Low Birth Weight among children experiencing Intergenerational Poverty in Utah, 2013-2019

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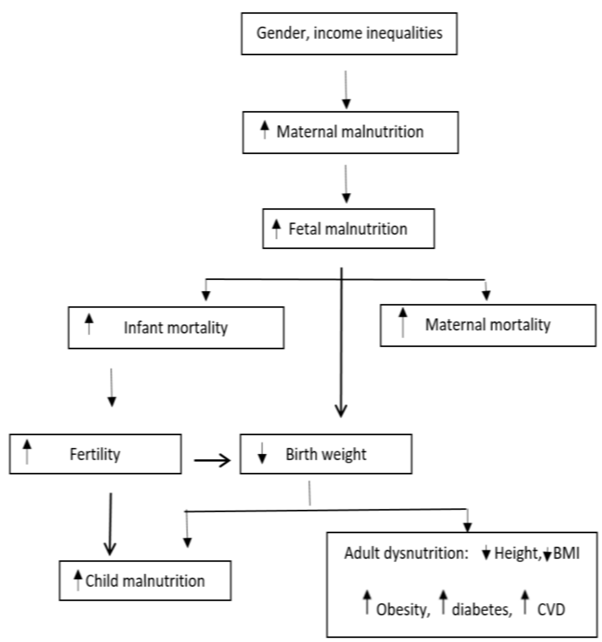
BACKGROUND

Intergenerational Poverty (IGP) is defined as the transmission of poverty from older generations to the younger generations. A child experiencing IGP in Utah in a given year received public assistance for one or more months, their parents received public assistance for at least 12 months as children and have an IGP status for the given year. In 2019, approximately 5.7% (52,795) of Utah children experienced IGP. Although the majority of women experiencing IGP in Utah received prenatal care, a low birth rate (LBW) (defined as a birth weight of less than 2500 grams or 5.5 pounds) among the children experiencing IGP is a concern.

In comparison to an average LBW rate in Utah of 6.8% during 2002-2018, unique children experiencing IGP in 2019 who were born between 2002 and 2018 had an average LBW rate of 8.6%. Literature showed that the social condition of parents at the time of a child's birth is associated with LBW and has an effect on the developmental outcomes of the child (Aizer and Currie 2014; Conley and Bennett 2000; Currie and Moretti 2007). LBW is a mechanism which can transmit socioeconomic disadvantage across generations (Aizer and Currie 2014; Case and Paxson 2006; Conley, Strully, and Bennett 2003; Palloni 2006; Kane et al., 2018).

As shown in Figure 1 (adapted from Osmani & Sen, 2003), LBW can be caused by fetal and maternal malnutrition which can stem from sex and income inequalities (Osmani & Sen, 2003). LBW leads to child malnutrition which can lead to adverse health outcomes in adulthood (Delisle, 2008).



Adapted from Osmani and Sen, 2003 by Delisle, 2008

Pregnant women experiencing poverty tend to exhibit a higher risk of adverse birth outcomes including LBW. Early maternal poverty is associated with substantial reductions in the birth weight of infants (Gigante et al. (2015)). Maternal disadvantages including poor health behaviors and lack of access to healthcare lead to LBW among infants (Aizer & Currie, 2014). A study by Collins et al. (2009) showed that transgenerational poverty among Black mothers is a risk factor for LBW among infants. LBW is more common among Blacks and parents with lower education level, low income, or occupational status (Robertson & Brien, 2018; Kost and Lindeberg 2015). The odds of delivering a LBW infant decreased with maternal body mass index (BMI) (Zhang & Yang, 2019). When compared to mothers with normal weight, underweight mothers are found to be 70% more likely to have a LBW child. (Zhang & Yang, 2019). A positive relationship between maternal age and the frequency of LBW was shown among women who received Temporary Assistance for Needy Families in 1998 (Border AEB et al., 2007). LBW is positively associated with inappropriate and inadequate prenatal care during pregnancy (Tayebi et al. (2013)). Infants born to women who do not receive prenatal care are three times more likely to have a LBW (Blakeney et al. (2019)).

LBW can lead to increased risk of adverse long-term health and social outcomes (e.g., neurodevelopmental problems, learning disabilities, behavioral problems, lower educational attainment, poorer cardiovascular health) (Behrman and Butler 2007; Conley, Strully, and Bennett 2003; Goldenberg and Culhane 2007; Kane et al. 2018). Children with LBW perform worse on a variety of cognitive measures (Hack et al. 1995). LBW among children has negative impacts on their educational achievement and attainment (Figlio et al. 2013; Robertson & Brien, 2018). LBW increases the odds of suffering from chronic conditions and reduces lifetime educational attainment and wages (Almond et al. 2005; Almond and Currie 2011; Black et al. 2007; Behrman and Rosenzweig 2004; Case et al. 2005; Conley and Bennett 2000; Conley et al. 2006).

Although the literature is abundant on LBW and its impacts on infants, a better understanding of the causes of LBW outcomes among children experiencing IGP will help in developing programs that prevent such outcomes and potentially disrupt intergenerational transmissions of disadvantage via birthweight (Kane et al., 2018). There is a limited amount of information available about the association between LBW and socioeconomic, demographic, and healthcare coverage disparities among children and the mothers giving birth to children experiencing IGP or transgenerational poverty in the US and Utah. To fill this knowledge gap, this research focuses on characterizing LBW among children experiencing IGP and examines how LBW is associated with demographic, socioeconomic, and health care characteristics of the children and their mothers who experience IGP in Utah.

