The Open Public Health Journal
DOI: 10.2174/0118749445361786250102072927, 2025, 18, e18749445361786
ISSN: 1874-9445
1

RESEARCH ARTICLE **OPEN ACCESS**

Reducing Low Birth Weight through Integrated Learning Groups: A Pregnancy Education House Approach

Lia Kurniasari[1,2,*], Sri Achadi Nugraheni[3], Martha Irene Kartasurya[3] and Farid Agushybana[4]

[1]*Doctoral Program in Public Health, Faculty of Public Health, Universitas Diponegoro, Semarang, Indonesia*
[2]*Department of Public Health, Faculty of Public Health, Universitas Muhammadiyah Kalimantan Timur, Samarinda, Indonesia*
[3]*Department of Public Health Nutrition, Faculty of Public Health, Universitas Diponegoro, Semarang, Indonesia*
[4]*Department of Biostatistics and Popualtion Health, Public Health Nutrition, Faculty of Public Health, Universitas Diponegoro, Semarang, Indonesia*

Abstract:

Background: Low birth weight remains a significant public health concern, as it increases the risk of morbidity and mortality in newborns. In Indonesia, pregnant women are encouraged to attend health-monitoring classes, though not all can participate.

Objective: This research aimed to develop an intervention model to enhance existing pregnant women's classes, called "Rumah Dila" (pregnancy education house).

Methods: A quasi-experimental research was conducted with pre- and post-tests involving 60 pregnant women in the intervention group and 60 in the control group. The Rumah Dila program was implemented over six months, from the second to third trimesters. The program's impact was measured by improvements in maternal health behaviors, birth weight, and infant length.

Results: Wilcoxon and paired sample t-tests revealed significant increases in knowledge, attitudes, and practices in both groups (p=0.001). The Cohen's d effect sizes for knowledge, attitudes, and practices were 1.861, 2.341, and 1.853, respectively. Meanwhile, the effect sizes for birth weight (0.511) and infant length (0.593) indicated a substantial impact on maternal behaviors and a moderate impact on delivery outcomes.

Conclusion: This research study demonstrates that well-monitored support from early pregnancy to delivery is essential to reducing the incidence of low birth weight and low birth length.

Keywords: Intervention, Pregnant women, Maternal class, Low birth weight, Learning class, Rumah Dila.

*Address correspondence to this author at the Doctoral Program in Public Health, Faculty of Public Health, Universitas Diponegoro, Semarang, Indonesia and Department of Public Health, Faculty of Public Health, Universitas Muhammadiyah Kalimantan Timur, Samarinda, Indonesia; Tel: +62 85231669773; E-mail: liakesmas86@students.undip.ac.id

Cite as: Kurniasari L, Nugraheni S, Kartasurya M, Agushybana F. Reducing Low Birth Weight through Integrated Learning Groups: A Pregnancy Education House Approach. Open Public Health J, 2025; 18: e18749445361786. http://dx.doi.org/10.2174/0118749445361786250102072927

Received: October 21, 2024
Revised: November 30, 2024
Accepted: December 04, 2024
Published: January 07, 2025

1. INTRODUCTION

Low Birth Weight (LBW) is associated with increased morbidity and mortality in neonates. The World Health Organization (WHO) states that among 15% of total births in the world, 20 million are LBW babies. By 2025, it is expected that LBW births can be reduced to 30% [1, 2]. Barker's Developmental Origins of Health and Disease (DOHad) theory posits that maternal health and nutrition during pregnancy directly affect fetal growth and long-term developmental outcomes [3].

The birth of LBW babies can be prevented by engaging in healthy behaviors during pregnancy [4]. The Health Belief Model (HBM) suggests that maternal health behaviors are shaped by perceived benefits, risks, and self-efficacy, which influence prenatal care adherence and optimal nutritional practices during pregnancy [5]. Healthy behaviors during pregnancy are directly related to the achievement of maternal nutrition during pregnancy, and many studies have stated that the nutritional status of pregnant women and maternal healthy behaviors affect fetal growth [6, 7]. Some ways that can be used to measure the nutritional fulfillment of pregnant women include measuring the circumference of the mother's upper arm (LiLA), measuring weight gain in every trimester, and measuring Haemoglobin (Hb) levels, which are closely related to the mother's anemia status during pregnancy [8-10].

Monitoring maternal nutrition during pregnancy is crucial for prenatal care, which begins early in pregnancy. In Indonesia, prenatal care is supported by the government, thus all pregnant women are required to undergo prenatal care at least according to current government regulations, corresponding to 6 visits [11]. The more the prenatal visits, the more information the mother will get about her pregnancy health. The number of these visits can reach from 10 to 14 prenatal visits during pregnancy. Prenatal visits consist of screening for various medical conditions, physical parameters, laboratory tests, and provision of health information [12]. Various studies have shown that adequate prenatal care can reduce LBW rates. However, this occurs in infants with full-term births only, since prenatal care is considered incapable of reducing the incidence of prematurity (Indonesian Ministry of Health, 2020). Research using data from the Indonesia Demographic and Health Survey (IDHS) found that factors associated with LBW in Indonesia are maternal education, antenatal care, and pregnancy complications [13-15].

