THE IMPACT OF MATERNAL NUTRITIONAL STATUS ON THE INCIDENCE OF LOW BIRTH WEIGHT AND PREMATURITY IN BOTSWANA

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Abstract

Low birth weight (LBW) and prematurity are significant public health problems facing Botswana and other developing countries. The prevalence of LBW is estimated to be at 15% worldwide, and 33-38% in developing countries. Prematurity and LBW are the primary risk factors and cause of under-five mortality which is a significant issue in Botswana. Evidence suggests that pre and during pregnancy, nutrition is a vital factor in the outcome of the pregnancy and the newborn's health. While this evidence exists, organizations such as UNICEF advocate for better maternal nutrition pre and during pregnancy, there is minimal efforts to address these in Botswana due to lack of data and awareness of the problem.

The goal of this paper is to describe and compare the relationship between maternal nutritional status using national statistics on poverty as a proxy for nutritional status with the incidence of LBW and prematurity in the two most impoverished districts in Botswana compared to the national averages and the two well off districts. Data on LBW from the Ministry of Health and poverty incidence from the Botswana Multi-Topic Household Survey. The results show that the incidence of LBW at the national level is 12.5% and the odds ratios between national rate and each district range from 0.57 to 1.39 while between the most impoverished districts and well off districts range from 0.82 to 2.4. Children born in poor districts are at higher risk of LBW than in well off districts.

Background

More than 20 million of world neonates are born with Low birth weight (LBW) and prematurity and the majority of these infants are born in developing countries where the prevalence of LBW and prematurity is estimated to be between 33-38% (Manson et al., 2015; Tallapragada et al, 2016). The prevalence of LBW weight and prematurity in Botswana constitutes 25% of all the births in the country (Majelantle, 2016). By districts it ranges from 5% in Tlokweng to 15% in Gantsi (Majelantle, 2016). The percentage increases as we move from the urban to the more rural districts of the country.

LBW and prematurity are one of the significant public health problems associated with both short term and long terms consequences such as financial burden, child morbidity and mortality and morbidity later in life (Tallapragada et al, 2016; Lopes et al, 2017).

Billions of *pulas* are spent annually on the specialized health care for this high-risk population and equally is lost in the economic and social productivity of the families of these infants. Apart from requiring intensive care immediately after birth, LBW and premature infants have a higher mortality rate. LBW and prematurity are the primary cause of death among children under the age of 1 year and immensely contribute to the mortality rate of children under the age of five (Tallapragadat et al, 2016; Botswana Ministry of health, 2016). Ministry of Health Botswana Statistics (2010) show that preterm and low birth weight in Botswana accounts for 27% of all neonatal mortality. Infants with LBW and prematurity also have higher readmission rate to the hospital after discharge from the neonatal intensive care unit hence utilizing the scarce health resources in developing countries and risking further injury and hospital-acquired infections (Tallapragada et al, 2016; Lopes et al, 2017). Lopes et al (2017) state that LBW and premature babies have an increased risk of non-communicable diseases in adult life, which consequently add to the global burden of disease. Many survivors of LBW and prematurity face a lifetime of disability, including learning disabilities and visual and hearing problems (WHO, 2018). Therefore, prevention of LBW and prematurity should be at the forefront of discussions in child health outcomes.

The World Health Organisation (WHO), defines LBW as weight at birth less than 2500g, irrespective of the gestational age of the infant. LBW includes very low birth weight (VLBW) less than 1500g, and extremely low birth weight (ELBW) less than 1000g (Lopes et al., 2017). Prematurity is defined as babies born alive before 37 weeks of gestation (WHO, 2018). Sub categories of preterm birth are: extremely preterm (less than 28 weeks), very preterm (28 to 32 weeks) and moderate to late preterm (32 to 37 weeks). By virtue, all premature babies are born LBW but not all LBW are premature babies. Several risk factors are attributable to LBW and prematurity such as maternal age, race/ethnicity, cigarette smoking, intra-uterine infections, maternal infections and chronic illness, previous pre-term birth and low pre-pregnancy weight and inadequate nutritional intake during pregnancy (Tallapragada et al, 2016; Han et al, 2011; Zerfu, Umeta & Baye, 2016). Majority of these risk factors are modifiable which means LBW and prematurity can be prevented most of the times. In Botswana, about 98% of women attend antenatal care and are often screened, treated and monitored for pregnancy-related problems