OBJECTIVE

The objectives of the current study are: a) to identify the rate of LBW among children experiencing IGP in Utah from 2013-2019 (who were born between 1997-2018); b) recognize the presence of any pattern in the rate of LBW during the study period across the Utah counties; c) examine the factors influencing LBW (such as demographics (race, ethnicity, child's age, mother's age, pre-pregnancy BMI, gestational weight gain), socioeconomic (mother's marital status, education level), behavioral (mother's smoking habit), healthcare (health insurance coverage, prenatal care utilization, WIC use) and geographic (county)); d) evaluate the cost of the LBW deliveries, identify their primary health outcomes and total costs of their health outcomes. This study also compares the group of children experiencing IGP to a control group of children not experiencing IGP. The children in the non-IGP group received one or more months of public assistance in 2019, are not included in the IGP group and the IGP status of parents is not considered. The study compares children experiencing IGP and non-IGP to identify differences in the rate of LBW, any pattern in the rate of LBW across the Utah counties compared to the control group, and the factors associated with LBW.

DATA

The Intergenerational poverty database (IGP) from the Utah Division of Workforce Services was used to identify unique children experiencing IGP and non-IGP for the study period of 2013-2019. Children included in the study period (2013-2019) are born between 1997 and 2018. Data collected at the individual level included social security number, unique identifier number, name, date of birth, county, and year. Because the IGP database lacks information on birth weight, key socioeconomic, demographic, healthcare coverage, and behavioral characteristics; the IGP database was merged with the Vital Records Database from the Utah Department of Health (UDOH) which included birth weight (in grams), child's sex, mother's- age, race, pre-pregnancy body mass index (BMI), gestational weight gain, education level, marital status, Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) use, Hispanic origin, type of insurance coverage, date of the beginning of prenatal care, number of prenatal visits, electronic cigarette use and tobacco use.

Since the IGP database does not contain healthcare use data, it was merged with Utah All Payers Claims database and Facilities Database from the Utah Department of Health which included primary diagnosis, encounter type (inpatient, outpatient), and total charges of live birth and diagnoses.

The Institutional Review Boards at the Utah Department of Health (Approval #592) determined that this study did not constitute human subjects research.

METHODS

The merged (IGP and Vital records) database was used to calculate the rate of LBW and graph the trends in the rate of LBW for children in the IGP and non-IGP group over the study period (2013-2019) to examine the difference in the rates between the two groups. Using GeoDa (a software used to perform spatial data analysis) (Anselin, 2003) and QGIS (software used to analyze geospatial data) (QGIS Development Team, 2009), county-level spatial maps of the LBW rate were created to identify the counties with the highest rates of LBW for both the IGP and non-IGP group.

The IGP and Vital Records merged database was also used to generate descriptive statistics and χ^2 (chi-square) tests to assess the association between LBW and the covariates for children in the IGP and non-IGP group. Multilevel logistic regression including county as a random effect (the rate of LBW at the county level varies substantially across the United States (Robertson & Brien, 2018)) was used to measure the association of LBW (categorizing birth weight<2500gms as 1 and >=2500gms as 0) with child age, sex (male, female), mother's age at delivery, mother's pre-pregnancy body mass index (BMI) (underweight is classified as a BMI < 18.5 kg/m2, normal weight as 18.5 to 24.9 kg/m2, overweight as 25.0 to 29.9 kg/m2 and obese as BMI>30 kg/m2), gestational weight gain (in pounds), mother's race (White, Black, Asian, American Indian, and Pacific Islander), mother's Hispanic origin, mother's marital status, mother's education level (Less than High school, High School, College, and above), mother's tobacco use, mother's WIC use, type of insurance coverage (Medicaid, Private Insurance, and Other) and mother's Kotelchuck prenatal care index also known as Adequacy of Prenatal Care Utilization (APNCU) Index (where the number of prenatal visits is compared to the expected number of visits for the period between when care began and the delivery date. The index is classified as Inadequate (received less than 50% of expected visits), Intermediate (50%-79%), Adequate (80%-109%) and Adequate Plus (110% or more) (IBIS Utah)) for both groups (IGP and non-IGP). Odds ratio and 95% confidence intervals were presented. The p-value indicated if there is a statistically significant difference between the LBW and non-LBW group by the covariates. The data analysis was performed using SAS software.

Healthcare utilization was measured by the rate of encounter type (emergency department visits, and inpatient visits), cost of live birth, primary diagnoses, and total charges of all diagnoses for IGP and non-IGP group children with and without LBW during the study period.

RESULTS

A total of 345,927 children from 2013-2019 were included in this study of which 88,525 experienced IGP and 257,402 did not experience IGP. Of the IGP group, 7846 children had LBW and of the non-IGP group, 20,193 had LBW.

Graph analysis (figure 1):

Among children experiencing IGP during the study period of 2013-2019 who were born between 1997 and 2018, the rate of LBW varied from 9.29% for the 2013 cohort to 8.56% for the 2019 cohort with an average of 8.9% over the study period. Among children who were not experiencing IGP, the rate of LBW varied from 8.08% in the 2013 cohort to 8.2% in the 2019 cohort with an average of 7.84% during the study period. The state-level rate of LBW in Utah varied from 5.9% in 1997 to 7.2% in 2018 with an average of 6.6% from 1997-2018 (American Health Rankings, 2019). The difference in the LBW rate between IGP and non-IGP groups was statistically significant.

