The Effect of a Preconception Maternal Mentoring Program on Fetal Growth among Indonesian Women: Results of a Cluster Randomized Controlled Trial

Hamam Hadi *, Siti Nurunniyah, Joel Gittelsohn, Ratih Devi Alfiana, Fatimatasari Fatimatasari, Emma Clare Lewis, Detty Siti Nurdiati

Posted Date: 4 October 2023

doi: 10.20944/preprints202310.0232.v1

Keywords: Stunting; fetal growth; maternal mentoring; maternal and child health; Indonesia

Article

The Effect of a Preconception Maternal Mentoring Program on Fetal Growth among Indonesian Women: Results of a Cluster Randomized Controlled Trial

Hamam Hadi [1,2]*, Siti Nurunniyah [3], Joel Gittelsohn [4], Ratih Devi Alfiana [3], Fatimatasari [3], Emma C. Lewis [4] and Detty Nurdiati [5]

[1] Alma Ata Graduate School of Public Health, the University of Alma Ata, Yogyakarta, Indonesia; hhadi@almaata.ac.id
[2] Alma Ata Center for Healthy Life and Foods (ACHEAF), the University of Alma Ata, Yogyakarta, Indonesia; hhadi@almaata.ac.id
[3] Department of Midwifery, Faculty of Health Sciences, the University of Alma Ata, Yogyakarta, Indonesia; nurunniyah.siti@almaata.ac.id;ratihdevi@almaata.ac.id; fatimatasari@almaata.ac.id
[4] Human Nutrition, Department of International Health, Johns Hopkins University Bloomberg School of Public Health, Baltimore, Maryland, USA; jgittel1@jhu.edu, elewis40@jhu.edu
[5] Department of Obstetrics & Gynecology, Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Indonesia
* Correspondence: hhadi@almaata.ac.id; Tel.: +62-274-434-2288, Fax: +62-274-434-2269

Abstract: The prevalence of stunting in young Indonesian children is the highest among Southeast Asian Nations, and is associated with poor growth during the prenatal and early postnatal periods. A maternal mentoring program was developed for Indonesian women to improve birth outcomes. A cluster randomized control trial (CRCT) was conducted in three sub-districts of the Special Region of Yogyakarta, Indonesia. A total of 384 eligible participants were randomly allocated to either intervention (received maternal mentoring program and standard care; n=189) or control (received standard care only; n=195). The maternal mentoring program provided preconception health education; health monitoring; and text message reminders for preconception women. Fetal growth was measured between gestational weeks 27-30 using estimated fetal weight generated from ultrasonographic measurement. Birth weight was measured within 24 hours of birth. A structured questionnaire captured women's' demographics, pregnancy readiness, and body mass index (BMI). After adjustment, fetal weight was 14% (95% CI: 5.1-23.0) higher in the intervention group than in the control group, and the average weight-for-length Z-score at birth was 0.16 (95% CI: 004-0.30) higher in the intervention group than in the control group. A maternal mentoring program was associated with improved fetal growth and birth weight in this population.

Keywords: maternal mentoring; preconception; fetal growth; maternal and child health; Indonesia

1. Introduction

Maternal and child health is a pressing health challenge worldwide. In Indonesia, the maternal mortality rate (MMR) and infant mortality rate (IMR) have been on the decline, but still remain relatively high. The MMR has decreased from 390 per 100,000 live births in 1990, to 305 per 100,000 live births in 2015, yet this current rate is far from the 2015 Millennium Development Goals target of only 102 deaths per 100,000 live births. [1–3]. In addistion, impaired growth and development of children is especially concerning in developing countries, where the prevalence of stunting and wasting in children under 2 years of age is 29.1% and 6.3%, respectively [4]. In Indonesia, 21.6% of children are stunted, and 7.7% are wasted, surpassing the average among all developing countries [5]

Stunting can result from inadequate fetal growth, which is typically characterized by having a birth weight that does not match the gestational age at birth (referred to as 'Small for Gestational Age (SGA)'). SGA babies born at term have 2.43 times greater risk of stunting and 2.52 times greater risk

 doi:10.20944/preprints202310.0232.v1

of wasting compared to normal weight babies, and not surprisingly, those born preterm are at even greater risk (4.51 times greater risk of stunting and 4.19 times greater risk of wasting) [4], [6]. There are no data regarding the current prevalence of SGA in Indonesia, but it is estimated that around 6% of babies are born with low birth weight (LBW) among those whose weights are recorded. Across all developing countries, estimates are higher, reaching nearly 27% of all live births being considered SGA[7].

