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Home-delivered cooked foods and nutrition education improve weight gain among pregnant women at nutritional risk in Jagakarsa Subdistrict, Jakarta, Indonesia: a pilot study

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ABSTRACT

Introduction: The government of Indonesia runs a food supplementation programme in the form of biscuits for undernourished pregnant mothers. However, a home-delivered cooked foods programme using catering services has not been explored in Indonesia. This study aimed to determine the effect of home-delivered cooked foods and nutrition education on pregnant women's gestational weight gain. **Methods:** This study employed a non-randomised controlled, open-label, parallel design. It enrolled 66 women consecutively assigned to intervention and control groups. The intervention group received home-delivered cooked foods and nutrition education, while control group received usual care at Public Health Centres (PHCs). **Results:** After two months of intervention, the average increase in body weight of women in intervention group was 4.7±3.0 kg, which was significantly higher than that observed in control group (3.3±1.8 kg). After adjusting for maternal nutritional status, weight before pregnancy, height, gestational age, and age, mothers who received home-delivered cooked foods and nutrition education gained 1.50 kg (95% CI 0.31, 2.70, p=0.015) more weight than those who did not. **Conclusion:** Home-delivered cooked foods combined with nutrition education improved body weight of pregnant women at nutritional risk. Further studies are recommended to determine impact of home-delivered cooked foods on pregnancy outcomes. These study findings advocate and support Indonesian and local governments in potentially implementing a programme that offers home-delivered cooked foods through catering services to pregnant women at nutritional risk.

Keywords: dietary supplementations, gestational weight gain, maternal nutrition

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INTRODUCTION

Undernutrition among pregnant women has potential consequences that can severely affect foetal and early life outcomes. Globally, approximately 2.3 million newborns die each year within the first 28 days of life (WHO, 2024); many of these deaths are linked directly or indirectly to poor maternal nutrition, infections, and complications around birth. A baby with low birth weight has a high risk of becoming stunted, leading to irreversible outcomes after 36 months of age (Victora *et al.*, 2008). Thus, improving gestational weight gain is important to prevent stunting, which is highly prevalent in Indonesia. The National Health Survey (2023) showed that 20.3% of pregnant women in Jakarta have risk factors including anaemia, chronic energy deficiency (CED), hypertension and others. In addition, based on the National Health Survey in 2018, the low energy intake among pregnant women in Indonesia was 52.9% in rural and 51.5% in urban areas (Ministry of Health Republic of Indonesia, 2018).

Balanced energy and protein supplementation is suggested to improve birth weight through gestational weight gain (Stevens *et al.*, 2015). In 2016, the World Health Organization (WHO) recommended a balanced energy and protein (BEP) dietary supplement for pregnant women to reduce the risk of stillbirth and small-for-gestational age (SGA) neonates among undernourished populations. A systematic review of evidence from low- and middle-income countries (LMICs) showed improvements in maternal, neonatal, infant, and child outcomes through BEP supplementation during pregnancy. The review suggests that BEP supplementation effectively improves rates of stillbirth, perinatal mortality, low birth weight (LBW), SGA, and birth weight (Keats *et al.*, 2021). In Pakistan, provision of wheat soya blend plus (WSB+) during pregnancy and lipid-based nutrient supplement-medium quantity (LNS-MQ) to children for 2 years improved child linear growth and reduced stunting in children at 24 months (Soofi *et al.*, 2022).

The government of Indonesia has implemented a food supplementation programme in the form of biscuits fortified with multiple micronutrients (MMN) for undernourished pregnant mothers (Ministry of Health Indonesia, 2015a). However, the National Health Research (2018) and National Health Survey in 2023 showed similar findings that 35.4% of pregnant women did not consume all the biscuits, and the majority (67.8%) disliked the taste (Ministry of Health Indonesia, 2023a). Consequently, numerous studies have been conducted to explore an alternative to the food supplementation programme in Indonesia. A 2023 evaluation showed that the existing programme (biscuits) was costly and ineffective in addressing CED in pregnant women (Ministry of Health Republic of Indonesia and United Nations Children's Fund, 2023). Therefore, in 2023, the Indonesian government launched a new strategy for food supplementation using local food supplements for meals and snacks in the form of fresh foods (Ministry of Health Republik Indonesia, 2023b).