Current efforts to prevent LBW in Indonesia focus primarily on providing nutrition to pregnant women. Nevertheless, few efforts are still being made to improve maternal understanding, despite the two things being interrelated. The Indonesian government has proposed a program aimed to improve the knowledge of pregnant women through maternity classes, facilitated by the midwives of public health centers [16]. This program has been proven to improve maternal knowledge, but it cannot be followed by all pregnant women [17] LBW can have various impacts on the long-term health of the baby after birth [18]. In a study, Kim showed that the risk of asthma is higher in groups with low birth weight (aHR 1.06, 95% CI 1.04 to 1.08) [18]. Issara's study suggested that an effort can be made to reduce the incidence of LBW by completing ANC visits and strengthening health workers in assisting pregnant women [15]. This study aimed to evaluate the effectiveness of improving healthy maternal behaviors during pregnancy as a strategy to prevent LBW.

The Rumah Dila approach is an innovative intervention that utilizes integrated learning groups to provide learning support to pregnant women. The intervention is grounded in Bandura's Social Learning Theory, which emphasizes that group-based learning, coupled with social support and positive reinforcement, fosters the adoption of healthy behaviors [19]. The effectiveness of learning groups with this new model has not been widely studied; therefore, research can be one of the strategic efforts to reduce the incidence of LBW. The model was developed by focusing on the comprehensive needs of pregnant women through education and community support. Through Rumah Dila, it is being examined directly in the community to see how this intervention model affects the reduction of LBW incidence.

2. METHODS

This research study used a quasi-experiment method. It was conducted on 120 pregnant women using the Lemeshow sample formula with a total of 60 pregnant women selected for each group, consisting of the intervention group and the control group. Pregnant women (participants) were selected by looking at data on maternal check-up visits from two health centers with the highest LBW cases, including Rapak Mahang Health Center for the treatment group and Loa Janan Health Center for the control group. These health centers are located in separate areas. To prevent further bias, the researchers randomized both groups, ensuring random assignment of participants, maternal anemia status, family income, and maternal education.

In the treatment group, pregnant women received education through the Rumah Dila model. This model consisted of six sessions conducted over six months, starting in the second trimester and continuing into the third trimester. The Rumah Dila model offered flexibility by integrating both offline and online meetings. The educational materials were delivered systematically and tailored to the health conditions of the pregnant women. The Rumah Dila model covered topics, such as nutrition during pregnancy (specific to the second and third trimesters) with a focus on preventing LBW. Participants were also educated on how to read food labels to avoid consuming packaged foods that are not recommended for pregnant women. Additionally, the program provided breathing exercises to prepare for labor and stress management techniques. Supporting materials included educational videos and modules. To ensure a comprehensive and interactive approach, health monitoring was conducted directly and participants engaged in interactive discussions through social media groups. The facilitators included three independent midwives, community health workers, and experts, such as nutritionists and psychologists. The control group attended conventional antenatal classes four times during pregnancy. These sessions used pre-existing materials that did not emphasize LBW prevention. All sessions were conducted in person, with lectures as the sole method of delivery. The facilitator in the control group was a midwife from the health center, with one midwife assigned to oversee the sessions.

This research used a closed-ended questionnaire as the

instrument, with true and false answer options that had been tested for the validity of each question item, followed by a questionnaire reliability test, which was carried out in an area similar to the intervention site. The reliability test results showed Cronbach's alpha values of 0.916 for knowledge, 0.872 for attitudes, and 0.954 for practices, all exceeding the threshold of 0.70, indicating a high level of reliability in accordance with research standards. The questionnaire was designed based on materials from the maternal and child health guidebook from the Indonesian Ministry of Health. It also incorporated various general theories on pregnancy health and supporting journal articles with all questions focusing on efforts to prevent Low Birth Weight (LBW). This research adhered to ethical principles during respondent selection by requiring participants to complete an informed consent form. The form detailed the study's purpose and objectives and included the participant's signature as a sign of agreement to participate in the research. Ethical clearance was granted by the research ethics commission of the Faculty of Public Health, Diponegoro University (no.: 281/EA/KEPK-FKM/2022). At the end of the research, birth weight and birth length were recorded to see the effect of the model on both.

The research questionnaire contained data on the characteristics of pregnant women and pregnancy-related data, such as the mother's initial weight at the first ANC examination, the mother's initial LiLA size, and the mother's anemia status at the beginning of pregnancy. These measurements were repeated at the end of pregnancy before birth, and completed with the measurement of the baby's birth weight. The data on LiLA size, anemia status, ANC visits, and low birth weight have been presented as mean, median, and standard deviation values. LiLA size was calculated through the delta of the final LiLA and initial LiLA. All statistical analyses were performed using SPSS statistical software. For the statistical analysis, a paired sample t-test was used to determine the improvement in the behavior of the pregnant women, and Cohen's d test was employed to assess the effect of the intervention model.

3. RESULTS

The characteristics of the participants included in this research study are presented in Table **1**. The characteristics of mothers in both intervention and control groups were similar in terms of age, employment status, family income, insurance ownership, parity, and anemia status in early pregnancy. However, maternal education was not homogeneous between the groups (p= 0,001).

There were differences in knowledge and attitudes between the intervention group and the control group before and after the intervention.

