

Original Paper

Protective Effects of Maternal Education against Low Birth Weight Deliveries: Blacks' Diminished Returns

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Abstract

Background: Racial and economic disparities in low birth weight (LBW) deliveries is among the most well-established differences between Blacks and Whites. As LBW is an established risk factor for chronic diseases such as asthma and diabetes, it is particularly important to understand drivers of racial and economic disparities in LBW deliveries in urban areas. **Aims:** Built on the Minorities' Diminished Returns framework, which argues that educational attainment generates fewer positive health outcomes for Black than White Americans, we conducted this study with three aims: 1) to test the association between mothers' educational attainment and LBW of babies born in urban areas, 2) to compare Blacks and Whites for the effect of mothers' educational attainment on LBW, and 3) to test whether LBW is predictive of future chronic diseases 15 years later. **Methods:** Data came from the Fragile Families and Child Well-being / included a random sample of births in cities larger than 200,000 population. For the aims 1 and 2, we analyzed data of 2,922 births to Black ($n = 2,146$) or White ($n = 776$) mothers. For aim 3, we analyzed data of a subsample of 1,604 Black or White newborns who were followed to age 15. The presence or absence of chronic diseases was determined at age 15. Logistic regression was used for data analysis. **Results:** Maternal educational attainment was inversely associated with LBW overall. We, however, found a significant interaction between maternal educational attainment and race, suggesting that the inverse association between maternal education and LBW is weaker for Black than White babies. At the same time, LBW increased the odds of chronic disease 15 years later. **Conclusions:** Diminished returns of maternal educational attainment contribute to racial disparities in LBW, which in turn contributes to future racial inequalities in chronic diseases in urban settings. That is, smaller protective effects of maternal education on reducing LBW for Black than White children contribute to the high prevalence of chronic diseases among adolescents in urban settings. Health disparities are not just due

to racial differences in socioeconomic status but also diminishing returns of socioeconomic status indicators such as education for racial and ethnic minorities. Research should study contextual factors that reduce Blacks' ability to translate their human capital to health outcomes in urban settings.

Keywords

African Americans, Blacks, maternal health, socioeconomic status, socioeconomic education, birth outcomes, low birth weight

1. Introduction

Low Birth Weight (LBW), defined as a birth weight of less than 2 ½ kilograms (Baghianimoghadam, Baghianimoghadam, Ardian, & Alizadeh, 2015), is a serious risk factor to the health of children (Baghianimoghadam et al., 2015; Krieger, 2000). Babies who are born with an LBW are more likely to have respiratory, cardiac, and cerebrovascular health issues at birth (Frontini, Srinivasan, Xu, & Berenson, 2004; Laina & Stellos, 2018). The LBW babies are also at increased risk of developing chronic diseases such as diabetes mellitus, heart disease, and hypertension later in life (Balci, Acikel, & Akdemir, 2010; Bassareo, Fanos, Crisafulli, Mura, & Mercuro, 2011; Frontini et al., 2004).

High socioeconomic status (SES), particularly high maternal education, is a strong protective factor against LBW ("Poverty, low birthweight and brain size," 2017) (Blumenshine, Egerter, Barclay, Cubbin, & Braveman, 2010). In a systematic review, high maternal education had a 33% protective effect against LBW (Silvestrin et al., 2013). There are, however, contexts in which SES shows weaker protective factors against LBW (Campbell et al., 2018).

A considerable body of research has suggested that SES indicators such as educational attainment may be less protective for Black mothers than White mothers (S. Assari, 2017; Shervin Assari, 2018a). For example, in a study published in 2019, educational attainment increased White but not Black women's exercise frequency (Shervin Assari, 2019a). In a study on the intersection of race, place, and SES, individual-level race and SES showed more powerful effects on LBW than community-level factors. Overall, being a Black mother was associated with 1.6 times higher odds of giving birth to LBW babies. Although maternal poverty was linked to 1.7 times greater odds of LBW deliveries, higher-SES Black women in predominantly White areas had the worst outcomes (14.5% LBW). In contrast, high-SES Black women who were residing in predominantly Black neighborhoods had the most desirable outcomes (4.0% LBW) (Kothari et al., 2016). This study showed an interaction between race and SES and also variation in the protective effect of SES across contexts.

