ORIGINAL ARTICLE

Association of socioeconomic status with adverse birth outcomes at the Women and Newborn Hospital of the University Teaching Hospitals in Lusaka, Zambia

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ABSTRACT

Background: Low socioeconomic status has generally been associated with adverse birth outcomes worldwide. Adverse birth outcomes significantly contribute to perinatal morbidity and mortality worldwide with some literatures showing conflicting results. At Women and New-born Hospital in Zambia, this relationship had remained unclear among women who experienced poor neonatal outcome; hence the study was done to explore this association between socioeconomic status and adverse birth outcomes.

Methods: A retrospective cohort study was conducted. Secondary data from ZAPPS study that had been collected prospectively between August 2015 and September 2017 was retrieved. Altogether, 1,450 participants' information was retrieved, out of which 1,084 data records were set out for analysis after excluding those not meeting eligibility criteria. Socioeconomic status was an explanatory variable which was estimated using the standardized wealth score derived from principal component analysis of 14 variables. The wealth quintiles were further categorised into poor and not poor. Response variables were low birth weight, preterm birth and small for gestation age. SPSS version 21 was used for data analysis and p value < 0.05 was significant

Results: This study found the incidences of SGA, LBW and preterm births to be 164, 124 and 135 per 1000 live births respectively. In survival analysis, the proportion of babies who survived LBW among mothers who were poor was lower (82.9%) compared to babies born to rich mothers (87.5%) (*p*-value = 0.189). Furthermore, the proportion of babies who survived SGA for the poor was lower (79.1%) compared to babies born to none poor mothers (85.8%) (*p*-value = 0.032) and preterm birth for the poor (78.4%) compared to babies born to mothers who were rich (83.6%) (*p*-value = 0.022). In multiple Cox regression analysis socioeconomic status was not a significant risk factor for SGA (aHR = 1.08; 95% CI; p=0.099), LBW and preterm birth (aHR = 1.17; 95% CI; p=1.41). However, male babies (aHR = 1.80; 95% CI; p=0.012), domestic violence or abuse during pregnancy (aHR = 3.48; 95% CI [1.59 – 7.34]; p = 0.002) and maternal anaemia (aHR = 2.1; 95% CI; p = 0.019) were risk

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factors for SGA while prior preterm birth (aHR = 2.02; 95% CI; p = 0.002), HIV infection (aHR = 1.22; 95% CI; p = 0.040) and anaemia (aHR = 1.37; 95% CI; p = 0.009) were predictors of preterm delivery.

Conclusion: There was no statistically significant association between low socioeconomic status and adverse birth outcomes although being pregnant with a male baby, HIV infection, anaemia and prior preterm birth were significantly associated with SGA and preterm.

INTRODUCTION

Socioeconomic status (SES) is a measure of an individual's or family's position in relation to others, within a hierarchical social and economic structure.[1] The common indicators of SES include; education attainment, household income and occupation.[2] Wealth and income provide access to good health services and food while education provides knowledge, skills, and beliefs that determine food choices and good nutrition.[3] Therefore, women with low SES are more likely to have poor living standards, inadequate medical care and subsequently susceptible to infections,[4] ultimately these lead to adverse birth outcomes.[5] Adverse birth outcomes here is defined as occurrence of one or more of the following: low birth weight (LBW), preterm birth (PTB) or small for gestation age (SGA). These significantly contribute to perinatal morbidity and mortality,[6,7] as well as lifelong health morbidities.[8]

Adverse birth outcomes are a serious public health concern and lead to increased health care service costs for families.[9,10] The World Health Organization (WHO) defines LBW as neonatal weight at birth of less than 2500g, preterm birth as birth before 37 weeks but after 28 weeks of pregnancy and SGA as birth weight less than 10th percentile appropriate for gestation age and sex.[11] The rates for Preterm births, Low birth weight, and Small for gestation age are higher in Low Income than in High Income Countries and even in these low-resourced countries; the rates are higher among low socioeconomic groups.[2] It is clearly demonstrated from several studies done in different parts of the world that a strong link exist between adverse birth outcomes and socioeconomic status.[12,13,14] However, some studies have shown no association between SES and adverse birth outcomes.[15]

