

Study of Incidence and Socio-Biological Factors Associated with Low Birth Weight Infants Born at Pravara Rural Hospital, Ahmednagar District of Maharashtra, India

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Abstract:

Infants born with a low birth weight (LBW) are significantly challenged in terms of short-term and long-term health outcomes. LBW is a major problem worldwide, but especially for the developing world; India in particular is the largest contributor to the global burden of LBW infants. Pravara Rural Hospital, in Maharashtra state, India, has been partnered with the Swedish Development Cooperation Agency since 2006 to implement initiatives aimed at improving maternal and neonatal health, and they have made considerable progress in achieving these goals. An analytical cross-sectional study was performed at Pravara to determine socio-biological risk factors for LBW. Two risk factors for LBW were found to achieve significance: preterm birth and nulliparity. Pravara can specifically target these two risk factors to achieve a further decrease in the incidence of LBW. Pravara's impressive progress can serve as a model for other organizations to combat global health problems locally.

Introduction:

Babies born with a low birth weight, defined by the World Health Organization as babies born with a weight of less than 2500 grams, are significantly disadvantaged in terms of short-term and long-term outcomes. Low birth weight is associated with a multitude of adverse health consequences, including perinatal and neonatal mortality and morbidity, impaired cognitive development, and chronic disease.³ Specifically, low birth weight (LBW) infants are 11 to 13 times more likely to die than normal birth weight (NBW) infants. LBW infants are also more likely to suffer from asphyxia, sepsis, hypothermia, and problems related to feeding. In addition, LBW increases the chances of stunting and wasting within the first five years of life. The average IQ of LBW infants at six years of age is statistically lower than those who had NBW, although within normal limits. In the long-term, LBW infants are predisposed to a variety of adult onset diseases, including diabetes and heart disease.^{7,9}

While LBW is a serious health challenge in both developing and developed countries, it is more prevalent in the developing world.³ Globally, approximately 20 million (16%) infants are born with a LBW, and an estimated 7.5 million of these births occur in India. Therefore, India accounts for more than one-third of LBW births worldwide, with around 30% of newborns in India having LBW. This makes India the largest contributor to the global burden of LBW infants.^{3,7,9}

An infant's LBW is either the result of preterm birth or of restricted intrauterine growth. For the same gestational age, females weigh less than males, and firstborn infants are lighter than subsequent infants (i.e. a nulliparous mother is more likely to give birth to a LBW infant). Birth weight is affected to a significant extent by the mother's

own growth and diet from conception to birth⁸; anemia and calcium and folic acid deficiencies have all been noted as risk factors for LBW.^{1,3} Mothers in deprived socio-economic conditions frequently have LBW infants, primarily due to poor nutrition or complications underpinned by poverty or physically demanding work throughout pregnancy. Women of short stature and young women are more likely to have LBW infants.⁸

The current study is to take place at Pravara Rural Hospital, which is a tertiary care hospital in Maharashtra, India. According to an oral interview with the director of Pravara's Centre for Social Medicine (K.V. Somasundaram, January 2017), there is an ongoing partnership between Pravara Medical Trust (PMT) and the Swedish Development Cooperation Agency (SIDA). The partnership put in place a variety of initiatives in 2006 to promote maternal and neonatal health. Three of these initiatives apply to reducing the incidence of LBW. The first was to create a task force of 300 trained community health workers to provide health education and diet consultation. The next was to create a mobile clinic to work in collaboration with health workers to provide regular pre-natal check-ups. This helped prevent malnutrition and anemia by providing supplements. Lastly, there was a supplementary diet scheme. This scheme provided meals to mothers who were anemic or low weight.

