iteration of the training was delivered across 7.5 hours, in a face-to-face classroom environment, to two cohorts of final year students. A third cohort of first year students received a streamlined package, to meet scheduling demands and in recognition of their stage of training. As the complexities of weight, including personal weight bias and cultural context are recognised to have a significant impact on the quality of intervention (Ewing, 2019; Feltham et al, 2023; Pearl et al, 2023) a considerable amount of time was devoted to these concepts. The classroom environment aimed to support interaction and reflection, with learners invited to address their own experience of weight and nutrition including any unconscious bias which may inform their practice.

Prior to the session, learners were invited to complete an anonymous survey to assess their perceived knowledge and confidence in delivering key information regarding maternal nutrition, which was repeated following the training, with the feedback data analysed.

Padlet of learning resources created:

https://padlet.com/All4Maternity/lancashire-south-cumbria-maternal-nutrition-toolkit-sois6tp81ecvw9sp

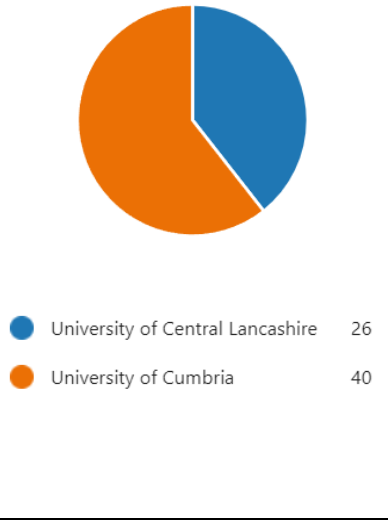
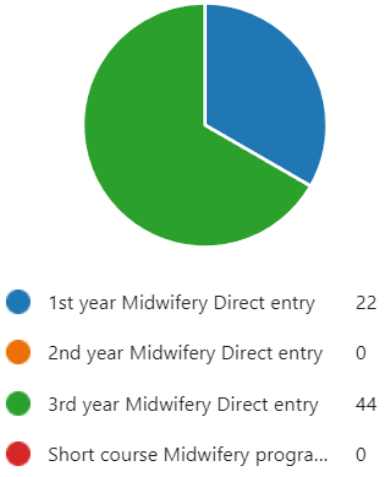
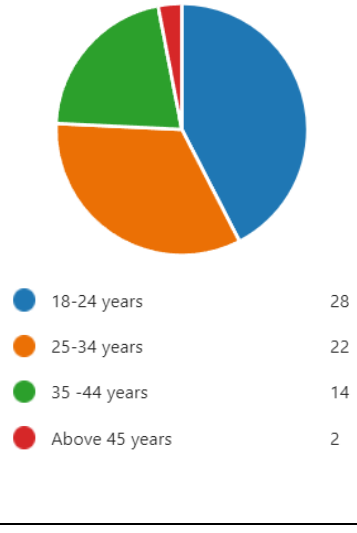
FINDINGS

Demographics

58 participants responded to the pre-session survey and 66 respondents completed the post-session survey. Demographics are presented for those completing the post-session survey only in this report, although the sample was the same across the pre- and post-survey (Figure 1). 60% (n=40) of respondents were from the University of Cumbria and 39% (n=26) of respondents were from UCLan. The UCLan students (n=25) were in their third year of study and there was a mix at the University of Cumbria with 22 first years and 18 third years responding to the post-session survey.

Most respondents were aged under 34 years (n=50) and all respondents that completed the question on gender (n=53) identified as female. Of those who completed the question on ethnicity (n=43) the majority (79%) identified as White British or British, and only 2% identified as African or White (any other background).

Figure 1 Demographic information from post-session survey respondents

Which University are you studying midwifery?	What is your year of midwifery studies?	What is your age range?
		