early in the pregnancy. While other risk factors and disease related to pregnancy are often treated in Botswana, pre-pregnancy nutritional status and adequacy of nutritional intake are often not addressed except with supplemental multivitamins and ferrous sulfate to prevent Anemia leaving a gap in the prevention of prematurity and LBW.

Evidence suggests that pre-pregnancy and during pregnancy nutrition is a vital factor in the outcome of pregnancy and the newborns' health (Potdar et al.,2014). Lopes et al (2017); Han et al (2011); Zerfu, Umeta & Baye (2016) and Muthayya (2009) reported that maternal nutritional deficiencies result in nutrient deprivation to the fetus, causing restricted growth which leads to LBW and prematurity. Early nutritional interventions starting before or early in pregnancy have the potential to prevent LBW and decrease the risks of adverse health outcomes related to LBW in infants (Lopes et al., 2017; WHO, 2014). However, such is not the practice in Botswana, apart from folate and iron supplementation despite Botswana being a member of WHO which endorsed a comprehensive implementation plan on maternal, infant and young child nutrition. The WHO comprehensive implementation plan on maternal, infant and young children nutrition specify six global targets for year 2025, which include; 40% reduction in the number of children under 5 who are stunted, 50% reduction of anaemia in women of reproductive age, 30% reduction in LBW, no increase in childhood overweight, increase the rate of exclusive breastfeeding in the first six months up to at least 50% and reduce and maintain childhood wasting to less than 5%. (WHO, 2014). Currently, no evidence in Botswana speaks towards addressing any of the years 2025 goals in maternal nutrition to improve outcomes of pregnancy, therefore this paper aims to raise awareness about how inadequate maternal nutrition in some districts impact the LBW and prematurity rates in those districts.

Poverty or low socioeconomic status is the major underlying cause of nutritional inadequacies in most of the African states and other developing countries (Kader et al, 2014). Evidence from Kader and colleagues (2014) study in India suggests that socio-economic status is directly associated with maternal nutritional status. Poverty or low socioeconomic status is associated with low BMI, short stature, Anemia and lack of other micronutrients which is risk factors for LBW and prematurity (Kader et al, 2014; Han et al (2011); Zerfu, Umeta & Baye (2016). Women at low socioeconomic status are at higher risk of LBW and prematurity due to nutritional inadequacies. Given the link between poverty or low socioeconomic status and nutritional status, poverty rates will be used as a proxy for nutritional status in this paper.

Given the magnitude of LBW and prematurity in Botswana and its significance in the health outcomes of children and meeting the Sustainable Development Goals (SDGs), Vision 2036 and the WHO 2025 targets, it is imperative that prevention of LBW and prematurity be looked at with broader perspective rather than at individual level. Therefore, the purpose of this article is to describe and compare the relationship between maternal nutrition using national statistics on poverty as a proxy for adequate nutrition with the incidence of LBW and prematurity in the two most impoverished districts in Botswana compared to the national data.

Methods

Study design

A cross-sectional descriptive case-control study using secondary data reported by the Ministry of Health (Ministry of Health, 2010) on LBW and prematurity and Botswana Statistics information on poverty levels as reported in the Botswana Multi-Topic Household Survey (BMTHS) 2015/2016 (Statistics Botswana, 2018).

