



Research article

Pathway linking unwanted pregnancy to low birth weight in Indonesia: A conditional mediation analysis

Dedik Sulistiawan^{a,b}, Chyi-Huey Bai^{a,c,*}^a School of Public Health, College of Public Health, Taipei Medical University, New Taipei City, 235, Taiwan^b Department of Public Health, Faculty of Public Health, Universitas Ahmad Dahlan, Yogyakarta, 55164, Indonesia^c Department of Public Health, College of Medicine, Taipei Medical University, Taipei, 110, Taiwan

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ABSTRACT

Unwanted pregnancies resulting in detrimental consequences for both the mother and the child, including low birth weight, pose a remarkable challenge in developing countries. Although the association between low birth weight (LBW) and unwanted pregnancy is widely demonstrated, the results have been inconsistent, and the underlying mechanisms remain unclear. We examined maternal antenatal care (ANC) completeness as a potential mediating factor of the association between unwanted pregnancy and LBW among women in Indonesia, as well as the moderating effect of family support during pregnancy. We used women's records from the Indonesian Demographic and Health Survey (IDHS), a population-based survey conducted in 2017. This study involved 13,179 women aged 15–49 whose most recent child was aged 1–5 years. The multiple logistic regression results demonstrated that unwanted pregnancy was not associated with LBW. The generalized structural equation modeling (GSEM) results depicted that the effect of unwanted pregnancy on LBW was overwhelmingly explained by incomplete ANC, suggesting the mediation and suppression effect in the model ($b = 0.32$; 95 % Bias-corrected CI = 0.19–0.50; $p = <0.001$). The indirect impact of unwanted pregnancy on LBW also varied among different family support levels. This study filled the gaps in previous research on how unwanted pregnancy affects maternal and health outcomes. In conclusion, adequate ANC intervention and positive family support should be strengthened in future policy implementation to prevent the adverse effects of unwanted pregnancy.

1. Introduction

Birth weight is an essential indicator for evaluating the implementation of maternal and child health service programs and a fundamental anthropometric parameter related to infant mortality [1–3]. According to the World Health Organization (WHO), nearly 30 million low birth weight (LBW) babies are born yearly (23.4 % of all births), and these babies frequently experience short- and long-term health effects [4,5]. Furthermore, in developing countries, LBW is the leading cause of death for 70 % of newborns [6].

Over the last decade, LBW has been a concern in Indonesia, where 6.2 percent of babies were born with LBW. According to the Indonesian health profile in 2020, LBW was the leading cause of neonatal death, consistent with global conditions [7]. Although LBW babies without complications can catch up with their weight with proper treatment, LBW babies are at risk for stunting as adults and

* Corresponding author. School of Public Health, College of Public Health, Taipei Medical University, Taiwan.
E-mail address: baich@tmu.edu.tw (C.-H. Bai).

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developing non-communicable diseases, i.e., hypertension, heart disease, diabetes mellitus, and other health consequences [7].

Previous research has demonstrated that LBW is more common among babies born to women with unwanted pregnancies [8–13]. Even though the mechanism has not been widely discussed, several studies have demonstrated that unwanted pregnancies are strongly associated with maternal antenatal care (ANC) behavior, smoking, and alcohol consumption [14,15]. Moreover, those with unwanted pregnancies were substantially less likely to receive iron-folic acid supplementation [16]. Doubts regarding the pregnancy may be the main obstacle to undergoing the first and subsequent pregnancy check-ups. Evidence said that mothers with untimely or unwanted pregnancies had fewer ANC visits than those with wanted pregnancies [14,15]. Consequently, women who conceive unwanted pregnancies are more likely to undergo a higher probability of inappropriate weight during pregnancy and cesarean section [17], as well as a higher risk of prematurity [18], and preeclampsia [10]. The worldwide prevalence of unintended pregnancies is estimated to be around 48 % [19]. Unexpectedly, approximately 61 % of unintended pregnancies ended in abortion during 2015–2019, representing a proportional increase of 18 % over the preceding three decades [20].

Indonesia has made efforts to improve access to and utilization of contraception in recent years; however, the prevalence of unintended pregnancies remains high. The use of modern contraception has increased from 12.6 % in 2007 to 61.4 % in 2017. Despite this increase, the total fertility rate decreased slightly, from 2.61 in 2007 to 2.47 in 2017. The Indonesian Demographic and Health Survey (IDHS) points out that approximately 7 % of pregnancies were unwanted, while 8 % were mistimed. The proportion of unintended pregnancies did not show any significant increase or decrease from 2012 to 2017 [21].

While there is evidence to suggest that unwanted pregnancies adversely affect maternal and child health outcomes, several studies have yielded conflicting results. Some studies failed to demonstrate a significant association between unintended pregnancy and infant outcomes, including preterm birth, preeclampsia [17], low birth weight [17,22], miscarriage, stillbirth, and neonatal death [22]. However, studies showed that some women, especially those with unwanted pregnancies, did not utilize ANC services during their pregnancy [23–25]. It probably leads to missed opportunities for early detection and management of complications, which can have detrimental consequences on maternal and child health outcomes.