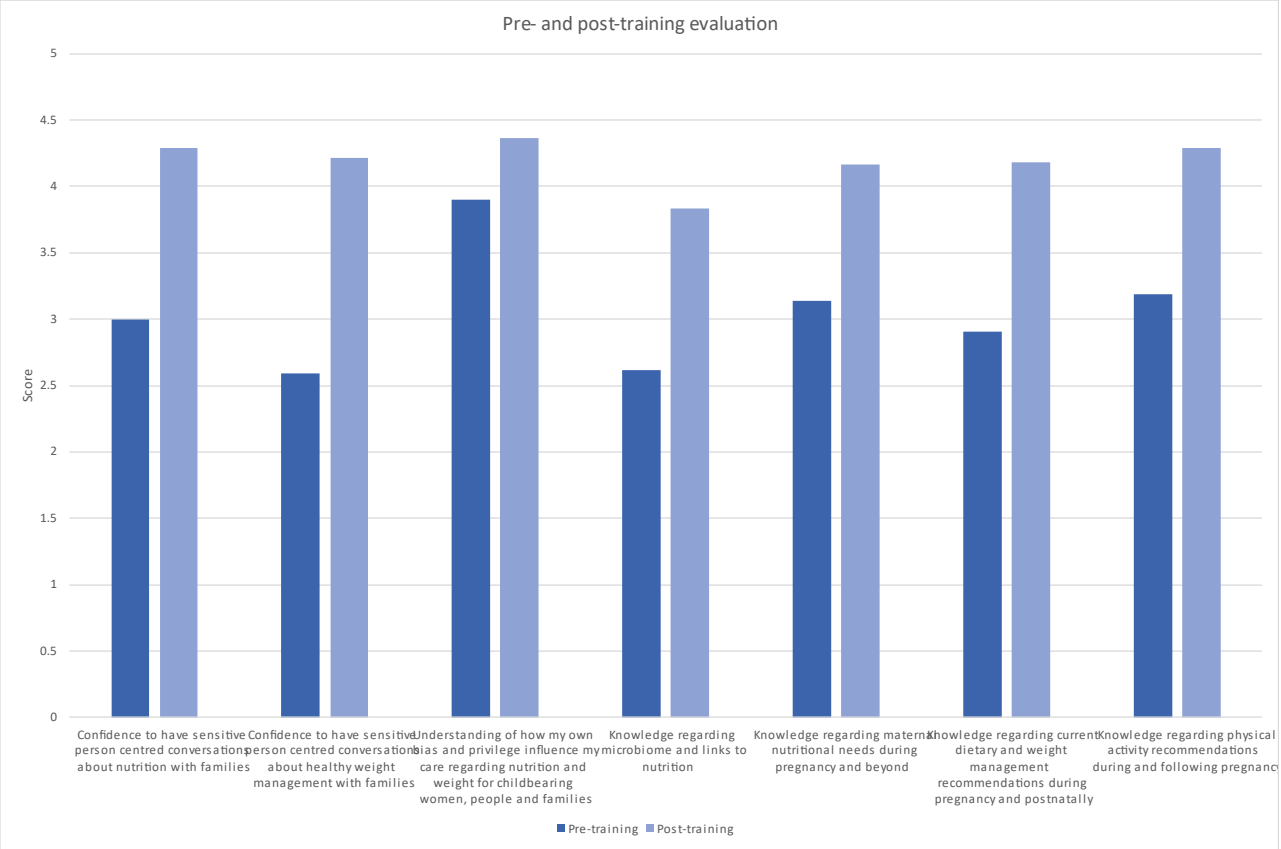
QUANTITATIVE FINDINGS

We invited participants of the education sessions to share pre- and post- session feedback. The quantitative questions asked them to share their existing experiences of discussing nutrition with families in their care. The questions also asked them to rate their knowledge relating to the learning outcomes identified for the education session, as determined by the training needs analysis completed as part of an earlier LSC system-wide maternal nutrition project.

We compared the pre- and post-survey self-assessed knowledge, confidence and application to practice responses (please see Figure 2). Respondents shared how their confidence had increased in having sensitive, person-centred conversations about nutrition and weight management in pregnancy. Whilst pre-training awareness of privilege and bias was positively reported, the session helped to increase awareness amongst respondents.