The score differences in knowledge, attitudes, and practices in the intervention group and control group are presented in Table **2**. The median score of knowledge in the intervention group changed from 17,00 to 28,00, while the median score of attitude changed from 60,00 to 69,00, and the median score of practice changed from 28,00 to 43,00. For the control group, the median score of knowledge changed from 20,00 to 22,00, while the median score of attitude changed from 45,00 to 63,00, and the median score of practice changed from 48,00 to 69,00.

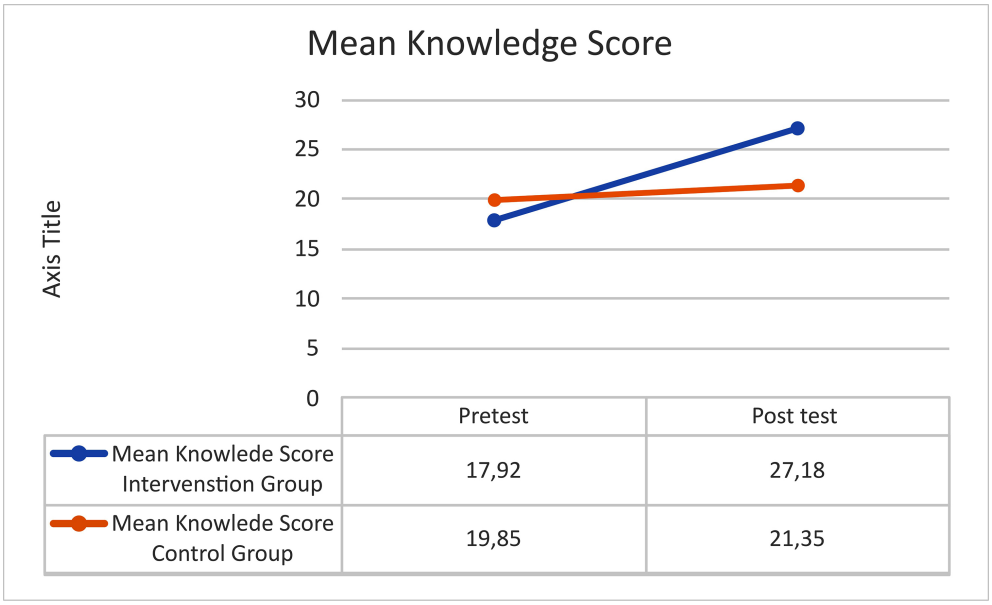
Table 1. Frequency distribution of participants in both intervention and control groups.

Variable		Intervention Group		Control Group		*p*-value
		n	%	n	%	
Maternal Age	< 20 years	2	3.3	2	3.3	0,680
	20-35 years	51	85	49	81.7	-
	>35 years	7	11.7	9	15	-
Maternal Education	Junior High School	3	5.0	4	6.7	0,001
	Senior High School	47	78.3	40	66.7	-
	University	10	16.7	16	26.7	-
Employment Status	Employed	-	-	-	-	1,000
	Unemployed	28	46.7	28	46.7	-
Family Income	> Regional minimum wage	21	35	19	31.7	-
	< Regional minimum wage	39	65	41	68.3	0,445
Insurance Ownership	Having insurance	50	83.3	42	71.7	0,189
	Don't have Insurance	10	16.7	17	28.3	-
Parity	First	12	20	12	20	0,267
	Second	16	26.7	17	28.3	-
	Third	22	36.7	26	43.3	-
	More than three	10	16.7	5	8.4	-
Nutritional status in early pregnancy	Thin	11	18.3	14	23.3.	0,339
	Normal	36	60.0	36	60	-
	More/obesity	13	21	10	16.7	-
Anemia status in early pregnancy	Anemic	19	31.7	18	30	0,110
	Not anemic	41	68.3	42	70	-

Table 2. Comparison of knowledge, attitude, and practice scores at pretest and post-test stages among mothers between the intervention and control groups.

Variable	Intervention Group			Control Group			*p*-value
	Median	Min-max	SD	Median	Min-max	SD	-
Knowledge							0,001[a]*
Pretest	17,00	12-23	2,739	20,00	12-27	3,541	-
Post-test	28,00	22-30	2,159	22.00	16-26	2,705	-
Attitude							0,001[b]*
Pretest	60,00	54-66	3,059	57,00	45-63	3,427	-
Post-test	69,00	62-78	3,635	61.00	48-69	24,623	-
Practice							0,001[a]*
Pretest	28,00	18-39	4,157	30,00	19-35	3,613	-
Post-test	43,00	44-45	2,244	37,00	27-43	3,020	-

Note: a= analyzed using independent sample t-test, b= analyzed using Mann-Whitney test.



