The Correlation between Increased Frequency of Antenatal Care Visits and Early Registration for Antenatal Care with Positive Birth Outcomes among Women in Hatcliffe Suburb in Harare

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Abstract

The World Health Organisation (WHO) recommends early registration, regular and consistent attendance of antenatal care (ANC) sessions for all pregnant women. There are notable gaps in the uptake of ANC services in some densely populated areas that lack sufficient resources in Zimbabwe.

To determine the relationship between ANC visits and selected birth outcomes among women aged 15-49 from Hatcliffe, Harare.

This was a health facility based analytical cross-sectional study. An interviewer administered questionnaire was used to collect data. Data was entered and analysed using SPSS version 25. Descriptive statistics, and associations between dependent and independent variables were determined using Pearson's Chi-square and Fisher's exact test. Ethical approval was granted from the Medical Research Council of Zimbabwe (MRCZ/B/1438).

A total of 75 mother child pairs were interviewed. Most (77.3%) had more than four ANC visits out of the recommended 8. Only 36% registered early for ANC services (during first trimester). Most of the children had normal birth weight ≥2500g (80.3%), birth length ≥47cm, (76%), head circumference ≥33cm (80%), and (Appearance, Pulse, Grimace, Activity, and Respiration) APGAR score ≥7 (96%). A positive association was observed between number of ANC visits and birth weight [Odds ratio (OR) 7.6; 95% Confidence Interval (CI) 1.6, 36.4 (P=0.013)], birth length [OR 6.1; 95%CI 1.8, 20.1 (P=0.010)], and head circumference [OR 4.3; 95% CI 1.3, 14.8 (P=0.013)]. Positive associations were also observed between timing of registration and birth weight [OR 1.2; 95% 1.05, 1.36 (P=0.045)], birth length [OR 0.16; 95% CI 0.03, 0.76 (P=0.012)].

In this study increased frequency (greater than 4 visits) and registration during first trimester for ANC had a positive relationship with birth weight, birth length and head circumference. These findings validate the need for improving the uptake of ANC services, early registration for ANC in the first trimester and adoption of community wide strategies to ensure that pregnant women attend all recommended visits for improved birth outcomes in this and related settings.

Keywords: ANC, frequency of visits, prenatal care, pregnant mothers, low birth weight, stunting, Zimbabwe

Introduction

Antenatal care (ANC) is one of the core interventions for improving maternal and birth outcomes (WHO, 2016). The overall aim of ANC services is to deliver evidence-based interventions delivered at critical times during pregnancy. According to WHO's definition, the components of ANC include: risk identification; prevention and management of pregnancy-related or concurrent diseases; and health education and health promotion in order to ensure the best health conditions for both mother and baby during pregnancy (WHO, 2016).

In low- and middle-income countries (LMICs) like Zimbabwe, the use of antenatal care (ANC) services increased significantly in 2002 with the introduction of Focused ANC (FANC), a targeted approach aimed at early detection and management of complications (WHO, 2002). Despite this improvement, there remains a need to enhance both the utilisation and quality of ANC services (Zimbabwe National Statistics Agency (ZIMSTAT) & ICF, 2024). This is particularly crucial given that the prenatal period is a vital aspect of the '1000-day window of opportunity' (McDonald & Thorne-Lyman, 2017). The first 1000 days are a critical period of growth and development in a child's life spanning from conception to a child's second birthday. It is referred to as a 'window of opportunity' because health and nutrition interventions during this stage can significantly and positively impact a child's developmental outcomes (Nores & Barnett, 2010). Early registration (during first trimester) and regular access by pregnant mothers to quality ANC services has potential to reduce maternal mortality and morbidity in LMIC settings (Tunçalp et al., 2017). The WHO recommend initiating ANC visits during the first trimester (ideally within the first 12 weeks) of pregnancy (WHO, 2016). Inadequate quality contacts between health workers and expectant mothers often results in rising deaths of mothers during delivery and some poor pregnancy outcomes; preterm birth and low birth weight (LBW) (Chou, Walker, & Kanyangarara, 2019). Nearly 15 million infants worldwide are born preterm each year and almost 20 million children worldwide are born with LBW (Ohuma et al., 2023; Okwaraji et al., 2024). In Zimbabwe, the average proportion of babies born with LBW according to ZDHS 2023-2024 was 9.3% for urban and 8.7% for rural (Zimbabwe National Statistics Agency (ZIMSTAT) & ICF, 2024).