In terms of knowledge development, the findings highlight that participant respondents had increased knowledge of the microbiome, maternal nutrition needs in pregnancy and beyond, antenatal and postnatal weight management guidelines, and physical activity guidelines. Knowlege about the microbiome was identified as being an area with the least baseline and post-session knowledge. Knowledge improvement, however, was consistent across all areas. Alongside the quantitative data it is useful to review the qualitative feedback shared by participants who completed the post-session survey.

Figure 2 – Self-reported confidence and knowledge of students pre- and post-session



QUALITATIVE FINDINGS

The post-survey asked the student responders to share what they enjoyed, or thought could be improved about the session in two open-ended questions. We report these findings here. All qualitative comments have been processed into themes and grouped in terms of how frequently comments were made and the context of the comments. Generative artificial intelligence was used to support the synthesis of these findings, supported by the research team who checked against original data. Anonymised direct quotes are used to illustrate each theme.

What respondents enjoyed about the education sessions

All respondents shared what they enjoyed about the session. This qualitative feedback can be grouped into key themes based on the comments provided by the participants from the University of Cumbria and UCLan. A summary with quantified insights can be found below:

1. Interactivity and Engagement (36 mentions)

- Interactive elements were highlighted by a significant portion of respondents, with 36 comments explicitly praising how interactive the session was. Phrases like "very interactive," "engaging session," and "enjoyed the games" were common.
- Many enjoyed the games and discussion-based learning, helping break up the day and enhance understanding.
- Respondents appreciated open discussions, which fostered confidence in their ability to engage with women and families.

"Very interactive session."
"The games were engaging, helped to break up the day."
"I enjoyed engaging in conversations."

"The interactive parts were really fun and thought-provoking."

2. Facilitator and Teaching Style (22 mentions)

- Facilitators were specifically praised for their passion, knowledge, and engagement. The student facilitator was mentioned in six comments with particular appreciation for her role in the session, while other facilitators were praised for being engaging and knowledgeable.
- Respondents felt the teaching style was excellent, with multiple comments emphasising how the information was easy to understand and detailed yet clear.

"I enjoyed the student facilitator and the games."
"the student facilitator was fabulous and should be proud!"
"the education facilitator was fab, so engaging and very knowledgeable."
"Great session from the education facilitator! Her passion for the subject was visible and very engaging."

3. Informative Content and Learning Outcomes (29 mentions)

- The session was frequently described as very informative, with a strong emphasis on the quality of information shared.
- The nutrition content, particularly around the microbiome and weight management, was well-received, with five comments explicitly stating how interesting this was. Several respondents wished they had more time to explore these topics further which corresponds with the quantitative knowledge rating from the post-session feedback identifying knowledge of the microbiome did not increase as significantly as other session topics covered.
- Participants appreciated the relevance of the content to real-life scenarios beyond standard NHS guidelines, noting it was practical for use in placements and real-world care.

"Lots of interesting information that I wasn't aware of."
"The microbiome stuff was very interesting! Wish we had more time on that!"
"Good refresh on nutrition in pregnancy–beneficial when on community placement during booking appointments."
"Nothing like the NHS guidance, much more applicable to real women in real life."
"Very informative, great PowerPoint with pictures, easy to understand."

4. Confidence and Application (Seven mentions)

- Several students noted feeling more confident in their ability to engage in conversations with women and families about nutrition and exercise, particularly with topics like weight management and BMI.
- Respondents valued how the session catered to diverse backgrounds and biases in healthcare, helping them approach discussions compassionately.

"It was really interesting, and I would feel more confident in speaking to women and families."
"I think this session gave a lot more detail than you would ever find on Google or the NHS website. I feel more confident now in this aspect of the career."
"It made me think about how I can talk to people with a higher BMI in a compassionate way."

5. Environment and Overall Satisfaction (Five mentions)

- Comments about the relaxed and positive environment of the session were noted, contributing to the overall enjoyment.
- Multiple respondents indicated they enjoyed every aspect of the session, with some leaving feeling inspired and equipped to apply the knowledge in practice.

"Relaxed environment."
"I always feel so inspired after sessions such as these, which encourage passionate and informed discussions."
"I enjoyed every aspect."