Moreover, the beliefs and behaviors of women regarding their pregnancy status were not always well correlated. Because of their family's support, several mothers with unintended pregnancies quickly changed their negative attitude toward pregnancy [26]. Studies also have shown that social supports, i.e., from family, friends, and the partner, improve positive pregnancy experiences [27], uptake of maternal health services [28], and early initiation and frequency of ANC [14], reduce postnatal depression [29], anxiety, and self-harm during pregnancy [30], and improve birth outcomes by reducing LBW occurrence [9,31] and preterm birth [31]. Therefore, understanding the mechanisms underlying the association between unwanted pregnancy and LBW, considering family support, is crucial for developing effective strategies to reduce LBW. This study investigated a pathway through which unwanted pregnancy affects LBW, considering antenatal ANC completeness and family support among women in Indonesia.

2. Methods

2.1. Study populations

The current study used the data from the 2017 IDHS, a cross-sectional survey conducted by the Indonesian Statistics Board, the National Population and Family Planning Board, and the Ministry of Health under the Demographic and Health Surveys (DHS) Program. In this household survey, a two-stage stratified sampling design was employed. This survey involved 49,627 women aged 15–49 years [21]. The current study targeted 15,357 respondents who met the inclusion criteria, namely, whose most recent child was aged 1–5 years and was a singleton. The exclusion criteria were respondents whose most recent-born babies were not weighed, who did not answer questions, or who had missed observation in every variable involved in the model. Consequently, the final sample size was 13,179 (weighted sample).

2.2. Measures

2.2.1. Dependent variable: low birth weight

The outcome of this study was LBW. The question for determining a baby's weight in the DHS was "How much did (name of child) weigh?" or the weight (in kilograms) reported on a health card (if available) [21]. In this study, LBW was specified as a birth weight of less than 2500 g (5.5 lbs), following the WHO definition [32].

2.2.2. Main independent variable: unwanted pregnancy

Unwanted pregnancy was the key variable of interest in this study. The DHS question on pregnancy intention asks women to recall their most recent pregnancy up to 5 years ago and classify it as "wanted then" (wanted), "later" (mistimed), or "not at all" (unwanted). This study treated pregnancy intention as a binary variable, with "wanted then" and "later" classified as wanted pregnancy and "not at all" as unwanted pregnancy. We classified mistimed and wanted altogether as wanted pregnancies since previous studies have documented non-significant differences among these concepts [33,34].

2.2.3. Mediator variable: antenatal care completeness

The DHS question on ANC visits was "How many times did you receive antenatal care in the first three months, between the fourth and sixth month, and between the seventh month and delivery?" [21]. This study followed the current Indonesian guidelines on ANC visits [35], under WHO recommendations [36] that pregnant women do a minimum of four ANC visits: the first before 12 weeks of

pregnancy, the second around 26 weeks, the third approximately 32 weeks, and the fourth between 36 and 38 weeks of gestation. A pregnant woman who followed the guidelines for ANC visits was classified as having ANC completeness, whereas ANC visits were incomplete in the other women.

2.2.4. Moderator variable: family support

Previous studies have criticized measures of men's engagement in maternal and child health based solely on indicators of ANC attendance, as they fail to capture the multifaceted nature of support provided to pregnant women by a group of people who share responsibility for care [37]. To address this limitation, the present study incorporates an additional indicator as a proxy for support from the mother's surrounding environment. Specifically, we used the DHS question on men's involvement: "Did your husband/partner accompany you to any antenatal care visits during this pregnancy?" and treated as a binary variable (yes and no) [21] and questions related to mother's surroundings' support on delivery-related issues, i.e., "During (child's name)'s pregnancy, did you discuss the following: the place of delivery, transportation to the delivery location, assistance during delivery, cost of delivery, blood donation, if required, and postpartum family planning with anyone?" and then categorized it as a binary variable, indicating either the presence (any discussion of the issues) or absence of support (never had discussion) [38]. Family support was assessed by combining measures of men's involvement and support from the surrounding environment. It was categorized into two groups: received no family support (women did not have their partner accompany them to ANC visits and never discussed delivery-related issues) and received family support (women were accompanied by their partner to ANC visits and/or discussed delivery-related matters).

2.2.5. Covariates

Sociodemographic characteristics, healthcare system factors, maternal and fetal factors, as well as environmental factors were included in the multivariable model. Age was classified as 15–24, 25–34, and 35+ years. Educational attainment was represented by incomplete primary, complete primary, complete secondary, and higher education. The type of place of residence was categorized as urban and rural. The wealth index used in this analysis was adjusted for the rural area (poorest, poorer, middle, richer, and richest). All of these classifications adhered to DHS guidelines [39].