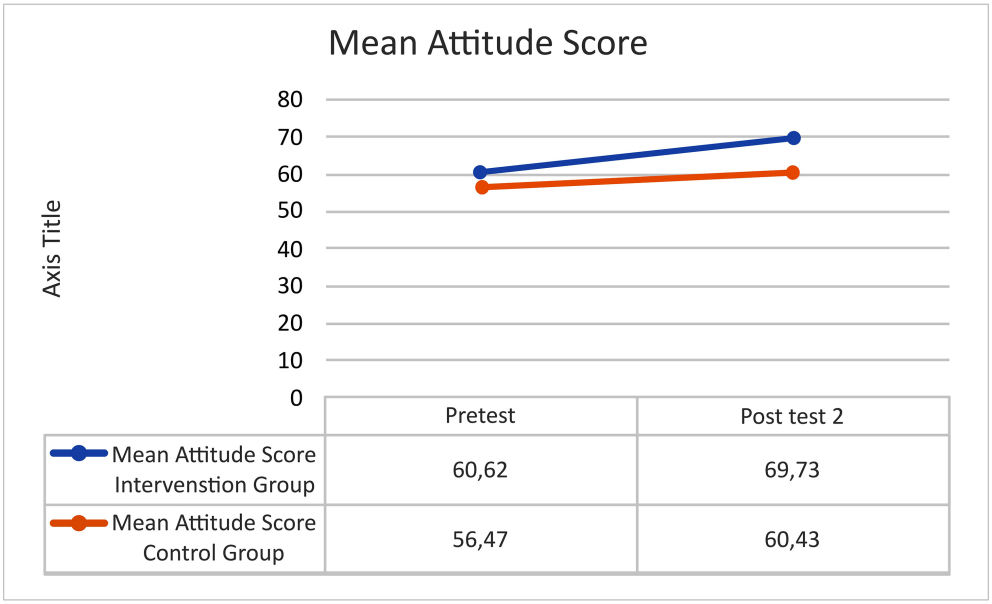


Fig. 1 contd.....

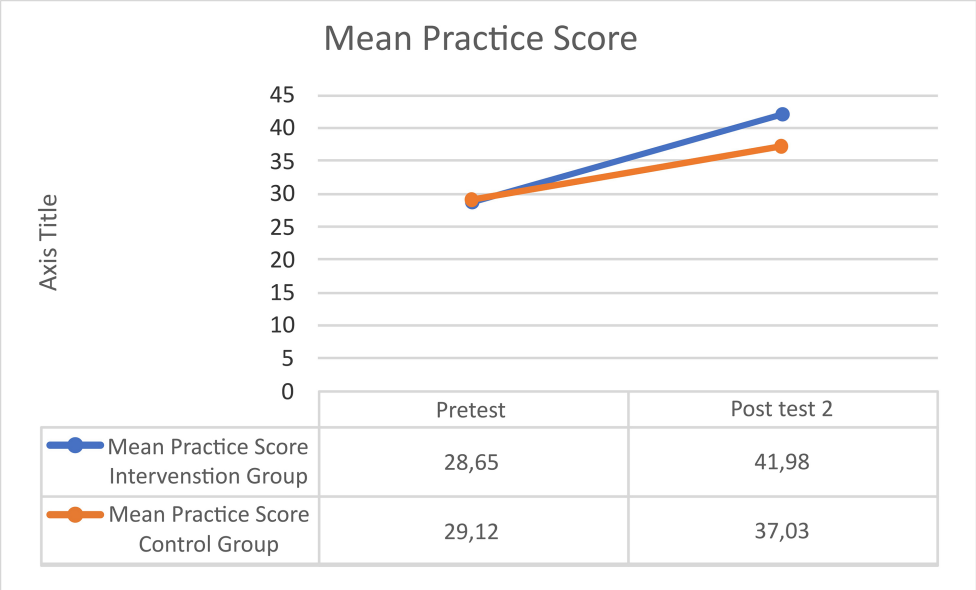


Fig. (1). Increased behavior characteristics of pregnant women in the intervention and control groups before and after the intervention.

Table 3. Changes in knowledge, attitude, and practice scores before and after the intervention between the intervention and control groups.

Variable	Intervention Group			Control Group			
-	Median Score	Min-max	SD	Median	Min-max	SD	*p*-value
Knowledge	29.00	22-31	2,371	22,00	17-28	2,924	0,001[c]*
Attitude	68,50	62-75	3,635	61,00	48-69	4,623	0,001[d]*
Practice	43,00	36-45	2,244	37,00	27-43	3,020	0,001[c]*

Note: C = statistics analyzed using paired sample t-test, d = statistics analyzed using Wilcoxon test.

Table 4. The effect size of intervention model on healthy behaviors, birth weight, and infant length.

Cohen's d/variable	Knowledge	Attitude	Practice	Birth Weight	Infant Length
Cohen's d score	1.861	2.341	1.853	0.511	0.593
Results	Huge effect	Huge effect	Huge effect	Medium effect	Medium effect

Fig. (**1**) above shows the average pretest and post-test scores before and after the intervention in both groups of pregnant women for healthy behaviors. It can be seen that the mean pretest score of knowledge and practice in the control group was higher than in the intervention group. Following the post-test measurement after the intervention, the mean value of the intervention group increased considerably from the pretest score, becoming higher than the control group. Meanwhile, the pretest score of attitude in the intervention group was higher than the control group, and it further increased after the intervention. This shows that the intervention provided was able to improve the knowledge, attitudes, and practices of pregnant women (Tables **3** and **4**).

4. DISCUSSION

All analyses revealed significant differences between knowledge, attitudes, and practices in the intervention and control groups. The intervention group was provided with assistance from midwives and cadres in the Rumah Dila model. Thus, the Rumah Dila model could increase the knowledge, attitudes, and practices of pregnant women during pregnancy. Maternal knowledge before and after the intervention both in the intervention group and the control group underwent significant changes in a positive direction. The increase was visible at each stage of measurement for approximately 6 months of research. The results in the intervention group for knowledge starting from the pretest measurement to the post-test measurement increased the mean score from 17.00 to 28.00, when compared to the control group. The knowledge variable demonstrated significance with a value of 0.001. This means that the knowledge provided during the intervention was able to increase the mothers' average value of knowledge related to their pregnancy health in an effort to prevent LBW births.