In summary, most respondents found the session highly engaging and interactive, with strong praise for the facilitators and the detailed, informative content. The inclusion of games and open discussions significantly enhanced the learning experience. Participants left feeling more confident and better prepared to apply their knowledge in practical settings.

Areas for development

All respondents were asked if they could share ways to improve the session. Of those responding, 34 did not offer any ways to enhance the session, two respondents left the question blank, and others reiterated that the session was great as it was delivered (n=4). There were 31 comments offering feedback on areas for improvement and these are summarised across several themes, presented below:

1. Time Management and Session Length (14 mentions)

- A common suggestion was related to the duration and timing of the session. 14 respondents mentioned the session either overran or felt too long.
- Suggestions included splitting the session over two days to avoid rushing through content and improve concentration, particularly towards the end of the day. Several participants found the amount of information overwhelming and felt it could be spaced out more effectively.

"Quite a long session, found at the end of the day I was not concentrated."
"Maybe have the session over 2 days if possible?"
"Possibly break it up a little. It was very long but interesting!"

2. Information Overload and Simplification (Seven mentions)

- Some respondents felt there was too much information, with suggestions to simplify or provide less content in one sitting. They expressed that at times the information felt overwhelming, and it was hard to absorb everything.
- Participants asked for more specific information to share with women and families, indicating a desire for clearer, actionable guidance.

"Less information, feels too much at times."
"Quite a lot of info - some areas rushed, maybe needs to be over 2 days?"
"Simplifying information would help."

3. More Interactivity and Group Work (Nine mentions)

- While the session was praised for being interactive, several respondents felt there could be more group activities or case studies to enhance engagement.
- There were also suggestions for increasing interaction across year groups and splitting the session into smaller work groups to cater to different experience levels (e.g., first years vs. third years).

"More group work to keep it interactive."
"I feel this could be split up into different work groups perhaps."
"More scenarios of different women/birthing people's situations, both physically and socioeconomically."

4. Tailoring Content to Experience Levels (Three mentions)

- Third-year students mentioned that some of the information felt basic or repetitive, suggesting a need to differentiate content to better suit varying skill levels among attendees.

> *"As a third-year student, some of this information has already been taught and was quite basic for our skill level."*

5. More Focus on Specific Topics (Seven mentions)

- Respondents asked for more focus or deeper exploration of certain topics, including postnatal nutrition, the microbiome, and fetal nutritional needs.
- There was also a suggestion to cover BMI in the NHS more critically, focusing on how to address this topic compassionately with women.

> *"More explanation on microbiome."*
> *"Perhaps more in terms of fetal nutritional needs in relation to the mother's intake."*
> *"Maybe slightly more information about postnatal, but otherwise it was really informative."*

6. Visual Aids and Infographics (Three mentions)

- A few participants suggested incorporating more visual aids such as infographics or videos to enhance understanding and make the session more engaging.

> *"Would be better with more infographics."*
> *"Maybe a video or interactive?"*

In summary, while participants generally enjoyed the session, they suggested improvements in time management, simplifying content, and increasing interactive elements to prevent information overload. Tailoring content to different student experience levels and offering more specific information to use in practice were also key areas for improvement.

FACILITATOR LEARNING AND INSIGHTS

Five facilitators were involved in preparing the education sessions with three involved in delivering the sessions to students. Two educators at UoC joined for training on the resource at the session at UoC. Our learning was consistent with the student feedback, recognising the need to trim and adjust some of the learning sessions to adapt to local curriculum frameworks. We identified the need for the learning to be mapped across curriculum years, so offering differentiated sessions for each year group aligned with a spiral curriculum approach and allowing for more practice-based case studies and application to clinical context. We all felt that student co-facilitation was valuable for student development, confidence building and supporting extra-curricula skill development. For students seeing a peer being invited as a co-facilitator has helped to strengthen engagement in future initiatives with some students seeking opportunities to be involved in future projects. Reflecting on the collaboration between system partners involved in the project it has been meaningful to work together to listen, learn and co-create and deliver an education programme with impact. UCLan offered research, education and student experience expertise and the vehicle to deliver the initiative and All4Maternity the skills to design and support delivery of the training.