Food-based supplementation, which includes the use of locally sourced foods as nutritious supplemental foods, is a nutritional intervention used during pregnancy (Ciulei *et al.*, 2023). The distribution of local foods needs to be considered in the successful implementation of food supplementation programmes (WHO, 2016). Home-delivered food approaches are common in other countries and have many benefits, including an improved healthy diet (Campbell *et al.*, 2015), reduced inpatient admissions, and lower medical spending among vulnerable patients

(Locher *et al.*, 2020). A study in the USA reported that grocery-delivered healthy foods to low-income pregnant women improved their diet, increased access to healthy foods, and promoted healthy habits during pregnancy (Locher *et al.*, 2020). Similarly, nutrition education that promotes intake of local nutrient-dense foods in Bangladesh significantly increased maternal weight gain and birth weight of the baby (Jahan *et al.*, 2014). Therefore, this study aimed to determine the effect of home-cooked foods delivered by catering and nutrition education on body weight gain of pregnant women at nutritional risk in Indonesia.

METHODOLOGY

Study setting

The study was conducted from April to December 2016 in six similar Public Health Centres (PHCs) with the same management and standard operating procedures in the Jagakarsa sub-district, Jakarta, Indonesia. Compared with other sub-districts, the population density in Jagakarsa reached 16 people per km^2 and has the largest percentage (17.22%) of South Jakarta's total population in 2021. Furthermore, in 2023, the crude birth rate reached 11.6 births per 1000 population. The percentage of poor people (under the poverty line) in South Jakarta was 3.53% in 2022 and 3.10% in 2023 (Biro Pusat Statistik, 2024). In 2016, antenatal care coverage included 7,409 pregnant women, with 232 (3.1%) having chronic energy malnutrition (Jagakarsa Public Health Centre, 2016). Ethical approval was obtained from Health Research Ethics Committee, Health Polytechnic Jakarta II, with number LB.02.01/5.2/KE.474/2016.

Participants and design

This was a non-randomised, open-label controlled trial, with a two-arm, parallel design. The study population included 7,409 pregnant women who visited the mother and child health clinic for antenatal care at six PHCs in the Jagakarsa sub-districts between April and December 2016. There were 232 pregnant women with chronic energy deficiency (CED), gestational weight gains of less than 2 kg within a month, and anaemia. A total of 66 pregnant women who met the inclusion criteria were consecutively assigned to the intervention and control groups. Inclusion criteria for enrolment were as follows: pregnant women in their 2nd or 3rd trimesters and with chronic energy malnutrition (MUAC<23.5cm) or gestational weight gain of less than 2 kg within a month (Ministry of Health Republik Indonesia, 2015a).

Minimum sample size was calculated based on a previous study using an estimated sample size for two-sample comparison means. Differences in maternal weight gain after intervention were 3.33 kg + 1.15 kg in the intervention group and 2.21 kg + 1.39 kg in the control group (Jahan *et al.*, 2014). With a significance level of α = 5%, a power of 1–β = 90%, and a two-sided *t*-test, the minimum sample size for each group was 28.

However, there were obstacles in the above implementation. Therefore, 33 pregnant women who first responded to phone calls were consecutively selected and included in the intervention group, while 36 pregnant women who were contacted later were included in the control group. During the intervention, three participants were lost to follow-up – one participant in the intervention group and two participants in the control group (moved outside the study area). Finally, there were 32 participants in the intervention group and 34 participants in the control group (Figure 1).