Spatial map analysis (Figure 2 and 3):

Twenty-two counties had greater than 9% LBW rate among children experiencing IGP in the study period. In comparison, only 9 counties had greater than 9% LBW rate among children in the non-IGP group. Seven counties namely Piute, Sevier, Carbon, Wayne, Summit, Morgan, and Daggett were in the highest quartile of LBW rate (greater than 11.8%) for children in the IGP group. Among children in the non-IGP group, no counties had LBW rates greater than 11.8%. Only three counties namely Duchesne, Piute, and Rich had LBW rates between 10.1-11.8% in the non-IGP group.

Descriptive statistics (Table 1):

Children and the mothers of the children affected by IGP with LBW- The mean age of children experiencing IGP with LBW were 5.54 years. 53.8% of the children impacted by IGP and LBW were female. 83.8% of the mothers of children affected by IGP and LBW were White, 3.7% were American Indian, 2.5% were Black, 1% were Asian and 18.3% of mothers were of Hispanic origin. The mean age of mothers of LBW children experiencing IGP at delivery was 24 years with a mean gestational weight gain during pregnancy of 26.2 pounds. Among the mothers of children in the IGP group with LBW, 48.5% were underweight, 25% were normal weight, 12% were overweight and 13.9% were obese. 16.5% of the mothers with LBW children impacted by IGP had less than a high school degree, 21.9% had high school or GED degree, and 19.5% had college and above degree and the remaining 42.1% had unknown/missing education attainment. Among the mothers of children in the IGP group with LBW, 45.8% were married, 16.2% had tobacco/electronic cigarette use, 32.4% had WIC use and 40% had some levels of prenatal care utilization (of which 21.4% had inadequate use, 2.3% had intermediate use, 5.2% had adequate use and 10.73% had adequate plus use). Most mothers with children impacted by IGP and LBW were covered by Medicaid (65.4%), followed by private insurance (9%) and other insurance (1%).

At a significance level of 0.05, there is a significant association between LBW rate in the IGP group with child's sex, mother's-race, Hispanic origin, educational level, marital status, tobacco use, WIC use, prenatal care utilization index, pre-pregnancy BMI, and insurance coverage (Table 1).
LBW was greater among female children (9.8%) compared to male children. Asian (14.5%) and Black (12.7%) mothers of children experiencing IGP gave birth to more LBW children compared to other races. These rates were considerably higher than the state-level Asian (10.8%) and Black (10.1%) LBW rates. The delivery of LBW children affected by IGP decreased significantly among mothers with higher educational levels, reaching 9.7% in the lower than high school education level to 8% in the college and above level. Comparing it to the state level, the LBW rates for mothers with less than high school level (8.6%) and college graduates (6.4%) were lower. Unmarried mothers of children experiencing IGP had significantly higher rates of LBW (9.3%) compared to married mothers. Mothers of children impacted by IGP who had tobacco use had a significantly higher LBW rate (12.4%) compared to non-tobacco users (7.8%). Mothers of children experiencing IGP with adequate plus prenatal care utilization had 14.4% of LBW, significantly higher than mothers with intermediate (5.8%) or adequate (5.4%) prenatal care utilization.

Children and the mothers of the children not affected by IGP with LBW - The mean age of children in the non-IGP group with LBW were 6.58 years with 52.2% female. 80.6% of the mothers of children in this group were White, 2.1% were Asian, 1.9% were Pacific Islanders, 1.7% were Black and 26.1% were of Hispanic origin. The mean age of mothers of LBW children not affected by IGP was 26.7 years at delivery with a gestational weight gain of 25.9 pounds. Among the mothers of children in the IGP group with LBW, 55.6% were underweight, 23% were normal weight, 10.32% were overweight and 10.1% were obese. 12.2% of mothers with LBW children not impacted by IGP had less than a high school degree, 14.1% had high school or GED degree, and 24% had college and above degrees. Most mothers of children not affected by IGP with LBW were married (62.8%), had lower tobacco use (6.7%), reported 24.3% of WIC use and 32.3% of some levels of prenatal care utilization (of which 17.1% had inadequate use, 1.8% had intermediate use, 3.9% had adequate use and 10% had adequate plus use). 43.7% of mothers with LBW children not impacted by IGP were enrolled in Medicaid, followed by 13.9% enrolled in private insurance and 1% in other insurance.

At a significance level of 0.05, there is a significant association between the LBW rate in the non-IGP group with sex, race, Hispanic origin, education, marital status, tobacco use, WIC use, prenatal care utilization index, pre-pregnancy BMI, and insurance coverage.

The LBW rate among children in the non-IGP group increased among females (8.4%), increased among Asian (10.9%) and Black (10.3%) mothers of children not impacted by IGP, and increased with a lower education level of mothers of children in the non-IGP group (from 7.5% among college-educated to 8.5% among less than high school educated mothers). The incidence of LBW also increased among unmarried mothers (8.7%), among mothers with tobacco use (12.4%), and among mothers with adequate plus prenatal care utilization (14.5%) of children not experiencing IGP.

Healthcare utilization (Table 2 and Table 3):

Outcomes and cost of birth-Approximately 98.5% of healthcare utilization were emergency room visits for children both in the IGP and non-IGP group with or without LBW. Among both groups, approximately 80% of the diagnoses consisted of diseases of the digestive system, ear, nose, mouth and throat, respiratory system, skin, infections, and parasites irrespective of being with or without LBW.

