

A comparison of the demographics and health systems in 4 Asian countries regarding antenatal care services and the prevalence of low birth weight.

Corresponding Author

Dr. Bishrut Sapkota

General Practitioner

Department of Emergency

Civil Service Hospital, Minbhawan, Kathmandu, Nepal 44600.

Co-Author

Dr. Tshetiz Dahal

General Physician, Clinical Researcher and Writer

Lugansk State Medical University, Luhansk Oblast, 93000 Luhansk, Ukraine

Dr. Sumit Prajapati

General Practitioner

Department of Emergency

Civil Service Hospital, Minbhawan, Kathmandu, Nepal 44600

ABSTRACT

Aim: This study aimed to see how the availability of comprehensive antenatal care (ANC) and its content affected the incidence of low birth weight (LBW) in four ASIAN member countries (ASIAN).

Methods : The frequency of ANC visits and the seven service components were used as indicators of the comprehensiveness of coverage and substance of ANC services (blood pressure measurement, iron supplementation, tetanus toxoid immunization, explanations of pregnancy complications, urine sample test, blood sample test, and weight measurement). If more than four ANC visits and all seven components were provided, the coverage and content of the ANC services were rated as high. Using data from the four ASIAN nations in question from the Demographic Health Survey, multi-variable logistic regression with complicated survey designs was performed from 2014 to 2017.

Results : Philippines (13.8%) had a greater percentage of LBW newborns than Indonesia (6.7%), Cambodia (6.7%), or Myanmar (7.5%). A low level of comprehensive coverage and substance of ANC services was linked to a 1.30 times higher incidence of LBW than a high level (adjusted odds ratio [aOR], 1.30; 95% confidence interval [CI], 1.11 to 1.52). In addition, after accounting for mothers' demographic/socioeconomic characteristics, health habits, and other factors, the risk of LBW was higher in the Philippines than in other nations (aOR, 2.25; 95% CI, 2.01 to 2.51).

Conclusion : In summary, the incidence of LBW in Indonesia, Cambodia, and Myanmar was substantially correlated with the comprehensive coverage and substance of ANC services. The Philippines had a greater risk of LBW with inadequate ANC but no statistically significant evidence for this connection.

Keywords : Female, Health surveys, Infant, Low birth weight, Pregnant women, Prenatal care.

GRAPHICAL ABSTRACT

VARIABLES	INDONESIA	CAMBODIA	MYANMAR	PHILLIPINES
Timing of the first ANC visit				
First Trimester	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Second / Third Trimester	1.01 (0.80, 1.28)	0.97 (0.64, 1.47)	0.98 (0.60, 1.59)	1.03 (0.81, 1.29)
None	0.78 (0.53, 1.15)	0.32 (0.05, 1.89)	1.14 (0.30, 4.33)	1.01 (0.57, 1.81)
Completeness of coverage and content of ANC services				
Good (frequency of visits ≥ 4 times and 7 complete components)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Less (frequency of visits < 4 times and 7 complete components)	1.56 (0.48, 5.09)	1.87 (0.96, 3.65)	0.82 (0.36, 1.87)	1.11 (0.63, 1.96)
Less (frequency of visits ≥ 4 times and 7 components were incomplete)	0.94 (0.76, 1.18)	0.99 (0.71, 1.38)	1.17 (0.70, 1.96)	1.08 (0.84, 1.39)
Poor (frequency of visits < 4 times and 7 components were incomplete)	1.57 (1.08, 2.27)	1.83 (1.13, 2.99)	2.59 (1.49, 4.49)	1.18 (0.80, 1.75)