Intervention

Stevens *et al.* (2015) and WHO (2016) recommended balanced energy and

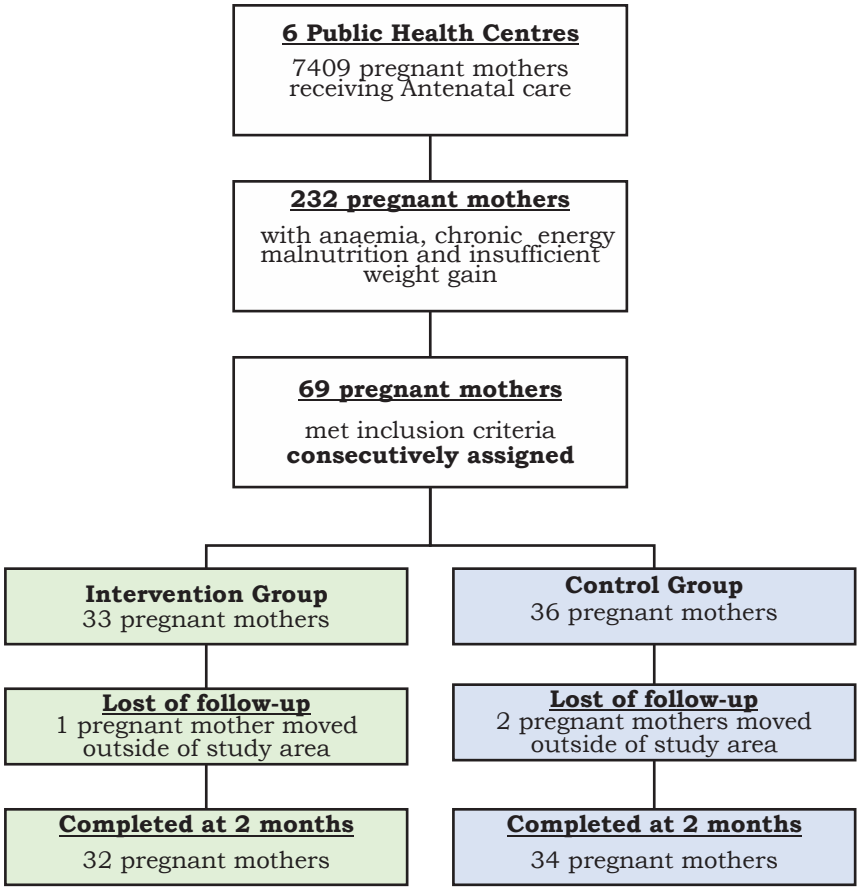

Figure 1. Flowchart depicting the participant selection process for local food supplements

protein supplementation to improve gestational weight gain. However, due to poor compliance and palatability issues of the biscuits, Jagakarsa PHC (2016) instead provided milk powder as a local-based supplementary feeding product for some pregnant women with chronic energy deficiency (Ministry of Health Republic of Indonesia & United Nations Children's Fund, 2023). Based on this background, the intervention group in this study received home-delivery cooked foods, as well as nutrition education by telephone, delivered by the study team.

Table 1 shows the eight types of home-delivery cooked foods given to pregnant mothers, with an average nutrient value of 484 calories and 14.8 g of protein for each portion a day. These foods were cooked by local catering services and delivered daily to the pregnant mothers' houses for 60 days. The types of foods can be snacks or one-dish meals with similar nutrient contents. Each day, mothers received 1 portion of food, for example, *batagor ikan tenggiri* on the first day, *baso tahu kuah* on the second day, followed by *bubur ayam* on the third day until *donut* and *martabak telur* on the eighth day. This was then rotated for 60 days. The home-cooked meals met the additional recommendation of 300-500 kcal and 10-30 g of protein a day for pregnant women, which was intended as supplementary feeding.

In the intervention group, nutrition

Table 1. Home-delivery cooked foods for pregnant mothers and their nutrition values

Day Name of Local Supplemental Foods	*Portion*	*Energy (Kcal)*	*Protein (g)*
1. *Batagor ikan tenggiri* (Fried fish tofu cake)	1 portion	464	15.7
2. *Baso tahu kuah* (Meatball tofu soup)	1 portion	453	15.2
3. *Bubur ayam* (Chicken porridge)	1 portion	479	14.7
4. *Bubur kacang hijau* (Green bean porridge) and *Combro* (Fried cassava and oncom)	1 package	510	14.8
5. *Arem-arem isi* (Rice with meat)	2 pieces	530	15.8
6. *Lumpia* (Chicken Spring roll with vegetables) and cake	1 package	470	15.1
7. *Risoles ragout ayam* (Chicken croquette) and *bakwan sayur daging* (Fried meat vegetable cake)	1 package	501	13.0
8. *Donut* (Doughnut) and *Martabak telur* (Fried egg spring roll)	1 package	472	14.0
Average of the nutrient content of foods		489	14.8

education was planned in the form of nutrition counselling, delivered weekly for two months. Besides nutrition counselling during antenatal care, this study delivered online nutrition counselling more frequently by WhatsApp as a convenient alternative method for education. Nutrition counselling was initially planned for eight times, but its implementation only ranged from three to six times for each participant.