Statistics were obtained in 2006 and then again in 2009 so that the progress and success of the initiatives could be measured. The table below shows some of these statistics:

	2005	2009
Abnormal Deliveries	21%	40%
Full ANC Coverage	51%	78%
Early Age of Marriage	51%	21%

Table 1 Statistics related to maternal health before implementation of SIDA (2006) project and after its implementation (2009).⁶

The initiatives undertaken by SIDA and PMT seem to have significantly improved the health situations of mothers giving birth at Pravara. In regards to LBW, in 2006 42% of infants born at Pravara Rural Hospital (PRH) were LBW.⁶ Ten years later (in 2016), the incidence of LBW was only 35% according to the head of PRH's Department of Obstetrics and Gynaecology (V.B. Bangal, email communication, February 2017). However, this is still a large proportion of infants being born with LBW, which means that continuing and further efforts are still needed. In order to further the understanding of birth weight and maternal health of those served by PRH, this study aims to study the current socioeconomic and health related risk factors for LBW at Pravara Rural Hospital.

Materials and Methods:

Study Design:

The study was an analytical cross-sectional study. It took place at the Department of Obstetrics and Gynecology of Pravara Rural Hospital, Loni, Maharashtra, India. The duration of the study was five days. The period of the study was January ninth through January thirteenth and January sixteenth in the year 2017. The study shall be a hospital-based study of patients who delivered at PRH during the period of study.

Sampling:

Included in the study were all women who, during the study period, delivered vaginally or by caesarean, irrespective of age, parity, gravidity, sociodemographic information, prior health care received, and health conditions present. The only exclusion criteria were those who delivered twins. 102 women gave birth during the study. Four patients gave birth to twins and an additional patient refused the interview.

Data Collection and Analysis:

Data was collected by looking through medical records of study participants and by interviewing them with a PRH intern for translation purposes while recording information with a predesigned questionnaire. Case records of the patients were obtained from the register in the delivery room of PRH and patients were interviewed before they left the hospital. All charts and tables were created on Microsoft Excel; all statistical tests were performed on Microsoft Excel. Independent two samples t-tests were performed for intergroup comparison of quantitative data (e.g. gestational age, BMI, maternal hemoglobin, etc.). Chi-square tests for independence were used for intergroup comparisons of categorical variables (e.g. sex of infant, supplementation taken by mother, caloric intake of mother, etc.). A significance level of $\alpha = 0.10$ was used to determine significance. The significance level was chosen due to the relatively small sample size and small effect size predicted of each explanatory variable. Power analysis of the statistical tests was performed using G*Power.

Results:

In the sample, 65 infants were NBW and 41 were LBW. This is an incidence of 38.7%. Not including the 4 pairs of twins, all of which were LBW, the incidence of LBW was 33.7%.

