



## RESEARCH ARTICLE

### TRENDS IN MATERNAL MORTALITY, ATTRIBUTABLE TO IRONDEFICIENCY IN GHANA FROM 1990 TO 2021

<sup>1</sup>Latifa Abubakari, <sup>2</sup>Abubakari Alhassan, <sup>3</sup>Sawuda Abdul Majeed and <sup>4</sup>Halidu Abugre Solomon

<sup>1</sup> Manhyia District Hospital, Department of Nutrition and Dietetics, Kumasi Ghana; <sup>2</sup> City and County Healthcare Group, England, United Kingdom; <sup>3</sup>Princess Marie Louise Children's Hospital, Accra, Department of Nutrition and Dietetics; <sup>4</sup>Nakom Health Center Ghana, Department of Nursing

#### ARTICLE INFO

##### Article History:

Received 27<sup>th</sup> August, 2025  
Received in revised form  
18<sup>th</sup> September, 2025  
Accepted 24<sup>th</sup> October, 2025  
Published online 30<sup>th</sup> November, 2025

##### Keywords:

Maternal mortality; Anaemia; Trends; Ghana.

##### \*Corresponding author:

Latifa Abubakari

Copyright©2025, Latifa Abubakari et al. 2025. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Latifa Abubakari, Abubakar Alhassan, Sawuda Abdul Majeed and Halidu Abugre Solomon. 2025. "Trends in maternal mortality, attributable to irondeficiency in ghana from 1990 to 2021. . International Journal of Current Research, 17, (11), 35341-35345.

#### ABSTRACT

**Background:** Maternal mortality continues to be a global public health problem with anaemia as one of its leading causes. There have been a number of interventions and strategies targeted at preventing anaemia in pregnancy and in effect, maternal mortality in Ghana. Despite these efforts, the problem persists. This study investigated the trends in anaemia aggravated maternal mortality in Ghana and examined how these rates varied across different age groups. **Objectives:** This study aims to assess the trends in maternal mortality attributable to iron deficiency in Ghana and also examine variations in the trend across different age groups. **Methods:** A linear regression was fitted to the natural log of the maternal mortality attributed to anaemia in the Joint point Regression Program to assess the overall trends in anaemia attributed maternal mortality. Pairwise comparison tests were also performed to ascertain whether the trends in the rate of mortality were identical across different age groups. **Results:** In general, it was observed that the rate of anaemia aggravated maternal deaths in Ghana declined from 1990 to 2021. Meanwhile, there were observed temporal increase in the rate among women aged 30 and above with those aged below 30 not recording any temporal rise. **Conclusion:** Considering the variations in trend across different age groups, this study recommends that age-specific targeted interventions be introduced to combat anaemia in pregnancy and improve maternal health outcomes in Ghana.

## INTRODUCTION

Maternal mortality continues to be a major public health problem, highly prevalent in low and middle-income countries including Ghana (Iyanda, 2017; TAWIAH, 2015; Wu *et al.*, 2024). Between the year 1990 and 2015, there were global records of 10.7 million deaths as a result of pregnancy and childbirth related complication. Approximately 303,000 women's lives were lost to maternal mortality in 2015 (Iyanda, 2017). According to the Ghana Demographic and Health Survey (GDHS) 2014 reports, the rates of maternal mortality in Ghana between 1990 and 2015 witnessed a reduction from 740 to 319 per 100,000 live births (GDHS 2014). Global Burden of Disease (GBD), 2015 Mortality and causes of Death Collaborators, 2016 reported that a total of 515,000 women are lost each year through maternal mortality. Statistics by the World Health Organization (WHO) indicate that Sub-Saharan African(SSA) countries account for about 66% of the global rate of maternal mortality and has the highest lifetime risk of maternal deaths with a value of 1 in 36 as compared to 1 in 4900, globally (Iyanda, 2017).Data from the WHO suggested that, there were 211 maternal deaths per 100,000 live births in 2017 indicating a total of approximately 295,000 maternal deaths(Wu *et al.*, 2024).Data from the 2017 Ghana Maternal Health Survey shows a maternal mortality ratio of 310 deaths per 100,000 live births (GMHS 2017). Currently, the maternal mortality rate in Ghana is 234 deaths per 100,000 live