Participants in the control group received regular services from the PHCs, including 400 grams of milk per month and nutrition education for those with CED. The milk consumption, which equalled 68 calories and 3.3 g of protein per day, did not meet the additional recommendation for pregnant women. Meanwhile, pregnant women with weight gain less than 2 kg in 1 month only received nutrition education. The topics of nutrition education for pregnant women in the control and intervention groups were the same, based on the Maternal and Child Health (MCH) Book, Guidelines for Chronic Energy Deficiency Intervention for Pregnant Women, and nutrition guidelines. Nutrition counselling for respondents in the control group was delivered by nutritionists at the PHCs monthly (Ministry of Health Republik Indonesia, 2015b).

Although this study was conducted in 2016, it remains relevant, as it is based on evidence of a recent local food supplementation programme for pregnant women (President of the Republic of Indonesia, 2024).

Variables

Body weight of pregnant mothers was measured using a SECA weighing scale (SECA 876, China), with 0.01 kg precision. Measurements were done at the PHC by nutritionists at baseline and after one and two months of intervention. In case participants could not come to the PHC, nutritionists visited and weighed participants at their homes. Chronic energy malnutrition was defined as a mid-upper arm circumference (MUAC) measurement of less than 23.5cm. MUAC was measured on the circumference of the left arm at the midpoint between the tip of the shoulder and the tip of the elbow using a fibreglass tape (*Pita Lila Bakti Husada Indonesia*), with a unit precision

Table 2. Characteristics of study participants

Characteristics	*Intervention (n=32)*	*Control (n=34)*	*p*
Age (years)	30.4±5.6	29.4±6.1	0.255
Gestational age (weeks)	23.4±4.9	27.0±7.1	0.010*
Trimester			
2nd	23	15	0.018*
3rd	9	19	
MUAC (cm)	26.0±4.1	24.7±3.8	0.088
≥ 23.5	22	17	0.122
< 23.5	10	17	
Height (cm)	154.5±6.1	155.5±6.0	0.370
≥ 150	28	30	0.821
< 150	4	4	
Weight (kg)	54.5±12.3	55.7±10.6	0.345
BMI (kg/m^2)	22.8±4.8	21.8±5.1	0.218
BMI category			
Underweight (<18.5 kg/m^2)	9	12	0.752
Normal (18.5–24.9 kg/m^2)	13	15	
Overweight (25.0–27.0 kg/m^2)	2	2	
Obese (>27.0 kg/m^2)	8	5	
	Intervention (n=17)	*Control (n=18)*	
Haemoglobin (g/dl)	11.8±1.5	11.6±0.9	0.251
Anaemia			
Yes	11	13	0.632
No	6	5	

BMI: Body mass index; MUAC: mid-upper arm circumference
Note: gestational age was adjusted for in the regression analysis

Table 3. Regression coefficient of gestational weight gain (kg) according to intervention groups and other study variables

Factors	*Weight gain (kg) mean±SD*	*Unadjusted*			*Adjusted*		
		Beta	*95% Cl*	*p-value*	*Beta*	*95% Cl*	*p-value*
Group							
No Intervention	3.34±1.84	0	[0,0]		0	[0, 0]	
Intervention	4.76±3.06	1.41*	[0.18,2.68]	0.025	1.50*	[0.31, 2.70]	0.015*
Chronic Energy Malnutrition							
No	3.34±2.45				0	[0, 0]	.
Yes	5.00±2.51				-1.28	[-3.02, 0.47]	0.001**
Maternal height (cm)					0	[0, 0]	
>150	4.15±2.57				-0.92	[-2.08, 0.24]	
≤150	3.11±2.77				0	[0, 0]	0.136
Maternal age (years)					-0.83	[-2.01, 0.36]	
<30	4.30±2.62				0	[0, 0]	.
≥30	3.73±2.57				-1.28	[-3.02, 0.47]	0.062
Gestational age					0	[0, 0]	
Trimester 2	4.58±3.12				0	[0, 0]	0.427
Trimester 3	3.28±1.34				-0.83	[-2.01, 0.36]	0.842