Preconception health services, including maternal mentoring programs, involve a series of interventions aimed at identifying and modifying behaviors pertaining to biomedical and social risks in order to improve maternal and child health before, during, and after pregnancy [8], [9]. Several studies conducted in other settings show that preconception health services improved childbirth and pregnancy outcomes, thus reducing the likelihood of maternal and infant mortality [10]. Likewise, poor preconception health can lead to poor pregnancy outcomes[11], [12].

Many women do not realize the importance of adopting healthy behaviors prior to becoming pregnant. Preconception health services allow pregnant women to receive adequate health services before the period of fetal organogenesis at which point the fetus begins development [13]. Importantly, most of the potential dangers that can arise during pregnancy occur in women who are unaware of the risks associated with not being properly prepared for pregnancy.

To date, no preconception interventions have been developed and tested in Indonesia. Thus, there is a need for interventions which target the pre-pregnancy period in this setting. Given previous literature which supports this need[14], the present study sought to examine the effect of a maternal mentoring program provided to Indonesian women during the preconception and pregnancy periods on fetal growth and birth weight.

2. Materials and Methods

The present study was conducted under the Community Alma Ata Partnership through Updated Research and Education (CAPTURE) project. Detailed methods of this study have been reported elsewhere [15]. A cluster randomized controlled trial (CRCT) design was used (N=122 clusters) consisting of preconception women residing in either the Sedayu Sub-district, Pajangan Sub-district, or Pleret Sub- district of Special Region of Yogyakarta, Indonesia. A total of 384 women were recruited within the identified clusters, and each was randomly allocated to either the intervention group (n=189) or control group (n=195). Data were obtained using a questionnaire conducted at two time points: pre-test and post-test. Pre-tests occurred during the period before pregnancy, while post-tests occurred three weeks later. Clusters were randomly allocated into treatment group, using Computed Generated Random Allocation [16]. Clusters 1–61 were assigned to the intervention group, and clusters 62–122 were assigned to the control group. Thus, the intervention and control groups each consisted of 61 clusters.

Recruitment was conducted using marriage registration data. Members of the research team met with preconception women and explained the research process, as well as the potential benefits and disadvantages of participating. If willing and able to participate, the women were asked to sign an informed consent form. Inclusion criteria included: (1) being a woman of childbearing age (but not currently pregnant) who was currently married; (2) planning to remain in the research area for at least the next two years; and (3) being willing to sign the informed consent form. Women were excluded from the study if they: (1) became pregnant at the beginning of the study; (2) planned to move in the next two years; or (3) planned to delay pregnancy. Out of a total of 1281 women recruited, 384 met inclusion criteria, were willing to participate, and sign the informed consent form. The data were collected from this final sample (N=384) via the CAPTURE data system from March 2019 to March 2020.

Mentors consisted of undergraduate students enrolled in the midwifery diploma program, nutrition program, nursing program, pharmacy program, and hospital administration program and who were already involved in maternal and child health surveillance activities conducted by the CAPTURE project.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 4 October 2023 doi:10.20944/preprints202310.0232.v1

In this study, the maternal mentoring program included: (1) preconception health education delivered once during the initial home visit using face-to-face counseling with a supplemental booklet provided; (2) monthly monitoring of pregnancy status via What's App (WA) or basic Short Messaging Service (SMS) where women were asked to respond to the text prompt, "Have you experienced signs or symptoms of pregnancy such as late menstruation, nausea, vomiting, or others?'; and (3) once women reported experiencing signs of pregnancy, they were sent a text reminder to book their first antenatal care (ANC) visit immediately. Follow-up messages sent every other day to women in the intervention group also included reminders to comply with routine provider visits and recommended iron supplementation.

The CAPTURE team trained mentors to ensure that they were competent in their role as a preconception health counsellor during the initial home visit phase of the program. In addition, a standardized preconception education booklet and worksheet were used to ensure intervention quality and validity [17].

Fetal weight between weeks 27 to 30 was estimated using ultrasonography (USG) examination conducted by trained obstetricians. Each pregnant woman in the study sample was scheduled to visit an approved obstetrician once she entered the 27th week of gestation. Birth weight and birth length were measured within 24 hours of the newborn's birth by a trained midwife or nurse in the health clinic or hospital in which the delivery took place. Weight was measured using a digital weighing scale (SECA 876, Hannover, Germany) to the nearest 100 grams, while length was measured using SECA measuring tapes to the nearest millimeter. Weight-for-Length Z-Scores and Weight-for-Age Z-Scores were generated using Stata 16 for each newborn.