INTRODUCTION

The World Health Organization (WHO) defines low birth weight (LBW) as less than 2500 g (5.5 pounds) at birth [1]. LBW can result from either a preterm birth or from a full-term baby's restricted intrauterine growth. In addition to an increased risk of neonatal mortality, LBW infants also run the risk of developmental delays, poorer IQ, and non-communicable disorders including obesity and diabetes as adults [2]. According to estimates, 14.6% of the 20.5 million kids born in 2015 had LBW, and 96.5% of those babies were born in developing nations. According to the WHO (2018), LBW was responsible for 60–80% of newborn mortality. More than half of infants with LBW were born on the Asian subcontinent, with South Asia being the region with the highest prevalence of LBW worldwide. Southeast Asia came in second with 12.3% of all LBW births worldwide. In Association of Southeast Asian Nations (ASIAN) countries, the incidence of LBW decreased slowly between 2000 and 2015, dropping by only 1.4% (95% confidence interval [CI], 0.9 to 1.9). In contrast, South Asian nations saw a decline of 5.9% (95% CI, 3.8 to 8.8) during the same time period [2–4]. Data from the Demographic Health Survey (DHS) revealed that the prevalence rates of LBW in four ASEAN nations were as follows: 7% in Indonesia (2017), 7.9% in Cambodia (2014), 15% in the Philippines (2017), and 8.1% in Myanmar (2015–2016) [5–8]. The United Nations Children's Fund statistics used to discover patterns in the prevalence of LBW from 2000 to 2015 revealed a 0.1% yearly decline in the incidence of LBW [2]. However, in Indonesia, Cambodia, Myanmar, and the Philippines, this has not been sufficient to lessen the risk of newborn death [9]. LBW incidence reduction has long been a top concern for worldwide public health. At the 65th World Health Assembly in 2012, nations pledged to reduce LBW by 30% from 2012 to 2025 [3]. Since the ANC services received by the mother during pregnancy and the health of the infant are related, high-quality antenatal care (ANC) is essential for lowering the prevalence of LBW [10–12]. These treatments focus on health maintenance, early identification, and prevention during pregnancy. The extensive WHO recommendations for ANC include a "targeted ANC" package that addresses both the quantity and quality of ANC as well as the frequency and scheduling of ANC visits. These recommendations call for a minimum of four ANC visits, two in the third trimester and one each in the first and second trimesters. During these visits, a woman's medical history may be investigated, her blood pressure, anaemia, and foetal movement may be checked, tests may be run, syphilis and bacteriuria may be treated if necessary, iron and folic acid supplements may be prescribed, and general health education may also be provided [13,14].

While ANC therapies can enhance birth outcomes, ineffective ANC can have a negative impact [15]. However, there are significant regional and national differences in the prevalence of LBW. Ninety-seven percent of LBW occurs in low- and middle-income countries [3], and it most frequently affects the most vulnerable groups of society, such as the impoverished who live in rural areas. Furthermore, it may be challenging for low-income residents of rural places to get access to quality medical care. Additionally, it's possible that impoverished women frequently lack access to high-quality medical care, which, together with their poor health and nutritional status, raises the likelihood that they will give birth to LBW children. Monitoring maternal health and spotting danger indicators early on depend on ANC services. An efficient method of lowering the prevalence of LBW is to prioritize body weight and foetal development measurements each month [16]. After adjusting for covariate factors and creating adjusted odds ratios (aORs), the findings of a study on the impact of ANC services on the incidence of LBW revealed that mothers who got subpar ANC had a higher probability of giving birth to infants with LBW. In a study done in So Paulo, Brazil, da Fonseca et al. [12] found that moms who got poor-quality ANC services were 4.13 times more likely to experience LBW than mothers who received good-quality ANC services (aOR, 4.13; 95% CI, 1.36 to 12.51). Among pregnant women who had at least four ANC visits, Oulay et al. [17] in the Lao PDR and Kananura et al. [18] in Eastern Uganda observed that those who received their first visit in the second trimester or later were more likely to deliver LBW babies.

To the best of our knowledge, no studies have looked at the impact of ANC service coverage and content on the prevalence of LBW in ASEAN nations. In four ASIAN countries, this study sought to ascertain these effects while controlling for factors affecting the mothers (age at conception and parity), the health and habits of the mothers (ANC provider and smoking status), the factors affecting the infants (sex, birth spacing), the social characteristics of the households (mother's education level, economic status, area of residence), and socio-familial empowerment (who makes decisions in the family).

METHODS

Over 90 countries around the world have undertaken DHSs; just four of the six ASIAN nations—Indonesia (2017), Cambodia (2014), Myanmar (2015–2016), and the Philippines—have done so in the past ten years (2017). Based on the availability of complete information on the necessary variables, particularly ANC services and the covariates, these 4 ASIAN nations were chosen. The DHSs were nationally representative and were sampled in two stages using stratified sampling techniques. The population was segmented using a stratification approach. Primary sampling units during the first step of sampling were based on census enumeration regions within each stratum that were chosen using the probability proportional to size technique. A systematic sample of households was selected from the list of households in the second stage. The main objective of the survey was to conduct interviews with all females (15–49 years old) in the chosen households. On the female's questionnaire, questions about prior pregnancies, socioeconomic status, demographic details, and participation in household decision-making were self-reported [19]. Participants in this study were all females aged 15–49 from Indonesia, Cambodia, Myanmar, and the Philippines who had given birth to live children within the previous five years. Singleton births and the ability to obtain the baby's birth weight from a written card or a mother's memory were the inclusion criteria. Because multiple births are closely associated to premature births, which are also likely to be LBW, we restricted our study to singletons. Incomplete data on any of the selected research variables met the exclusion criteria. Table 1 provides specifics regarding the research sample.