ANC services have long been endorsed as a major means to identify and to reduce the risks of pre-term, low-birth weight, and other adverse pregnancy conditions and birth outcomes (WHO,

2016). However, there is limited evidence on the uptake and impact of ANC services in LMICs to inform programme, policy decisions and social behaviour change communication strategies (SBCC) (Gamberini, Angeli, & Ambrosino, 2022; Kuhnt & Vollmer, 2017). The new ANC guidelines in Zimbabwe recommend that all pregnant women receive at least eight antenatal care (ANC) contacts with a skilled provider during pregnancy (Ministry of Health and Child Care (MOHCC), 2018). These contacts should include urine testing for bacteriuria and proteinuria, measurement of blood pressure, blood grouping and Rhesus factor determination, blood testing for syphilis, HIV, and anaemia, as well as weight and height measurements (Ministry of Health and Child Care (MOHCC), 2018; WHO, 2016).

In 2024, ANC coverage from the Zimbabwe demographic health survey showed that 71% of women (15-49 years) who gave birth 2 years before the survey had received 4 or more contacts from a skilled worker during pregnancy (a decrease from 73% in 2015), whilst only 9% had attended all 8 contact visits (Zimbabwe National Statistics Agency (ZIMSTAT) & ICF, 2024). Only thirty-four percent of women had attended their first ANC contact during the first trimester, a decrease from 37% (2010-2011) (Zimbabwe National Statistics Agency (ZIMSTAT) & ICF, 2024). This shows the need to expand the coverage and utilisation of ANC services in Zimbabwe. In addition, there are still worrying gaps in knowledge and impact of ANC services in population dense low resourced areas of Zimbabwe. Therefore, this study investigated the relationship between frequency and timing of ANC visits and birth outcomes among women aged 15-49 years in Hatcliffe suburb, Harare, Zimbabwe.

Methodology

Study design and setting

A facility based retrospective cross-sectional study was conducted to establish the relationship between ANC visits and birth outcomes in Hatcliffe. The study recruited women with children below 2 years of age attending a polyclinic in Hatcliffe, Harare for routine growth monitoring services. The ANC clinic at this community facility was used as the study site. Hatcliffe suburb is a peri-urban high density community in North-East of the capital city Harare. The area has the following geographical coordinates 17° 41' 18" South, 31° 6' 35" East and experiences subtropical highland climate or temperate oceanic climate with dry winters. Based on the results of the 2022 national census, Hatcliffe has a population of 86639 people (ZIMSTAT, 2024). Hatcliffe lacks comprehensive healthcare resources and faces socioeconomic challenges that limit access to adequate antenatal care for pregnant women (Masimba & Walnycki, 2024).

Sampling and sample size determination

While a larger sample size may offer broader generalisability, the primary aim of this study was to explore the relationship between ANC visits and birth outcomes within this specific community. The use of the chosen sample size in this study was compounded by the constraints of its facility-based nature, wherein only 75 mother-child pairs were available for recruitment. Convenient sampling method was used to select mothers attending the growth monitoring and ANC sessions at Hatcliffe polyclinic. Mothers always bring child health cards for ANC visits and this ensured collection of correct information on birth weight, birth length and APGAR score.

Data collection and tools

The questionnaire used in the study was adapted from the multiple indicator cluster survey (MICS) tool (MICS, 2014). This interviewer administered questionnaire was used to collect data on the number and timing of ANC visits, type of ANC service provider, content of ANC, which include blood pressure measurement, blood and urine samples taken and iron and folate supplementation. Birth outcomes (the child's length, weight, Apgar score and head circumference) were recorded from the child health card.