Although historically neglected, recent research has introduced Minorities' Diminished Returns (MDRs) as a systemic cause of health disparities in middle-class Black families, particularly in urban settings (S. Assari, 2017; Shervin Assari, 2018a). According to the MDRs framework, the health effects of SES indicators, particularly educational attainment, are smaller for Black than White Americans (S. Assari, 2017; Shervin Assari, 2018a). That means educational attainment generates fewer positive health outcomes for Black than White individuals and populations (S. Assari, 2018e; Assari S, 2019). As a

result, we observe worse than expected health outcomes for children from highly educated Black parents in urban settings (B. M. Assari S; S. Assari & Mistry, 2018; S. Assari, Schatten, et al., 2019). We, however, are not aware of any studies testing diminished effects of educational attainment (e.g., MDRs) on LBW among Black in comparison to White mothers in urban areas.

1.1 Aims

Built on the MDRs framework (S. Assari, 2017; Shervin Assari, 2018a), this study was performed with three aims: First, to test the effect of mothers' educational attainment on LBW of babies born in urban areas. Second, to compare the effect of mothers' educational attainment on LBW births between Blacks and Whites. Third, to test if LBW at baseline predicts the incidence of chronic diseases over a 15 year follow up period. We hypothesized that the magnitude of the effect of educational attainment on LBW is smaller for Black than White Americans, suggesting that in U.S urban areas, babies born to highly educated Black mothers would still be at risk of LBW, despite their SES.

2. Materials and Methods

2.1 Design and Setting

This longitudinal study used 15 years of follow up data on a national urban sample of newborns from the Fragile Families and Child Wellbeing Study (FFCWS). The FFCWS was conducted from 1998 to 2016 and is an ongoing longitudinal study. However, the most current wave of data collection occurred in 2016. The FFCWS has followed racially diverse and economically fragile families for 15 years from the birth of their newborns to when the child is 15 years old. A full description of the FFCW sampling, design, and methodology of the study are available elsewhere (Waldfogel, Craigie, & Brooks-Gunn, 2010). Here we provide a brief description of the FFCWS sample, sampling, and methods.

2.2 FFCWS Sample and Sampling

The FFCWS recruited newborns that were from economically challenged families. These births were selected from 20 US cities in which the population was 200,000+ people. The FFCWS has used a random sample of urban families. This, however, included an oversampling of non-married and Black and Hispanic couples (Waldfogel et al., 2010). Most births in the FFCWS were non-marital, low SES, and racial and ethnic minorities. As a result, the sample overall reflects economically challenged and fragile families. Despite being a random sample, this national sample is not representative of the U.S. general population. The baseline sample size of the FFCWS was composed of 4,898 families.

2.3 Analytical Sample

The baseline sample size of the FFCWS was composed of 4,898 families that entered the FFCWS, 1876 were excluded due to missing data on race, mixed race, interracial marriages, other races, or Hispanic ethnicity. Besides, 100 other individuals did not have data on LBW, leaving the sample to 2922 Blacks and Whites with LBW data who entered our analysis for aim 1. From the initial number of 2922 Black of White births who started the study, 1604 Black or White newborns were successfully followed for 15 years (S. Assari, 2019b; S. Assari & Caldwell, 2019; S. Assari, C. H. Caldwell, & R. Mincy, 2018a; S.