Table 1 : Study population of the Demographic and Health Surveys (2014-2017)

Country	All female	Singleton births	Babies who were weighed	Complete data
Indonesia	17 848	17 595	16 115	15 155
Cambodia	7165	7031	6299	5691
Myanmar	4815	4726	1986	1875
The Philippines	10 551	10 372	8471	7741
Total	40 379	39 724	32 871	30 462

Variables and Measurements

Outcome Variable

The WHO's definition of LBW (birth weight less than 2500 g) and normal weight (i.e., weight equal to or greater than 2500 g), as determined by a written card or by the mother's memory, served as the outcome variables.

The Explanatory Variables

The following explanatory variables were used: Females who initiated ANC with a healthcare professional (a doctor, midwife, village midwife [Indonesia], or nurse) or a community volunteer (a barangay health worker in the Philippines, a village health volunteer in Cambodia, or an auxiliary midwife in Myanmar) whether in the first, second, or third trimester—or with no ANC visit at all—were measured according to the timing of their first visit. Participants' first ANC visits were recorded as occurring during the first trimester (0–12 weeks), second and third trimesters (>13 weeks), and none of these trimesters (or no ANC visit at all). The completeness of coverage and content of ANC services was measured by the number of visits (with the ideal being at least 4 antenatal consultations) and receiving 7 aspects of ANC services. The components of ANC service consisted of (1) measurement of blood pressure, (2) iron supplementation, (3) tetanus toxoid immunization, (4) explanations of potential pregnancy complications, (5) a urine sample test, (6) a blood sample test, and (7) measurement of weight. The complete coverage and content of ANC services of participants were recorded as follows: “good (frequency of visits ≥4 times and 7 complete components),” “less (frequency of visits <4 times and 7 complete components),” “less (frequency of visits ≥4 times and 7 components were incomplete),” and “poor (frequency of visits <4 times and 7 components were incomplete).” Mother's age at conception, parity, maternal health and habits (ANC provider, smoking status), baby's sex, birth spacing, household social characteristics (mother's education level, wealth index, area of residence), and socio-familial empowerment were among the covariates that needed to be controlled (who makes the decisions in the family).

Statistical Analysis

Data analysis was carried out in accordance with the DHS sample design, which employs a 2-stage probability sampling technique, employing the complicated survey design, which takes weighted, strata, and clusters into account. To ascertain the impact of full coverage and content of ANC services on the incidence of LBW, multi-variable logistic regression was performed. All variables that were significantly connected to the incidence of LBW were included in the final model. By removing covariates with a p-value > 0.05 and analyzing changes in the OR, the confounding variables were evaluated. The covariate variable was retained in the model if the OR changed by more than 10% [20].

In Myanmar's DHS (2015-2016 MDHS), there were no weight measurements; instead, its analysis focused on 6 components of ANC services, whereas the data analyzed for Indonesia, the Philippines, and Cambodia contained 7 components.

Ethics Statement

This study's foundation was a DHS secondary data analysis. LSMU approved the authors' request to use and download the data. An ethical commission from the Faculty of Public Health, LSMU Ukraine, gave its clearance.

RESULTS

The prevalence of LBW and the respondents' characteristics differed greatly among the 4 ASEAN nations included in this study (Table 2). In the Philippines, Myanmar, Indonesia, and Cambodia, the corresponding percentages were 13.8%, 7.5%, 6.7%, and 6.7%. Additionally, the Philippines had a higher risk of LBW than other nations (aOR, 2.25; 95% CI, 2.01 to 2.51). An overview of ANC in the 4 nations may be found in Table 3. Myanmar had the highest percentage of successful ANC (more than 4 visits and 7 completed components), at 45.5%, while Cambodia had the highest percentage of unsuccessful ANC (less than 4 visits and 7 completed components), at 23.3%. There were only minor variations in the rates of 4 or more ANC visits; Indonesia had the highest rate at 84.7% while Cambodia and Myanmar had the lowest at 73%. Myanmar had the highest percentage of the 7 completed ANC components (52.2%), while Indonesia had the lowest percentage (14.3%). The kinds of ANC services received differed as much between nations. Blood pressure measurements were most frequently performed (90.5%) while urine sample testing were least frequently performed (34.0%). The most popular method in Cambodia was iron supplementation (90.4%), whereas the least popular method was urine tests (45.8%). The most prevalent form in Myanmar was iron supplementation (91.3%), whereas urine sample tests (68.6%) were the least prevalent. Blood pressure measurements were the most frequently performed type in the Philippines (83.6%), while blood sample tests were the least frequently performed type (61.2%).

Table 2 : Incidence of LBW and characteristics of respondents in Indonesia, Cambodia, Myanmar, and the Philippines.