Beta: Beta coefficient indicates the average change in weight gain associated with each factor
*p<0.05, **p<0.01, ***p<0.001

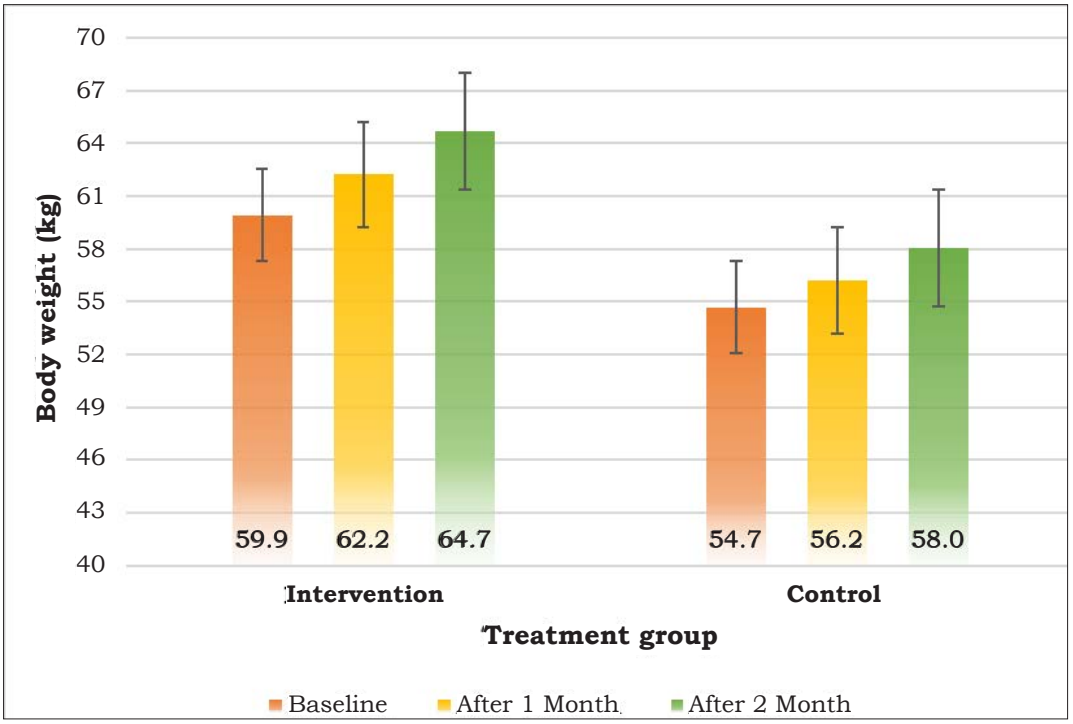

Figure 2. Body weight change before and after intervention between two groups

of 0.1 cm. Height of the participants was measured using a stature meter (GEA Medical, SH2A, China), with a precision of 0.1 cm (Gibson, 2005). Two non-consecutive days of 24-hour dietary recalls were performed to obtain nutrient intake. The Indonesian food composition table [*Tabel Komposisi Pangan Indonesia (TKPI)* 2007] was used to analyse the nutrient content of food intake. Other variables, including age, haemoglobin, and gestational age, were obtained from midwife records at the PHC.

Statistical analysis

Chi-square, Fisher's exact, or student *t*-tests were employed to compare baseline characteristics between mothers in the intervention and control groups using STATA 15.1 (Copyright 1985-2017 Stata15.1, Stata Corp LLC, Lakeway Drive, College Station, Texas 77845 USA). Mean differences before and after treatment in the intervention and control groups were assessed using multivariable linear regression. Estimate of the coefficient beta was presented.

RESULTS

The characteristics of participants are presented in Table 2. There were no significant differences between the two intervention groups in terms of age, trimester, MUAC, height, and haemoglobin level, except for gestational age (p<0.05).

The average age of pregnant women was 30 years (16–39 years) in the intervention group and 29 years (17–41 years) in the control group. The average gestational age of participants in the intervention group was 21 weeks and 24 weeks in the control group.

In the intervention group, 31% of pregnant women had chronic energy deficiency and 69% had a body weight gain of less than 2 kg per month. In the

control group, 50% had chronic energy deficiency and 50% had a body weight gain of less than 2 kg a month. Based on available data, respondents with anaemia in the intervention group were 66.7% and 72.2% in the control group.