Assari, C. H. Caldwell, & R. B. Mincy, 2018b; S. Assari, Thomas, Caldwell, & Mincy, 2018). The 15-year retention rate of Black and White families was 55%. The current analysis, however, only included births to Black and White mothers, given the study aim was to compare Black and White families for the effects of educational attainment on LBW (aim 1) and to test if baseline LBW would predict chronic diseases 15 years later (Wave 6). Figure 1 shows the flowchart of the sample and sample size for aims 1 to 3.

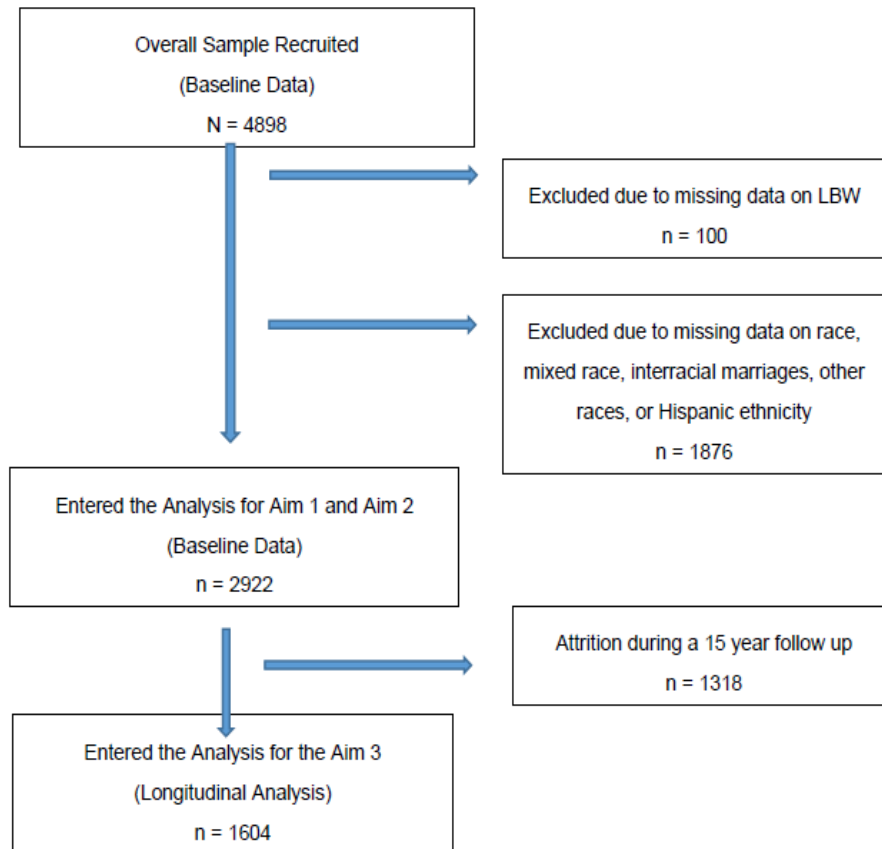


Figure 1. The Flowchart of the Sample Size for Study Aims

2.4 Study Variables

2.4.1 Independent Variables

The main independent variable was maternal educational attainment at the time of the birth of newborn (wave 1). Maternal educational attainment was a four-level variable: 1) “less than high school”, 2) “high school completed”, 3) “some college education”, and 4) “college completed”.

2.4.2 Covariate

Child gender, maternal age, family marital status, and family income at baseline were the study covariates. Child gender was a dichotomous variable: male = 1, female = 0. Maternal age at birth was a continuous measure. Household income level was also treated as a continuous measure (annual income divided by 1,000 US dollars). Family structure was a dichotomous variable: married=1, non-married=0.

2.4.3 Dependent Variables

Our outcome for aims 1 and 2 was LBW, defined as weight less than 2 ½ kilograms at birth (Baghianimoghadam et al., 2015). LBW was determined based on a direct measure of the weight of the newborn at the time of birth (Baghianimoghadam et al., 2015). We coded LBW (<2.5 kg) as 1 and 0 for normal birth weight.