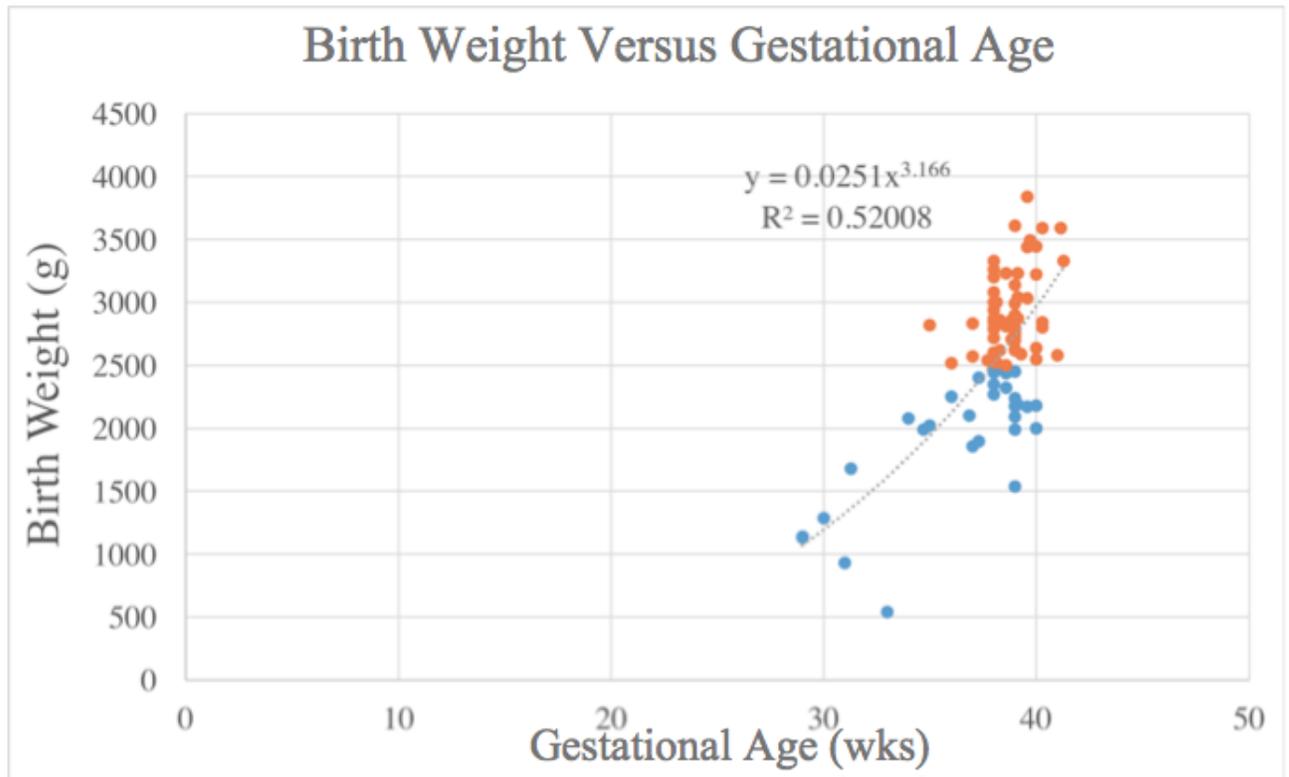


Figure 1 A scatter plot of birth weight and gestational age. A power regression was utilized as the curve of best fit. It yielded an R^2 of 0.52 indicating a moderately-strong relationship. Blue data points represent LBW infants and orange data points represent NBW infants.

The mean gestational age of LBW infants was 36.65 weeks with a standard deviation of 3.31 weeks. The mean gestational age of NBW infants was 38.70 weeks with a standard deviation of 1.10 weeks. A two-sample t-test run on the data returned a P-value that was less than 0.10.