Variables	Indonesia 2017 (n = 15 155)	Cambodia 2014 (n = 5691)	Myanmar 2015-2016 (n = 1875)	The Philippines 2017 (n = 7741)
LBW				
Yes	1019 (6.7)	383 (6.7)	140 (7.5)	1071 (13.8)
No	14 136 (93.3)	5308 (93.3)	1735 (92.5)	6670 (86.2)
Baby's sex				
Female	7356 (48.5)	2787 (49.0)	854 (45.5)	3667 (47.4)
Male	7799 (51.5)	2904 (51.0)	1021 (54.5)	4074 (52.5)
Mother's age at pregnancy (y)				
20-35	11 253 (74.3)	4586 (80.6)	1396 (74.5)	5642 (72.9)
<20 or >35	3902 (25.7)	1105 (19.4)	479 (25.5)	2099 (27.1)
Mother's education				
Secondary or higher	7525 (49.6)	480 (8.4)	340 (18.1)	5056 (65.3)
Primary	6604 (43.6)	2278 (40.0)	1015 (54.1)	2006 (25.9)
None	1026 (6.8)	2933 (51.6)	520 (27.8)	679 (8.8)
Wealth index¹				
Richest	3570 (23.5)	1518 (26.6)	458 (24.4)	834 (10.8)
Richer	3056 (20.2)	1067 (18.8)	480 (25.6)	1163 (15.0)
Middle	2956 (19.5)	951 (16.7)	345 (18.4)	1492 (19.3)
Poorer	2853 (18.8)	1033 (18.2)	329 (17.6)	1946 (25.1)
Poorest	2720 (18.0)	1122 (19.7)	263 (14.0)	2306 (29.8)
Area of residence				
Urban	7820 (51.6)	1662 (29.2)	694 (37.0)	2667 (34.5)
Rural	7335 (48.4)	4029 (70.8)	1181 (63.0)	5074 (65.5)
Socio-familial empowerment²				
Discussion	7911 (52.2)	2340 (41.1)	729 (38.9)	5789 (74.8)
No discussion	7244 (47.8)	3351 (58.9)	1146 (61.1)	1952 (25.2)

Values are presented as number (%).

LBW, low birth weight.

1 A composite indicator dividing the households into 5 categories using principal component analysis based on information from housing characteristics and ownership of household durable goods.

2 Female's power balance within social networks and their freedom of mobility; As well as representing woman's familial and marital roles, the model also shows the household status in conflict situations and negotiation.

Table 3 : Overview of ANC services in Indonesia, Cambodia, Myanmar and the Philippines.

Variables	Indonesia 2017 (n = 15 155)	Cambodia 2014 (n = 5691)	Myanmar 2015-2016 (n = 1875) ¹	Philippines 2017 (n = 7741)
Timing of the first ANC visit				
First trimester	11 292 (74.5)	4336 (76.2)	856 (45.6)	4603 (59.5)
Second/third trimester	2379 (15.7)	830 (14.6)	873 (46.6)	1923 (24.8)
None	1484 (9.8)	525 (9.2)	146 (7.8)	1215 (15.7)
Completeness of the coverage and content of ANC services				
Good (frequency of visits ≥4 times and 7 complete components)	2234 (14.7)	1603 (28.2)	854 (45.5)	3425 (44.2)
Less (frequency of visits <4 times and 7 complete components)	50 (0.3)	212 (3.7)	125 (6.7)	220 (2.8)
Less (frequency of visits ≥4 times and 7 components were incomplete)	10 601 (70.0)	2551 (44.8)	517 (27.6)	2477 (32.0)

Variables	Indonesia 2017 (n = 15 155)	Cambodia 2014 (n = 5691)	Myanmar 2015-2016 (n = 1875) ¹	Philippines 2017 (n = 7741)
Poor (frequency of visits <4 times and 7 components were incomplete)	2270 (15.0)	1325 (23.3)	379 (20.2)	1619 (21.0)
ANC frequency				
≥4 visits	12 835 (84.7)	4154 (73.0)	1371 (73.1)	5902 (76.2)
<4 visits	2320 (15.3)	1537 (27.0)	504 (26.9)	1839 (23.8)
Completeness of ANC components				
Complete (7 components)	2168 (14.3)	1806 (31.7)	979 (52.2)	2846 (36.8)
Incomplete (<7 components)	12 897 (85.7)	3885 (68.3)	896 (47.8)	4895 (63.2)
Received ANC services				
Blood pressure measurement	13 712 (90.5)	4985 (87.6)	1684 (89.8)	6475 (83.6)
Iron supplementation	12 374 (81.6)	5147 (90.4)	1712 (91.3)	6253 (80.8)
Tetanus toxoid immunization	9926 (65.5)	4399 (77.3)	1661 (88.6)	5784 (76.9)
Counseling about pregnancy complications	8718 (57.5)	4361 (76.6)	1456 (77.7)	5764 (74.5)
Urine sample examination	5569 (34.0)	2607 (45.8)	1287 (68.6)	5131 (66.3)
Blood sample examination	6728 (44.4)	3962 (69.6)	1325 (70.7)	4738 (61.2)
Weight measurement	13 604 (89.8)	4979 (87.5)	-	5842 (75.5)
Provider of ANC				
Health workers	13 186 (87.0)	5149 (90.5)	1676 (89.4)	6406 (82.7)
Non-health workers	485 (3.2)	17 (0.3)	53 (2.8)	120 (1.6)
No visits	1484 (9.8)	525 (9.2)	146 (7.8)	1215 (15.7)