All data were then analyzed using Stata 16, which involved constructing a frequency distribution to determine participant characteristics, as well as bivariate and multivariable analyses. The average difference test between treatment groups was performed using Chi-Square and Independent *t*-tests. Multilevel mixed effects linear regression was used to explore the effect of the intervention on fetal growth and infant birthweight, controlling for cluster, age, parity, level of education, employment status, income, and maternal body mass index (BMI).

3. Results

There were no significant differences in socioeconomic or demographic characteristics between the intervention and control groups (Table 1). The majority of participants were of a healthy reproductive age; being nulliparous; had less than 12 years of education; were employed; had an income equal to or below the regional minimum wage; and reported spending less than six months preparing for pregnancy. The Majority of BMI at baseline was in the normal category for both groups 61,9% for control group and 68% for intervention group, 14,8% for control group and 17,9% for intervention group in the underweight category and the others in the overweigh category. There is no significant difference within two groups.

Table 1. Participant characteristics at study baseline.

Intervention group			**Control group**		
Variable	**Total (*n*=189)**	**Percentage(%)**	**Total (*n*= 195)**	**Percentage(%)**	***p*-value**
Age					
Healthy reproductive age	173	91.5	174	89.2	0.064
No	12	8.5	21	10.8	
Parity					
Nulliparous	182	96.2	189	97	0.187*
Multiparous	7	3.8	5	3	
Education level					
≤ 12 years	153	81	166	85.1	0.275
>12 years	36	19	29	14.9	
Employment status					

 doi:10.20944/preprints202310.0232.v1

Yes	140	74	138	71.1	0.445
No	49	26	56	28.9	
Income					
≤ Regional income	143	75.7	142	72.8	0.525
> Regional income	46	24.3	53	27.2	
Time for pregnancy preparation					
≤ 6 months	166	88.3	160	85.1	0.362
> 6 months	22	11.7	28	14.9	
Maternal Body Mass Index					
<18,5	28	14.8	35	17.9	
18,5 – 24,5	117	61.9	133	68.2	0.056
>24,5	44	23.3	27	13.8	

p-value from the chi-squared test. *p-value from Fisher's exact test.

3.1. The effect of maternal mentoring on fetal growth

The estimated fetal weight (EFW) at 27-30 weeks of gestational age was 245.5 g higher (p<0.001) in the intervention compared to the control group (Table 2). Likewise, the percentile of EFW was 17.7 points higher (p<0.001) in the intervention compared to the control group (Table 2). Birth weight of babies was found to be 78.8 g higher (p<0.05) in the intervention group than the control group (Table 2). Both WLZ and WAZ were significantly higher (p<0.05) in the intervention group than in the control group (Table 2). No impact was seen in terms of birth length.

Table 2. Fetal and newborn anthropometric characteristics.

Study Groups			
Fetal Anthropometric Characteristics	**Intervention, n= 113**	**Control, n =119**	***p*-Value**
Estimated Fetal Weight/EFW (g), mean (SD)	1415.8 (443.3)	1170.3 (226.8)	<0.001
Percentile of EFW, mean (SD)	57.7 (34.5)	40.0 (26.6)	<0.001
	Intervention, n =129	**Control,n=123**	
Newborn birth weight, mean (SD)	3117.8 (277.5)	3039.0 (264.7)	<0.05
Newborn length, mean (SD)	49.2 (1.2)	49.1 (1.1)	>0.05
WLZ-score, mean (SD)	-0.3 (0.7)	-0.5 (0.7)	<0.05
WAZ-score , mean (SD)	-0.4 (0.6)	-0.5 (0.6)	<0.05

EBW was estimated by using USG measurement
EBW's Percentile was calculated based on Intergrowth WLZ-score was calculated based on Intergrowth Standard WAZ-score was calculated based on Intergrowth Standard
*p-value was obtained from Independent t-test

3.2. The Effect of Maternal Mentoring on Newborn Weight-for-Length Z-Score

Further analyses using cluster-adjusted multilevel mixed-effects linear regression were performed to examine the effect of maternal mentoring on EFW percentile. In addition to adjusting for clusters, variables including maternal age, maternal education, maternal employment status, maternal monthly income, and maternal BMI were also adjusted for. Based on this, we determined that the EFW percentile was 14 points higher (95% CI: 5.1-23.0) in the intervention group than in the control group (Table 3).