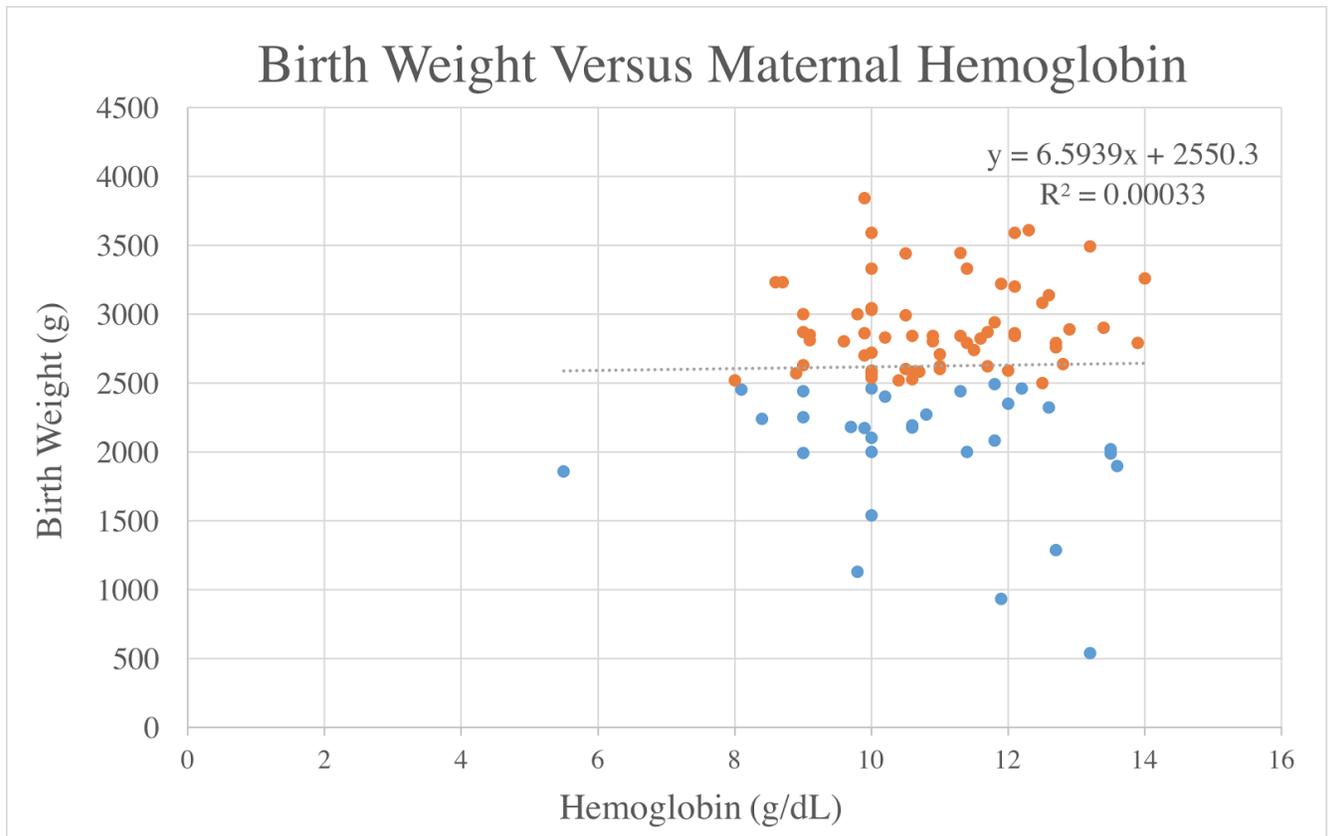


Figure 2 A scatter plot of birth weight and maternal hemoglobin levels. A linear regression was utilized as the curve of best fit. It yielded an R^2 of 0.00033 indicating no relationship between the two variables. Blue data points represent LBW infants and orange data points represent NBW infants.

The mean maternal hemoglobin of mothers who gave birth to LBW infants was 10.74g/dL with a standard deviation of 1.85g/dL. The mean maternal hemoglobin of mothers who gave birth to NBW infants was 10.91g/dL. A two sample t-test run on the data returned a P-value greater than 0.10.