Values are presented as number (%).

ANC, antenatal care.

¹ Myanmar was the only country for which data were available on 6 components of the complete coverage and content of ANC services.

Finally, the likelihood of developing LBW was 1.30 times higher in pregnant women who received poor ANC services (in terms of comprehensive coverage and substance) than in those who received good ANC services (aOR, 1.30; 95% CI, 1.11 to 1.52). (Table 4). In none of the 4 nations was a first-trimester ANC visit substantially linked to the prevalence of LBW (Table 5). The outcomes of this analysis also revealed a strong correlation between the frequency of LBW in Indonesia, Cambodia, and Myanmar and the comprehensiveness of coverage and content of ANC services. The Philippines showed a potential risk of LBW associated with poor complete coverage and content of ANC services, despite the fact that its results were not statistically significant. The odds for the incidence of LBW in mothers with poor complete coverage and content of ANC services were 1.18 times higher than those with good ANC services (aOR, 1.18; 95% CI, 0.80 to 1.75).

Table 4 : Relationships of the timing of the first ANC visit and the complete coverage and content of ANC services with the incidence of LBW (multi-variable logistic regression).

Variables	Incidence of LBW ¹	p-value ²
Timing of the first ANC visit		
First trimester	1.00 (reference)	
Second/third trimester	0.98 (0.89, 1.10)	0.781
None	0.84 (0.61, 1.17)	0.302
Completeness of coverage and content of ANC services		
Good (frequency of visits ≥4 times and 7 complete components)	1.00 (reference)	
Less (frequency of visits <4 times and 7 complete components)	1.28 (0.97, 1.69)	0.079
Less (frequency of visits ≥4 times and 7 components were incomplete)	0.94 (0.85, 1.05)	0.250
Poor (frequency of visits <4 times and 7 components were incomplete)	1.30 (1.11, 1.52)	0.001
ASIAN country		
Indonesia	1.00 (reference)	

Variables	Incidence of LBW ¹	p-value ²
Cambodia	0.88 (0.75, 1.02)	0.086
Myanmar	1.02 (0.83, 1.26)	0.826
The Philippines	2.25 (2.01, 2.51)	<0.001

Values are presented as adjusted odds ratio (95% confidence interval).

ANC, antenatal care; LBW, low birth weight; ASIAN, Association of Southeast Asian Nations.

1 Adjusted odds ratio controlled for maternal age during pregnancy, parity, antenatal care provider, smoking status, baby's sex, birth spacing, mother's education level, wealth index, area of residence, and socio-familial empowerment variables.

2 Analysis with multi-variable logistic regression.

Table 5.: Multi-variable logistic regression analysis¹ of factors affecting the incidence of LBW in 4 ASIAN countries.

Variables	Indonesia	Cambodia	Myanmar ²	Philippines
Timing of the first ANC visit				
First trimester	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Second/third trimester	1.01 (0.80, 1.28)	0.97 (0.64, 1.47)	0.98 (0.60, 1.59)	1.03 (0.81, 1.29)
None	0.78 (0.53, 1.15)	0.32 (0.05, 1.89)	1.14 (0.30, 4.33)	1.01 (0.57, 1.81)
Completeness of coverage and content of ANC services				
Good (frequency of visits ≥4 times and 7 complete components)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Less (frequency of visits <4 times and 7 complete components)	1.56 (0.48, 5.09)	1.87 (0.96, 3.65)	0.82 (0.36, 1.87)	1.11 (0.63, 1.96)
Less (frequency of visits ≥4 times and 7 components were incomplete)	0.94 (0.76, 1.18)	0.99 (0.71, 1.38)	1.17 (0.70, 1.96)	1.08 (0.84, 1.39)
Poor (frequency of visits <4 times and 7 components were incomplete)	1.57 (1.08, 2.27) ²	1.83 (1.13, 2.99) ²	2.59 (1.49, 4.49) ²	1.18 (0.80, 1.75)

Values are presented as adjusted odds ratio (95% confidence interval).LBW, low birth weight; ASEAN, Association of Southeast Asian Nations; ANC, antenatal care.