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 4 October 2023 doi:10.20944/preprints202310.0232.v1

Table 3. The Effect of maternal mentoring on percentile of estimated fetal weight.

Percentile EFW	***Cluster- Adjusted Multilevel Mixed-Effects Linear Regression***			
	Coefficient	**SE**	**(95%CI)[b]**	***p*-value**
Study Groups:				
Intervention	14.0	4.6	5.1–23.0	0.002*
Control	-	-	-	
Age (years)				
< 20	4.4	7.9	-11.2–20.0	0.583
20-35	-	-	-	-
>35	-6.2	12.9	-31.5–19.1	0.630
Maternal Education				
≤12 years	-13.7	5.5	-24.5-(-3.0)	0.012*
>12 years	-	-	-	
Employment Status				
Employed	-	-	-	0.314
Not Employed	-4.47	4.4	-13.2–4.2	
Maternal monthly income				
< National Wage	-	-	-	
≥ National Wage	-5.74	4.8	-15.0–3.6	0.228
Maternal Body Mass Index				
Underweight	-4.4	5.5	-15.3–6.4	0.422
Normal	-	-	-	-
Overweight	-10.5	5.4	-21.3–0.15	0.053

Regression Coefficients, SE, 95% CI, and p-values were generated from multilevel mixed-effects linear regression adjusting for cluster, age, maternal education, employment status, maternal monthly income, and BMI (n cluster=106); *Significant at p<0.05.

3.3. The Effect of Maternal Mentoring on Newborn Weight-for-Length Z-Score

After adjustment in the multivariate models, we found a significant difference in birth weight, but not in length, between intervention and control groups (Table 4). Accordingly, the mean of Weight-for-Length Z-Score was 0.16 points higher (95% CI: 0.01-0.30) in the intervention group than in the control group adjusting for cluster, maternal age, maternal education, and socio- economic status, and maternal preconception BMI (Table 4).

Table 4. The Effect of Maternal Mentoring on Newborn Weight-for-Length Z-Score.

Weight-for-Length Z-score	***Cluster Adjusted Multilevel Mixed-Effects Linear Regression***			
	Coefficient	**SE**	**(95% CI)**	**p-value**
Study Groups: InterventionControl	0.16 -	4.6 -	0.04–0.3 -	0.002* -
Maternal age (years)				
< 20	4.4	7.9	-11.2–20.0	0.58
20-35	-	- 12.9	-	- 0.63
>35	-6.2		-31.6–19.1	
Maternal education				
≤12 years	-13.7	5.45	-24.5-(-3.0)	0.77
>12 years	-	-	-	

 doi:10.20944/preprints202310.0232.v1

Maternal Employmentstatus				
Employed	-4.5	4.44	-13.2-4.2	
Not Employed	-	-	-	0.31
Maternal Monthly Income				
< Minimum Nationalwage				
≥ Minimum National	-	- 4.76	-	- 0.23
Wage	-5.7		-15.09-3.59	
Maternal Body MassIndex				
Underweight Normal	0.11	5.53	-0.10–0.3	0.422
Overweight	- 0.22	- 5.46	- 0.08-0.4	- 0.045*

Regression Coefficients, SE, 95% CI, and p-values were generated from multilevel mixed-effects linear regression adjusting for cluster, Age, Maternal Education, Employment Status, Maternal monthly income, and BMI. *Significant at $p<0.05$.

4. Discussion

The preconception maternal mentoring program developed as part of this study is the only one of its kind to be delivered as an intervention among Indonesian women with the goal of improving maternal and child health[15]. In the present analysis, we found that receiving the maternal mentoring program during the preconception phase and during pregnancy significantly improved fetal growth and birth weight for newborns. We also found that newborn birth weight was significantly higher for women who received the program compared to those who only received standard care.

Importantly, the maternal mentoring program also led to improved reported readiness for pregnancy (i.e., women felt more prepared for pregnancy, had more time for motherhood, had time to discuss their pregnancy with their partner, were more likely to consume recommended iron and folic acid supplementation, were more likely to maintain a healthy diet, were more likely to not smoke, were more likely to avoid over-the-counter and herbal drugs, were more likely to have health care insurance, were more able to manage stress, and were more likely to seek early detection of STDs) [18]. Preconception maternal mentoring improved the timing of the first ANC visit; women who received preconception maternal mentoring were 3 times more likely to have an earlier ANC visit than those who did not receive this mentoring [15]. This latter finding may help to explain, in part, the effect of the maternal mentoring program on improved fetal growth and birth weight in this study, given that early ANC has been associated with improved birth outcomes.