Our main outcome in aim 3 was any chronic diseases that were diagnosed by a doctor. The parents/caregivers of the child at age 15 were asked: “Has a doctor or health professional ever told you that YOUTH has...?” Potential response options included yes 1, no 0. People could also refuse to answer or say don’t know, in which case, the data were coded as missing. Conditions that were assessed included heart disease, diabetes (DM), asthma, anemia, depression, limb disorders, seizure, Attention Deficit Hyperactivity Disorder (ADHD), autism, and others.

2.4.4 Moderator

Race/ethnicity, the focal moderator, was self-identified by the mother. This variable was operationalized as a dichotomous variable: non-Hispanic Blacks=1, non-Hispanic Whites=0.

2.5 Statistical Analysis

SPSS 22.0 (SPSS Inc., Chicago, IL, USA) was used for the data analysis. To describe the sample, we applied univariate analyses and reported frequency (%) and mean (standard deviation) for categorical and continuous measures. For the multivariable analysis, we used a series of nested logistic regression models in which the sample size was constant, and we were gradually adding covariates and interaction terms. We ran models in the overall sample and specific to race. For aims 1 and 2, our logistic regression models had LBW as the outcome and maternal education as the independent variable. For aim 3, we had chronic diseases (any) at age 15 as outcome and LBW at baseline (birth) as the predictor.

We ran five models for aims 1 and 2. *Model 1* only included the main effects of race, gender, and age. *Model 2* also controlled for SES indicators such as educational attainment. *Model 3* included a race by maternal education interaction term. *Model 4* and *Model 5* tested the same models in White and Black families, respectively. For aim 3, we only ran one logistic regression model. Regression coefficient, standard error (SE), Odds Ratios (OR), their 95% confidence intervals (95% CI), and their p-values were reported. As there were no more than one baby per family, all the modeling focused on between-family variation. There was no nested data with within family variation.

2.6 Ethics

The FFCWS was approved by the Institutional Review Board (IRB) of Princeton University. Mothers (and fathers if present) provided written informed consent. Youth provided assent at age 15. All the FFCWS data were collected, stored, and analyzed anonymously. Respondents received some financial compensation for their participation.

3. Results

3.1 Descriptive Statistics

This study included 2922 families who were either Black ($n = 2146$) or White ($n = 776$). All of these families had data on demographics and SES at wave 1 as well as LBW status. These families were followed from birth to the time that their child was 15 years old. One thousand six hundred four families had valid data on chronic diseases 15 years later. From this number, 590 did not have and 1014 did have a chronic disease at age 15. These numbers were indicative of independent observations (one youth per household).

Table 1 shows a summary of the descriptive statistics of the sample overall and by race/ethnicity. Most White and Black families were composed of married and unmarried couples.

Table 1. Categorical Data Overall ($n = 2922$)

Characteristics	N	%
Family Race		
White	776	26.6
Black	2146	73.4
Child Gender		
Male	1542	52.8
Female	1380	47.2
Family Structure (Married Parents) at Baseline ^{*a}		
No	2203	75.4
Yes	719	24.6
LBW		
No	2492	87.9
Yes	344	12.1
Chronic Diseases at age 15		
No	590	36.8
Yes	1014	63.2

* $p < 0.05$ (Blacks compared to Whites); ^a Pearson Chi-square test

As Table 2 shows, maternal age, educational attainment, and family income were all significantly lower in Black than White families. In addition, LBW and chronic diseases at age 15 were more common in Blacks than Whites.

Table 2. Continuous Data Overall and by Race/Ethnicity (n = 2922)

Characteristics	All n = 2922		Whites n = 776		Blacks n = 2146	
	Mean	SD	Mean	SD	Mean	SD
Maternal Age ^a	25.47	6.17	27.84	6.57	24.62	5.79
Family Income ^a	33.59	33.24	58.06	42.05	24.75	23.90
Maternal Education (1-4) ^a	2.23	1.01	2.82	1.06	2.02	0.90

* $p < 0.05$ (Blacks compared to Whites); ^a Independent sample t-test.