The knowledge process in Rumah Dila was implemented through interventions administering offline and online classes to pregnant women. These were complemented by additional modules given to pregnant women, as well as discussion of various questions asked by pregnant women in the WhatsApp group. Focused information on infant health to prevent LBW births was given to the intervention group. Hence, the provided information about LBW became one form of stimulation received by the mothers, involving the stages of knowing, understanding, applying, analyzing, synthesizing, and evaluating. The information provided was intended to serve as a memory recall that can be remembered by the mothers as the lowest stage of knowledge. Then after the mothers would know, they were assumed to have the ability to explain well what has been conveyed by the facilitators and be able to relate to other conditions and transfer additional information to those who do not know. The results of this research study have been found to be in line with the research introducing the principles of clean and healthy living to the community through the direct role of community health workers, besides the results of the research conducted by Rachmawati mentioning interpersonal communication as something that must be owned by health workers, with the aim that the information conveyed can be understood and accepted by the community [20]. Ineffective interpersonal communication between health centers and health workers can worsen the relationship between the two, thus impacting the delivery of health information. The results of a research study in Japan showed that the support of health workers can increase awareness within the community, thus significantly increasing the non-communicable disease prevention scores in community groups. It stated that 85% of the sources of information related to iodine intake in pregnancy account for health personnel. Consultation duration has also been reported to reduce the risk of malpractice. It has been suggested that communication will be impacted if the health workers (doctors, midwives) are in a hurry, angry, or under work pressure [21, 22].

The results of attitude measurements in the intervention group showed a very significant increase in scores from the pretest to the post-test. This increase was attributed to the intervention as the mothers were taught about the correct attitudes to adopt during pregnancy. They were given a case study and invited to jointly think about the solution to the case study so the mothers could have better attitudes than before. The intervention group aimed to make the mothers' attitudes better, especially for the fulfillment of nutrition during pregnancy. The prevention of LBW directly affects the food nutrition of the mothers. This research work was not able to directly assess the mother's daily diet; however, at the education house, pregnant women are introduced to a balanced diet and taught to calculate the macronutrient content of food from packaged foods, showing the nutritional portion of daily food with the help of food photo books.

The results of this research study concluded the participation of pregnant women in classes to lead to increased knowledge and attitudes toward recognizing the danger signs of pregnancy [16, 23]. Furthermore, Bahrami's research work concluded that pregnant women who actively participated in prenatal classes had positive perceptions and attitudes and higher satisfaction than mothers who did not attend prenatal classes [24]. Slow changes in attitudes, according to psychology concepts, are related to a combination of emotions, beliefs, values, and behaviors that are deeply embedded over time. All of these then form a perception. However, attitudes are dynamic because they are the result of individuals' interactions with their environment. Thus, they can always change as they are a result of learning. It can be said that attitudes are conditions or influences adopted from the social learning process as well as the results of the acquisition of behavioral and attitudinal information obtained from others.

According to our findings, the pretest score of the control group was slightly higher than the intervention group. Mothers received knowledge from an obstetrician, and because in this research work, many pregnant women had their third pregnancy and above, they felt comfortable visiting an obstetrician. After the intervention, the post-test score of the practice in the intervention group increased. The purpose of the efforts made at the house was to ensure that pregnant women follow healthy routines in their current pregnancy. Pregnant women require considerable effort and time to gain knowledge and change their attitudes because it is closely related to certain behaviors that have been long embedded in the mindset of pregnant women for generations. Pregnant women are exposed to certain patterns of behaviors and practices related to pregnancy that are believed to be true, some of which even become habits. Studies within the Iranian context have confirmed stress to be among the concerns that pregnant women are likely to suffer, affecting their pregnancy. In a recent research study, up to 50 percent of pregnant women were discovered to be suffering from moderate depression, which should be considered a serious concern due to its numerous adverse effects on the mother and the child (during the fetal stage, neonatal period, *etc*.). It should be noted that depression disorder during pregnancy can be a sign of further complications during the pregnancy term [25].

Some cases show that pregnant women often avoid risky behaviors that are harmful to their pregnancy, but do not understand why they should avoid them. The provision of information sharing, socialization, and intense communication can be one of the strategies for increasing knowledge and enhancing the understanding of pregnant women. A research study by Nabwera *et al*. showed that significant attention from caregivers and healthcare workers can be very good in increasing knowledge and adoption of preventive behavior for infectious diseases in pregnant women. A group of pregnant women in the form of a WhatsApp group can be a reinforcing element to provide direct support, especially emotional support and information support, as well as instrumental support. It is

because group membership is not limited to mothers, but also midwives who are fully responsible for the process of communication, interaction, and discussion in the group. Widyantari's research proved that social support from the husband's family and the community in the form of emotional, instrumental, and informational support could influence the practice of attending maternal classes in Denpasar [26]. A research study conducted by Katayon in Arak city stated that social support from husbands is very important when it comes to the fear of childbirth. While primiparae mostly depend on the labor staff to provide care and support during delivery, they also require supportive partners to have a successful delivery [27, 28].