Zambia is one of the poorest nations in the world with high poverty and unemployment rate, having 60% of the population living below the poverty datum line.[16] Despite the move towards universal health coverage, the rates of adverse birth outcomes have remained stubbornly high in Zambia and Women and Newborn hospital in particular.[17,18] However, the socioeconomic status of mothers giving birth to these babies at Women and Newborn Hospital of the University Teaching Hospitals remains unclear and not documented. It is therefore, important that the socioeconomic status influencing poor birth outcomes in women giving birth at Women and Newborn Hospital (WNH) of the University Teaching Hospitals (UTH) is studied. Kramer et al in 2014 noted that improvement in socioeconomic status results in reduction in adverse birth outcomes.[19] This study sought to determine the relationship between socioeconomic status and adverse birth outcomes at Women and Newborn Hospital of the University Teaching Hospitals which is the largest tertiary referral hospital in Zambia.

METHODS

This was a retrospective cohort study. It was a sub-study, using secondary data from the ZAPPS project conducted between August 2015 and September 2017. The aim of the project was to establish a well-characterized pregnancy cohort in order to understand the risk factors associated with poor pregnancy outcomes in a LMIC setting. The calculated sample size was 1,015, that is, 406 women with low SES (poor) and 609 with no low SES. Socioeconomic status was estimated using the standardized wealth score derived from principal component analysis of 14 variables (Radio, bed, table sofa, refrigerator, watch, television, mobile

phone, water source, type of toilet, cooking fuel, flooring type, livestock, land and bicycle or car). Low SES was defined as being in the wealth quintile categories (poorest and poorer) and (middle, richer and richest) represented not being poor. Complete case analysis was done on 1,084 data records who met the eligibility criteria. Response variables were small for gestation age (SGA), low birth weight (LBW) and preterm birth.

Data analysis was done using Stata version 13 (Stata corp. college. Texas. USA). Descriptive statistics, bivariate and multiple Cox regression analyses were used for determinants of Small for gestation age, Low birth weight, and Preterm birth. A p-value of 0.05 was used to determine the significance of the findings.

RESULTS

A total of 1,084 participants were studied. From table 1, the incidences of LBW, SGA and Preterm birth were 164(16.4%), 124(12.4%) and 135(13.5) per 1000 live births respectively.

Table 1: Description of Adverse birth outcomes in relation to socioeconomic status for women at Women and Newborn Hospital

Variable	Preterm birth N =736 (%)		Low birth Weight N= 716 (%)		Small for Gestational Age N = 703 (%)	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*
Missing data	126		146		159	
Poor						
No	58 (58.6)	387 (60.8)	51 (57.3)	383 (61.1)	63 (54.8)	362 (61.6)
Yes	41 (41.4)	250 (39.3)	38 (42.7)	244 (38.9)	52 (45.2)	226 (38.4)
Total	99 (**13.5**)	637 (86.5)	89 (**12.4**)	627 (87.6)	115 (**16.4**)	588 (3.6)

Fugure 1 shows that women in the poor category were more likely to have babies born small for gestation age compared to women in the rich category (Chi-Square = 4.60, *p*-value = 0.032)

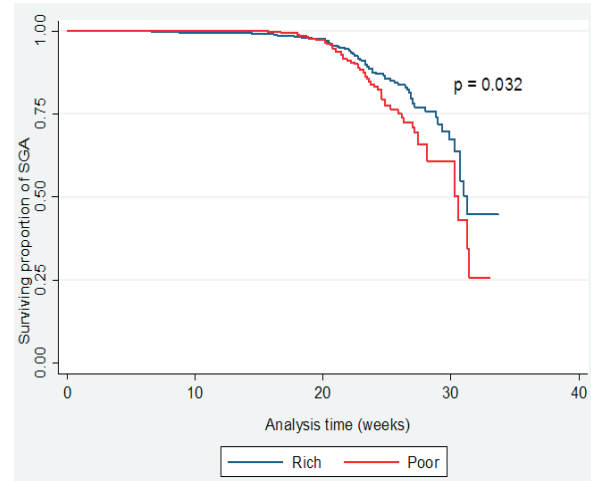

Figure 1: Kaplan – Meier curve of surviving proportion of Small for Gestational Age based on socioeconomic status