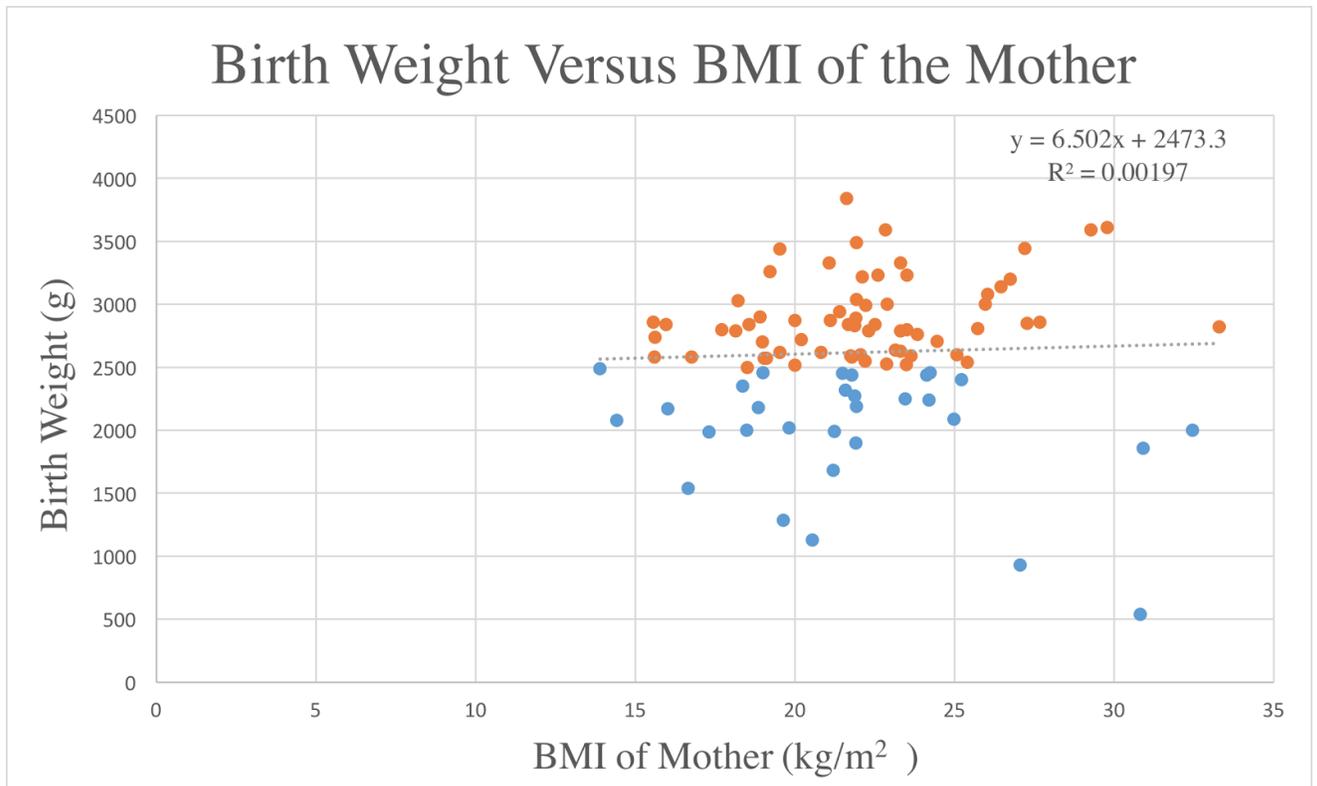


Figure 3 A scatter plot of birth weight and maternal BMI. A linear regression was utilized as the curve of best fit. It yielded an R^2 of 0.00197 indicating no relationship between the two variables. Blue data points represent LBW infants and orange data points represent NBW infants.

The mean maternal BMI for mothers who gave birth to LBW infants was 21.78 kg/m^2 with a standard deviation of 1.85 kg/m^2 . The mean maternal BMI for mothers who gave birth to NBW infants was 22.15 kg/m^2 with a standard deviation of 1.38 kg/m^2 . A two sample t-test run on the data returned a P-value greater than 0.10.