Definitions and cut-offs

Early registration for ANC was defined in this study as registering within the first 12 weeks of pregnancy and registration after 12 weeks of pregnancy was regarded as late registration. The definitions of normal birth weight (≥2500g), length (≥46.9 cm) and head circumference (≥32.9 cm) were based on standard published methods (Villar et al., 2014). While birth complications were defined as presence of any of the following: birth by Caesarean section, longer duration of labour (> 7 hours) and preterm birth (delivery before 37 completed weeks of gestation based on the last self-reported menstrual period) (WHO, 2017). Adequate ANC visits were based on WHO guidelines whereby eight are considered as adequate. (WHO, 2016). We used a cut-off of four or more visits based on similar studies for comparability (Kuhnt & Vollmer, 2017).

Ethical Considerations

The study was conducted in conformity with the Helsinki Declaration. The study was introduced and approved by the Hatcliffe Polyclinic Administrator and Matron in charge of the ANC clinic. Ethical approval was sought and granted by the Medical Research Council of

Zimbabwe (MRCZ/B/1438). Written informed consent was obtained from the study participants.

Data analysis

Data collected was entered and analysed using SPSS v 25 (IBM Inc). Normality of data was assessed using the Shapiro-Wilk test and visualisations via Q-Q plots. Continuous data was presented as mean ± standard deviation (SD) while categorical data was presented as frequencies and percentages. Pearson's Chi-square test was used to compare categorical data, when cell counts were less than 5, Fisher's exact test was used instead. Level of significance was set at $P<0.05$.

Results

Demographic characteristics of participants

A total of 75 mothers of children aged 0-24 months consented to participate in this study. Table 1 presents a summary of the demographic variables of the participants. The youngest mother interviewed was 18 years old and the oldest was 45 years. Most of the women were married (84%), and most had achieved at least secondary school level of education (70%). Out of the 75 women, 93.2% received care from a nurse and a smaller number (6.8%) were attended to by a doctor during ANC period before delivery. In terms of assistance during child birth, 74.7% were attended to by a nurse and 21.3% by a doctor.

Most of the women had the following basic ANC assessments: blood pressure assessed (74%), urine sample collected (74%), iron and folate supplementation provided or prescribed (76%). Almost all infants of interviewed mothers had been delivered at a health facility (94%). The mean ±SD duration of labour was 7.6 ±4.7 hours and the prevalence of normal delivery was 89.3%. The mean ±SD birth weight was 2804± 3.96g, birth length was 48.44 ±3.92 cm, head circumference was 33.91 ± 1.91cm (Table 2).

Table 1: Demographic and selected health characteristics of the study participants

Variable		Frequency (n)	Percentage (%)
Total		75	100
Mother`s age (years):	15–19	5	6.7
	20–34	53	70.6
	35–45	17	22.7
Marital status: Single		2	2.7
	Married	63	84
	Divorced/ Separated	10	13.4
Education level:No formal education		2	2.7
	Primary	5	6.7
	Secondary	53	70.7
	Tertiary	15	20
Sex of child:	Boys	36	48
	Girls	39	52
Child age (months):	0-6	29	38.7
	7-12	21	28
	13-24	25	33.3
Child`s birth order:	1st born	21	28
	2nd to 5th born	54	72
ANC staff consulted:	Doctor	5	6.8
	Nurse	68	93.2
Blood pressure measured		74	98.6
Urine sample assessed		74	98.6
Iron and folate supplementation		57	76
Tetanus injection		67	89.3
Birth delivery by:	Doctor	16	21.3
	Nurse	56	74.7
	Relative or friend	3	4
Place of delivery:	Home	4	5.3
	Health facility	71	94.7
Mode of delivery:	Normal	67	89.3
	C-Section	8	10.0