Figure 2 shows that poor women were more likely to have preterm deliveries compared to their rich counterpart (Chi-Square = 5.23, *p*-value = 0.022)

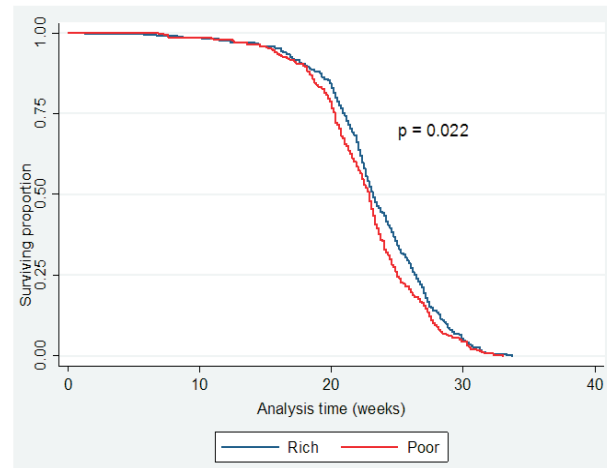

Figure 2: Kaplan – Meier curve of surviving proportion of preterm delivery based on socioeconomic status

Figure 3 shows that there was no significant difference in the poor and rich categories of mothers (Chi-Square = 1.72, *p*-value = 0.189)

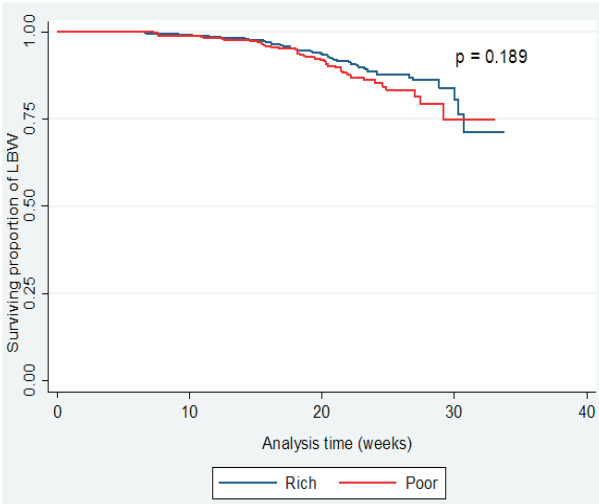

Figure 3: Kaplan – Meier curve of surviving proportion of low birth weight delivery based on socioeconomic status

Table 2 shows that, maternal low socioeconomic status was 1.08 times at higher risk of being born SGA compared to babies born from rich mothers (aHR = 1.08; 95% CI [1.03 – 2.14]; p=0.099). However, male sex was 1.80 times at higher risk of being born as SGA baby than female (aHR = 1.80; 95% CI [1.14 – 2.84]; p=0.012). Maternal anemia during pregnancy were more than twice at risk of giving birth to SGA babies compared to their counterparts with no anaemia (aHR = 2.1; 95% CI [1.13 – 3.92]; p = 0.019). Similarly, women who had a history of domestic violence or abuse during pregnancy were almost three and half times at higher risk of having SGA babies than those without history of abuse (aHR = 3.48; 95% CI [1.59 – 7.34]; p = 0.002). Furthermore, employed women were 42% less likely to deliver SGA babies compared to their counterparts who were not employed (aHR = 0.58, 95% CI [0.36 – 0.92]; p = 0.023).