3.2 Types of Chronic Diseases by Race/Ethnicity and LBW Status

Table 3 shows the descriptives of the type of chronic diseases by race/ethnicity and LBW. For Blacks without and with LBWs, asthma was the most common chronic disease at age 15, with a prevalence of 25.8% and 40.1%, respectively ($p < 0.05$). ADHD was the second most commonly diagnosed chronic disease in Black youth without and with LBW, with a prevalence of 16.4% and 21.6%, respectively ($p < 0.05$). For Whites without and with LBW, other chronic diseases had a prevalence of 12.5% and 23.1% respectively, which was significantly different ($p < 0.05$). Asthma was also slightly more common in LBW+ than LBW- Whites with a prevalence of 20.5% versus 17.2%; however, these rates were not significantly different ($p < 0.05$).

Table 3. Descriptive of Each Type of Chronic Disease by Race/Ethnicity and LBW

	Whites						Blacks	
	LBW-		LBW+		LBW-		LBW+	
	n	%	n	%	N	%	n	%
Asthma	80	17.2	8	20.5	327	25.8*	71	40.1*
Anemia	9	1.9	0	0	30	2.4	5	2.8
Heart	12	2.6	3	7.7	34	2.7	4	2.3
Depression	90	19.4	6	15.8	95	7.5	16	9.0
DM	5	1.1	0	0	7	.6	3	1.7
Limb Disorders	20	4.3	3	7.7	33	2.6	3	1.7
Seizure	7	1.5	2	5.1	22	1.7	4	2.3
ADHD	101	21.7	6	15.4	207	16.4*	38	21.6*
Autism	23	4.9	2	5.1	20	1.6	3	1.7
Others	58	12.5*	9	23.1*	139	11.0	22	12.4

LBW: Low Birth Weight, ADHD: Attention Deficit Hyperactivity Disorder, DM: Diabetes Mellitus;

* $p < 0.05$ (LBW- compared to LBW+)

3.3 Race, Maternal Education, and LBW

Table 4 shows the main results of two logistic regression models. *Model 1*, which did not include our interaction term, showed that high maternal education was associated with lower odds of LBW. *Model 2* showed a significant interaction between race and maternal education level, suggesting a larger effect of high maternal education on reducing LBW for Whites than Blacks.

Table 4. Logistic Regression Models in the Overall Sample with Low Birth Weight as the Outcome

	Model 1 (Main Effects)			Model 2 (M1 + Interaction)		
	OR	95% CI	p	OR	95% CI	p
Race (Black)	1.39	1.00-1.93	.053	0.70	0.34-1.44	.329
Gender (Female)	1.31	1.04-1.65	.020	1.31	1.04-1.64	.021
Baseline Household Income (USD1000)	1.00	0.99-1.00	.765	1.00	0.99-1.00	.882
Baseline Family Structure (Married Parents)	0.55	0.37-0.81	.003	0.59	0.40-0.87	.008
Maternal educational Attainment (1-4)	0.87	0.75-1.00	.048	0.67	0.51-0.89	.006
Maternal educational Attainment (1-4) × Race				1.37	1.01-1.85	.044

Overall models are statistically significant; Outcome: LBW; Confidence Interval (CI); Odds Ratio (OR).

3.4 Maternal Education and LBW by Race/Ethnicity

Table 5 presents the statistics for two logistic regressions that were performed for race/ethnic groups. *Model 3* (Whites) and *Model 4* (Blacks) showed an association between maternal education and LBW for Whites but not Blacks.