1 Adjusted odds ratio controlled for maternal age during pregnancy, parity, antenatal care provider, smoking status, baby's sex, birth spacing, mother's education level, wealth index, area of residence, and socio-familial empowerment variables; Analysis with multi-variable logistic regression.

2 Myanmar was the only country for which data were available on 6 components of the complete coverage and content of ANC services.

* $p < 0.05$.

DISCUSSION

This research aimed to determine the effects of comprehensive ANC service coverage and content on the incidence of LBW in 4 ASEAN nations. After adjusting for maternal age, the baby's sex, the ANC provider, smoking status, maternal education, parity, wealth index, area of residence, and socio-familial empowerment variables, the findings revealed that mothers who received subpar ANC services were 1.30 times more likely to give birth to LBW babies. Statistically significant LBW risks were found in Indonesia, Cambodia, and Myanmar, with Myanmar having the highest risk (aOR, 2.59; 95% CI, 1.49 to 4.49). It should be emphasized that Myanmar has a high proportion of missing data, which could have impacted the study's findings. The findings of this study are consistent with those of Servan-Mori et al. [21], who found that lowering the incidence of LBW requires both timely ANC visits and high-quality basic care. A risk of LBW was associated with poor complete coverage and content of ANC services in the Philippines, even though the results were not statistically significant (aOR, 1.18; 95% CI, 0.80 to 1.75). Mothers with poor complete coverage and content of ANC services had a 1.18-fold higher chance of experiencing LBW than those with good ANC services. These results are in line with earlier findings that have been published in the literature [11,22,23]. These findings also demonstrated that the incidence of LBW in the four nations was unaffected by an ANC visit during the first trimester. However, Bhaskar et al. [24] in Eastern Nepal and Paul et al. [11] in India found conflicting results, finding that moms who had their first ANC check in the second or third trimester were more likely to have babies with LBW than mothers who had their first ANC visits in the first trimester. We anticipate that the significance of the initial ANC visit was significantly influenced by the fixed effect of the composite variable of the full coverage and substance of ANC services in this study.

Therefore, first-trimester ANC alone is insufficient to lower the incidence of LBW; a minimum amount of quality ANC is instead required. Pregnant women should receive a full variety of services during ANC visits. Full ANC services are the most successful tactic, according to the literature, to lower the incidence of LBW [11]. But according to the study's findings, only roughly 14.7% of

females in Indonesia, 28.2% in Cambodia, 44.2% in the Philippines, and 45.5% in Myanmar receive ANC services that are complete and of high quality. The low frequency of laboratory tests (blood and urine; ranging from 34.0 to 68.6% for blood sample tests and 44.4 to 70.7% for urine sample tests) in all 4 nations was the cause of the incompleteness of the 7 ANC service components. Benova et al. [25] concluded that obtaining urine and blood samples had the lowest coverage of ANC components and said that this area needs the most improvement based on a mapping of common ANC components in Asian nations. It's possible that focusing just on ANC visits decreased the effectiveness of coverage. Even though the median number of ANC visits was higher overall, nations with a wider range of ANC visits (such as Egypt, Jordan, and Indonesia) were less likely to achieve high coverage levels for all six routinely measured care components, which include blood pressure checks, urine and blood samples, tetanus vaccination, iron supplementation, and receiving information on potential complications. The 2016 ANC guideline, according to the WHO, stresses the standard of care delivered during each interaction, emphasizing the elements of high-quality treatment.

Monitoring maternal health and spotting danger indicators early on depend on ANC services. An efficient method of lowering the prevalence of LBW is to prioritize measuring body weight and foetal development each month. At every visit, the mother is weighed to look for foetal growth problems. A foetal growth problem is indicated by a weight gain of less than 9 kg over the course of the pregnancy, or less than 1 kg per month [16]. Given that uncontrolled hypertension during pregnancy can result in pre-eclampsia and that mothers with both mild and severe pre-eclampsia frequently give birth to LBW kids, measuring blood pressure is meant to identify any potential risk of hypertension. Similar to this, iron supplements serve as dietary additions for both the mother and the foetus. For pregnant women who develop anaemia, the WHO advises giving them iron supplements of 20–60 mg and folic acid supplements of 0.4 mg in addition to context-specific therapies [13]. One of the goals of the examination of a blood sample is to identify the haemoglobin levels because low haemoglobin levels can suggest anaemia [16]. Another goal of the urine sample test is to find out if there is protein in the urine (proteinuria), which is another sign of pre-eclampsia. In all 4 of the study's participating nations, there is a worry about the limited or insufficient monitoring of maternal health and the lack of fundamental laboratory tests. The findings of this study support those of earlier research from Colombia (2015) that employed DHS data, which found that the probability of LBW was 1.8 times higher after non-standardized ANC services than after standardised ANC services [26]. Children whose mothers did not receive ANC components, such as measurements of weight and blood pressure and blood and urine tests, had a higher risk of LBW than those whose mothers did, according to the findings of a different study by Zhou et al. [10] conducted in 42 underdeveloped counties in Western China.