Moreover, the region category (i.e., Java–Bali and other islands) was determined by considering each region's infrastructure [40]. Birth order was categorized into three levels: 1, 2, and 3 or more. To comprehensively assess women's empowerment, we adopted a composite index called the Survey-based Women's empOWERment (SWPER). Women were defined as empowered if they usually make all three designated decisions (healthcare, large household purchases, and visits to family or relatives) either alone or jointly with their husband, disagree with all the particular reasons justifying wife-beating (going out without telling him, neglecting the children, arguing with him, refusing to have sexual intercourse with him, and burning food), experience first-time motherhood after the age of 19 years, get married after the age of 17 years, and complete primary education [41].

Health insurance coverage was measured using the DHS household standard questionnaire "Do you have any health insurance?" with a binary response (yes or no). Perceived barriers to accessing healthcare facilities and financial constraints were measured using the question, "There are various reasons why women may not be able to access healthcare or treatment. When you are ill and require medical attention, does the (distance/money) to access the health facility pose a problem for you?" with binary response (yes or no) [39].

Any complication during pregnancy was assessed using the question, "Did you experience any signs of complications during your pregnancy with (child's name)?" with a binary response (yes or no). Terminated pregnancy experience was asked using the question "Have you ever had a pregnancy that ended in miscarriage, termination, or stillbirth?" with binary response (yes or no). Smoking frequency was categorized as never, daily, or some days. Iron–folic acid supplementation during pregnancy was examined using question "During your pregnancy, did you receive or purchase iron tablets/pills/syrup?" The response to this question was binary (yes or no). High-risk fertility behavior was a dichotomous variable (yes or no) determined based on whether a woman met any of the following criteria: too early childbearing age (<20 years) [42], too late childbearing age (>40 years) [4], narrow birth intervals (<24 months), and too many births (>3 children) [43]. The genders of the children was boy and girl.

We also included the potential effects of pollutants, such as both outdoor and indoor air pollution, as controlled covariates that might increase the risk of LBW, as suggested by prior studies [44,45]. The variables included were secondhand tobacco smoke (SHS) and household cooking fuels. SHS exposure was determined based on the frequency of household members smoking inside the house, categorized as daily, weekly, monthly, less than monthly, or never [46]. Household cooking fuels were classified based on whether the household used clean or solid cooking fuels. Additionally, the use of clean and safe drinking water, determined by whether the household used improved or unimproved drinking water sources, and access to improved toilet facilities, determined by whether the household used improved or unimproved toilet facilities [39] were also included in the model.

2.3. Statistical analysis

Descriptive statistics were summarized as numbers and percentages, considering that all variables were categorical. Respondent distributions according to low birth weight and ANC completeness were assessed using Chi-square tests. We then applied a multiple logistic regression model to examine the association of unwanted pregnancy and ANC completeness with LBW. The adjusted b coefficient with 95 % confidence intervals (CIs) was shown. Statistical significance was tested at $p < 0.05$. A generalized structural equation model (GSEM) with interaction terms was further fitted for the conditional (moderated) mediation analysis, adjusted for covariates. A p-value of <0.05 was used as the threshold for the significance of all pathways and moderation in the model. Instead of adhering to the conventional causal steps approach [47], we adopted a distinct method for assessing mediation introduced by recent

works that enhanced the method [48–50]. A bias-corrected bootstrap CI with 1000 replications was applied to better infer the indirect effect in the mediation analysis to alleviate irregularity of the sampling distribution of indirect effect [49,50]. As recommended by DHS, all statistical procedures incorporated complex sampling weighting since this survey used a two-stage stratified sampling design. Data were analyzed using Stata Statistical Software (Release 18: StataCorp LLC).

2.4. Ethical Considerations

Review and/or approval by an ethics committee was not needed for this study since we did not interact directly with study participants. The data was already collected by the original DHS survey data collectors, ICF International, on behalf of the United States Agency for International Development (USAID). These data collectors adhered to ethical standards set by the ICF Institutional Review Board (IRB), including obtaining informed consent from participants.

3. Results

This study analyzed the data of 13,179 women who fulfilled the inclusion criteria, of which approximately half were in the age range of 25–34, and about a third were aged 35 years and older. Approximately half and a third of the women attained primary and secondary education. Women were equally distributed in urban and rural areas. Women's wealth distribution was nearly equal across all wealth categories, with the poorest to wealthiest families comprising approximately one-fifth of the population. Moreover, almost 60 % of women were from Java–Bali region (Table 1).

The prevalence of unwanted pregnancy and low birth weight births among Indonesian women was approximately 8 % and 6 %, respectively. Women in the 15–24 and 35+ age groups tended to experience LBW. The distribution of LBW varied by education level, wealth index, and region. LBW was more prevalent among women with incomplete primary education, from poor families, and living outside Java–Bali and Sumatera. Less empowered women also tended to experience LBW. Furthermore, LBW was more common among women who believed that access to healthcare services was constrained by distance (Table 1).