The mean cost of live birth among children experiencing IGP with LBW increased from $46,540 in 2013 (adjusted to 2019 inflation rate, US Department of Labor; Bureau of Labor Statistics)) to $59,700 in 2019. The mean cost of live birth for IGP children with LBW was 11 to 14 times the mean cost of live birth of IGP children without LBW. For the children with LBW not impacted by IGP, the mean cost of live birth increased from $59,129 in 2013 (adjusted to 2019 inflation rate, US Department of Labor; Bureau of Labor Statistics)) to $72,633 in 2019. The mean cost of live birth for LBW among non-IGP group children was 15 to 18 times the mean cost of live birth of non-IGP group children without LBW. For both IGP and non-IGP groups, female children had a lower mean cost of live birth. The mean cost of live birth for Medicaid and private insurance was the same for children with IGP status with LBW. However, the mean cost of live birth for Medicaid ($55,005) was lower than for private insurance ($63,682) for non-IGP status children with LBW.

The total cost of all diagnoses-The total cost of all diagnoses for LBW children experiencing IGP increased from $20,667 in 2013 (adjusted to 2019 inflation rate, US Department of Labor; Bureau of Labor Statistics)) to $26,000 in 2019. For the children with LBW not impacted by IGP, the total cost was $28,643 in 2013 (adjusted to 2019 inflation rate, US Department of Labor; Bureau of Labor Statistics)) and decreased to $24,085 in 2019. The female children with LBW in both IGP and non-IGP groups had a lower total cost compared to the male children. The LBW children experiencing IGP enrolled in Medicaid had a higher total cost ($20,780) compared to private insurance ($15,284). Similarly, the children in the non-IGP group with LBW enrolled in Medicaid had a higher total cost ($30,550) compared to private insurance ($22,010) coverage.

Multilevel model analysis (Table 4):

For children experiencing IGP, females had 1.3 times greater odds of LBW compared to the odds of LBW for males. The age of mothers at delivery has increased odds of LBW. The odds of having LBW children affected by IGP for Black mothers were 1.7 times the odds of White. Mothers with Hispanic origin had increased odds (1.16) of having LBW children compared to the non-Hispanic origin. With an increase in gestation weight gain, the odds of LBW decreased. The odds of LBW children impacted by IGP among underweight mothers was 1.7 times the odds of LBW children among mothers with normal BMI. The odds of LBW children with IGP status among overweight (OR: 0.76) and obese mothers (OR: 0.57) were lower compared to the odds of LBW children among normal BMI mothers. Mothers with a high school/GED degree and mothers with college and above degrees had lower odds (OR: 0.87) of LBW children experiencing IGP compared to the odds of mothers with less than a high school diploma. Mothers with tobacco/electronic cigarette use had 1.6 times greater odds of LBW children compared to mothers with no tobacco use. Compared to the inadequate prenatal care use, the odds of LBW decreased for mothers with adequate and intermediate prenatal care use and increased with adequate plus use. Children's age, mothers' marital status, WIC use, and insurance coverage had no statistically significant association with LBW.

Among children in the non-IGP group- The odds of LBW rate decreased with the age of the children. The odds of LBW among female children were 1.2 times greater than the odds of LBW among male children. The odds of LBW children in the non-IGP group increased with mothers' age. The odds of LBW was 1.3 times for Black mothers compared to White mothers. Mothers with Hispanic origin had lower odds (OR: 0.84) of having LBW children with non-IGP status compared to the non-Hispanic origin. With an increase in gestation weight gain, the odds of LBW children decreased. The odds of LBW children not impacted by IGP among underweight mothers were 1.5 times the odds of LBW children among mothers with normal BMI. The odds of LBW children with IGP status among overweight (OR: 0.78) and obese mothers (OR: 0.72) were lower compared to the odds of LBW children among normal BMI mothers. Married mothers had lower odds (OR: 0.84) of having LBW children in the non-IGP group when compared to unmarried mothers. The odds of LBW children not experiencing IGP increased (OR: 1.76) with tobacco use of mothers compared to mothers with no use. Mothers with intermediate and adequate prenatal care use had 0.69 times and 0.6 times lower odds of having LBW children as compared to mothers with inadequate prenatal care use. Also, mothers with adequate plus prenatal care use had 2.4 times greater odds of having LBW children compared to mothers with inadequate prenatal care use. Mothers with Medicaid coverage had lower odds of delivering LBW children (OR: 0.75) with non-IGP status compared to other insurance coverage. Education level and WIC use had no statistically significant association with LBW.

DISCUSSION

The findings of the study are consistent with the literature. The demographic, socioeconomic, behavioral, and healthcare inequalities are more likely to be associated with higher rates of LBW (Martison and Rickman, 2016). Black mothers are systematically disadvantaged minorities who experience poverty 2.6 times more than Whites (Bloome, 2014). With extreme intergenerational poverty, living in racially segregated Black neighborhoods exposed to pollution, dilapidated housing, zoning, broken social support, norms, crime, political power, and limited health, nutrition, recreation, and transportation resources (Kothari et al. (2016)), LBW is disproportionately high among them.

Maternal age is also a significant predictor of LBW (Ratnasiri e al. (2018)). Advanced maternal age increases the risk of female infertility, pregnancy loss, fetal anomalies, stillbirth, poorer pregnancy, and perinatal outcomes (Sauer, 2015).