The results demonstrate that a first-trimester ANC visit is insufficient to significantly lower the incidence of LBW. We found similar outcomes in four ASEAN nations (Indonesia, Myanmar, Cambodia, and the Philippines), showing that the quality of ANC services is just as crucial as their number. It is recommended that pregnant women get at least 4 ANC visits, each of which includes all 7 ANC component services. Pregnant women with low education levels and low socioeconomic position require special attention. First and foremost, it is advised that healthcare professionals who offer ANC services aim to enhance the comprehensiveness of coverage and substance of ANC services offered to all pregnant women. Second, improving maternal health literacy is crucial for both mothers' and infants' well-being (for example, emphasizing the importance of full ANC services). Thirdly, among the ANC components that need the most improvement across 4 ASEAN nations are blood and urine samples. Fourthly, it is essential to place an emphasis on ANC services' quality in addition to their bare minimum. Lastly, efforts need to be taken to improve the accessibility and financial burdens of ANC, as shown by the study's findings that the majority of participants in rural areas had a higher risk of LBW.

Strengths and Limitations of This Study

This research has the advantage of using survey data with a large national sample size, allowing for highly accurate national definitions of the analysis' findings. Based on maternal recall up to 5 years, measurements of the full coverage and substance of ANC services may have included reporting and recall bias. The DHS data provide no means for determining whether the ANC components were completed on time, with the right frequency, or with the right response. Perhaps far bigger impacts could have been shown with a more precise quality measurement, to which females with problems or illnesses that are known to raise the risk of LBW responded appropriately. Additionally, mothers' memories of LBW could not have been accurate. Measurements of the result of LBW are susceptible to error, especially if they rely on maternal memory rather than a health card (which can also be subject to mis-measurement and misreporting). Additionally, a sizable number of the kids' birth weights weren't documented (Table 1). These missing values (selection bias) may have an impact on the current results, particularly for Myanmar, which had high missing rate (up to 48%). Finally, because the study did not account for other factors that may influence the likelihood of LBW, such as maternal nutritional status, changes in weight throughout pregnancy, and occupation, confounding bias was probable.

CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

ACKNOWLEDGEMENTS

The Demographic Health Survey, which owns the data used in this study, is among the people the authors would like to thank for their contributions.

REFERENCES

1. World Health Organization. Global nutrition targets 2025: low birth weight policy brief; 2014 [cited 2020 Nov 12]. Available from: <https://www.who.int/publications/i/item/WHO-NMH-NHD-14.5>.
2. United Nations Children's Fund (UNICEF). Low birthweight; 2019 [cited 2020 Nov 12]. Available from: <https://data.unicef.org/topic/nutrition/low-birthweight/>.
3. United Nations Children's Fund (UNICEF); World Health Organization (WHO). UNICEF-WHO low birthweight estimates: levels and trends 2000-2015: new global, regional and national estimates of low birthweight. 2019 [cited 2021 Nov 12]. Available from: <https://www.unicef.org/reports/UNICEF-WHO-low-birthweight-estimates-2019>.