Women who experienced high-risk fertility behavior and complications during pregnancy tended to experience LBW. LBW was more common in newborn girls and those born in the first and third or higher birth orders. Likewise, women who lived in households that used solid fuels for cooking, exposed them to cigarette smoke daily, and had substandard toilet and drinking water facilities tended to experience LBW (Table 1).

This study also found that LBW was more common among women with incomplete antenatal care (ANC). As evidenced by this study, for every ten pregnant women, four of them did not visit healthcare facilities to do ANC completely as recommended. Our findings also suggested that incomplete ANC was associated with a higher rate of unwanted pregnancy among women. Additionally, the distribution of ANC completeness varied by age group, education level, place of residence, wealth index, and region. Incomplete ANC was more prevalent among women aged 15–24 and 35 years and older, with less than secondary education, resided in rural areas, from poor families, and living outside Java–Bali. Incomplete ANC was more common in women whose last birth order was 3 or more. Likewise, women who were less empowered, did not receive any family support, did not have health insurance, and those who believed that access to healthcare services was constrained by distance and financial issues tended to have lower rates of ANC coverage (Table 2).

Although the multivariable model controlled for sociodemographic characteristics, healthcare system, maternal, fetal, and environmental factors, the basic model from multiple logistic regression demonstrated no association between unwanted pregnancy and LBW (adjusted $b = -0.39$, 95 % CI = $-0.78-0.01$; $p = 0.058$). However, this model indicated that ANC completeness was significantly associated with LBW. Women with incomplete ANC had a greater likelihood of experiencing LBW (adjusted $b = 0.60$, 95 % CI = $0.40-0.79$; $p < 0.001$) (Table 3).

The mediation analysis further examined the mediating role of incomplete ANC in the association between unwanted pregnancy and LBW. The direct effect (path c') of unwanted pregnancy on LBW was not significant. It indicates that unwanted pregnancy did not predict LBW directly ($b = -0.35$, 95 % CI = $-0.72-0.02$; $p = 0.067$). We tested the effect of unwanted pregnancy on incomplete ANC (path a) and incomplete ANC on LBW (path b) and found that the coefficient of these paths was significant ($b = 0.55$, 95 % CI = $0.37-0.72$; $p < 0.001$ and $b = 0.59$, 95 % CI = $0.41-0.78$; $p < 0.001$, respectively). We then product these two coefficients to get an indirect effect (ab) and observed that the result was statistically significant ($b = 0.32$, 95 % CI = $0.19-0.50$; $p < 0.001$), indicating that incomplete ANC was proven to be a mediator of the association between unwanted pregnancy and LBW (Fig. 1).

To test the occurrence of the conditional indirect effect, we conducted a first-stage moderated mediation with unwanted pregnancy and family support interaction to predict ANC completeness. This process revealed a significant interaction effect on path a , indicating that the effect of unwanted pregnancy on ANC completeness differed across levels of family support (Fig. 2). We then calculated the overall conditional indirect effect using a bias-corrected confidence interval approach to probe the extent to which the effect differed. This process confirmed that the indirect effect of unwanted pregnancy on LBW through incomplete ANC differed among women who received full/some family support and those who did not receive any family support during pregnancy ($b = 0.32$, 95 % bias-corrected CI = $0.19-0.50$; $p < 0.001$ and $b = 1.19$, 95 % bias-corrected CI = $0.42-2.66$; $p = 0.008$, respectively) (Table 3).

A further issue that emerged from our study was the direct (c') and mediated effect (ab) of unwanted pregnancy on LBW had opposite signs. In this situation where ab and c' had opposite signs, ab was an estimate of the suppressor effect. Since the direct and mediated effects were almost of the same magnitude and opposite sign (also indicated by total effect (c) of approximately zero), there was a complete suppression [51]. To put it another way, the effect of unwanted pregnancy on LBW in our study was overwhelmingly explained by incomplete ANC (Table 3).

Table 1
 Characteristics of sociodemographic and pregnancy factors among Indonesian childbearing women with low or normal birth weight.