DISCUSSION

Maternal nutrition education is a crucial component in midwifery training, equipping student midwives and maternity staff with the knowledge and confidence needed to provide effective care to pregnant women, birthing people and their families. Our study found that, following the training session, student midwives felt more confident to be able to have person centred discussions with families about nutrition and healthy weight management and reported improvements in their nutrition knowledge. Other studies have also demonstrated the effectiveness of nutrition training for midwives. Lucas et al (2019) examined the effectiveness of both face-to-face and online nutrition training modules and found that both methods improved midwives' nutrition knowledge and confidence, especially on topics like healthy eating, supplements, and breastfeeding. Similarly, an evaluation of a healthy eating education package found that midwives' knowledge and confidence in discussing healthy eating significantly improved after attending either a workshop or webinar and that knowledge gains were sustained for 6-8 weeks post-intervention (Othman et al 2020). Both studies however, noted better outcomes (completion rates, better sustained knowledge) for midwives who attended in person compared to online training.

A recent study of UK midwives found that whilst they consider themselves ideally placed to provide physical activity advice to pregnant women, they reported a lack of advice provision, with barriers including a lack of confidence, knowledge, time, and education (Mitra et al 2024). Our study found an improvement in midwives' knowledge regarding physical activity recommendations during and following pregnancy post training. This resonates with the findings of a recent study which assessed the impact of a training package for health care professionals on providing physical activity guidance to pregnant women and new mothers. Post training there was a significant increase in professionals' confidence to discuss physical activity at 3 and 6 months. The frequency of discussions with pregnant women and new mothers also increased significantly after training (Taylor et al 2023).

The qualitative and quantitative feedback from the maternal nutrition education sessions highlighted several key areas, including increased confidence and knowledge, as well as areas for improvement for future sessions. In this discussion we contextualise these findings within wider research and evidence from both global and UK-focused perspectives, alongside key guidelines and reports relevant to maternal nutrition education.

Increased Confidence and Knowledge in Nutrition and Weight Management

The post-session survey data responses clearly demonstrated that participants experienced a significant increase in confidence when having sensitive, person-centred conversations about nutrition and weight management in pregnancy. This aligns with existing literature emphasising the importance of tailored, compassionate communication when addressing these topics. Studies show that midwives often report feeling unprepared to have these conversations due to a lack of formal training on how to manage nutrition-related discussions sensitively (Arrish, Yeatman, & Williamson, 2017). The reported

improvement in confidence suggests that the session successfully addressed this gap, a crucial outcome supported by similar findings in midwifery education research (McFadden et al., 2014).

In addition, person-centred care—as highlighted in global maternity guidelines such as those from the World Health Organisation (WHO)—is a key principle in improving maternal health outcomes (WHO, 2016). The participants' increased ability to engage in these conversations reflects the session's alignment with best practices and the NICE guidelines (NICE, 2010), which recommend that healthcare providers use non-judgemental, sensitive language when discussing weight and nutrition.

Knowledge Development: Maternal Nutrition, the Microbiome, and Physical Activity

Participants consistently reported increased knowledge across several key areas of maternal nutrition, including the microbiome, maternal nutritional needs, weight management guidelines, and physical activity during pregnancy. This aligns with research indicating that nutrition education for midwives can significantly improve their understanding of how maternal diet impacts both the mother's and baby's health (Lucas et al., 2019). In particular, the microbiome was noted as an area of lower baseline knowledge, a trend observed in other studies that highlight the relatively recent focus on the microbiome in clinical education (Collado et al., 2019).

Despite the increase in microbiome knowledge, participants expressed a desire for more in-depth coverage of the topic, suggesting a need to expand future educational sessions to provide a deeper exploration of gut health and its relevance to maternal and infant outcomes. Current research underscores the importance of educating midwives on the gut-brain axis and microbial diversity during pregnancy, as these have been shown to influence long-term health outcomes for the child (Hill et al., 2017).