births. With this rate of decline, Ghana risks achieving the Sustainable Development Goal(SDG) target 3.1, which aims at reducing the global maternal mortality ratio to less than 70 per 100,000 live births by 2030 (Kahansim *et al.*, 2023).Iron deficiency anaemia has been recognized as the leading cause of maternal mortality in low- and middle-income countries and was identified as the major risk factor for maternal disorders in the GBD 2019 study. There are reports from the WHO stating that, anaemia accounts for 16,800 to 28,000 deaths annually among women of reproductive age (Wu *et al.*, 2024). However, in Ghana, little evidence exists about the contribution of iron deficiency to maternal death. Although previous studies (Eghan, 2019; Khaskheli *et al.*, 2016; Wu *et al.*, 2024) have examined the associated between iron deficiency and maternal mortality, none has specifically quantified the exact proportion of these deaths that are attributed to iron deficiency and more importantly, the variations among different populations and age groups. In addition, earlier work in the field has relied on cross-sectional designs (Brabin *et al.*, 2001) which limit the ability to establish causal relationships and track changes over time. Addressing these knowledge gaps is critical to achieving the SDG target 3.1, as it would help to identify the most vulnerable populations to provide more targeted interventions that lead to better resource allocation, maximizing the efficiency and effectiveness of interventions. This study investigated the trends and patterns of maternal mortalitythat could be attributed to iron deficiency in Ghana, and how they vary among different age groups. The subsequent sections provide a detailed description of the study

methodology, followed by an analysis of the results and a discussion of the key findings. Finally, we offer evidence-based recommendations, highlighting targeted interventions and strategies to mitigate this burden and enhance maternal health outcomes.

### Study objectives

1. To assess the trends in maternal mortality, attributable to iron deficiency in Ghana
2. To determine the variations in the rate of mortality across different age groups

## MATERIALS AND METHODS

**Study design:** Serial cross-sectional ecological study.

**Study Setting:** Ghana is one of the 16 West African countries and second most populous in the sub region after Nigeria. Sharing borders to the north with Burkina Faso, to the east with Togo and to the west with Cote D'Ivoire. The country is made up of 16 administrative regions, each with unique socio-cultural and economic characteristics subdivided into 261 Metropolitan, Municipal and District Assemblies (MMDAs). The population and housing census conducted in 2021 by the Ghana Statistical Service (GSS) estimated Ghana's population to be 30.8 million. The WHO estimated the Maternal Mortality Ratio (MMR) in Ghana at the end of 2015 to be 319 per 100,000 live births, which was significantly greater than the global ratio of 216 per 100,000 live births at the time (WHO and UNICEF, 2015). Although a portion of maternal deaths in Ghana are inevitable, above 50% of these maternal deaths occur as a result of substandard clinical care. The lives of some of these women are lost because their conditions were not diagnosed early enough and others as a result of ineffective management and care.

**Study population:** The population selected for this study was pregnant women in Ghana. This population was chosen to capture women who are at risk of maternal mortality.

**Data Source:** The Global Burden of Disease (GBD 2021) data which is being managed by the Institute for Health Metrics and Evaluation (IHME) was adopted for this study. The IHME is undoubtedly the most comprehensive source of global health data. It is also noted for constantly providing highly effective, reliable and quality data set necessary for global health monitoring, making it the best fit for this study. GBD data is obtained from a variety of sources including scientific literature censuses, surveys (e.g. Demographic and Health Surveys), hospital and clinical records, government reports and collaborative networks such as the WHO.