After two months of intervention, both groups showed a significant increase in body weight (p=0.015), as illustrated in Figure 2. The average increase in body weight after 2 months for women in the intervention group (4.7 kg±3.0 kg) was significantly higher compared to women in the control group (3.3 kg ±1.8 kg). After adjusting for maternal nutritional status, weight before pregnancy, height, gestational age, and age, mothers who received food and education gained 1.50 kg (95% CI 0.31, 2.70) more weight than those who did not (Table 3).

DISCUSSION

This study showed that pregnant women at nutritional risk had a body weight increase of 4.7 kg after 2 months of intervention, meeting the IOM guidelines of gaining 0.53 kg per week required for delivering a healthy baby (Moore Simas *et al.*, 2013). In the present study, the increase in body weight after 1 month of intervention was 2.3 kg in the intervention group compared to 1.5 kg in the control group; after 2 months, it was 4.7 kg in the intervention group and 3.3 kg in the control group. These findings confirmed that the intervention with home-delivery cooked foods supplemented, rather than substituted, the regular diet of participants.

Similar results were also found among pregnant women in Iran, where maternal weight gain was 9.1±1.8 kg and 7.9±1.6 kg in supplemented and control groups, respectively (Tabrizi *et al.*, 2019). The higher weight gain might be because of the higher energy content in food supplements (1500 calories/ day) and a longer period of intervention. Moreover, a trial in rural Burkina Faso found that mothers consuming food-fortified supplements had higher birth lengths than those consuming multiple micronutrients (Huybregts *et al.*, 2009).

However, the findings differed from two studies conducted in Cambodia and Bangladesh, which found no significant increase in maternal weight gain among pregnant women who received food supplementation. Bangladeshi pregnant women received 600 kcal/day food supplements consisting primarily of a cereal–pulse mixture containing raw sugar (jaggery) and oil, while Cambodian pregnant women received 760 kcal/day of Corn Soya Blend Plus – a fortified maize and soybean flour (Janmohamed *et al.*, 2016). In these cases, the results could be explained by the possibility of food supplementation acting as a replacement rather than a supplement. The pregnant women were reportedly feeling "full" after food supplementation, leading them to consume less of their regular household foods.

Besides home-delivery cooked foods, the advantage of this intervention was that nutritionists provided nutrition counselling via telephone. Although the frequency of nutrition counselling was less than planned, it helped to motivate pregnant women to consume food supplements. This finding was supported by a study that used nutrition education as the main intervention to promote the consumption of nutrient-dense foods purchased locally among urban poor women in Bangladesh (Jahan *et al.*, 2014). A combination of nutrition education and food supplementation resulted in maternal weight gain – the increase in body weight from the 6th to the 7th month was 2.37 kg versus 1.41 kg in controls, while from the 7th to the 8th month it was 2.89 kg versus 1.74 kg in controls, and from the 8th to the 9th month it was 3.33 kg versus 2.21 kg in the control group (Jahan *et al.*, 2014). This

shows that providing nutrition education to improve food intake, as well as feeding with or without nutrition education, can promote positive outcomes (Ota *et al.*, 2015).

The use of WhatsApp application for nutrition education in this study seemed practical to be widely applied. The use of telephone or WhatsApp for evaluating the compliance of food consumption is possible when combined with several times of face-to-face 24-hour dietary recalls. A study showed that the WhatsApp application in parental assistance improved the body weight of schoolchildren with overweight and obesity (Damayanti *et al.*, 2025).

In other studies, the types of food supplementation used in interventions include chocolate energy drinks, groundnut biscuits, lipid nutrient spreads, protein energy drinks, varying food baskets, milk, biscuits, and rice noodles (Stevens *et al.*, 2015). A randomised controlled trial of a home-delivered food box in rural Oklahoma counties found improved daily consumption of fruits, vegetables, and whole grains among children (Cabili *et al.*, 2021). Similar home-delivery meal programmes have also shown to improve the diet quality and body mass index of older adults (Denissen *et al.*, 2017). The use of a catering service was an added value in this study since it provided the opportunity to serve eight types of ready-to-eat local foods, directly delivered to pregnant women every day.