The NICE physical activity guidelines for pregnant women (NICE, 2010) also emphasize the importance of maintaining an active lifestyle to improve maternal outcomes, and this was reflected in the participants' increased understanding of physical activity recommendations. The UK Chief Medical Officers' Physical Activity Guidelines (Department of Health and Social Care, 2019) further support this, advocating for pregnant women to engage in at least 150 minutes of moderate-intensity exercise per week. The participants' improved knowledge in this area indicates that the session effectively incorporated up-to-date evidence-based recommendations, supporting holistic care for pregnant women.

Tailored Educational Approaches and Person-Centred Learning

One of the key themes from the qualitative feedback was the participants' appreciation of the interactive nature of the session. Interactive learning methods such as group discussions and games were frequently cited as beneficial. This aligns with the constructivist learning theory, which emphasizes that knowledge is built through interaction and active engagement (Vygotsky, 1978). Research in midwifery education also supports the use of interactive tools like case studies, simulations, and group work to enhance learning outcomes (McKenna & Rolls, 2011).

However, there were also calls for more differentiation in content for third-year students, with some respondents feeling that some of the material was too basic for their level. Tailoring educational content to match students' differing levels of experience is essential, especially in clinical fields like midwifery where students' practical exposure varies significantly. This mirrors findings from educational research that advocate for scaffolded learning, where content complexity increases alongside the learner's experience and skill level (Pritchard & Woollard, 2010).

Improvements in Structure: Time Management and Information Overload

The qualitative feedback also indicated that the session was perceived as too long, with suggestions to break it into multiple days to avoid information overload. Research suggests that long sessions can lead to cognitive fatigue, reducing the effectiveness of learning, especially when complex topics like maternal nutrition are covered in depth (Kalyuga, 2009). Participants specifically requested more time to delve into topics like the microbiome, a finding echoed in other educational research that emphasizes the need for spaced learning to enhance retention of information (Cepeda et al., 2006).

Moreover, the feedback suggesting more group activities reflects best practices in midwifery education, where collaborative learning enhances students' ability to apply theoretical knowledge in clinical settings (McFadden et al., 2014). Increasing the amount of case-based learning and group discussions could help students engage more deeply with the material while also addressing the need for active learning across diverse cohorts.

CONCLUSION

The feedback from the maternal nutrition education session provides valuable insights into effective teaching strategies for student midwives and maternity staff. The significant increase in confidence and knowledge, particularly in areas like nutrition, weight management, and the microbiome, underscores the value of interactive, evidence-based education in midwifery training. However, there is room for improvement in terms of time management and ensuring the content is appropriately tailored to different experience levels. By incorporating more spaced learning, case studies, and differentiated content, future sessions can further enhance the learning experience and equip midwives with the skills and knowledge they need to support maternal health.

NEXT STEPS:
Next Step Actions for Future Education Sessions:

1. Split Sessions and Tailor Content by Experience Level
    - Break sessions into multiple shorter ones to avoid cognitive overload and provide more in-depth exploration of key topics like the microbiome. Tailor content to different experience levels (e.g., first-year vs. third-year students).
2. Increase Group Work and Case-Based Learning
    - Incorporate more interactive group activities and real-world case studies to enhance engagement and help students apply their learning to practical situations.
3. Enhance Use of Visual and Digital Learning Tools
    - Integrate more visual aids, such as infographics and videos, to simplify complex concepts and maintain student engagement.

Wider Practice Considerations for Lancashire and South Cumbria HEIs and Maternity Services:

1. Standardise Maternal Nutrition Education Across Institutions
    - Collaborate across higher education institutions to ensure consistent and evidence-based maternal nutrition education, supporting all students with key topics like weight management and nutrition.
2. Implement Ongoing Sensitivity and Bias Training
    - Introduce continuous training in maternity services to help staff navigate sensitive topics like nutrition and weight management, addressing privilege and bias in care.
3. Create a Resource Hub for Maternity Staff and Families
    - Develop a digital resource hub where maternity staff can access up-to-date guidelines and materials on maternal nutrition and share these resources with women and families for informed care.
    -