**Variables:** Annual age-specific aggregate level Iron-deficiency aggravated maternal mortality was extracted for Ghana, over the time interval from 1990 to 2021. This period was selected based on data availability. There have been progressions in global and local health outcomes within this time frame including improvements in maternal health outcomes in Ghana.

**Statistical methods:** The trends in maternal mortality attributed to anaemia was analysed using the Joint point Regression Program (version 5.2.0). A linear regression was fitted to the natural log of the maternal mortality attributed to anaemia in the Joint point Regression Program, with the slope denoting the annual percentage change (APC) for a specified period. The average annual percentage change (AAPC) and corresponding 95% CI were calculated for each age group as a weighed average of the APC. The overall trend in maternal mortality attributed anaemia was described using AAPC. The R Studio (version 4.4.1) "Lattice package" was used to produce line graphs to illustrate the trends across different age groups. Also, pairwise comparison tests were performed to determine whether the trends in maternal mortality across various age groups were identical. The null hypothesis was that at least two different age groups would have an identical joint point regression function. Bonferroni

correction was used to adjust the significance level to control the overall probability of a Type 1 error. There were no missing data in the dataset.

## RESULTS

**Current burden:** The trends in the rate of maternal mortality, attributable to iron deficiency in Ghana as at 2021 ranged from (1.4(95%CI: 0.6 to 2.5)) in adolescents aged 15-19 to (4.8(95%CI: 2.0 to 8.5)) among those aged 30-34. Adolescents within the ages of 15 to 19 recorded the least rate, followed closely by older adults aged 45 to 49 with a rate of (1.5(95%CI: 0.6 to 3.0)). Women aged 40 to 44 had a rate of (3.1(95%CI: 1.2 to 5.7)) and young adults, 20 to 24 followed with a rate of (3.9(95%CI: 1.7 to 7.1)). Maternal mortality for those aged 25 to 29 and 35 to 39 were similar with rates of (4.5(95%CI: 1.8 to 7.7)) and (4.6(95%CI: 2.0 to 7.8)), respectively in 2021. The highest rate of maternal mortalities attributable to iron deficiency in 2021 was recorded among women aged 30-34.

**Temporal Trends and Patterns:** Maternal mortality attributable to iron deficiency in Ghana exhibited a general decline across all age groups between 1990 and 2021. However, there were notable variations in the direction and rate over time. The average annual percentage change (AAPC) ranged from (-2.4% (95% CI: -2.6 to -2.2)) in those aged 25 to 29 and another (-2.4% (95% CI: -2.9 to -2.0)) in the final age group, 45 to 49 to (-3.2(95% CI: -3.4 to -2.9)) in those aged 15 to 19, indicating sustained reductions across the various reproductive age groups. Among adolescents aged 15-19, mortality declined steadily in the early 1990s (-3.1% (-3.6 to -2.7)), plateaued around 1999-2002 (0.0% (-2.0 to 2.1)), then resumed a downward trajectory with sharper decreases after 2007. The steepest decline occurred between 2017 and 2021 (-7.4% (-8.0 to -6.8)), consistent with the overall AAPC of -3.1%. Women aged 20-24 and 25-29 followed a broadly similar pattern, with gradual declines through the 1990s (e.g., -2.3% (-2.6 to -2.0) for ages 20-24), brief periods of stagnation or minimal change around 2012-2017 (0.5% (-1.3 to 0.4) for ages 20-24), and renewed sharp declines in the final period (-7.2% and -6.0%, respectively). For women aged 30 to 34, the decline was strongest in the 1990s (-4.0% (-4.3 to -3.7)), slowed between 1999 and 2012 (-1.8% (-2.0 to -1.6)), and then shifted to near stability in 2012-2017 (0.1% (-0.8 to 1.1)) before resuming a marked decrease after 2017 (-5.1%). In the 35-39 group, mortality decreased consistently through the 1990s and 2000s (-2.6% (-2.7 to -2.4) during 1999-2012), but a temporary increase was observed between 2012 and 2017 (2.1% (1.3 to 2.9)), followed by a return to decline thereafter (-3.4%). Older women experienced more fluctuations. Among those aged 40-44, steep declines were recorded in the 1990s (-5.2% (-5.7 to -4.8)) followed by smaller decreases in the 2000s, a temporary increase between 2012 and 2017 (4.1% (3.2 to 5.0)) and then a modest decline in the final period (-1.3%).