The research results showed the Rumah Dila model as effective in improving maternal behavior in terms of the knowledge, attitudes, and practices of pregnant women to enhance their healthy behaviors during pregnancy, thus preventing the birth of LBW babies. This research work has been found to be in line with the results of Sriatmi's research, which stated that virtual pregnant women's classes had a positive influence on mothers in efforts to prevent high-risk pregnancies [29]. A research work conducted in Jordan on pregnant women with anemia that involved a health information package program, adapted to Jordanian culture, showed significant results with respect to the knowledge of pregnant women about anemia, thus improving compliance with pregnancy checks and food selection, as well as increasing Hb levels [30]. Another research study that was in line with this research work tried to provide educational interventions regarding nutritional behavior to pregnant women. The intervention was given for 3 months and the results in the educated intervention group showed the mothers' nutritional behavior to significantly increase from knowledge to self-efficacy [31].

A research study conducted in Saudi Arabia provided information packages to pregnant women from the 16th week of pregnancy for 90 days, with a reminder technique employed *via* the WhatsApp group to take Fe tablets every week. The final results of the research showed an increase in Hb levels and also knowledge related to anemia [10]. Interventions in the form of classes have been proven to increase the self-efficacy of pregnant women during pregnancy. This is in line with Brixval's research study, which stated that antenatal education in small classes can increase self-confidence during labor until after delivery, and mothers can deal with problems that exist during labor (anxiety, pain, *etc*.) better than mothers who do not receive antenatal education in class. The results of a literature review suggested that antenatal care education can prevent depression in pregnant women, increase the focus on pregnancy health, and influence the process of successful breastfeeding [32].

Based on the results obtained in the intervention group, 10% of babies were born with LBW, compared to the control group, which accounted for 23.3%, indicating a difference of 13% between the two groups. This shows that the intervention provided by the education house had a positive influence on the birth of babies with normal weight. The same result was observed with respect to the length of babies born to pregnant women in the intervention group and control group. Mothers who attended the Dila house tended to have 86.7% normal infant length (47 cm or more), while in the control group, 31.7% of mothers had babies with short infant length less than 47 cm. This may have happened because in the Rumah Dila model, pregnant women were directly taught how to assess maternal weight gain during pregnancy, as recorded in the MCH book and modules that had been given. Moreover, the intervention group was also taught how to choose the right menu during pregnancy after the first trimester has passed, especially for mothers who experienced nausea and vomiting in early pregnancy. In the intervention group, pregnant women were closely monitored for their daily diet and consumption of Fe tablets, and were required to weigh regularly from two weeks to one month to see changes in body weight that would eventually impact the birth weight of the fetus. In terms of support from others, in the intervention group, there was family involvement, as they were asked to accompany and directly control the mother's behavior during pregnancy. Thus, the mothers felt pregnancy to not be their sole responsibility.

Another thing visible was the change in pregnant women, not consuming drinks with high caffeine or tannins that could inhibit iron absorption [33]. This behavior was adopted by mothers as they were given information related to the dangers of beverage sources inhibiting iron absorption until the end of pregnancy and continuing in the breastfeeding process; this practice was also recommended to be applied to their babies when their babies reach 6 months of age and require complementary foods.

The problems of pregnant women in Indonesia remain huge, increasing the need for education of pregnant women facilitated by independent midwives. Thus, this study has proposed the Rumah Dila intervention model, which appeared to be quite good in assisting pregnant women in improving their healthy behaviors during pregnancy, starting from adopting clean and healthy living behavior, knowing the minimum standard of weight gain according to the recommendations, understanding a balanced nutritional diet during pregnancy, increasing ANC check-ups and knowing the benefits well, and understanding the importance and benefits of Fe tablets during pregnancy. Thus, the pregnant women involved became more compliant in consuming Fe tablets every day along with other micro-vitamins. This study also ensured a better environment for pregnant women by recommending husbands or other family members to not smoke inside and around the house area, and also increase participation in health insurance. This model can be adopted by other regions as an effort to improve maternal health behaviors and prevent LBW births. This statement is in accordance with the results of the Cohen's d test, showing this model to have a moderate/medium influence on the prevention of LBW in the intervention group.

The effect of the model on infant birth weight and

length after controlling for confounding variables was that the percentage of mothers who gave birth to infants with normal weight and length from the intervention group increased, with a difference of more than 13% from the control group who gave birth to LBW babies with short infant length. Moreover, the research results showed that the model had a moderate influence on low birth weight and infant length. This can be attributed to the factors directly related to this effect, including nutritional intake during pregnancy. Erma's research stated that health determinants, such as energy intake, protein intake, vitamin C intake, folic acid intake, and calcium intake, affect the incidence of chronic energy deficiency in pregnant women. Chronic energy deficiency in pregnant women increases the risk of LBW babies [34]. A good collaboration between the implementation of intensive education classes for pregnant women and monitoring nutritional intake during pregnancy can prove to be the best effort for pregnant women to be able to have a healthy pregnancy and give birth to babies with normal weight and normal length. The limitations of this research study have included cost-related challenges, as conducting in-person classes and involving non-health personnel required funding. Additionally, technical issues, such as unstable internet connections during online sessions, also posed obstacles. To adopt this model effectively, further preparation and resources are needed. This model has appeared to be promising for adoption in other regions as a preventive measure to promote maternal healthy behaviors and reduce LBW incidence. The findings have been supported by Cohen's d test, which has revealed the model to have a moderate effect on preventing LBW within the intervention group.