References

Arrish, J., Yeatman, H., & Williamson, M. (2017). Midwives and nutrition education during pregnancy: A literature review. *Women and Birth, 30*(1), 5-9. https://doi.org/10.1016/j.wombi.2016.06.003

Bambra, C., Hillier, F., Moore, T., & Cairns-Nagi, J. M. (2016). Poverty and food insecurity in the UK: Implications for health inequalities. *Perspectives in Public Health, 136*(6), 304-310. https://doi.org/10.1177/1757913916679860

Barker, D. J., & Thornburg, K. L. (2013). The obstetric origins of health for a lifetime. *Clinical Obstetrics and Gynecology, 56*(3), 511-519. https://doi.org/10.1097/GRF.0b013e31829cbb98

Blumfield, M. L., Hure, A. J., Macdonald-Wicks, L., Smith, R., & Collins, C. E. (2013). A systematic review and meta-analysis of micronutrient intakes during pregnancy in developed countries. *Nutrition Reviews, 71*(2), 118-132. https://doi.org/10.1111/nure.12089

Cepeda, N. J., Pashler, H., Vul, E., Wixted, J. T., & Rohrer, D. (2006). Distributed practice in verbal recall tasks: A review and quantitative synthesis. *Psychological Bulletin, 132*(3), 354-380. https://doi.org/10.1037/0033-2909.132.3.354

Collado, M. C., Rautava, S., Aakko, J., Isolauri, E., & Salminen, S. (2019). Human gut colonisation may be initiated in utero by distinct microbial communities. *Scientific Reports, 9*(1), 1-8. https://doi.org/10.1038/s41598-019-52945-w

Department of Environment, Food and Rural Affairs. (2024). *United Kingdom Food Security Report 2021: Theme 4: Food security at household level*. Retrieved from https://www.gov.uk/government/statistics/united-kingdom-food-security-report-2021/united-kingdom-food-security-report-2021-theme-4-food-security-at-household-level

Department of Health and Social Care. (2019). *UK Chief Medical Officers' Physical Activity Guidelines*. Retrieved from https://www.gov.uk/government/publications/physical-activity-guidelines-uk-chief-medical-officers-report

Felker, A., Patel, R., Kotnis, R., Kenyon, S., & Knight, M. (Eds.) on behalf of MBRRACE-UK. (2024). *Saving lives, improving mothers' care compiled report: Lessons learned to inform maternity care from the UK and Ireland confidential enquiries into maternal deaths and morbidity 2020-22*. Oxford: National Perinatal Epidemiology Unit, University of Oxford.

Hill, C. J., Lynch, D. B., & Murphy, K. (2017). Evolution of gut microbiota composition from birth to 24 weeks in the INFANTMET Cohort. *Microbiome, 5*(1), 1-18. https://doi.org/10.1186/s40168-017-0284-4

Higgins, S., West, S., Halliday, S., Cowdell, F., & Jackson, C. (2016). A survey of midwives' knowledge, confidence, and practice in relation to low-glycaemic-index diets in pregnancy. *Journal of Pregnancy, 2016*, 1-8. https://doi.org/10.1155/2016/8929743

Jones, A., Di Mascio, D., Crozier, S., & Godfrey, K. (2013). Knowledge and practice of maternal nutrition care providers: An exploratory study. *Journal of Human Nutrition and Dietetics, 26*(5), 433-439. https://doi.org/10.1111/jhn.12043

Kalyuga, S. (2009). *Managing cognitive load in adaptive multimedia learning*. Hershey, PA: Information Science Reference.