Table 5. Logistic Regression Models with Low Birth Weight as the Outcome by Race

	Model 3 (White)			Model 4 (Black)		
	OR	95% CI	p	OR	95% CI	p
Gender (Female)	1.55	0.89-2.69	.124	1.26	0.98-1.62	.067
Household Income (USD1000) at Baseline	1.00	0.99-1.01	.668	1.00	0.99-1.01	.674
Family Structure (Married Parents) at Baseline	0.42	0.20-0.86	.018	0.69	0.44-1.08	.104
Maternal educational Attainment (1-4)	0.70	0.51-0.97	.031	0.92	0.78-1.08	.297

Overall models are statistically significant; Outcome: LBW; Confidence Interval (CI); Odds Ratio (OR).

3.5 Baseline LBW and Future Chronic Disease (any)

LBW was associated with higher odds of chronic disease in the sample. The effect of LBW on odds of chronic diseases remained significant above and beyond all confounders in the model ($p < 0.05$) (Table 6).

Table 6. Logistic Regression Model in the Overall Sample with Low Birth Weight as the Predictor and Chronic Disease (Any) as the Outcome

	OR	95% CI	p
Race (Blacks)	0.74	0.58-0.95	.019
Gender (Female)	0.71	0.60-0.85	< .001
Maternal Age	1.00	0.98-1.02	.974
Maternal educational Attainment	1.03	0.92-1.16	.586
Household Income (USD1000) at Baseline	1.00	0.99-1.00	.259
Family Structure (Married Parents) at Baseline	0.73	0.55-0.96	.026
LBW	1.38	1.03-1.85	.032
Intercept	1.56		.074

Overall models are statistically significant; Outcome: Any chronic diseases at age 15; Confidence Interval (CI); Odds Ratio (OR). LBW: Low Birth Weight

4. Discussion

The current study showed three findings: (a) overall, high maternal education protects newborns against LBW, (b) high maternal education protects White newborns but not Black newborns against LBW, (c) LBW predicts chronic diseases 15 years later.

We found that while highly educated White mothers are less likely to deliver LBW babies, highly educated Black mothers are at similarly high risk of delivering LBW babies as low educated Black mothers. This result is an indicator of MDRs of maternal education on LBW. Previously, MDRs of maternal education, family income, and household income have been reported for impulsivity (S. Assari, Caldwell, & Mincy, 2018a), school achievement (Assari S, 2019), and school bonding (S. Assari, 2019b). Similarly, Black kids from high SES families remain at high risk of obesity (S. Assari, Thomas, et al., 2018), anxiety (S. Assari, Caldwell, & Zimmerman, 2018), depression (S. Assari, 2018d), as well as chronic diseases (S. Assari, 2018a) such as ADHD (S. Assari & Caldwell, 2019), and asthma (S. Assari & Moghani Lankarani, 2018). That is, Black children and youth receive little protection from their family SES, which is in line with the MDRs.

This finding is similar to what was shown recently by Ross and his colleagues (Ross et al., 2019). Ross et al. tested if higher SES has a smaller impact on preeclampsia. The authors argued that preeclampsia risk should be accounted for when race-by-SES disparities in birth timing are considered. They studied 718,604 Black and White women who were a part of a California based population-based cohort. The study looked at smoking status during pregnancy, gestational length, public health insurance status, maternal education, and preeclampsia diagnosis. The authors found that race-by-SES interactions were significant for both education and insurance status. For White women, high SES further reduced the risk of preeclampsia. For Black women, however, the risk for preeclampsia was high, and SES did not

attenuate such high risk. The results suggest that diminishing returns of high SES contribute to a high prevalence of preeclampsia in Blacks (Ross et al., 2019).

The patterns reported here may help us understand why MDRs exist for adults. Our study suggests that MDRs that are commonly observed in adults can be traced back to childhood (S. Assari & Moghani Lankarani, 2018), adolescence (S. Assari, Caldwell, & Mincy, 2018a; S. Assari, Caldwell, & Mincy, 2018b; S. Assari, Thomas, et al., 2018), and even at birth. As a result of such an unequal start of the life-course, education does not equally translate to health outcomes for Blacks and Whites over the life-course.