Table 2: Selected maternal and neonatal outcomes[1]

Variable	Mean ±SD
Duration of labour (hrs)	7.6±4.8
Birth weight (g)	2804±40
Birth length (cm)	48.4±3.9
Head circumference (cm)	33.9±1.9

[1]N=75 except for duration of labour N=67

Relationship between number of ANC visits and birth outcomes

A correlation was observed between number of ANC visits and birth weight [OR 95% CI; 7.6 [1.6, 36.4] (*P*=0.013)], birth length [OR 6.1; 95%CI 1.8, 20.1 (*P*=0.010)], and head

circumference [OR 4.3; 95% CI 1.3, 14.8 (*P*=0.013)]. There was no relationship between the number of ANC visits and Apgar score (*P*=0.127) (Table 3).

Table 3: Relationship between number of ANC visits on birth weight, length, head circumference and Apgar score

Variable	Total n=75	ANC visits less than 4 n=17 n (%)	ANC visits 4 or more n=58 n (%)	*P*-value	OR (95%CI)
Birth weight (<2.5kg)	8 (10.6)	5 (42.1)	3 (5.4)		
Normal (≥2.5kg)	67 (80.3)	12 (57.9)	55 (94.6)	0.013*	7.6 (1.6, 36.4)
Birth length (<47cm)	18 (24.0)	9 (57.9)	8 (14.3)		
Normal (≥47cm)	57 (76.0)	8 (42.1)	49 (85.7)	0.010*	6.1 (1.8, 20.1)
Head circumference (<33cm)	15 (20)	7 (42.1)	8 (12.5)		
Normal (≥33cm)	60 (80)	10 (18.3)	50 (81.7)	0.013*	4.3 (1.3, 14.8)
Apgar Score (<7 points)	3 (4)	2 (10.5)	1 (1.8)		
Normal (≥7 points)	72 (96)	15 (89.5)	57 (98.2)	0.127	7.6 (0.6, 89.6)

[1]Chi-square test of association was used to obtain *P* values and Odds ratios except where cell count is<5 Fisher's exact test was used. **P* value significant at *P*<0.05

Comparison of the relationship of early vs. late registration for ANC with the birth outcomes

There was a significant correlation between timing of registration and birth weight [OR 1.2; 95% 1.05, 1.36 (*P*=0.045)], as well with birth length [OR 0.16; 95% CI 0.03, 0.76 (*P*=0.012)]. There was no significant association between early registration of ANC and infant Apgar score (*P*=0.293) (Table 4).

Table 4: Relationship of early vs. late registration for ANC with the birth outcomes

Variable	Total n=75, n (%)	Registration for ANC: Before 1st trimester n=27	Registration for ANC: After 1st trimester n=48	[1]*P*-value	OR (95%CI)
Birth weight (<2.5kg)	8 (10.6)	0	8	0.045	1.2 (1.05, 1.36)
Normal (≥2.5kg)	67 (80.3)	27	40		
Birth length (<47cm)	18 (24.0)	2	16	0.012	0.16 (0.03, 0.76)
Normal (≥47cm)	57 (76.0)	25	32		
Head circumference (<33cm)	15 (20)	2	13	0.070	0.2 (0.04, 1.04)
Normal (≥33cm)	60 (80)	25	35		
Apgar Score (<7 points)	3 (4)	2	1	0.293	3.7 (0.32, 43.5)
Normal (≥7 points)	72 (96)	25	47		

[1]Fisher's test of association was used to obtain *P* values and Odds ratios

Discussion

The current study sought to investigate the relationship between frequency and timing of ANC visits with various selected birth outcomes in women aged 15-49 at Hatcliffe Polyclinic, Harare. In this study increased frequency and early registration of ANC visits had a positive relationship with birth weight and length. Only for head circumference was the relationship significant for the number of ANC visits. Similarly, a study conducted to identify a broad range of interventions that positively affect pregnancy outcomes and reduce infant mortality found that increased frequency and proper timing of ANC visits were found to be effective in producing positive birth outcomes such as higher birth weight, stunting and underweight reduction (Kuhnt & Vollmer, 2017). Other studies have come to the same conclusion that ANC visits are an instrumental factor in improving birth outcomes (Habte, Tamene, & Melis, 2024; WHO, 2016).