In a study conducted for a cohort of women in California from 2005-2014, the researcher found that Hispanic women were 30% more likely to give birth to a LBW infant (Ratnasiri e al. (2018)). Our research is consistent with their results. They also found that women with less than a high school diploma had a 36% greater chance of having a LBW child than women with a bachelor's degree or higher. Maternal education level is a proxy measure of socioeconomic status. It is a measure of inequality to assess pregnancy outcomes which leads to significant changes in birth weight (Gage et al. 2013). Higher maternal education level is related to the higher socioeconomic level of mothers, who might have a higher weight gain during pregnancy, early and increased use of prenatal visits & consultations, and less prenatal smoking leading to lower LBW and improved health of their infant (Currie and Moretti (2003)).

Kane et al. (2018) found that lower family-of-origin and transmissions of inequality of socio-economic status were associated with an increased risk of prenatal smoking, which in turn was associated with lower birth weight. The greater effect of pre-pregnancy BMI on LBW can be explained by excess maternal weight leading to high glucose levels, increasing insulin production, resulting in increased fat deposition resulting in higher birth weight (Starling et al., 2015).

Medicaid is the major source of payment (65%) for children born with LBW in the IGP group. Structurally, Medicaid payment rates are lower compared to private and other insurance coverage. This might lead to a lower mean cost of live birth among LBW children with IGP status compared to non-IGP status. Medicaid is also the major insurance coverage (80%) for total healthcare utilization of children with LBW after their birth in Utah. This might have led to a higher average total cost for Medicaid children in the IGP and non-IGP group for the 2013-2019 cohort.

CONCLUSION

In this study, an average of 8.9% of children experiencing IGP in Utah had LBW for the study period (2013-2019), higher than the state and non-IGP group average rate. The analysis demonstrated that the rate of LBW among children experiencing IGP was higher across demographic, socioeconomic, behavioral, and health care covariates when compared to the children in the non-IGP group with LBW. The findings reported that in the IGP group- female children, older mothers, mothers with a Hispanic origin, mothers with tobacco use, Black mothers, underweight mothers, and mothers with adequate plus prenatal care utilization were associated with a higher LBW rate. Also, mothers with higher education, mothers with higher gestational weight gain, overweight and obese mothers, and mothers with intermediate and adequate prenatal care utilization were associated with a lower LBW rate. The mean cost of live birth among LBW children with IGP status was lower than LBW children in the non-IGP group. The mean cost of live birth was lower for females compared to males with LBW children in both groups. The total mean cost of all diagnoses increased for LBW children in the IGP group and decreased for LBW children in the non-IGP group. Medicaid enrollment had a higher total cost for LBW children in both IGP and non-IGP group.

LIMITATIONS

Physical and mental health comorbidities such as hypertension, diabetes, asthma, drug abuse, and other substance abuse of mothers were not included in the study because the databases had a large percentage of missing values. Although rates among the six counties shown in Figure 2 ("LBW rate among children experiencing IGP") and three counties in Figure 3 ("LBW rate among non-IGP group children") were high, the total number of children experiencing IGP and children in the non-IGP among these counties showing high rates were comparatively small which might have led to a higher LBW rate.

POLICY IMPLICATIONS

An increased understanding of the LBW rate and the associated factors between the IGP and non-IGP group children will help to have a better understanding and help in establishing interventions or programs that will prevent such outcomes and potentially disrupt intergenerational transmissions of disadvantage via birth weight. The output from the analysis will assist public health officials to make decisions to invest more prevention efforts among the IGP cohort to reduce the LBW rate and thereby reduce the future healthcare consequences. Based on the analysis, the Utah Department of health or Utah Division of Workforce services should target their interventions efforts on mothers with an IGP status who are- 1) older for pregnancy, 2) Black, 3) Hispanic, 4) use tobacco, 5) less educated and 6) underweight. Public provision of education, income provisions, adequate prenatal care utilization, nutritional programs, and subsidy might be some of the prevention efforts to reduce transmission of poverty through LBW across generations.

However, prevention efforts had been difficult from the Utah Medicaid perspective. A mother might have an IGP status when the workforce services identify them and this might happen after they have already given birth. Also, many women enroll late in pregnancy; some in the month of birth. This makes it difficult to provide targeted intervention for mothers with an IGP status who are at a higher risk of LBW.

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Figure 1: Percent of LBW among children ages 0-18 years by IGP status, 2013-2019