Lancashire and South Cumbria Integrated Care Board. (n.d.). *Our geography and population*. Retrieved from https://www.lancashireandsouthcumbria.icb.nhs.uk/about-us/welcome-lancashire-and-south-cumbria

Lucas, C., Charlton, K. E., & Yeatman, H. (2019). Nutrition advice during pregnancy: Do midwives provide appropriate support? *BMC Pregnancy and Childbirth, 19*, 222. https://doi.org/10.1186/s12884-019-2360-8

McCann, M. T., Newson, L., Burden, C., Rooney, J. S., Charnley, M. S., & Abayomi, J. C. (2018). A qualitative study exploring midwives' perceptions and knowledge of maternal obesity: Reflecting on their experiences of providing healthy eating and weight management advice to pregnant women. *Maternal & Child Nutrition, 14*(e12520), e12520. https://doi.org/10.1111/mcn.12520

McFadden, A., Renfrew, M. J., & Bastos, M. H. (2014). Continuity and humanised care in maternal and child health services: A scoping review of the evidence. *Midwifery, 30*(1), e15-e24. https://doi.org/10.1016/j.midw.2013.09.003

McKenna, L., & Rolls, C. (2011). Undergraduate midwifery students' performance in problem-based learning tutorials and their application of knowledge during clinical

practice. *Nurse Education Today, 31*(5), 507-511. https://doi.org/10.1016/j.nedt.2010.08.014

Milman, N., Paszkowski, T., Cetin, I., & Castelo-Branco, C. (2016). Supplementation during pregnancy: Beliefs and science. *Gynecological Endocrinology, 32*(7), 509–516. https://doi.org/10.1080/09513590.2016.1197202

National Institute for Health and Care Excellence. (2010). *Weight management before, during and after pregnancy*. Retrieved from https://www.nice.org.uk/guidance/ph27

National Institutes of Health. (2010). *Maternal nutrition and the outcomes of pregnancy*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3110651/

NHS England. (2020). *Maternity and neonatal health inequalities*. Retrieved from https://www.england.nhs.uk/south-east/our-work/south-east-clinical-network/maternal-neonatal-health/health-inequalities/

Olloqui-Mundet, M. J., Cavia, M. M., Alonso-Torre, S. R., & Carrillo, C. (2023). Nutritional education in the midwife's consultation room. *Nutrients, 15*(13), 2906. https://doi.org/10.3390/nu15132906

Procter, S. B., & Campbell, C. G. (2014). Position of the Academy of Nutrition and Dietetics: Nutrition and lifestyle for a healthy pregnancy outcome. *Journal of the Academy of Nutrition and Dietetics, 114*(7), 1099–1103. https://doi.org/10.1016/j.jand.2014.05.005

Public Health England. (2018). *Maternity care: Women's experiences*. https://www.gov.uk/government/publications/maternity-services-annual-report/maternity-services-annual-report-2017-to-2018#antenatal-care

Soltani, H., Duxbury, A., Rundle, R., & Marvin-Dowle, K. (2017). Dietary habits and supplementation practices of young women during pregnancy: An online cross-sectional survey of young mothers and health care professionals. *BMC Nutrition, 3*, 19. https://doi.org/10.1186/s40795-017-0132-z

Taylor, K. A., De Vivo, M., Mills, H., Hurst, P., Draper, S., & Foad, A. (2024). Embedding physical activity guidance during pregnancy and in postpartum care: 'This Mum Moves' enhances professional practice of midwives and health visitors. *Journal of Midwifery & Women's Health, 69*(1), 101-109.

Thomson, G., Cook, J., Crossland, N., et al. (2022). Minoritised ethnic women's experiences of inequities and discrimination in maternity services in North-West England: A mixed-methods study. *BMC Pregnancy and Childbirth, 22*, 958. https://doi.org/10.1186/s12884-022-05279-6

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Watts, A., Hill, C., & Jones, Z. (2023). Child and infant mortality in England and Wales: 2021. Retrieved from https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/childhoodinfantandperinatalmortalityinenglandandwales/2021

World Health Organisation. (2016). *WHO recommendations on antenatal care for a positive pregnancy experience*. Retrieved from https://www.who.int/publications/i/item/9789241549912

World Health Organisation. (2020). *WHO antenatal care recommendations for a positive pregnancy experience: Nutritional interventions update: Multiple micronutrient supplements during pregnancy*. Geneva, Switzerland: WHO.

World Health Organisation. (2024). *Maternal mortality*. https://www.who.int/news-room/fact-sheets/detail/maternal-mortality