The 45-49 group showed the sharpest early declines, particularly in the mid-1990s (-13.2% (-15.0 to -11.4)), followed by smaller reductions in the 2000s, a brief period of stability and then a notable increase between 2012 and 2017 (9.0% (7.6 to 10.5)), before stabilizing again after 2017. The overall AAPC for this group was -2.3% with the steepest long-time decline among all age groups.

## DISCUSSION

**Trends and disparities in Iron deficiency attributed maternal deaths:** This study sought to assess the trends in iron deficiency aggravated maternal deaths among women of reproductive age (15 to 49) in Ghana over a 31 year period, that is 1990 to 2021 and also to examine the age-related disparities in rate for these women. The findings of this study revealed that there were significant reductions in the rate of mortality over the said period, across all age groups although the rate of decline did not follow a general pattern. Upon analysis, it is evident that there were notable disparities in the trends for the various birth cohorts

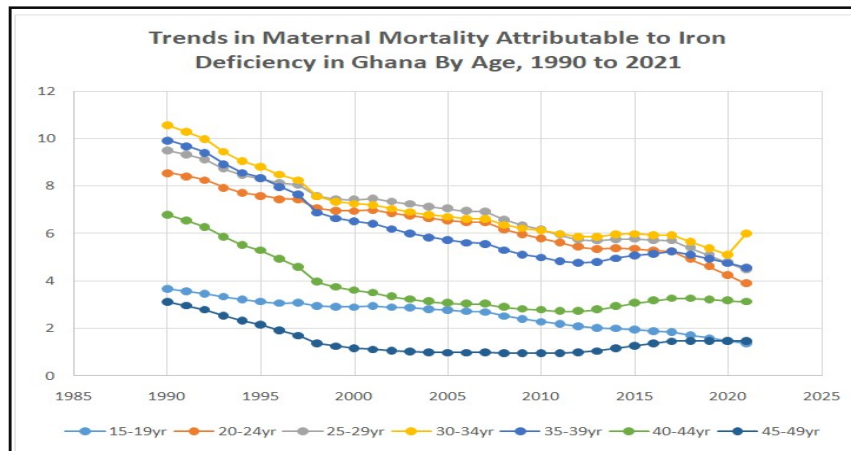


Figure 1. Trends in maternal mortality in Ghana attributable to iron deficiency, 1990-2021

Table 1. Iron deficiency attributed age standardised mortality rate (ASMR) and estimated annual percentage change (net drift) among women in Ghana, 1990 to 2021

AGE (years)	ASMR(95% CI), 1990	ASMR(95% CI), 2021	Net Drift (95% CI), 1990-2021
15-19	3.7(1.5 to 6.3)	1.4(0.6 to 2.5)	-3.2(-3.4 to -2.9)
20-24	8.6(3.5 to 15.0)	3.9(1.8 to 7.1)	-2.5(-2.7 to -2.3)
25-29	9.5(3.8 to 16.4)	4.5(1.8 to 7.7)	-2.4(-2.6 to -2.2)
30-34	10.6(4.5 to 18.1)	4.8(2.0 to 8.5)	-2.5(-2.7 to -2.3)
35-39	9.9(4.4 to 16.8)	4.6(2.0 to 7.8)	-2.5(2.8 to 2.2)
40-44	6.8(2.8 to 11.9)	3.1(1.2 to 5.7)	-2.5(-2.9 to -2.2)
45-49	3.1(1.1 to 6.3)	1.5(0.6 to 3.0)	-2.4(-2.9 to -2.0)

Table 2. Trends in maternal mortality attributable to iron deficiency among women in Ghana by age, 1990-2021