Table 2: Cox regression analysis of the determinants of the incidence of Small for Gestational Age for women at Women and Newborn Hospital

Variable	cHR	95% CI	P-Value	aHR	95% CI	P-value
Maternal age (years)	0.96	. . .	0.323			
Sex of the baby						
Female	Ref					
Male	1.42	1.02 – 2.01	0.040	**1.80**	. . .	**0.012**
Education level						
Primary	Ref					
Secondary	0.83	0.54 – 1.26	0.399	1.00	0.56 – 1.77	0.981
Tertiary	0.35	0.17 – 0.67	0.002	0.57	0.25 – 1.31	0.191
Employment status						
Not employed	Ref					
Employed	0.64	0.45 – 0.89	0.010	0.58	0.36 – 0.36	0.023
Domestic violence						
No	Ref					
Yes	2.22	1.19 – 4.11	0.011	**3.48**	**1.59 – 7.34**	**0.002**
BMI category						
Normal	Ref					
<18.5	0.83	0.41 – 1.71	0.632			
≥31	0.43	0.22 – 0.82	0.011			
Anaemia						
No	Ref					
Yes	1.68	1.07 – 2.93	0.033	**2.10**	**1.13 – 3.93**	**0.019**
HIV status						
Negative	Ref					
Positive	1.36	0.93 – 1.99	0.112	1.33	0.81 – 2.22	0.267
Economic status						
not poor	Ref					
Poor	1.48	1.03 – 2.14	0.033	1.08	0.95 – 2.57	0.099

cHR= Crude hazard ratio; aHR = adjusted hazard ratio; CI = confidence interval; Ref= reference category; HIV = Human Immunodeficiency virus; BMI = Body mass index; MUAC = mid-upper arm circumference

Table 3 shows that, maternal low socioeconomic status was 1.97 times at higher risk of being born LBW compared to babies born from rich mothers (cHR = 1.97; 95% CI [0.73 – 2.25]; p=0.375). Maternal anemia during pregnancy (cHR = 1.52; 95% CI [0.77 – 1.84]; p=0.421), history of domestic violence or abuse during pregnancy(aHR = 1.83; 95% CI [0.72 – 4.62]; p=0.199)and employment (aHR = 0.66; 95% CI [0.41 – 1.08]; p=0.106)were not predictors for LBW

Table 3: Cox regression analysis of the determinants of the incidence of Low Birth Weight for women at Women and Newborn Hospital

Variable	cHR	95% CI	P-Value	aHR	95% CI	P-value
Maternal age (years)	0.98		0.474			
Sex of the baby						
Female	Ref					
Male	0.73	0.51 – 1.07	0.116	0.68	0.42 – 1.11	0.130
Education level						
Primary	Ref					
Secondary	0.85	0.52 – 1.39	0.531			
Tertiary	0.66	0.33 – 1.34	0.237			
Employment status						
Not employed	Ref					
Employed	0.69	0.47 – 1.02	0.064	0.66	0.41 – 1.08	0.106
Domestic violence						
No	Ref					
Yes	2.12	1.06 – 4.2	0.032	1.83	0.72 – 4.62	0.199
BMI category						
Normal	Ref					
<18.5	1.39	0.67 – 2.89	0.367			
≥30	0.61	0.30 – 1.19	0.147			
Anaemia						
No	Ref					
Yes	1.52	0.83 – 2.70	0.169			
HIV status						
Negative	Ref					
Positive	1.19	0.77 – 1.84	0.421			
Economic status						
Not poor	Ref					
Poor	1.97	0.73 – 2.25	0.375			

cHR= Crude hazard ratio; aHR = adjusted hazard ratio; CI = confidence interval; Ref= reference category; HIV = Human Immunodeficiency virus; BMI = Body mass index; MUAC = mid-upper arm circumference

Table 4 shows that babies born from mothers in the poor category were1.17 times more likely to be born preterm compared to those born from their rich counterparts (aHR = 0.108; CI [0.87 – 1.98]; p =1.41). Women with anaemia had almost one and half times higher risk of delivering preterm birth compared to their counterparts (aHR = 1.37; 95% CI [1.08 – 1.73]; p = 0.009). Likewise, women who were HIV positive had a higher risk of having preterm babies than those women who were HIV negative (aHR = 1.22; 95% CI [1.01 – 1.48]; p = 0.040). But women who were employed had 18% reduced risk of delivering preterm babies compared to those who were not employed (aHR = 0.82; CI [0.69 – 0.97]; p =0.021)