The results reported here, and those shown by other studies propose that MDRs are not specific to any specific health outcomes. This observation suggests that upstream socialization processes that accompany race, also called racism, are responsible for a systemic difference between Whites and Blacks' ability gain health and well-being from educational attainment and other resources (S. Assari, 2017; Shervin Assari, 2018a). These patterns may not even be specific to race, as they have also been shown across ethnicities (Shervin Assari, 2019b; S. Assari, Farokhnia, & Mistry, 2019; Shervin & Ritesh, 2019) and sexual orientations (S. Assari, 2019a; Shervin Assari & Bazargan, 2019). Thus, it is not just racism, but any form of marginalization that reduces the health gain that follows SES.

MDRs can be seen in the context of the findings by other scholars. For example, Farmer and Ferraro published on MDRs of education on self-rated health (Farmer & Ferraro, 2005). In this study, Whites gained more than Blacks from an increase in their educational attainment. Shapiro and Oliver have published on the inequalities in wealth distribution as a consequence of unfair social policies such as Jim Crow and redlining (M. Oliver & Shapiro, 2013; M. L. Oliver & Shapiro, 1999). In the same line, Hamilton and Darity have conducted several studies documenting the enormous wealth gap in the United States (Hamilton & Darity Jr, 2009). Other scholars have also published on MDRs (Fuller-Rowell, Curtis, Doan, & Coe, 2015). For example, Hudson et al. have shown a reduced gain of SES in the lives of Blacks (Hudson, Bullard, et al., 2012; Hudson, Neighbors, Geronimus, & Jackson, 2012, 2016). In a recent study by Wilson, Thorpe, and LaVeist, income was found to differently reduce discrimination for Whites and Blacks (Wilson, Thorpe, & LaVeist, 2017). These are all in line with the Navarro's argument that living conditions and health are not a function of race or class (SES) but race and class (Navarro, 1989, 1990, 1991).

MDRs are attributed to several mechanisms and social processes (S. Assari, 2017; Shervin Assari, 2018a). First, they are due to structural and environmental factors (S. Assari, 2017; Shervin Assari, 2018a). For example, highly educated Black people have a higher tendency than their highly educated White counterparts to be exposed to second-hand tobacco smoke (B. M. Assari S). Similarly, highly educated ethnic minorities are more likely to be obese (S. Assari, 2018c; S. Assari, Thomas, et al., 2018), have high blood pressure (Shervin Assari, 2019b), have a worse diet (S. Assari & Lankarani, 2018), smoke cigarettes (S. Assari & Mistry, 2018), drink alcohol (S. Assari, Farokhnia, et al., 2019), be

depressed (S. Assari, 2018d), and have multiple chronic diseases (S. Assari & Moghani Lankarani, 2018).

Another mechanism behind MDRs is the higher psychosocial tax that Blacks pay for upward social mobility (S. Assari, 2018f). Blacks report high levels of stress at all mobility statuses. At the same time, highly educated Blacks report more stress associated with race and discrimination (S. Assari, 2018b). Blacks and Whites with the same education do not have similar wealth; wealth that could operate as a buffer and protect Blacks if life conditions become out of hand (M. Oliver & Shapiro, 2013; M. L. Oliver & Shapiro, 1999). Education also does not have the very same effects on generating income for Blacks and Whites, and doesn't necessarily bring the Black family out of poverty (Shervin Assari, 2018b).

Our last finding was also of significance. Although we found an association between LBW and chronic illness by the age of 15, the study does not implicate that all LBW babies will have a chronic disease. We also do not suggest that LBW is linked to birth "defects" that almost automatically leads to chronic illness by the age of 15 years. Presumably, the LBW babies who receive nutritious food, get access to health care and live in higher educational families do just as well as the normal birth weight babies. There is also a need for studying behavioral, nutritional, and environmental confounders of this association. It is more likely that the families with LBW babies are economically fragile; they have less education and income and are from unmarried families. They may also have poor adherence to the health care system. Thus, the link between LBW and future chronic disease may be because in these families, the child gets less nutritious food, does not get adequate health services, and have a lower level of parental education and family income. The mechanisms by which LBW increases the risk of chronic illness at the age of 15 should be investigated.