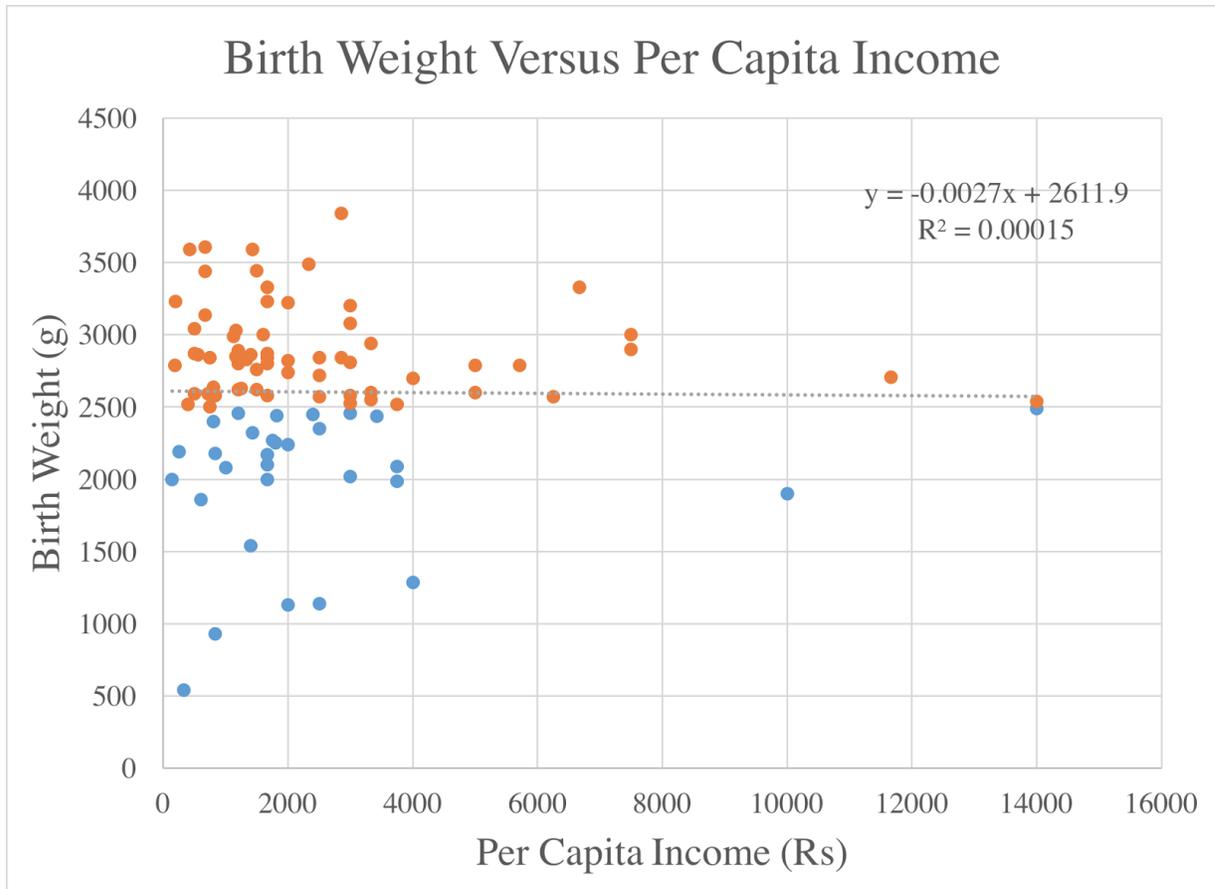


Figure 4 A scatter plot of birth weight and per capita income. A linear regression was utilized as the curve of best fit. It yielded an R^2 of 0.00015 indicating no relationship between the two variables. Blue data points represent LBW infants and orange data points represent NBW infants.

The mean monthly per capita income for families whose mothers gave birth to LBW infants was 2517.27 Indian rupees (Rs) with a standard deviation of 2834.55 Rs. The mean monthly per capita income for families whose mothers gave birth to NBW infants was 2520.07 Rs with a standard deviation 2559.28 Rs. A two sample t-test run on the data returned a P-value that was greater than 0.10.

Variables		N	LBW	NBW	Chi-square P-value
Parity	0	55	72.73%	47.69%	P-value < 0.10
	1	32	18.18%	40.00%	
	2	10	9.09%	10.77%	
	3	1	0.00%	1.54%	
Sex of Infant	Male	47	48.48%	47.69%	P-value > 0.10
	Female	51	51.52%	52.31%	
Calcium Supplementation	Yes	81	75.00%	87.69%	P-value > 0.10
	No	16	25.00%	12.31%	
Folic Acid Supplementation	Yes	42	43.75%	43.08%	P-value > 0.10
	No	55	56.25%	56.92%	
Iron Supplementation	Yes	89	90.32%	93.85%	P-value > 0.10
	No	7	9.68%	6.15%	
Food Intake per Meal	Less than Normal	9	15.63%	6.15%	P-value > 0.10
	Normal	37	40.63%	36.92%	
	More than Normal	51	43.75%	56.92%	
Meals per Day	0	0	0.00%	0.00%	P-value > 0.10
	1	0	0.00%	0.00%	
	2	24	28.13%	23.08%	
	3	72	71.88%	75.38%	
	4	1	0.00%	1.54%	

Education	Illiterate	6	9.38%	4.62%	P-value > 0.10
	Primary	4	6.25%	3.08%	
	Secondary	43	43.75%	44.62%	
	Higher Secondary	32	25.00%	36.92%	
	Undergraduate	10	12.50%	9.23%	
	Post-graduate	2	3.13%	1.54%	
Number of Pre-Natal Visits	1-2	14	15.63%	13.85%	P-value > 0.10
	3-4	32	40.63%	29.23%	
	5-6	14	12.50%	15.38%	
	7-8	12	6.25%	15.38%	
	9-10	25	25.00%	26.15%	
Maternal Age at Time of Marriage	Younger than 18	22	25.00%	21.88%	P-value > 0.10
	18 or older	74	75.00%	78.13%	

Table 2 Relationship between the socio-biological variables' relative frequencies for low and normal birth weight infants.