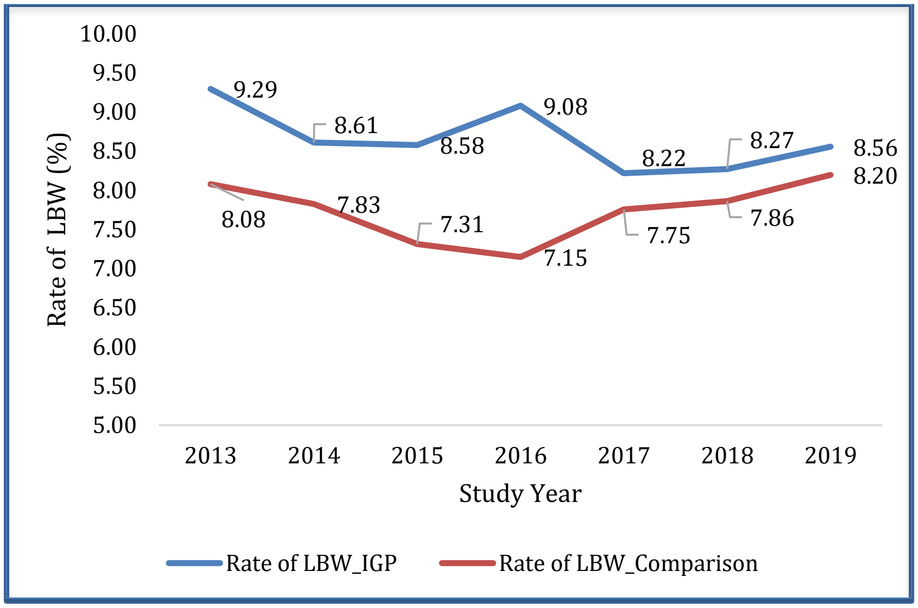

Figure 2: County-level graph showing the rate of LBW among children experiencing IGP in the study period (2013-2019)

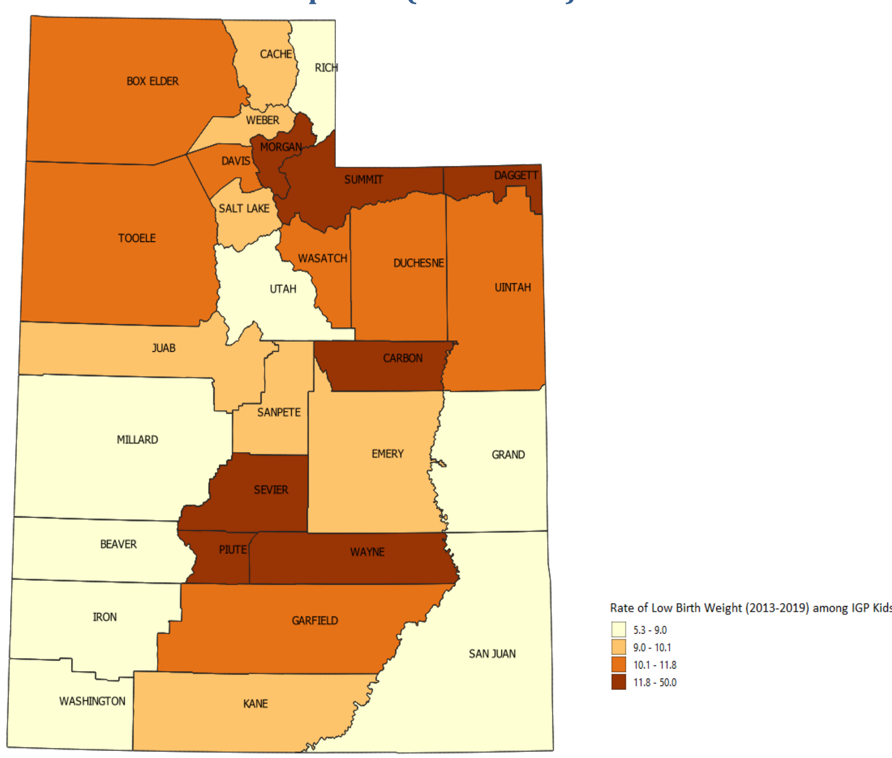

Figure 2: County-level graph showing the rate of LBW among children in the non-IGP group for the study period of (2013-2019)

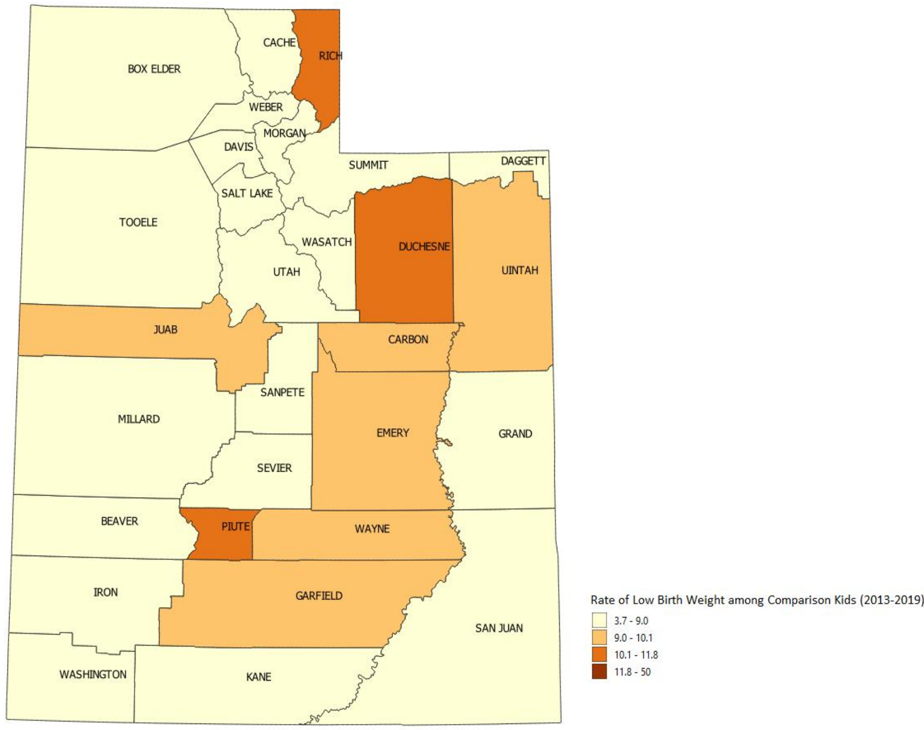

Table 1: Descriptive Statistics of children by IGP status with or without LBW for the study period of 2013-2019