Previous studies have found that nutrition education during pregnancy can lead to a 54% reduction in preterm births [19], and a 74.3% [20] to 96% reduction [19] in low birth weight (LBW). Monthly nutrition education delivered during the third trimester has led to 60% higher weight gain, 20% higher birth weight, and 94% lower LBW, as well [21]. Similarly, guided nutrition counseling delivered during pregnancy through home visits has led to 0.95 kg higher average gestational weight gain and 0.26 kg higher average birth weight during a previous intervention [22]. More interestingly, nutrition education for women during pregnancy has resulted in improved newborn birth weight to a greater extent when partners are included in the educational delivery as well. In one study, newborn birth weight was 0.40 kg higher for the newborns of couples where both partners received nutrition education compared to only the woman [23].

Given that inadequate fetal growth is strongly associated with stunting in developing countries, including Indonesia, the present study provides support for implementing maternal mentoring in addition to standard care for preconception and pregnant women as an effective strategy to reach national goals for reduced stunting and wasting among children. However, it is important to note that this study sample was obtained from women in Yogyakarta who may not be representative of all women across rural and urban regions of Indonesia.

5. Conclusions

To our knowledge, this is the first intervention trial to investigate the impact of preconception maternal mentoring on fetal growth and birth weight outcomes in Indonesia, where child stunting and wasting are highly prevalent. Our findings demonstrate that a maternal mentoring program conducted in addition to standard care procedures may be effective for improved fetal growth and increased birth weight among this high-risk population. Further research is needed to determine how other interventions can be combined with maternal mentoring to most effectively improve outcomes for both mothers and children.

Author Contributions: HH was involved in research initiation, research design, data analysis, and writing of the manuscript. SN, was involved in the research preparation, data collection, and management, data analysis, and manuscript preparation. FS and RDA were involved in data collection and manuscript preparation. JG, EL, and DSN were involved in writing and reviewing the manuscript. All authors read and approved the final manuscript.

Funding: The University of Alma Ata as well as the Ministry of Education and Culture, Research and Technology and Higher Education, the Republic of Indonesia contributed to this manuscript preparation.

Institutional Review Board Statement: The study received ethical approval from the Medical and Health Research Ethics Commission of Gadjah Mada University on March 1, 2019, under approval number KE/FK/0219/EC/2019.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Authors are very pleased to share the research data used in this manuscript.

Acknowledgments: The Alma Ata University supported this work. The first author would also like to acknowledge the financial support from the Ministry of Education and Culture, Research and Technology and Higher Education, the Republic of Indonesia through the grant of World Class Professor No: 108/E/KPT/2023, July 27, 2023. We also acknowledge the contribution of Yhona Paratmanitya, and other faculty members and students of the Faculty of Health Sciences, the University of Alma Ata who involved in the CAPTURE Project.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. National Population and Family Planning Board, S. Indonesia, and M. of Health, "Indonesia Demographic and Health Survey 2012," 2013. doi: 10.1111/j.1471-0528.2007.01580.x.
2. Ministry of Health Indonesia, "Basic Health Research 2018," 2018.
3. World Health Organization (WHO), "WHO Recommendations on Antenatal Care for A Positive Pregnancy Experience," 2016.
4. P. Ssentongo *et al.*, "Global, regional and national epidemiology and prevalence of child stunting, wasting and underweight in low- and middle-income countries, 2006–2018," *Sci. Rep.*, vol. 11, no. 1, pp. 1–12, 2021, doi: 10.1038/s41598-021-84302-w.
5. Ministry of Heath Indonesia, "Nutritional Status Survey Indonesia 2022," 2022.
6. P. Christian *et al.*, "Risk of childhood undernutrition related to small-for-gestational age and preterm birth in low- and middle-income countries," *Int. J. Epidemiol.*, vol. 42, no. 5, pp. 1340–1355, 2013, doi: 10.1093/ije/dyt109.
7. R. E. Black, "Global Prevalence of Small for Gestational Age Births.," *Nestle Nutr. Inst. Workshop Ser.*, vol. 81, pp. 1–7, 2015, doi: 10.1159/000365790.
8. S. V Dean, A. M. Imam, Z. S. Lassi, and Z. a Bhutta, "Systematic Review of Preconception Risks and Interventions," Karachi, 2012.
9. C. L. Robbins *et al.*, "Core state preconception health indicators - pregnancy risk assessment monitoring system and behavioral risk factor surveillance system, 2009.," *Morb. Mortal. Wkly. report. Surveill. Summ. (Washington, D.C. 2002)*, vol. 63, no. 3, pp. 1–62, Apr. 2014.
10. N. Farahi and A. Zolotor, "Recommendations for preconception counseling and care," *Am. Fam. Physician*, vol. 88, no. 8, pp. 499–506, 2013.
11. R. N. Das, R. S. Devi, and J. Kim, "Mothers' lifestyle characteristics impact on her neonates' low birth weight," *Int. J. Women's Heal. Reprod. Sci.*, vol. 2, no. 4, pp. 229–235, 2014, doi: 10.15296/ijwhr.2014.33.
12. S. J. Genuis and R. A. Genuis, "Preconception Care: A New Standard of Care within Maternal Health Services.," *Biomed Res. Int.*, vol. 2016, p. 6150976, 2016, doi: 10.1155/2016/6150976.