Characteristics	Total (n = 13,179)		Birth weight category				p
			Normal (n = 12,386)		Low (n = 794)		
	n	%	n	%	n	%	
Pregnancy intention							
Wanted	12,141	92.1	11,397	92.0	744	93.7	0.845
Unwanted	1038	7.9	988	8.0	50	6.3	
<u>Sociodemographic characteristics</u>							
Age in 5-year groups (year)							
15-24	2451	18.6	2293	18.5	158	19.9	0.015
25-34	6783	51.5	6406	51.7	377	47.5	
35+	3945	29.9	3687	29.8	259	32.6	
Educational attainment							
Incomplete primary	718	5.4	661	5.3	57	7.2	<0.001
Complete primary	6296	47.8	5875	47.4	420	53.0	
Complete secondary	4090	31.0	3869	31.2	220	27.8	
Higher education	2076	15.8	1981	16.0	96	12.0	
Type of place of residence							
Urban	6608	50.1	6212	50.2	395	49.8	0.121
Rural	6572	49.9	6173	49.8	399	50.2	
Wealth index							
Poorest	2205	16.7	2031	16.4	175	22.0	<0.001
Poorer	2634	20.0	2461	19.9	173	21.8	
Middle	2823	21.4	2655	21.4	168	21.2	
Richer	2793	21.2	2639	21.3	154	19.5	
Richest	2725	20.7	2601	21.0	124	15.5	
Region							
Java-Bali	7790	59.1	7333	59.2	457	57.6	<0.001
Sumatera	2864	21.7	2716	21.9	148	18.6	
Kalimantan	830	6.3	768	6.2	62	7.8	
Sulawesi	868	6.6	804	6.5	64	8.1	
Nusa Tenggara, Maluku, Papua	827	6.3	764	6.2	63	7.9	
Women's empowerment							
Empowered	2840	21.5	2695	21.8	145	18.2	0.002
Less empowered	10,340	78.5	9691	78.2	649	81.8	
Family support during pregnancy							
Received full/some support	12,888	97.8	12,117	97.8	771	97.1	0.145
Received no support	292	2.2	269	2.2	23	2.9	
<u>Healthcare system factors</u>							
Covered by health insurance							
Yes	7870	59.7	7388	59.7	482	60.7	0.129
No	5309	40.3	4997	40.3	312	39.3	
Financial issue to access healthcare facility							
Not a big problem	11,300	85.7	10,643	85.9	656	82.7	0.056
Big problem	1880	14.3	1743	14.1	137	17.3	
Distance issue to access healthcare facility							
Not a big problem	11,852	89.9	11,159	90.1	692	87.2	0.018
Big problem	1328	10.1	1227	9.9	101	12.8	
<u>Maternal factors</u>							
Antenatal care completeness							
Complete	7907	60.0	7540	60.9	367	46.2	<0.001
Incomplete	5272	40.0	4845	39.1	427	53.8	
Any complications during pregnancy							
No	10,804	82.0	10,238	82.7	567	71.4	0.028
Yes	2375	18.0	2148	17.3	227	28.6	
Ever had a terminated pregnancy							
No	11,245	85.3	10,572	85.4	673	84.9	0.593
Yes	1934	14.7	1814	14.6	120	15.1	
Smoking frequency							
Never	13,008	98.7	12,223	98.7	786	99.0	0.437
Daily	62	0.5	58	0.5	4	0.5	
Some days	110	0.8	105	0.9	4	0.5	
Iron supplementation during pregnancy							
Yes	11,853	89.9	11,155	90.1	698	87.9	0.082
No	1327	10.1	1231	9.9	96	12.1	
High-risk fertility behavior							
Low risk	8429	64.0	7944	64.1	485	61.1	0.027
High risk	4751	36.0	4442	35.9	308	38.9	

(continued on next page)

Table 1 (continued)

Characteristics	Total (n = 13,179)		Birth weight category				p
			Normal (n = 12,386)		Low (n = 794)		
	n	%	n	%	n	%	
<i>Fetal's factors</i>							
<i>Birth order number</i>							
1	4469	33.9	4146	33.5	323	40.7	<0.001
2	4720	35.8	4497	36.3	224	28.2	
3+	3990	30.3	3743	30.2	247	31.1	
<i>Sex of child</i>							
Female	6436	48.8	6031	48.7	405	51.0	0.028
Male	6744	51.2	6355	51.3	389	49.0	
<i>Environmental factors</i>							
<i>Frequency of household members smoke inside the house</i>							
Never	3161	24.0	3002	24.2	160	20.1	0.013
Daily	7422	56.3	6935	56	487	61.4	
Some	2596	19.7	2450	19.8	147	18.5	
<i>Type of cooking fuel</i>							
Clean fuels	10,947	83.1	10,317	83.3	630	79.3	<0.001
Solid fuels	2233	16.9	2069	16.7	164	20.7	
<i>Source of drinking water</i>							
Improved	12,142	92.1	11,425	92.2	717	90.3	0.002
Unimproved	1038	7.9	961	7.8	77	9.7	
<i>Type of toilet facility</i>							
Improved	11,740	89.1	11,058	89.3	682	85.9	0.012
Unimproved	1440	10.9	1328	10.7	112	14.1	

4. Discussion

The study was performed to assess the importance of ANC as a third variable linking unwanted pregnancy and LBW among women in Indonesia. The most prominent finding to emerge from the analysis is that there was no direct association between unwanted pregnancy and LBW. These results corroborate the results of prior studies that have reported an inconsistent association between pregnancy intention and LBW. A meta-analysis [8] and other studies [9,10,13,52,53] have reported a substantial unadjusted odds ratio for the association between unintended pregnancies and LBW. Nevertheless, few studies [17,22,54] have demonstrated no association between unintended pregnancy and LBW.