In the current study, early registration for ANC had a positive relationship with the birth weight. Studies from various regions, including Africa (Engdaw et al., 2023) and China (Wenling et al., 2024), confirm that early registration is positively correlated with birth weight. A study conducted in Tajikistan found that having the first antenatal care (ANC) visit during the first trimester was associated with an increase in birth weight by 304 grams (Habibov, Fan, Campbell, & Cheung, 2017). Based on these results, initiatives aimed at encouraging early registration for ANC among mothers could be beneficial in reducing the risk of LBW infants. Although only 10.6% of children in our study had a LBW, community awareness campaigns are recommended as a strategy to prevent adverse birth outcomes in line with the WHO target to achieve a 30% reduction in LBW in communities by 2025 (WHO, n.d.).

From this study, there was no relationship between the number of ANC visits and the Apgar score of the new-born. On the contrary, studies in Bangladesh (Doss, ElRayes, & Shireen Rajaram, 2023) and Brazil (Mendonça et al., 2022) that examined the relationship between the number of ANC visits and infant Apgar scores found a positive relationship between ANC visits and infant Apgar scores. The difference in our results may be attributed to variations in sample sizes. Our study enrolled 75 women, whereas the Brazil study involved 1028 women from both public and private health institutions, and the Bangladesh study enrolled 182 women in a refugee camp. This may also be reflective of the differences in the quality of care; for example, the study among the refugees who were receiving humanitarian aid in Bangladesh, and the Brazil study included women from both private and public settings. The current study

was conducted in Hatcliffe a high-density area with reduced service provision (Masimba & Walnycki, 2024). We recognise that numerous other socio economic and environmental factors, including maternal education, wealth quintile, and the gender of the head of household, influence birth outcomes as indicated by Rahut et al. (Rahut, Singh, & Sonobe, 2024). However, these aspects were not the primary focus of this study.

In this study, the mean duration of labour was found to be 7.6 hours. Studies that have investigated labour progression show variations in the onset and duration of labour in pregnant women (He et al., 2023). Studies have indicated a median/mean duration of the active phase (<4.5cm dilation) in nulliparas women ranging from 2.4 to 8.4 hours, and in multiparous (1.5 to 3.4 hours) whilst second stage of labour (period from full dilation of the cervix until the birth of the infant) median duration from 16 to 93 minutes in nulliparous women and mean of 1.4 to 5.7 hours in multiparous women (He et al., 2023). The current study did not fully assess parity or the use of epidural analgesia, key factors influencing labour duration; thus, limiting our ability to make adequate comparisons with existing literature.

The majority of women in this study received care from nurses. According to the World Health Organization (WHO, 2021), nurses, especially midwives, provide a substantial portion of maternal delivery services globally. To improve neonatal outcomes and achieve the WHO's global target of 'Health for All', it is recommended that more nurses be trained, underscoring the critical role of this professional group (WHO, 2019).

This study was localised in an urban setting hence findings may not be representative to those in rural areas and those in urban areas who seek services in the private sector. This focused approach allowed for an in-depth analysis of the targeted population, ensuring that the findings remain relevant to the local context. These findings can be used to design appropriate messages for awareness campaigns aimed at improving ANC attendance in similar settings. Future studies may consider larger samples to validate these findings across broader settings.

Conclusions

This study found that increased frequency and early registration for antenatal care (ANC) visits are positively correlated with birth weight, birth length, and head circumference. These results underscore the importance of enhancing the uptake of ANC services, including early registration in the first trimester and the implementation of community-wide strategies to ensure pregnant women attend all recommended visits. Such measures can significantly

improve birth outcomes in this and similar contexts. Consequently, nutrition and health education programmes targeting all women of childbearing age are essential.