This study has demonstrated the effectiveness of the pregnancy education house model (Rumah Dila) for reducing the incidence of low birth weight in newborn babies.

CONCLUSION

There have been found differences in knowledge, attitudes, and practices in the treatment group and control group during the intervention process in this study, as assessed according to median values obtained from pretest to post-test. The effect of the model on infant birth weight and length after controlling for confounding variables was that the percentage of mothers who gave birth to infants with normal weight and length in the intervention group increased, indicating a difference of more than 13% from the control group who gave birth to LBW babies with short infant length.

AUTHORS' CONTRIBUTION

L.K., S.N., M.I., and F.A.: Contributed to the research concept and design; L.K.: Collected the data and performed analysis and interpretation of results; L.K., S.N., M.I., and F.A.: Drafted the manuscript. All authors have reviewed the results and approved the final version of the manuscript.

LIST OF ABBREVIATIONS

LBW = Low Birth Weight

WHO = World Health Organization

HBM = Health Belief Model

Hb = Haemoglobin

IDHS = Indonesia Demographic and Health Survey

LBW = Low Birth Weight

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This research has received research ethics approval from the Ethics Commission of the Faculty of Public Health, Universitas Diponegoro, Indonesia with no. 281/EA/KEPK-FKM/2022.

HUMAN AND ANIMAL RIGHTS

All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent was obtained from the participants.

STANDARDS OF REPORTING

TREND guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available on request from the corresponding author [L.K].

FUNDING

This study was funded by Schoolarship Universitas Muhammadiyah Kalimantan Timur, Indonesia, Funder ID. 2018.07, Awards/Grant number: Nomor. 080/KEP/SKT/A.4/B/2018.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

The authors thank all collaborators who helped during the data collection process.

REFERENCES

[1] Musoke RN. Low birthweight. East Afr Med J 1986; 63(2): 89-90.
[2] UNICEF-WHO. Vol. 1, Lancet. 1966 [cited 2023 Jan 11]. p. 587–8 Low birthweight. Available from: https://data.unicef.org/topic/nutrition/low-birthweight/
[3] Barker DJP. Fetal origins of coronary heart disease. BMJ 1995; 311(6998): 171-4. http://dx.doi.org/10.1136/bmj.311.6998.171
[4] Herzog-Petropaki N, Derksen C, Lippke S. Health behaviors and behavior change during pregnancy: Theory-based investigation of predictors and interrelations. Sexes 2022; 3(3): 351-66.
[5] Rosenstock IM. The health belief model and preventive health

behavior. HEdMon 1974; 2(4): 354-86.
http://dx.doi.org/10.1177/109019817400200405

[6] Astari AMA, Ayut Merdikawati , Muladefi Choiriyah . Nutritional status of pregnant women aged less than 20 years is a risk factor for the incidence of babies with low birth weight (LBW). IJHN 2022; 9(1): 61-9.
http://dx.doi.org/10.21776/ub.ijhn.2022.009.01.6

[7] Villar J, Purwar M, Merialdi M, *et al*. World Health Organisation multicentre randomised trial of supplementation with vitamins C and E among pregnant women at high risk for pre-eclampsia in populations of low nutritional status from developing countries. BJOG 2009; 116(6): 780-8.
http://dx.doi.org/10.1111/j.1471-0528.2009.02158.x PMID: 19432566

[8] Mubasher S, Akram H, Abbas A. Impact of short inter pregnancy interval on anemia, miscarriage and fetal low birth weight babies. P J M H S 2019; 13(4): 848-50.

[9] Fallah F, Pourabbas A, Delpisheh A, Veisani Y, Shadnoush M. Effects of nutrition education on levels of nutritional awareness of pregnant women in Western Iran. Int J Endocrinol Metab 2013; 11(3): 175-8.
http://dx.doi.org/10.5812/ijem.9122 PMID: 24348589

[10] Arefi Z, Sadeghi R, Shojaeizadeh D, Yaseri M, Shahbazi Sighaldeh S. The effect of educational intervention on nutritional behavior in pregnant women based on social cognitive theory. J Matern Fetal Neonatal Med 2022; 35(25): 9724-9.
http://dx.doi.org/10.1080/14767058.2022.2050901 PMID: 35282747

[11] Training of trainers curriculum for facilitators of mother's classes (pregnant women's classes and mothers under five classes). 2015; 9-21. Available from: https://www.behaviourchange.net/docs/module-14-training-of-trainers.pdf

[12] Butler Tobah YS, LeBlanc A, Branda ME, *et al*. Randomized comparison of a reduced-visit prenatal care model enhanced with remote monitoring. Am J Obstet Gynecol 2019; 221(6): 638.e1-8.
http://dx.doi.org/10.1016/j.ajog.2019.06.034 PMID: 31228414

[13] Pregnancy Class Implementation Guidelines. Jakarta: Departemen Kesehatan RI : Katalog Dalam Terbitan (KDT). 2011; 1-26. Available from: https://www.researchgate.net/publication/367067206_Pregnancy_Class_Model_for_High-Risk_Pregnant_Women_RESTIKOL

[14] Pregnancy CIG. Pregnancy Class Implementation Guidelines. 2020; p. 53.