Table 4: Cox regression analysis of the determinants of the incidence of Preterm birth for women at Women and Newborn Hospital

Variable	cHR	95% CI	P-Value	aHR	95% CI	P-value
Maternal age (years)	0.99	0.97 – 1.01	0.331			
Sex of the baby						
Female	Ref					
Male	1.01	0.89 – 1.16	0.776			
Education level						
Primary	Ref					
Secondary	0.90	0.75 – 1.07	0.192	0.99	0.78 – 1.28	0.949
Tertiary	0.68	0.52 - 0.84	0.001	0.77	0.56 – 1.05	0.107
Employment status						
Not employed	Ref					
Employed	0.81	0.71 – 0.92	0.002	**0.82**		**0.021**
Abused in Pregnancy						
No	Ref					
Yes	1.26	0.93 – 1.71	0.134			
Prior preterm						
No	Ref					
Yes	2.23	1.67 – 4.15	<0.0001	**2.02**	**1.51 – 4.32**	**0.002**
Parity	1.07	1.02 – 1.12	0.007	1.05	0.97 – 1.12	0.168
Anaemia						
No	Ref					
Yes	1.47	1.18 – 1.85	0.001	**1.37**	**1.08 – 1.73**	**0.009**
HIV status						
Negative	Ref					
Positive	1.32	1.14 – 1.54	<0.001	**1.22**	**1.01 – 1.48**	**0.040**
Pregnancy interval (months)						
≥24	3.35	2.01 – 5.63	<0.0001	1.54	0.98 – 4.81	0.065
<24						
Economic status						
Not poor	Ref					
Poor	1.32	0.87 – 1.98	0.108	1.17	0.96 – 1.41	1.41

cHR= Crude hazard ratio; aHR = adjusted hazard ratio; CI = confidence interval; Ref= reference category; HIV = Human Immunodeficiency virus; BMI = Body mass index; MUAC = mid-upper arm circumference

DISCUSSION

This study found that the incidence of SGA was 16.4% during the study period. This sets the baseline as no study had reported the incidence of SGA in Zambia at the time the study was being conducted. Other studies have found lower incidences such as 5.1% in Brazil, 10.5 % in Nepal and 2.8% in China.[20,21,22] The difference between this study and others could be the influence of the study site. Our study site is a referral Hospital receiving pregnant women with complications like hypertensive diseases in pregnancy, Sickle cell disease, cardiac disease and Diabetes to mention a few. These can on their own lead to adverse pregnancy outcomes. In addition, this could also be due to the difference in the methods used to classify SGA.[23] For instance; other countries use -2 standard deviation as cut-off for SGA while others including this study use the 10th percentile. Multiple studies demonstrate the use of 10th percentile to be more accurate.[24]

In this study the association between SGA and socioeconomic status was not statistically significant. This is in keeping with a study done by Muhihi in Tanzania[25] and a similar observation was made in Japan.[26] This observation could be due to early detection and management of pregnancy related health complications as well as improved pregnancy interventions during antenatal care like iron and folic acid supplementation, routine deworming and malaria intermittent presumptive treatment.[27] The measure for socioeconomic status used in this study was the wealth score. This could have influenced the results seen as other studies have used: Education, employment, residence or a combination of 2 or more of these measures.[15] Contrary to the results in this study, in Brazil, lower socioeconomic status or disadvantaged economic groups were significant predictors of SGA.[28] Similarly, another study from Australia also showed a strong link between low socioeconomic status and SGA.[24] According to these studies women in the low socioeconomic bracket are less likely to access proper health care and full antenatal care services compared to women in higher category of economic status. Moreover, pregnancy requires good and adequate nutrition for the optimal growth of the unborn baby which may be challenging for the women in the low socioeconomic strata.[20] However; male sex was 1.80 times at higher risk of being born as SGA baby at any time than female baby. This is in line with a study conducted by Muhihi in 2016.[25] Women who reported to have anemia (defined according to WHO as haemoglobin level of less than 11.0g/dL) during pregnancy were more than twice at risk of giving birth to SGA babies compared to their counterparts with no anemia. This was similar to a study by Badfar.[29] Women who had a history of domestic violence or abuse during pregnancy were almost three and half times at higher risk of having SGA babies than those without history of abuse and this was comparable to a study by Ahusen.[30]