This discrepancy may be attributable to unknown mechanisms of unwanted pregnancy, which may or may not have influenced LBW in previous research. Furthermore, this study demonstrated that LBW was indirectly associated with unwanted pregnancy because of incomplete ANC. According to our existing knowledge, this study was the first to confirm the mediating effect of ANC in the association of unwanted pregnancy and LBW among childbearing women in Indonesia. This finding is consistent with previous studies that reported that the association between pregnancy intention and delivery outcome, particularly LBW, is complex [9,55]. Unwanted pregnancy may influence LBW because of inappropriate maternal behavior during pregnancy, such as smoking, alcohol intake, and insufficient ANC [9]. Women who did not recognize their pregnancy did not want to acknowledge it; thus, they did not seek ANC [53] or decreased the frequency of ANC visits [34]. Therefore, they did not receive adequate counseling and information during ANC visits, such as optimal nutrition and food during pregnancy, anthropometric examinations, and other health tests. These factors may have a detrimental effect on the baby's birth outcomes [9].

According to the recent report, the availability and quality of ANC services significantly improved the pregnancy care behavior of pregnant women unintentionally. In Indonesia, dietary treatments such as folic acid, vitamin A, iron, zinc, calcium, and other micronutrients are administered to pregnant women according to WHO ANC guidelines. Furthermore, ANC includes echocardiography, blood pressure measurement, and the collection of blood samples and urine samples. ANC is crucial for examining an unborn child's growth during this critical stage of newborn development, particularly for women living in low-resource areas [56].

Because the association between pregnancy intention and the delivery outcome is complex, women's views and behaviors toward pregnancy status may be inconsistent. These feelings can be dynamic, especially if the birth outcome differs [8]. Women frequently declare that they are avoiding pregnancy and do not want to become pregnant but later express satisfaction with their pregnancy. Furthermore, several women who have unwanted pregnancies change their unfavorable reactions to pregnancy acceptance quickly. This change prevents the pregnant woman from engaging in unsafe behavior that is detrimental to her and her unborn child's health. Because of the changes that occur during pregnancy, these contradictory emotions are typically experienced [26].

Furthermore, women in Indonesia's communities prioritize children. Women are motivated to equip with a healthy and supportive environment for their children, and accept all pregnancies [57]. Their poor decision-making abilities and high dependence on others [58] facilitate them to acquire good encouragement and support from family members. These results reflect those of Powis in his study, who also found that even though husbands may not be present during ANC visits due to work or other reasons, women still receive support from their accompaniment system. This system distributes care responsibilities, such as prenatal care and an ANC visit companionship, to family members and relatives [37].

Table 2

Distribution of antenatal care completeness based on pregnancy intention and women's characteristics.

Characteristics	Antenatal care completeness						p
	Total (n = 13,179)		Complete (n = 7907)		Incomplete (n = 5272)		
	n	%	n	%	n	%	
Pregnancy intention							
Wanted	12,141	92.1	7434	94	4707	89.3	<0.001
Unwanted	1038	7.9	473	6	565	10.7	
<i>Sociodemographic characteristics</i>							
Age in 5-year groups (year)							
15-24	2451	18.6	1390	17.6	1062	20.1	<0.001
25-34	6783	51.5	4249	53.7	2534	48.1	
35+	3945	29.9	2268	28.7	1677	31.8	
Educational attainment							
Incomplete primary	718	5.4	314	4	404	7.7	<0.001
Complete primary	6296	47.8	3446	43.6	2850	54.0	
Complete secondary	4090	31.0	2676	33.8	1414	26.8	
Higher education	2076	15.8	1471	18.6	605	11.5	
Type of place of residence							
Urban	6608	50.1	4378	55.4	2230	42.3	<0.001
Rural	6572	49.9	3529	44.6	3043	57.7	
Wealth index							
Poorest	2205	16.7	1021	12.9	1184	22.5	<0.001
Poorer	2634	20.0	1452	18.4	1182	22.4	
Middle	2823	21.4	1681	21.3	1141	21.6	
Richer	2793	21.2	1804	22.8	989	18.8	
Richest	2725	20.7	1948	24.6	776	14.7	
Region							
Java-Bali	7790	59.1	5262	66.6	2528	47.9	<0.001
Sumatera	2864	21.7	1530	19.3	1334	25.3	
Kalimantan	830	6.3	422	5.3	409	7.8	
Sulawesi	868	6.6	299	3.8	569	10.8	
Nusa Tenggara, Maluku, Papua	827	6.3	394	5	433	8.2	
Women's empowerment							
Empowered	2840	21.5	2029	25.7	811	15.4	<0.001
Less empowered	10,340	78.5	5878	74.3	4461	84.6	
Family support during pregnancy							
Received full/some support	12,888	97.8	7810	98.8	5078	96.3	<0.001
Received no support	292	2.2	97	1.2	195	3.7	
Birth order number							
1	4469	33.9	2927	37	1542	29.3	<0.001
2	4720	35.8	2952	37.3	1768	33.5	
3+	3990	30.3	2028	25.6	1962	37.2	
<i>Healthcare system factors</i>							
Covered by health insurance							
Yes	7870	59.7	4824	61.0	3046	57.8	0.001
No	5309	40.3	3083	39.0	2226	42.2	
Financial issue to access healthcare facility							
Not a big problem	11,300	85.7	6951	87.9	4349	82.5	<0.001
Big problem	1880	14.3	956	12.1	924	17.5	
Distance issue to access healthcare facility							
Not a big problem	11,852	89.9	7244	91.6	4608	87.4	<0.001
Big problem	1328	10.1	663	8.4	664	12.6	