	IGP group with LBW (n = 7846)	IGP group without LBW (n = 80679)	% of LBW in IGP group		Non IGP group with LBW (n = 20193)	Non IGP group without LBW (n= 237209)	% of LBW in Non IGP group	
Characteristics	**n**	**n**	**%**	***P*-value**	**n**	**n**	**%**	***P*-value**
Sex				<.0001				<.0001
Male	3626	41708	8.00		9650	122745	7.29	
Female	4220	38917	9.78		10543	114464	8.43	
Mother's Race				<.0001				<.0001
White	6579	66810	8.96		16254	192665	7.78	
Black	195	1344	12.67		348	3025	10.32	
Asian	78	460	14.50		431	3535	10.87	
American Indian	289	3906	6.89		280	3651	7.12	
Pacific Islander	119	1903	5.89		375	4570	7.58	
Other	318	3807	7.71		1571	19149	7.58	
Unknown	268	2449	9.86		934	10614	8.09	
Mother's Hispanic origin				0.0236				<.0001
No	6118	62668	8.89		13957	160743	7.99	
Yes	1434	15379	8.53		5262	66084	7.38	
Unknown/Missing	294	2632	10.05		974	10382	8.58	
Mother's pre-pregnancy BMI				<.0001				<.0001
Underweight	3803	36380	9.46		11239	128944	8.02	
Normal	1965	19729	9.06		4645	54188	7.9	
Overweight	942	10776	8.04		2084	27664	7.01	
Obese	1095	13262	7.63		2125	25102	7.8	
Unknown	41	532	7.16		100	1311	7.1	
Mother's Education				<.0001				<.0001
Less than High School	1294	12053	9.70		2466	26630	8.48	
High School	1716	17907	8.74		2846	30809	8.46	
College and above	1528	17448	8.05		4844	59894	7.48	
Unknown/Missing	3308	33272	9.04		10037	119876	7.73	
Mother's Marital Status				<.0001				<.0001
No	4249	41320	9.32		7510	78642	8.72	
Yes	3596	39340	8.38		12680	158533	7.40	
Unknown/Missing	1	19	5.00		3	34	8.11	
Mother's Tobacco Use				<.0001				<.0001
No	3208	38103	7.77		8674	106683	7.52	
Yes	1267	8954	12.40		1352	9597	12.35	
Unknown/Missing	3371	33622	9.11		10167	120929	7.76	
Mother's WIC use				0.0252				0.0281
No	1761	18092	8.87		4620	52391	8.10	
Yes	2539	27245	8.52		4899	58567	7.72	
Unknown/Missing	3546	35342	9.12		10674	126251	7.80	
Kotelchuck Index Prenatal Care level				<.0001				<.0001
Inadequate	1679	20491	7.57		3615	50876	6.63	

Intermediate	179	2906	5.80		382	7174	5.06	
Adequate	410	7252	5.35		816	18942	4.13	
Adequate Plus	842	5025	14.35		1998	11826	14.45	
Missing	4736	45005	9.52		13382	148391	8.27	
Type of Insurance				0.0004				<.0001
Private Insurance	702	7955	8.11		2931	32260	8.33	
Medicaid	5130	53205	8.79		9212	112539	7.57	
Other	64	831	7.15		210	2133	8.96	
Unknown/Missing	1950	18688	9.45		7840	90277	7.99	
	Mean (SD)	Mean (SD)			Mean(SD)	Mean (SD)		
Age (years)	5.54 (4.52)	5.5 (4.43)			6.58 (4.66)	6.69 (4.65)		
Mother's age at delivery (years)	24 (5.55)	23.71 (5.15)			26.65 (6.6)	26.23 (6)		
Gestational weight gain (pounds)	26.2 (16.8)	31.13 (16.53)			25.85 (15.6)	30.6 (14.96)		
Birth weight (grams)	2074.7 (433.75)	3289.8 (415.91)			2030.3 (468.62)	3336.95 (424.66)		

***p<0.001, **p<0.01, and *p<0.05.
*P value indicates if there is a statistically significant difference between the LBW and non-LBW group by the covariates.

Table 2: Cost of Live birth of children by IGP status with or without LBW by Cohort, sex, and type of insurance (all values adjusted to 2019 Cost price index for Medical care services)

	IGP group with LBW	IGP group without LBW	IGP group with LBW	IGP group without LBW	The non-IGP group with LBW	The non-IGP group without LBW	The non-IGP group with LBW	The non-IGP group without LBW
Characteristics	**Mean $**	**Mean $**	**Median $**	**Median $**	**Mean $**	**Mean $**	**Median $**	**Median $**
Cohort-2013	46,540	3,306	5,368	1,845	59,130	3,201	7,933	1,813
Cohort-2014	51,882	3,470	6,176	1,948	59,841	3,311	8,245	1,865
Cohort-2015	48,623	3,711	6,822	2,049	58,647	3,311	8,032	1,848
Cohort-2016	54,841	4,088	7,358	2,186	61,924	3,526	8,618	1,911
Cohort-2017	54,922	4,616	7,479	2,419	67,621	4,086	11,424	2,207
Cohort-2018	57,948	5,019	7,927	2,573	77,081	4,535	14,636	2,437
Cohort-2019	59,700	5,200	7,906	2,670	72,633	4,896	13,280	2,541
Sex								
Male	58,437	4,055	11,881	2,070	70,498	3,758	16,600	1,951
Female	39,743	3,596	4,283	2,015	48,835	3,252	5,722	1,853
Type of Insurance								
Private Insurance	49,926	3,473	10,676	1,912	63,682	3,185	13,120	1,713
Medicaid	49,992	4,316	6,154	2,208	55,005	3,784	7,860	1,998
Other	42,672	2,470	8,318	1,550	47,162	4,188	20,484	2,102
Unknown/Missing	28,274	2,391	13,515	1,230	17,461	1,827	1,725	1,177