In this study the incidence of LBW was 12.4% during the study period which was higher than 9% reported in the Zambia Demographic Health Survey2018.[31] This could be due to complicated cases seen at Women and Newborn hospital being a referral hospital. Similar to this study, studies in Ethiopia have reported prevalence of 14.6% and 15.8% both in Southern part of the country[32,33] and 12.5% in the Butajira.[34] Equally Dilie and Chanie reported the incidence of 11.9% and alluded this high rate to poor antenatal care attendance with the majority only having one or two visits during pregnancy[35] which is against the WHO recommendations of at least eight antenatal visits.[36]

In this study, there was no statistically significant association between low socioeconomic status and LBW. This was consistent with other studies conducted in Ghana[12] and Iran.[37] This could be due to the fact that at the study site, being a tertiary institution, all antenatal women receives basic micronutrient pregnancy supplements such as folic acid and ferrous sulphate and prevention and treatment for conditions such as malaria and worm infestations. To the contrary, other studies have reported association between low socioeconomic status and LBW as observed in Tanzania[38]. Similar findings were also observed in other studies.[39,40]

In this study the incidence of preterm birth was 13.5% during the study period which is higher than 9.9% found by Blencowe.[18] The finding of this study is in keeping with other studies from Ethiopia, Kenya and India, which reported 13.3%, 16.6% and 15% respectively.[41,42,43] The similarities could be explained by comparable health care systems provided to women during antenatal care since these countries are low and middle income countries. To the contrary, other studies have reported much low prevalence such as 8.5% according to Abdelhady&Abdelwahid in Egypt, 4.5% from Ethiopia and 8.2% from Iran.[44,45,46] The discrepancy between this and others could be due to different definition of preterm births and inclusion and exclusion criteria of the participants.

This study also found no statistically significant association between low socioeconomic status and preterm birth similar to study findings by Chen and Basso in the USA.[47] This could be explained by improvement in the provision of antenatal care and routine administration of supplements such as iron and folic acid as well as the measure of socioeconomic status used for this study. Contrary to this study, a number of studies have reported that low socioeconomic status is linked to preterm birth.[48,49] The plausible explanation could be due to nutritional deficiency and insufficient health care compounded by stressful lifestyles which are mostly observed in women with socioeconomic deprivation.[50] The present study has shown that women who had anemia at first antenatal visit were 22% more likely at risk of giving birth to preterm babies relative to their counterparts without anemia. Similar to this study, some studies have assessed anemia at first antenatal visit and reported that it was a risk factor for preterm birth.[51,7] In this study prior preterm birth was a significant predictor of preterm births. Women who had prior history of preterm were twice more likely to experience preterm birth. This finding was in agreement with several other studies from Malawi, Ethiopia and Kenya.[52,40,41] Also, in this study maternal HIV-positive status was a risk factor for preterm birth. This is in agreement with a number of studies.[53,54,55] HIV infection compromises the immunity of the pregnant woman resulting in increased susceptibility to infection by other organisms thereby affecting fetal nutrition and growth.

CONCLUSION

There was no statistically significant association between socioeconomic status and adverse neonatal outcomes. The incidence of SGA, low birth weight and preterm were 164, 124 and 135 per 1000 live births during the study period. The risk factors for Small for Gestational Age were male baby and anemia. None of the studied variables significantly predicted low birth weight. In terms of preterm birth, the risk factors were prior preterm, HIV infection and anemia.

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