In contrast to previous explanations, however, women with wanted pregnancies may lack familial or partner support for effective healthcare-seeking behavior [59,60]. Consequently, they were less likely to seek adequate ANC from qualified healthcare professionals than their counterparts [59]. These results support the previous study in which social support highly influenced pregnancy outcomes [9,14,61]. Since the results of this study corroborated the suppression effect of ANC completeness in the association of unwanted pregnancy, which was exacerbated by a lack of family support and LBW, improving broad community and healthcare provider support for healthcare-seeking during pregnancy may benefit women, particularly those with a lack of family support and unwanted pregnancies.

4.1. Study limitations

This study successfully demonstrated the mediator and suppressor role of ANC in the association between unwanted pregnancy and LBW. It also proved the significance of family support during pregnancy in increasing maternal health-seeking behavior to prevent LBW. Nevertheless, because the intervals between the interview and the onset of pregnancy varied, recall bias may occur in this study.

Table 3

Conditional mediating effect of antenatal care completeness and family support on the association between unwanted pregnancy and low birth weight in Indonesia (n = 13,179).

Pathway	Path coefficient (b)	Standard error (Sb)	95 % CI	p
The basic model (multiple logistic regression) ^a				
Unwanted pregnancy → Low birth weight	-0.39	0.20	-0.78-0.01	0.058
Incomplete antenatal care → Low birth weight	0.60	0.10	0.40-0.79	<0.001
Mediation analysis				
Unwanted pregnancy → Incomplete antenatal care (a)	0.55	0.09	0.37-0.72	<0.001
Unwanted pregnancy × No family support → Incomplete antenatal care	1.45	0.69	0.10-2.80	0.035
Incomplete antenatal care → Low birth weight (b)	0.59	0.09	0.41-0.78	<0.001
Direct effect (c')				
Unwanted pregnancy → Low birth weight	-0.35	0.19	-0.72-0.02	0.067
Indirect effect (ab)				
Unwanted pregnancy → Incomplete antenatal care → Low birth weight	0.32	0.08 ^b	0.19-0.50 ^c	<0.001
- Received full/some family support	0.32	0.08 ^b	0.19-0.50 ^c	<0.001
- Did not receive any family support	1.19	1.21 ^b	0.42-2.66 ^c	0.008
Total effect (c)	-0.02	0.19	-0.40-0.33	0.906

The p-values in bold represent statistical significance (p < 0.05); CI: Confidence Interval. (a) Mediation model for X to M was adjusted for age in 5-year groups, educational attainment, type of place of residence, wealth index, region, women’s empowerment, family support during pregnancy, birth order number, covered by health insurance, financial and distance issue to access healthcare facility, while. (b) M to Y was adjusted for any complications during pregnancy, ever had a terminated pregnancy, smoking frequency, iron supplementation during pregnancy, high-risk fertility behavior, sex of the child, frequency of household members smoking inside the house, type of cooking fuel, source of drinking water, and type of toilet facility.

^a Models for multiple logistic regression were adjusted for all covariates, including sociodemographic characteristics, healthcare system, maternal, fetal’s, and environmental factors.

^b Bootstrap standard error

^c Bias-corrected confidence interval from 1000 bootstrap samples.