[15] Siramaneerat I, Agushybana F, Meebunmak Y. Maternal risk factors associated with low birth weight in Indonesia. Open Public Health J 2018; 11(1): 376-83.
http://dx.doi.org/10.2174/1874944501811010376

[16] Husna PH, Purwandari KP, Mawarni S. The effectiveness of pregnant women class to increase knowledge and hemoglobin level. JMCH 2020; 5: 49-56.
http://dx.doi.org/10.26911/thejmch.2020.05.01.06

[17] Technical guidelines for using the MCH book. 2015. Available from: https://www.jica.go.jp/Resource/project/cambodia/021/materials/ku57pq00003udyda-att/materials_03.pdf

[18] Kim JH, Ha EK, Lee SW, Cha HR, Baek HS, Han MY. Growth pattern during early infancy, body mass index during childhood and childhood asthma. Clin Exp Allergy 2023; 53(1): 39-51.
http://dx.doi.org/10.1111/cea.14221 PMID: 36032030

[19] Bandura A. Social Learning Theory. Englewood Cliffs 1977.

[20] Rachmawati TS. The role of puskesmas health workers as communicators in the “indonesia sehat” program with a family approach. 2020. Available from: http://ejournal.unitomo.ac.id/index.php/jkp

[21] Imamatsu Y, Iwata Y, Yokoyama A, Tanaka Y, Tadaka E. Empowering community health workers in Japan: Determinants of non-communicable disease prevention competency. Healthcare 2024; 12(3): 297.
http://dx.doi.org/10.3390/healthcare12030297 PMID: 38338182

[22] Hirata K, Kimura T, Hirano S, Wada K, Kusuda S, Fujimura M. Outcomes of outborn very-low-birth-weight infants in Japan. Arch Dis Child Fetal Neonatal Ed 2021; 106(2): 131-6.
http://dx.doi.org/10.1136/archdischild-2019-318594 PMID: 32788390

[23] Susilawati E. Development of module for prenatal class program and its impact to knowledge pregnant women at the community health center. 2019. Available from: https://www.atlantis-press.com/proceedings/esic-18/125910513

[24] Bahrami N, Simbar M, Bahrami S. The effect of prenatal education on mother’s quality of life during first year postpartum among Iranian women: A randomized controlled trial. Int J Fertil Steril 2013; 7(3): 169-74. PMCID: PMC3914493
PMID: 24520482

[25] Abbasi Z, Saghari S, Nashtifani AH, Daneshi S, Hushmandi K, Raesi R. Frequency distribution of depression and its associated factors among pregnant women during the COVID-19 pandemic. Open Public Health J 2023; 16(1): e18749445252830.
http://dx.doi.org/10.2174/0118749445252830231026060947

[26] Widyantari NMA, Nuryanto IK. The relationship between physical activity, diet, and family income with the incidence of obesity in elementary school children. NHRJ 2018; 2(2): 214-22.
http://dx.doi.org/10.37294/jrkn.v2i2.121

[27] Schwartz L, Toohill J, Creedy DK, Baird K, Gamble J, Fenwick J. Factors associated with childbirth self-efficacy in Australian childbearing women. BMC Pregnancy Childbirth 2015; 15(1): 29.
http://dx.doi.org/10.1186/s12884-015-0465-8 PMID: 25879780

[28] Vakilian K, Zarin F, Zaraj H. The relationship between perceived social support in pregnancy and self-efficacy for childbirth fear - A cross-sectional study in Arak city, 2017. Open Public Health J 2018; 11(1): 546-51.
http://dx.doi.org/10.2174/1874944501811010546

[29] Sriatmi A, Suwitri S, Shaluhiyah Z, Nugraheni SA. Can virtual model maternity classes improve pregnancy high risk prevention practices. HRD Media 2020; 30(1): 1-14.

[30] Abujilban S, Hatamleh R, Al- Shuqerat S. The impact of a planned health educational program on the compliance and knowledge of Jordanian pregnant women with anemia. Women Health 2019; 59(7): 748-59.
http://dx.doi.org/10.1080/03630242.2018.1549644 PMID: 30596538

[31] Khani Jeihooni A, Rakhshani T, Harsini PA, Layeghiasl M. Effect of educational program based on theory of planned behavior on promoting nutritional behaviors preventing Anemia in a sample of Iranian pregnant women. BMC Public Health 2021; 21(1): 2198.
http://dx.doi.org/10.1186/s12889-021-12270-x PMID: 34852814

[32] Brixval CS, Axelsen SF, Thygesen LC, Due P, Koushede V. Antenatal education in small classes may increase childbirth self-efficacy: Results from a Danish randomised trial. Sex Reprod Healthc 2016; 10: 32-4.
http://dx.doi.org/10.1016/j.srhc.2016.03.003 PMID: 27938870

[33] Delimont NM, Haub MD, Lindshield BL. The impact of tannin consumption on iron bioavailability and status: A narrative review. Curr Dev Nutr 2017; 1(2): 1-12.
http://dx.doi.org/10.3945/cdn.116.000042 PMID: 29955693

[34] Wati EK, Murwani R, Kartasurya MI, Sulistiyani S. Determinants of chronic energy deficiency (CED) incidence in pregnant women: A cross-sectional study in Banyumas, Indonesia. Narra J 2024; 4(1): e742.
http://dx.doi.org/10.52225/narra.v4i1.742 PMID: 38798863