Diagnosis-related group for newborn: 385-391, 789-795

Table 3: Total Cost of all diagnoses of children by IGP status with or without LBW by Cohort, sex, and type of insurance (all values adjusted to 2019 Cost price index for Medical care services)

	IGP group with LBW	IGP group without LBW	IGP group with LBW	IGP group without LBW	The non-IGP group with LBW	The non-IGP group without LBW	The non-IGP group with LBW	The non-IGP group without LBW
Characteristics	**Mean $**	**Mean $**	**Median $**	**Median $**	**Mean $**	**Mean $**	**Median $**	**Median $**
Cohort-2013	20,668	12,910	6,259	5,085	28,644	11,771	4,971	4,215
Cohort-2014	20,805	12,025	5,872	4,697	35,955	12,728	5,538	4,495
Cohort-2015	21,083	11,425	5,633	4,547	38,205	12,975	4,951	4,256
Cohort-2016	20,896	11,194	5,235	4,346	39,309	12,290	5,066	4,255
Cohort-2017	23,405	10,910	5,121	4,168	30,525	12,380	4,752	4,111
Cohort-2018	24,191	10,534	4,875	3,957	33,372	12,562	5,265	4,078
Cohort-2019	26,001	9,543	4,610	3,670	24,085	11,613	4,653	3,784
Sex								
Male	23,964	9,876	5,080	4,008	33,326	10,946	5,166	3,897
Female	17,232	10,354	4,615	3,817	26,247	11,396	3,975	3,634
Type of Insurance								
Private Insurance	15,284	7,325	3,845	2,972	22,010	8,831	4,157	2,992
Medicaid	20,780	10,120	4,989	4,076	30,550	11,008	4,830	3,932
Other	4,619	12,445	2,613	8,791	5,214	10,345	1,108	6,356
Unknown/Missing	1,098	1,694	841	1,036	1,090	1,015	902	780

*Total Cost of diagnoses is the cost of healthcare utilization from the year they are born to the cohort year they were included in the IGP group

Table 4: Multilevel logistic modeling of LBW among children with or without IGP status (2013-19)

	IGP group (n=49615)			The non-IGP group (n=119246)		
Variable	Odds ratio	95% Confidence Interval		Odds ratio	95% Confidence Interval	
		Lower	Upper		Lower	Upper
Age	0.985	0.96	1.011	0.958***	0.94	0.977
Sex						
Male (reference)						
Female	1.325***	1.222	1.437	1.272***	1.202	1.346
Mother's age at delivery	1.02***	1.011	1.029	1.015***	1.01	1.02
Mother's Race						
White (reference)						
Black	1.697***	1.311	2.197	1.32**	1.074	1.621
Asian	1.181	0.766	1.822	1.07	0.886	1.292
American Indian	0.876	0.7	1.096	0.973	0.758	1.251
Pacific Islander	1.05	0.76	1.45	1.1	0.879	1.377
Other	0.901	0.747	1.086	0.999	0.891	1.12
Mother's Hispanic origin						
Not Hispanic (reference)						
Hispanic	1.164*	1.033	1.312	0.841**	0.767	0.923
Mother's pre-pregnancy BMI						
Normal(reference)						
Underweight	1.714***	1.477	1.988	1.553***	1.396	1.727
Overweight	0.756***	0.679	0.843	0.785***	0.728	0.847
Obese	0.572***	0.512	0.639	0.722***	0.667	0.782
Gestational weight gain	0.976***	0.974	0.979	0.977***	0.975	0.979
Mother's Education						
Less than High School (reference)						
High School	0.871**	0.786	0.965	1.05	0.964	1.143
College and above	0.872*	0.782	0.972	0.949	0.871	1.033
Mother's Marital Status						
No (reference)						
Yes	0.943	0.863	1.031	0.836***	0.782	0.894
Mother's Tobacco Use						
No (reference)						
Yes	1.629***	1.481	1.792	1.759***	1.61	1.922
Mother's WIC use						
No (reference)						
Yes	1.008	0.924	1.099	1.042	0.979	1.109
Kotelchuck Index Prenatal Care level						
Inadequate(reference)						
Intermediate	0.745***	0.627	0.886	0.687***	0.604	0.782
Adequate	0.682***	0.604	0.77	0.602***	0.55	0.657
Adequate Plus	2.035***	1.847	2.243	2.441***	2.285	2.608
Type of insurance coverage						
Other(reference)						
Medicaid	1.189	0.854	1.655	0.75**	0.619	0.909
Private/Self-pay	1.132	0.805	1.591	0.925	0.762	1.124
Variance Estimate	Estimate	Standard Error		Estimate	Standard Error	
County	0.013		0.009	0.01		0.009

***p<0.001, **p<0.01, and *p<0.05.