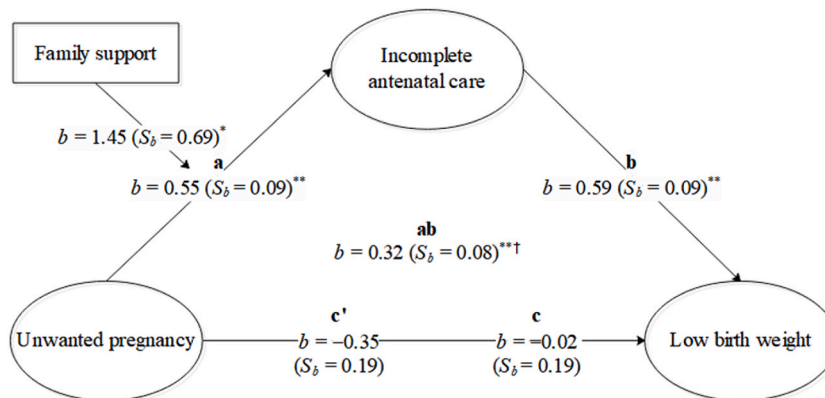


Fig. 1. Conditional mediating effect of incomplete antenatal care and family support on the association between unwanted pregnancy and low birth weight. *b* represents unstandardized path coefficient, whereas *S_b* is standard error. Path *a* is coefficient for the effect of unwanted pregnancy and interaction term of unwanted pregnancy with family support on the mediator (incomplete antenatal care) after adjusted for covariates. Path *b* is coefficient for the effect of mediator on low birth weight after the main independent variable and covariates are adjusted for. Path *c'* represents the direct effect of unwanted pregnancy on low birth weight when the mediator is adjusted for. *ab* is indirect effect of unwanted pregnancy on low birth weight, quantified as the product of path *a* and *b* coefficient. Path *c* is the total effect of unwanted pregnancy on low birth weight, quantified as the sum of *c'*+*ab*. ^{**}Significant at p < 0.001; ^{*}p < 0.05. [†] Standard error from 1000 bootstrap samples.

Furthermore, the pregnancy intention with a single-item measurement could have led to misclassification. Future research may take into account a more reliable scale to evaluate the intention to become pregnant. Moreover, the cross-sectional design of this study prevents it from conclusively demonstrating a causal relationship between predictors and outcomes; hence, further research employing a more robust methodology is needed. Finally, the suppression effect observed in this study should be interpreted cautiously and requires further examination to rule out the type I error possibility.

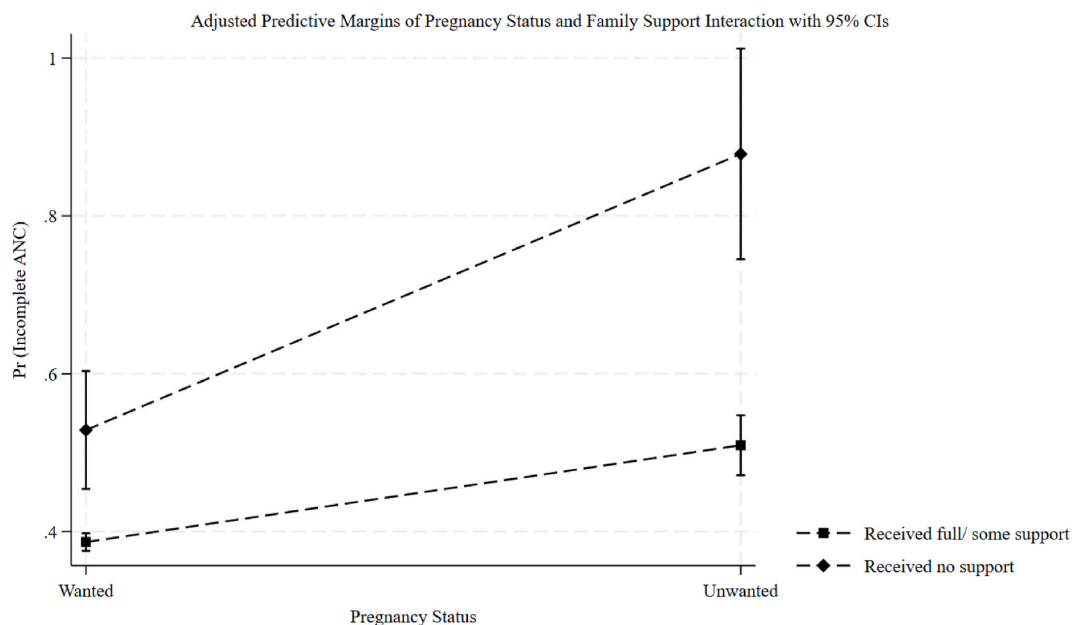


Fig. 2. A visual representation of the moderation of the effect of pregnancy status on antenatal care completeness by family support.

5. Conclusions

The completion of ANC and family support significantly influence the association between unwanted pregnancy and LBW among women in Indonesia. Improving ANC completeness during pregnancy could reduce the likelihood of LBW across different pregnancy intentions. Family support to improve healthcare seeking during pregnancy may also benefit women in preventing the adverse effects of unwanted pregnancy. Future studies should confirm these findings using more robust study designs and measurements.

Data availability

This study used data from the Indonesian individual records section of the DHS, which is free at <https://dhsprogram.com> with some agreements. Permission to access and use the datasets was granted by MEASURE DHS. A subset of the data and the statistical codes used in this study will be made available upon reasonable request.

CRedit authorship contribution statement

Dedik Sulistiawan: Writing – original draft, Visualization, Methodology, Formal analysis, Conceptualization. **Chyi-Huey Bai:** Writing – review & editing, Writing – original draft, Supervision.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Chyi-Huey Bai reports financial support and article publishing charges were provided by Ministry of Science and Technology of Taiwan. Chyi-Huey Bai reports financial support and article publishing charges were provided by National Science and Technology Council of Taiwan. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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