4. World Health Organization. Preterm and low birth weight infants. 2018 [cited 2020 Nov 12]. Available from : <https://www.who.int/teams/maternal-newborn-child-adolescent-health-and-ageing/newborn-health/preterm-and-low-birth-weight>.
5. National Population and Family Planning Board (BKKBN); Statistics Indonesia (BPS); Ministry of Health (Kemenkes); ICF. Indonesia Demographic and Health Survey 2017; 2018 [cited 2020 Nov 12]. Available from: <https://dhsprogram.com/pubs/pdf/FR342/FR342.pdf>.
6. National Institute of Statistics; Directorate General for Health; ICF International. Cambodia Demographic and Health Survey 2014; 2015 [cited 2020 Nov 12]. Available from: <https://dhsprogram.com/pubs/pdf/fr312/fr312.pdf>.
7. Philippine Statistics Authority; ICF. Philippines National Demographic and Health Survey 2017. 2018[cited2020Nov12].Availablefrom: https://psa.gov.ph/sites/default/files/PHILIPPINE%20NATIONAL%20DEMOGRAPHIC%20AND%20HEALTH-%20SURVEY%202017_new.pdf.
8. Ministry of Health and Sports; ICF. Myanmar Demographic and Health Survey 2015-16; 2017 [cited 2020 Nov 12]. Available from: <https://dhsprogram.com/pubs/pdf/FR324/FR324.pdf>.
9. United Nations Children's Fund (UNICEF). Maternal and newborn health disparities country profiles; [cited 2022 Nov 14]. Available from: <https://data.unicef.org/resources/maternal-newborn-health-disparities-country-profiles/>.
10. Zhou H, Wang A, Huang X, Guo S, Yang Y, Martin K, et al. Quality antenatal care protects against low birth weight in 42 poor counties of Western China. *PLoS One* 2019;14(1):e0210393.
11. Paul P, Zaveri A, Chouhan P. Assessing the impact of antenatal care utilization on low birthweight in India: analysis of the 2015-2016 National Family Health Survey. *Child Youth Serv Rev* 2019;106: 104459.
12. da Fonseca CR, Strufaldi MW, de Carvalho LR, Puccini RF. Adequacy of antenatal care and its relationship with low birth weight in Botucatu, São Paulo, Brazil: a case-control study. *BMC Pregnancy Childbirth* 2014;14: 255.
13. World Health Organization. WHO recommendations on antenatal care for a positive pregnancy experience.2016[cited2020Nov12].Availablefrom: <https://www.who.int/publications/i/item/9789241549912>.
14. Lincetto O, Mothebesoane-Anoh S, Gomez P, Munjanja S. Antenatal care. In: Lawn J, Kerber K, editors. *Opportunities for Africa's newborns: practical data, policy and programmatic support for newborn care in Africa*. Geneva: World Health Organization; 2019. p. 51-62.
15. Bountogo M, Sié A, Zakané A, Compaoré G, Ouédraogo T, Lebas E, et al. Antenatal care attendance and risk of low birthweight in Burkina Faso: a cross-sectional study. *BMC Pregnancy Childbirth* 2021;21(1):825.
16. Indonesian Ministry of Health. Regulation of the Republic of Indonesia Health Minister Number 97 in2014.2015[cited2020Nov12].Availablefrom: https://sikompak.bappenas.go.id/pembelajaran/view/52/id/other_doc/Permenkes%20No%2097%20tahun%202014%20tentang%20P4K/download.pdf (Indonesian).
17. Oulay L, Laohasiriwong W, Phajan T, Assana S, Suwannaphant K. Effect of antenatal care on low birth weight prevention in Lao PDR: a case control study [version 1; peer review: 1 approved with reservations, 1 not approved]. *F1000Research* 2018;7: 1138.
18. Kananura RM, Wamala R, Ekirapa-Kiracho E, Tetui M, Kiwanuka SN, Waiswa P, et al. A structural equation analysis on the relationship between maternal health services utilization and newborn health outcomes: a cross-sectional study in Eastern Uganda. *BMC Pregnancy Childbirth* 2017;17(1):98.
19. United States Agency for International Development (USAID). Guide to DHS statistics. 2018 [cited 2020 Nov 12]. Available from: <https://dhsprogram.com/publications/publication-dhsg1-dhs-questionnaires-and-manuals.cfm>.
20. Hastono SP. Health data analysis. Depok: Rajawali Pers. 2016 (Indonesian).
21. Servan-Mori E, Sosa-Rubí SG, Najera-Leon E, Darney BG. Timeliness, frequency and content of antenatal care: which is most important to reducing indigenous disparities in birth weight in Mexico? *Health Policy Plan* 2016;31(4):444-453.
22. Tafere TE, Afework MF, Yalaw AW. Providers adherence to essential contents of antenatal care services increases birth weight in Bahir Dar City Administration, north West Ethiopia: a prospective follow up study. *Reprod Health* 2018;15(1):163.
23. Assefa N, Berhane Y, Worku A. Wealth status, mid upper arm circumference (MUAC) and antenatal care (ANC) are determinants for low birth weight in Kersa, Ethiopia. *PLoS One* 2012;7(6):e39957.
24. Bhaskar RK, Deo KK, Neupane U, Chaudhary Bhaskar S, Yadav BK, Pokharel HP, et al. A case control study on risk factors associated with low birth weight babies in eastern Nepal. *Int J Pediatr* 2015;2015: 807373.

25. Benova L, Tunçalp Ö, Moran AC, Campbell OM. Not just a number: examining coverage and content of antenatal care in low-income and middle-income countries. *BMJ Glob Health* 2018;3(2):e000779.

26. Khanal V, Zhao Y, Sauer K. Role of antenatal care and iron supplementation during pregnancy in preventing low birth weight in Nepal: comparison of national surveys 2006 and 2011. *Arch Public Health* 2014;72(1):4.