13. N. Ricks, L. Comer, F. Liu, H. DeGrande, and O. Adeniran, "Substance use and preconception care: A review of the literature," *Int. J. Women's Heal. Reprod. Sci.*, vol. 5, no. 1, pp. 3–10, 2017, doi: 10.15296/ijwhr.2017.02.
14. Z. S. Lassi, T. Mansoor, R. A. Salam, J. K. Das, and Z. A. Bhutta, "Essential pre-pregnancy and pregnancy interventions for improved maternal, newborn and child health.," *Reprod. Health*, vol. 11 Suppl 1, no. Suppl 1, p. S2, 2014, doi: 10.1186/1742-4755-11-S1-S2.
15. H. Hadi *et al.*, "The effect of a maternal mentoring program on the timing of first antenatal care visit among pregnant women in Bantul, Indonesia: Results of a cluster randomized trial," *Heal. Promot. Perspect.*, 2021, doi: 10.34172/hpp.2021.39.
16. J. Kim and W. Shin, "How to do random allocation (randomization)," *Clin. Orthop. Surg.*, vol. 6, no. 1, pp. 103–109, 2014, doi: 10.4055/cios.2014.6.1.103.
17. S. Nurunniyah, D. S. Nurdiati, M. Julia, and H. Hadi, "Development process of the preconception education booklet," *Int. J. Res. Med. Sci.*, vol. 9, no. 7, p. 1864, 2021, doi: 10.18203/2320-6012.ijrms20212350.
18. S. Nurunniyah, M. Julia, H. Hadi, D. S. Nurdiati, and E. C. Lewis, "The effect of a Maternal Mentoring Programme on Pregnancy Readiness among Indonesian Women: Results of a Cluster Randomised Control Trial," *Afr. J. Nurs. Midwifery*, vol. 24, no. 2, 2022, doi: 10.25159/2520-5293/9367.
19. E. Ota, H. Hori, R. Mori, R. Tobe-Gai, and D. Farrar, "Antenatal dietary education and supplementation to increase energy and protein intake.," *Cochrane database Syst. Rev.*, no. 6, p. CD000032, Jun. 2015, doi: 10.1002/14651858.CD000032.pub3.
20. M. M. A. de S. Santos, D. C. de Barros, J. L. Nogueira, M. R. Baião, and C. Saunders, "Impacto de un programa de intervención nutricional prenatal en el peso de los recién nacidos de madres adolescentes," *Nutr. Hosp.*, vol. 28, no. 6, pp. 1943–1950, 2013, doi: 10.3305/nh.2013.28.6.6860.
21. K. Jahan *et al.*, "Short-Term nutrition education reduces low birthweight and improves pregnancy outcomes among urban poor women in Bangladesh," *Food Nutr. Bull.*, vol. 35, no. 4, pp. 414–421, 2014, doi: 10.1177/156482651403500403.
22. Y. M. Demilew, G. D. Alene, and T. Belachew, "Effect of guided counseling on dietary practices of pregnant women in West Gojjam Zone, Ethiopia," *PLoS One*, vol. 15, no. 5, pp. 1–14, 2020, doi: 10.1371/journal.pone.0233429.
23. D. Tsegaye, D. Tamiru, and T. Belachew, "Effect of a theory-based nutrition education intervention during pregnancy through male partner involvement on newborns' birth weights in Southwest Ethiopia. A three-arm community based Quasi-Experimental study," *PLoS One*, vol. 18, no. 1 January, pp. 1–16, 2023, doi: 10.1371/journal.pone.0280545.