Variable	Trend 1		Trend 2		Trend 3		Trend 4		Trend 5		Trend 6		Trend 7		AAPC, % (95% CI) (1990-2021)
	APC, % (95% CI)	Years	APC, % (95% CI)	Years	APC, % (95% CI)	Years	APC, % (95% CI)	Years	APC, % (95% CI)	Years	APC, % (95% CI)	Years	APC, % (95% CI)	Years	
Age groups															
15-19	-3.1 (-3.6 to -2.7)	1990 -1995	-1.8 (-2.8 to -0.8)	1995 -1999	0.0 (-2.0 to 2.1)	1999 -2002	-1.8 (-2.4 to -1.1)	2002 -2007	-4.8 (-5.5 to -4.2)	2007 -2012	-2.3 (-2.9 to -1.6)	2012 -2017	-7.4 (-8.0 to -6.8)	2017 -2021	-3.2(-3.4 to -2.9)
20-24	-2.3 (-2.6 to -2.0)	1990 -1998	-1.1 (-1.4 to -0.8)	1998 -2007	-3.4 (-4.2 to -2.5)	2007 -2012	0.5 (-1.3 to 0.4)	2012 -2017	-7.2 (-8.0 to -6.3)	2017 -2021	NA	NA	NA	NA	-2.5(-2.7 to -2.3)
25-29	-2.7(-3.0 to -2.5)	1990 -1998	-1.2 (-1.4 to -0.9)	1998 -2007	-3.6 (-4.3 to -2.8)	2007 -2012	0.0 (-0.8 to 0.8)	2012 -2017	-6.0 (-6.7 to -5.2)	2017 -2021	NA	NA	NA	NA	-2.4(-2.6 to -2.2)
30-34	-4.0 (-4.3 to -3.7)	1990 -1999	-1.8 (-2.0 to -1.6)	1999 -2012	0.1 (-0.8 to 1.1)	2012 -2017	-5.1 (-6.0 -4.1)	2017 -2021	NA	NA	NA	NA	NA	NA	-2.5(-2.8 to -2.3)
35-39	-3.7 (-4.1 to -3.3)	1990 -1996	-5.8 (-8.1 to -3.4)	1996 -1999	-2.6 (-2.7 to -2.4)	1999 -2012	2.1 (1.3 to 2.9)	2012 -2017	-3.4 (-4.2 to -2.7)	2017 -2021	NA	NA	NA	NA	-2.5(-2.8 to -2.2)
40-44	-5.2 (-5.7 to -4.8)	1990 -1996	-9.4 (-11.9 to -6.8)	1996 -1999	-3.2 (-4.1 to -2.4)	1999 -2004	-1.9 (-2.3 to -1.5)	2004 -2012	4.1 (3.2 to 5.0)	2012 -2017	-1.3 (-2.2 to -0.4)	2017 -2021	NA	NA	-2.5(-2.9 to -2.2)
45-49	-7.1 (-8.0 to -6.3)	1990 -1995	-13.2 (-15.0 to -11.4)	1995 -1999	-5.2 (-7.2 to -3.2)	1999 -2003	-0.4 (-0.9 to 0.0)	2003 -2012	9.0 (7.6 to 10.5)	2012 -2017	-0.2 (-1.5 to 1.1)	2017 -2021	NA	NA	-2.4(-2.9 to -2.0)

While young women aged 15 to 29 consistently for each year recorded reductions in the rate over the period, it was quite different from the observations for older women aged 30 to 49 years. Although generally they all recorded a reduction in mortality rate in 2021 as compared to the beginning of the study duration which is 1990, their annual percentage changes were observed to have temporal increases at some point along the line. For those aged 30-34, the temporal rise was observed from 2014 to 2017 and for the 35-39 birth cohorts, it was from 2013 to 2019. Women aged 40-49 recorded increase in rate of mortality from 2013 to 2021.