Most catering services in Indonesia are micro and small enterprises (MSEs) that contribute significantly to Indonesia's national economy through gross domestic product formation and labour absorption. However, the productivity of MSEs is low. Thus, integrating local catering services into the food supplementation programme might increase MSE productivity. Harnessing local catering services could empower micro-small enterprises while creating many new recipes for pregnant women.

The use of home-cooked meals or snacks served by local caterers is a way to provide healthy and fresh foods because they contain higher nutrient contents due to less storage time. The use of local caterers for food supplementation is also favourable for local farmers. Finally, this approach provides food with less carbon footprint, which supports environmental policies for preventing climate change.

The main challenge of implementing this programme widely is how to distribute or deliver the foods to participants. This matters because it is important to ensure that they are accepted by the target group, that is, pregnant women. In 2023, only 20.2% of pregnant women received food supplements in Indonesia (Ministry of Health Indonesia, 2023a). Based on guidelines, PHCs deliver food supplements for pregnant women through integrated community health services (Posyandu), health posts, village midwives, or other health workers from PHCs (Ministry of Health of Indonesia, 2023b). However, a study in Semarang City revealed that if an undernourished pregnant woman could not come to the PHC, the food supplements would be delivered either through the nutritionist, village supervisor, or voluntary health worker (Rohmah, 2020). This study showed that the food delivery system using motorcycles was more client-orientated than provider-orientated and thus a better option to be used for similar programmes.

Although the study involved a modest number of participants, a post-hoc power calculation indicated that, with an observed effect size of 0.56 for gestational weight gain between groups, the achieved statistical power was approximately 64% at α=0.05. This suggests that the sample size was adequate to support the robustness of the main conclusion. However, this study

had several limitations. Firstly, the use of a non-randomised design limits the generalisability of the findings. Secondly, this study did not address participants' compliance with food supplementation consumption and nutrition education. Thirdly, food intake data from dietary recalls were not complete; therefore, they were not included in the regression analysis. Fourthly, this study focused only on maternal weight gain as an outcome. While weight gain is a key indicator of improved nutritional status, other critical maternal and neonatal outcomes, such as birth weight, birth length, gestational duration, or infant health, were not assessed. Future studies with a longer follow-up period are needed to evaluate the impact of such interventions on birth outcomes. Lastly, the study was conducted in an urban area with access to catering services and reliable delivery infrastructure. Thus, the feasibility of scaling this model to remote or rural areas with limited service providers remains uncertain.

CONCLUSION

This study provides preliminary evidence that home-delivered cooked foods combined with nutrition education can significantly improve gestational weight gain among pregnant women at nutritional risk. The intervention used fresh, nutrient-dense foods from local catering services, supported by weekly telephone-based nutrition education. Together, these strategies contributed to a 1.50 kg greater weight gain compared to the control group, after adjusting for key covariates.

The findings have important implications for national health policy. Firstly, they support the ongoing transition from fortified biscuits to fresh local food-based supplements as part of the maternal nutrition programme by the Indonesian Ministry of Health. This study also aligns with the Presidential Decree (2024) establishing the National Nutrition Agency, which emphasises the use of local resources and community-based delivery models to tackle malnutrition. Secondly, integrating local catering services into national supplementation programmes not only provides culturally appropriate, acceptable, and nutritionally adequate meals for pregnant women but also stimulates local micro- and small enterprises (MSEs), creating a double-duty benefit for nutrition and economic empowerment. Thirdly, this pilot supports a scalable, urban-friendly model that leverages local food systems and transportation services (e.g., online couriers), with potential for replication in other cities.

In summary, home-delivered local food supplementation offers a promising alternative to traditional supplementation models. Further research on its impact on birth outcomes and cost-effectiveness is essential to inform policy scale-up and inclusion in the national nutrition strategy.

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Authors' contributions

Didit D, principal investigator, conceptualised and designed the study, prepared the draft of the manuscript and reviewed the manuscript; Sa'diah MK, led the data collection, intervention and reviewed the manuscript; Kun AS, conducted data analysis and interpretation and reviewed the manuscript; Iskari N, supervised the data collection, intervention and reviewed the manuscript; Leliyana N, led the data collection, data analysis and assisted in drafting of the manuscript.

Conflict of interest

All authors declared that there was no conflict of interest.

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