Discussion and Conclusion:

Only two variables had significance at $\alpha = 0.10$. The first was gestational period, where a lower gestational period was associated with a lower birth weight. The second variable to achieve significance was parity, where parity here is defined as the number of times that a woman has given birth to a fetus with a gestational age of 20 weeks or more, regardless of whether the child was born alive or was a stillborn. LBW infants were much more likely to have a nulliparous mother than were NBW infants. However, all the trends between the variables that were identified matched those established by the literature except for sex of the infant and folic acid supplementation.^{1,8} The differences between the proportions for these two variables between populations was very small though, and it may be more accurate to claim that the data for these two

variables show no association rather than an association opposite of that cited in the literature.

There are numerous factors that predispose an infant to preterm delivery, including lack of adequate nutrition, low body mass index, young maternal age, anemia, and maternal high blood pressure.⁵ PMT should continue to address these factors to reduce the incidence of preterm birth and thus LBW. Parity is an interesting factor to work with because it is unavoidable. However, the physicians at Pravara could pay special attention to nulliparous mothers since they know they are predisposed to have infants that have LBW. Hinkle et al.⁴ suggests having weight gain recommendations that are parity specific. They also suggest that the increased risk of LBW in nulliparous mothers is due to different physiological conditions in nulliparous, primiparous, and multiparous mothers. It is also possible that nulliparity is associated with mothers who have a lack of knowledge and/or appreciation for the standard medical practices of pregnancy, and this in turn could lead to the increased risk of LBW.

Before concluding that there were no associations between the variables that did not achieve significance, it should be noted that the power of these statistical tests was rather low. The variable with the highest effect size that did not achieve significance was calcium supplementation. The power for this test was 0.473, which means that only 47.3% of the time would a statistically significant difference in these populations be detected if there were in fact a difference between them. This is a considerably low power for a statistical test, especially since standard practice dictates a power between 0.80 and 0.95.² Since the difference between the populations simply might not have been detected due to the low power of the tests, it would be wise to take a second look at variables that

were going along with trends that are already established by the literature. Calcium supplementation in particular had an appreciably large effect size; it also had a P-value that just missed significance (P-value = 0.11), and therefore could be another risk factor that PMT could target to effectively combat LBW.

This study did have some considerable limitations. The first was already mentioned and it is the low power of the tests utilized. Two ways to increase the power of these tests would be to increase the α level or to increase the sample size. Since an α level above 0.10 is not considered standard practice, only an increased sample size would yield a desired test.² The second limitation is that there may have been a significant amount of communication errors. Since a translator was used, details from the interviews could have been lost in translation. Furthermore, the details from the interviews could have been inaccurate, for some of the women interviewed were unable to understand and subsequently unable to answer the questions being asked; some women also may have intentionally responded inaccurately. Lastly, this was an observational study, and causation cannot be properly established. However, it does still suggest causation and it does provide a basis for which further studies can test for causation. Furthermore, this study provides predictive power.

PMT has made a lot of progress in reducing its incidence of LBW. By partnering with SIDA, Pravara was able to achieve a 7% decrease in its incidence of LBW. However, their current incidence of 35% is still substantially higher than the global incidence (16%) and even the incidence in the developing world (18.6%).⁸ PMT must continue its current efforts aimed at lowering the incidence of LBW as well as

identifying new methods to meet this objective. This study has identified two risk factors—preterm birth and nulliparity—that Pravara could target to achieve this.

Lastly, these results and implications do not necessarily have to be isolated to Pravara, for this study can function as a useful case study. LBW is a global issue, and these findings confirm what has already been established in the literature. The methods that Pravara utilized to combat LBW are more relevant to global health though. Pravara embodies the global public health mantra “Think globally, act locally.” Pravara considered a global health issue—LBW—and then thought about ways to combat that issue locally—the three initiatives that PMT and SIDA put into place in 2006, and they saw very promising results. If localities are in a similar situation to Pravara’s, those localities can put in place similar initiatives to combat LBW. Regardless, Pravara can act as a model for *any* locality to start acting locally to combat global health issues.

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