5. Implications

Our findings propose policy solutions that can help reduce health disparities in the United States. Previous policies have mainly tried to reduce inequalities in access to resources and have assumed that the elimination of inequalities in access would result in elimination of inequalities in outcomes. Our findings, however, suggest that given the MDRs, some of the racial and ethnic inequalities are not because of unequal access but the systemic disadvantage of Blacks and other ethnic groups in society. Without addressing MDRs, solely enhancing access to SES resources would not be enough for the elimination of health disparities. Thus, MDRs may contribute to the advancement of policies to reduce health disparities (Bailey et al., 2017; Butler & Rodgers, 2019; Gee & Ford, 2011; Louis, Menard, & Gee, 2015; Rodriguez, Bound, & Geronimus, 2014).

6. Limitations

The study has a few limitations. First, we did not have balanced samples of Blacks and Whites. The sample was not random. Other risk factors of LBW were not included in this study. A previous history of LBW, for example, could have a role as a confounder. The results are not generalizable to the total

population of White and Black American mothers. FFCWS has predominantly recruited economically fragile participants from large cities. Another limitation was that we did not have data on gestational age or premature deliveries. Racial differences are well described regarding birth weight and infant growth (Jung & Czajka-Narins, 1986). As the preterm birth rate is also higher in Black than White infants, future research may consider both LBW and preterm birth. Some research may also control for gestational age at delivery if studies have also measured gestational age at birth. The FFCWS cohort, as its title suggests, reflects the economically challenged and fragile families. In addition, this study has not matched Black and White participants for SES. Whites still have a higher income and higher overall education than Blacks. In addition, these data are from the U.S, and disparities found cannot be generalized to other countries with other ethnicities/races.

We did not include data on mothers' BMI or diabetes. Both high birth weight as well as LBW are common among diabetic mothers. While in this study the outcome variable was low birth weight (<2.5 kg), in the US, delivery of high weight babies is also a growing problem. Diabetic mothers are at risk of LBW deliveries as well having high weight babies. Future models could use either categorical variable <2.5 kg, 2.5-maybe 4 kg, >4 kg (check literature for correct cut-offs, or preferably use weight as a continuous variable). As relationships between race, SES, and baby weight may be U-shaped, modelling can face some challenges. Our study also did not take into account the normal cross-racial variation in the weight of babies. African American babies and White babies may differ in weight, regardless of their size. These normal differences should be studied. The lack of association between education and birth weight among black babies can presumably also due to the low/high weight babies. Black mothers are more often than White mothers to be obese and diabetic, therefore they are more likely also to have big babies. Diabetes and obesity may also be transferred to children who then may develop chronic health problems by the age of 15. In addition, due to poor employment conditions, lower education, low income, and early pregnancy, or even associate drug use during pregnancy, Black families may have difficulties with their nutrition, and may be exposed to a wide range of environmental and growth risk factors. All these mechanisms may contribute to the development of chronic health problems by the age of 15.

7. Conclusions

In a national sample of new mothers and their babies in U.S urban areas, in contrast to Whites for whom high maternal education reduces the odds of LBW, we observe a high prevalence of LBW across all education levels of Black women. That means that for White women, the prevalence of LBW is a function of educational attainment, and LBW deliveries are least common for highly educated White women. For Blacks, however, the LBW risk always remains high, regardless of the educational level of the mother. We also found evidence suggesting that LBW predicts chronic diseases 15 years later.

Author Contributions

S.A. conceptualized this paper, conducted the statistical analysis, prepared the first draft of the manuscript, and revised the paper. He also approved the final draft.

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Conflicts of Interest

The author declares no conflicts of interest.

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