**Interpretation:** The significant temporal rise observed between 2013 and 2021 in women aged 30 and above as compared to the little to no rise in mortality among younger women aged (15-29) throughout the study period suggests that there was a significantly greater risk of maternal mortality among women as they age, accounting for the observed temporal rise. Similar to this study, other studies including those conducted by (Creanga *et al.*, 2017) and (Callaghan & Berg, 2003) observed a greater risk of maternal mortality in women as they reach the extremities of their reproductive stage. A recent study in the US, has also reported a rise in maternal mortality being recorded among women aged 35 years and above. Women aged from 35 years were found to be at a higher risk of maternal death with the risk increasing in each older age group (Huang *et al.*, 2025).

This observed temporal rise in older women may be due to a number of factors, which increases the risk of severe anaemia and its associated complications such as increased risk of haemorrhage, resulting in maternal death. As women age, several biological changes occur, which may increase their vulnerability to severe anaemia and its pregnancy related complications which may result in maternal death. An increased risk of chronic health conditions like diabetes, heart disease and hypertension with age may play a major role. The pre-existing conditions render them more susceptible to both pregnancy and childbirth related complications. Studies including those by (Bateman *et al.*, 2012) and (Kuklina and Callaghan, 2011) both conducted in the US found out that hypertension and chronic heart disease respectively are partly responsible for the incidence of maternal mortality. Conditions such as cardiomyopathy and postpartum haemorrhage are also noted to be highly prevalent in older women. Other possible factors may be social and economic related. A study by (Adamba, 2013) found that women living in less privileged communities and those with lower levels of education are at a higher risk of maternal mortality as compared to those in better communities and with higher levels of education. Younger women may probably be less at risk because they are new to motherhood and adhere more to informed guidelines and strategies targeted at anaemia (Balcha *et al.*, 2023). Older women may not adhere to information and knowledge on the recommended diets necessary to support pregnancy, possibly because they are already mothers and so believe they are experienced in pregnancy and childbirth. Their only means of getting informed and educated may be limited to their antenatal visits, where they are educated by health professionals, whereas younger women are usually more informed through modern sources such as the internet, giving them wider insights and knowledge. Conversely, a study in Ethiopia revealed that women aged from 35 years were more adherent to iron supplementation compared to younger women (Ba, 2019).

**Policy Implications and Recommendations:** The findings of this study highlight the need for the nation's healthcare stakeholders to recognize the risk of anaemia aggravated maternal death especially in women at their extreme reproductive stage, and in response consider designing appropriate age specific strategies and interventions, targeted at routine screening, treatment and education on anaemia and as well, strengthen the management of chronic conditions such as diabetes and hypertension. Alternatively, for younger women, although there have been general reductions in their mortality rates, the incidence of maternal mortality persists, and hence there is the need to intensify the ongoing monitoring and intervention programs targeted to further reduce the rate of anaemia and consequently, maternal mortality.

**Acknowledgement:** We extend our profound gratitude to the GBD 2021 Collaborative Network and the IHME for providing the comprehensive dataset used in conducting this study. Their work has greatly impacted on our study.

**Conflict of interest:** The authors declare no conflict of interest

**Funding:** This study received no external funding

## GLOSSARY OF ABBREVIATIONS

- AAPC: Average Annual Percent Change
- APC: Average Percent Change
- ASMR: Age -Standardized Mortality Rate
- GBD: Global Burden of Disease
- GDHS: Ghana Demographic and Health Survey
- IHME: Institute for Health Metrics and Evaluation
- SDG: Sustainable Development Goals
- SSA: Sub-Saharan Africa
- UNICEF: United Nations Children's Fund
- US: United States