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References

Chou, V. B., Walker, N., & Kanyangarara, M. (2019). Estimating the global impact of poor quality of care on maternal and neonatal outcomes in 81 low- and middle-income countries: A modeling study. *PLoS Medicine*, *16*(12), e1002990. https://doi.org/10.1371/JOURNAL.PMED.1002990

Doss, V., ElRayes, W., & Shireen Rajaram, F. S. (2023). The Association of Apgar Score Outcomes with the Number of Midwife Antenatal Care Visits Among Infants Born to Rohingya Refugees in Cox's Bazar, Bangladesh. *Capstone Experience*. Retrieved from https://digitalcommons.unmc.edu/coph_slce/244

Engdaw, G. T., Tesfaye, A. H., Feleke, M., Negash, A., Yeshiwas, A., Addis, W., … Engidaw, M. T. (2023). Effect of antenatal care on low birth weight: a systematic review and meta-analysis in Africa, 2022. *Frontiers in Public Health*, *11*, 1158809. https://doi.org/10.3389/FPUBH.2023.1158809

Gamberini, C., Angeli, F., & Ambrosino, E. (2022). Exploring solutions to improve antenatal care in resource-limited settings: an expert consultation. *BMC Pregnancy and Childbirth*, *22*(1), 1–11. https://doi.org/10.1186/S12884-022-04778-W/TABLES/1

Habibov, N., Fan, L., Campbell, D., & Cheung, C. H. (2017). Effect of Prenatal Care Frequency, Timing, and Quality on Child Birth Weight in Tajikistan. *World Medical and Health Policy*, *9*(1), 89–102. https://doi.org/10.1002/WMH3.216

Habte, A., Tamene, A., & Melis, T. (2024). Compliance towards WHO recommendations on antenatal care for a positive pregnancy experience: Timeliness and adequacy of antenatal care visit in Sub-Saharan African countries: Evidence from the most recent standard Demographic Health Survey data. *PLOS ONE*, *19*(1), e0294981. https://doi.org/10.1371/JOURNAL.PONE.0294981

He, X., Zeng, X., Troendle, J., Ahlberg, M., Tilden, E. L., Souza, J. P., … Zhang, J. (2023). New insights on labor progression: a systematic review. *American Journal of Obstetrics and Gynecology*, *228*(5), S1063–S1094. https://doi.org/10.1016/J.AJOG.2022.11.1299/ASSET/074C2647-1866-46E8-BA64-63CCF4C8F9B1/MAIN.ASSETS/GR3.JPG

Kuhnt, J., & Vollmer, S. (2017). Antenatal care services and its implications for vital and health outcomes of children: evidence from 193 surveys in 69 low-income and

middle-income countries. *BMJ Open*, *7*(11), e017122. https://doi.org/10.1136/BMJOPEN-2017-017122

Masimba, G., & Walnycki, A. (2024). *Harare: City report*. Retrieved from www.african-cities.org

McDonald, C. M., & Thorne-Lyman, A. L. (2017). The Importance of the First 1,000 Days : An Epidemiological Perspective. *The Biology of the First 1,000 Days*, 3–14. https://doi.org/10.1201/9781315152950-1

Mendonça, K., Rodrigues, D., Zoldan, C., Bernardes De Oliveira Silva, C., Félix, E., Santana, M., … Borges Peixoto, A. (2022). Relationship between the number of prenatal care visits and the occurrence of adverse perinatal outcomes. *Rev Assoc Med Bras*, *68*(2), 256–260. https://doi.org/10.1590/1806-9282.20211239

MICS. (2014). *Zimbabwe Multiple Indicator Cluster Survey 2014*, *Final Report*. Harare, Zimbabwe.

Ministry of Health and Child Care (MOHCC). (2018). *Zimbabwe Antenatal Care Protocol*.