Data sources

The Ministry of Health data of births is national data available on request from the Ministry of Health. It is comprised of data of all cases of live births per district and health facility for the year 2010. The data was collected via national reporting of births which occur in the health settings. Data from the births is usually accurate and often classify the birth weights of the babies and has fewer chances of duplication of entries as the only facility where the baby is born complete the registry even when the baby is transferred to other higher care facilities does not get re-registered.

The BMTHS data on poverty is publicly available through a report from Central Statistics Botswana. The BMTHS present poverty indicators as reported in the Botswana Multi-topic Household Survey of 2015/2016. Data for BMTHS was collected over a year with a total of 24,720 persons and 7,060 household participating in the survey (Statistics Botswana, 2018). The BMTHS ensured the heterogeneity of the sample in terms of geographic locations and demographic characteristics of participants (Statistics Botswana, 2018). Therefore the BMTHS data was found to be the best proxy for maternal nutritional status by districts. BMTHS data is used to classify districts as either high or low poverty districts.

Sample and Population

Both the BMTHS and Ministry of health data distinguish districts at village levels and care was taken to ensure that the districts included in the study represents the same villages in both data sets. Some of the districts are classified differently between BMTHS and the Ministry of Health birth data hence the only district that matches the descriptions were chosen for this study being Kweneng West, Ghazni, North East and South East to avoid discrepancy in the population under study. Cities and towns were not included to ensure homogeneity of the samples included in this study by ensuring that each district is composed of both rural areas including villages and settlements and semi-urban areas. Even though such is the case, it should be noted that both districts with low poverty levels are near cities while the poorer districts are a bit far from the cities.

Statistically analysis

First the counts of total live births and births under 2.5 kg at National level and districts are presented by gender and live births under 2.5 kg are presented as a percentage of live birth at both national and districts level. Odds ratios are used to compare the attributable risk of maternal nutritional status on LBW and prematurity. Chi-square and p-value 0.05 are used to test the significance of the odds ratio of LBW between the national and districts and between the districts.

Results

The total national live births for the year 2010 was 48,531 of which 51% were males and the population from the four districts in this study is 8.41% of the total live births for the year 2010. The less improvised districts have more birth rate compared to the poor districts. A further breakdown of the number of birth by districts and gender is presented in figure 1 below.

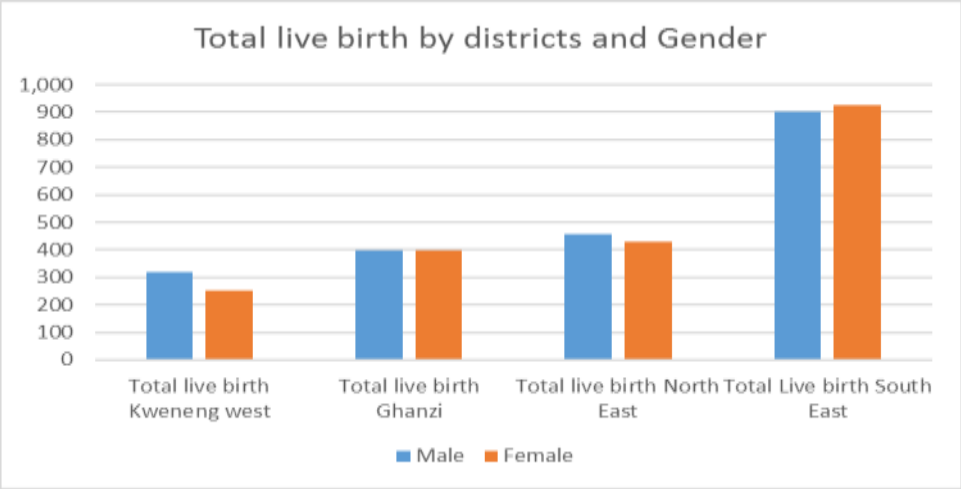

Figure 1: Total Live Birth in Kweneng West, Ghanzi, North East and South East by gender in 2010 in Botswana.