## REFERENCES

- Adamba, C. (2013). *Socioeconomic Inequalities and Maternal Health Outcomes*. 1–244.
- Ba, D. M. (2019). *Adherence to Iron Supplementation in 22 Sub-Saharan African Countries and Associated Factors among Pregnant Women: A Large Population-Based Study*. 3(12). <https://doi.org/10.1093/cdn/nzz120>
- Balcha, W. F., Eteffa, T., Tesfu, A. A., & Alemayehu, B. A. (2023). *Maternal Knowledge of Anemia and Adherence to its Prevention Strategies: A Health Facility-Based Cross-Sectional Study Design*. <https://doi.org/10.1177/00469580231167731>
- Bateman, B. T., Bansil, P., Hernandez-Diaz, S., Mhyre, J. M., Callaghan, W. M., & Kuklina, E. V. (2012). Prevalence, trends, and outcomes of chronic hypertension: A nationwide sample of delivery admissions. *American Journal of Obstetrics and Gynecology*, 206(2). <https://doi.org/10.1016/j.ajog.2011.10.878>
- Brabin, B. J., Hakimi, M., & Pelletier, D. (2001). An analysis of anemia and pregnancy-related maternal mortality. *Journal of Nutrition*, 131(2 SUPPL. 2), 604S-615S. <https://doi.org/10.1093/jn/131.2.604s>
- Callaghan, W. M., & Berg, C. J. (2003). Pregnancy-related mortality among women aged 35 years and older, united states, 1991-1997. *Obstetrics and Gynecology*, 102(5), 1015–1021. [https://doi.org/10.1016/s0029-7844\(03\)00740-3](https://doi.org/10.1016/s0029-7844(03)00740-3)
- Creanga, A. A., Syverson, C., Seed, K., & Callaghan, W. M. (2017). Pregnancy-Related Mortality in the United States, 2011-2013. *Obstetrics and Gynecology*, 130(2), 366–373. <https://doi.org/10.1097/AOG.0000000000002114>
- Eghan, E. S. (2019). *Factors Associated With Maternal Mortality in Greater Accra Ghana 2016: Case-Control Study*. Walden University.
- Huang, R. S., Spence, A. R., & Abenhaim, H. A. (2025). Age-related disparities in national maternal mortality trends: A population-based study. *PLoS ONE*, 20(1), 1–12. <https://doi.org/10.1371/journal.pone.0316578>
- Iyanda, A. (2017). *The geography of maternal health indicators in Ghana* (University of North Texas). <https://www.researchgate.net/publication/320947301>
- Kahansim, M. L., Da'ap, P., Nyango, D. D., Anyaka, C. U., Egbodo, C. O., & Mutihir, J. T. (2023). Causes and trends in maternal mortality in a tertiary health facility in North Central Nigeria. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, 12(7), 1980–1985. <https://doi.org/10.18203/2320-1770.ijrcog20231907>
- Khaskheli, M. N., Baloch, S., Sheeba, A., Baloch, S., & Khaskheli, F. K. (2016). Iron deficiency anaemia is still a major killer of pregnant women. *Pakistan Journal of Medical Sciences*, 32(3), 630–634. <https://doi.org/10.12669/pjms.323.9557>

Kuklina, E. V., & Callaghan, W. M. (2011). Chronic heart disease and severe obstetric morbidity among hospitalisations for pregnancy in the USA: 1995-2006. *BJOG: An International Journal of Obstetrics and Gynaecology*, 118(3), 345–352. <https://doi.org/10.1111/j.1471-0528.2010.02743.x>

TAWIAH, K. (2015). *Modeling Maternal Mortality in Ghana Using By This Thesis Is Submitted To the Department of Statistics , Requirements for the Award of Master of Philosophy College of Basic and Applied Sciences* (Issue June) (University of Ghana). <https://doi.org/10442609>

Wu, N., Ye, E., Ba, Y., Caikai, S., Ba, B., Li, L., & Zhu, Q. (2024). The global burden of maternal disorders attributable to iron deficiency related sub-disorders in 204 countries and territories: an analysis for the Global Burden of Disease study. *Frontiers in Public Health*, 12(September), 1–13. <https://doi.org/10.3389/fpubh.2024.1406549>

\*\*\*\*\*