Nores, M., & Barnett, W. S. (2010). Benefits of early childhood interventions across the world: (Under) Investing in the very young. *Economics of Education Review*, *29*(2), 271–282. https://doi.org/10.1016/J.ECONEDUREV.2009.09.001

Ohuma, E. O., Moller, A. B., Bradley, E., Chakwera, S., Hussain-Alkhateeb, L., Lewin, A., … Moran, A. C. (2023). National, regional, and global estimates of preterm birth in 2020, with trends from 2010: a systematic analysis. *The Lancet*, *402*(10409), 1261–1271. https://doi.org/10.1016/S0140-6736(23)00878-4

Okwaraji, Y. B., Krasevec, J., Bradley, E., Conkle, J., Stevens, G. A., Gatica-Domínguez, G., … Hayashi, C. (2024). National, regional, and global estimates of low birthweight in 2020, with trends from 2000: a systematic analysis. *The Lancet*, *403*(10431), 1071–1080. https://doi.org/10.1016/S0140-6736(23)01198-4

Rahut, D. B., Singh, A., & Sonobe, T. (2024). Continuum of maternal and new-natal health care: empirical evidence from 10 developing countries in South and South East Asia. *Journal of Population Research*, *41*(2), 1–33. https://doi.org/10.1007/S12546-024-09327-0/TABLES/8

Tunçalp, Pena-Rosas, J. P., Lawrie, T., Bucagu, M., Oladapo, O. T., Portela, A., & Metin Gülmezoglu, A. (2017). WHO recommendations on antenatal care for a positive pregnancy experience—going beyond survival. *BJOG: An International Journal of Obstetrics & Gynaecology*, *124*(6), 860–862. https://doi.org/10.1111/1471-0528.14599

Villar, J., Ismail, L. C., Victora, C. G., Ohuma, E. O., Bertino, E., Altman, D. G., … Enquobahrie, D. (2014). International standards for newborn weight, length, and head circumference by gestational age and sex: The Newborn Cross-Sectional Study of the INTERGROWTH-21st Project. *The Lancet*, *384*(9946), 857–868. https://doi.org/10.1016/S0140-6736(14)60932-6,

Wenling, H., Jiangli, D., Aiqun, H., Wei, Z., Huanqing, H., & Sidi, C. (2024). Analysis of the relationship between the quality of antenatal care examinations and the incidence of preterm birth and low birth weight. *BMC Public Health*, *24*(1), 3134. https://doi.org/10.1186/S12889-024-19967-9/FIGURES/2

WHO. (2002). *WHO antenatal care randomized trial: Manual for the implementation of the new model*. Retrieved from https://iris.who.int/handle/10665/42513

WHO. (2016). New guidelines on antenatal care for a positive pregnancy experience. Retrieved June 4, 2025, from https://www.who.int/news/item/07-11-2016-new-guidelines-on-antenatal-care-for-a-positive-pregnancy-experience

WHO. (2017). *Managing Complications in Pregnancy and Childbirth (MCPC): A Guide for Midwives and Doctors Background and Purpose*. Retrieved from www.mcsprogram.org

WHO. (2019). Survive & thrive. *Delicious Living*, *29*(8), 20–37. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/326495/9789241515887-eng.pdf

WHO. (2021). The State of the World's Midwifery 2021. Retrieved June 6, 2025, from https://www.who.int/publications/i/item/sowmy_2021

WHO. (n.d.). Global nutrition targets 2025: low birth weight policy brief. In *2025*. Retrieved from https://www.who.int/publications/i/item/WHO-NMH-NHD-14.5

Zimbabwe National Statistics Agency (ZIMSTAT), & ICF. (2024). *Zimbabwe Demographic and Health Survey 2023-2024*. Harare, Zimbabwe.

ZIMSTAT. (2024). Zimbabwe Data Portal National Census 2022. Retrieved June 6, 2025, from https://zimbabwe.opendataforafrica.org/