The national total live births weighing under 2.5kg (LBW) in 2010 was 6,060 (12.5% of total live births) and the four districts accounted for a total of 433 LBW births (7.14 % of the total LBW in 2010). A further breakdown of the LBW by the districts under study and gender as well as percentage poverty incidence of each district is presented in figure 2 below. In total, the number of LBW mirrors the birth rates in these districts with South East districts having the most number of LBW while Ghanzi and North East trade places with the populace of LBW compared to total live births.

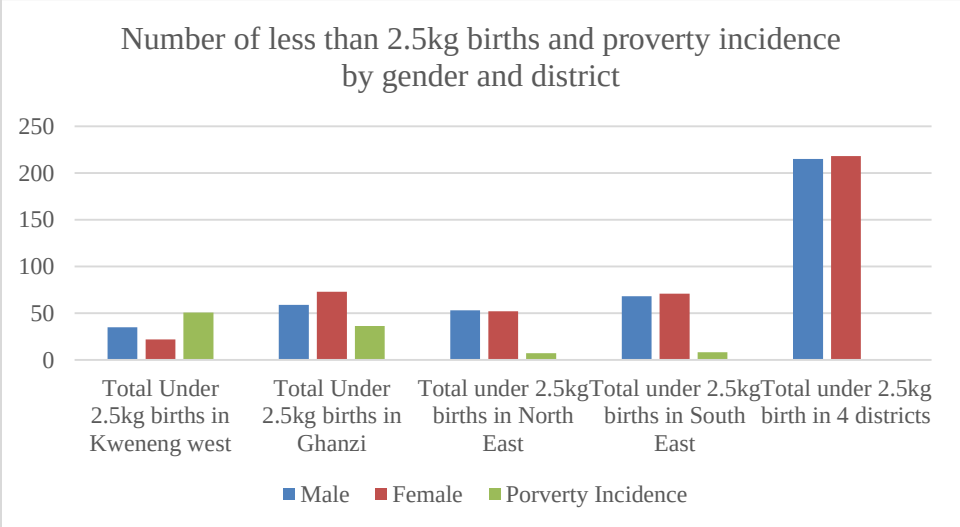

Figure 2: LBW (<2.5kg) in Kweneng West, Ghanzi, North East and South East by gender. Percentage poverty incidence in each district as reported by the BMTHS 2018.

Table 1 below shows the odds ratio of children likely born with LBW in each district when compared to the national rate. Children born in Kweneng West are 77.2% (.0644) less likely to be born with LBW when compared to the national rate but this is not statistically significant at p = 0.05, therefore the odds of children in Kweneng west to be born with LBW is not different from the national rate. Similar assumptions can be drawn for North East where children are only 6 % (.555) likely to be born with LBW when compared to the national rate. Children born in Ghanzi on the other hand are 39.6% (.0005) more likely to be born with LWB while those born in South East district are 57% (.0000) less likely to be born with LBW.

Table 1Odds Ratios of LBW in the Districts compared to the national LBW

District	**National**	**Chi-Square**	**P-value (Pr>chi) = 0.05**
Kweneng West	0.772	3.42	0.0644
Ghanzi	1.396	12.11	0.0005***
North-East	0.94	0.35	0.555
South-East	0.5696	40.69	0.0000***

Overall, compared to the national risks, the risk of LBW and prematurity is greater in Ghanzi an impoverished district and less likely in South East a well off district with the highest live births among the districts under study.

The between districts comparison also show similar results as the comparison of districts and national levels. Table 2 below shows that there is not statistically differences between Kweneng West and both North East and South East while Ghanzi is at more risk than both Districts. The results show that children in Kweneng West are 82% (.2615) less like to be born with LBW when compared to those from North East but this is not statistically different therefore we can deduce that there is no difference between this two districts. Similarly, Children in Kweneng West are 34% more likely to be born with LBW compared to those born in South East but this is not statistically significant hence rendering that the districts are not different.

On the other hand when comparing Ghanzi and the two districts shows a somewhat different picture with children born in Ghazhi 1.5 and 2.4 increased risk of being born with LBW compared to those in North East and South East respectively. Notably here is that the risk is increased against both districts.

Table 2: Odds Ratios between high and low poverty districts

Districts	North East	South East
Ghanzi	1.48 (7.75, 0.0054)	2.4 (47.97, 0.0000)
**(1.26, 02615) = (chi-square, P-value)*		
Kweneng West	0.82 (1.26, 0.2615)	1.34 (3.13, 0.0750)

Discussion

To our knowledge, this is the first study to look at the impact of maternal nutritional status as measured by the poverty level on the outcome of pregnancy in Botswana at the population level. The results of this study show that, maternal nutritional status as measured by poverty levels plays a significant role in population pregnancy outcomes such as LBW and prematurity.
The results show that poor districts have less total birth count compared to the national rate which may be due to the population being low in those areas compared to the well off districts. Less population is expected in the impoverished regions due to migration to urban settings in search of economic opportunities. Despite low population in poor districts, the incidence for LBW is almost the same as that of well off districts which shows that the risk of having a child with LBW in impoverished regions is higher than in the well of districts.

The odds of children being born with LBW between the selected districts and national level shows an interesting picture, with mixed results between national and between districts risks. Overall, the poor districts have higher risks of LBW compared to well off districts despite having fewer birth counts than the well off districts. Similar results were reported by Misra, Ray and Patrikar (2015) in their longitudinal study where they found that mothers with low pre-pregnancy weight and those that gain less weight during pregnancy or have Anemia are more likely to have children with LBW higher than the national rates. Mitao and colleagues (2015) and Amosu and Degan (2014) also reached the same conclusion that maternal nutritional status plays a vital role in infants LBW with mothers with poor nutritional status have more children with LBW in Tanzania and Nigeria respectfully. The higher than national rates risks indicate that poor districts are more vulnerable than other districts and require interventional approaches targeting such districts to ensure equity and reduction in LBW births.
Furthermore, the between districts differences indicate a severe gap in the current system in addressing the LBW risk in all districts, because studies have shown that groups with low socioeconomic status such as those in impoverished districts in Botswana require a different approach than those with better socioeconomic status (Parandare, 2012). Parandare (2012) suggests that some interventions proved to be beneficial in reducing LBW. Among the emphasized interventions include micro-nutrient supplementation beyond iron and folate supplementation as well as increasing the energy sources that are increasing the servings per day in low socioeconomic areas (Parandare, 2012). The differences in the risk between the districts further call for a district approach rather than a national level approach to reduce the costs. Also, addressing the problem of poor nutritional status should be at the population level rather than an individual to reduce stigma and discrimination usually associated with handouts or food baskets which often result in low uptake of the programmes in some areas. These interventions have also

been shown to improve other pregnancy-related problems such as maternal mortality and infant mortality which is a significant issue in Botswana (Parandare, 2012). Addressing the LBW from a pragmatic standpoint is vital since evidence suggests that several factors in addition to nutritional status play a significant role in LBW outcomes (Misra, Ray, Patrikar, 2015, Amuso & Degan, 2014, Mitao et al, 2015).

There are limitations to our study being that latest data was not available from the Ministry of Health of LBW. We also used national poverty levels as a proxy for nutritional status which may not be an accurate reflection of nutritional status as the majority of families in poor districts are on national safety nets such as food baskets. We limited our study to four districts only, if more districts were included more conclusive results could be drawn from the patterns observed between districts.

Conclusion

Children born in poor districts are at higher risk than children at national level and children born in good districts. In order to reach the WHO's goal of a 30% reduction in the global rate of LBW by 2025, there is need to introduce practical steps to improve maternal nutritional status in poor districts and villages across Botswana. We recommend that the government introduce pregnancy micronutrients supplements in addition to iron and folate supplements and nutritional food baskets in the impoverished villages.

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