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Racial Disparities in Gestational Weight Gain, Body Mass Index, And Physical Activity During Pregnancy and After Delivery

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RACIAL DISPARITIES IN GESTATIONAL WEIGHT GAIN, BODY MASS INDEX, AND PHYSICAL ACTIVITY DURING PREGNANCY AND AFTER DELIVERY

By

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ABSTRACT

Background & Purpose: African American women have higher rates of obesity than white women. Pregnancy is characterized by rapid weight gain, and 48.8% of women in South Carolina exceed recommended limits. Prenatal exercise is recommended and may help prevent excessive gestational weight gain (GWG). Our purpose was to determine whether GWG and prenatal exercise levels differed between African American and Caucasian women.

Methods: We included 79 women who delivered a singleton infant 6 months - 3 years ago and were free from smoking, type 1 or 2 diabetes, or use of steroids or protease inhibitors (mean age =31.3 yrs; mean BMI= 29.5 kg/m^2; 22.4% African American). Participants self-reported their exercise habits during their second trimester of pregnancy using a validated survey. GWG in their most recent pregnancy was self-reported. Height and weight were measured with a stadiometer and digital scale. Differences in mean GWG and physical activity by race were assessed using Wilcoxon ranked-sum tests and a t-test. Associations of race with exercise and GWG were evaluated with linear regression, adjusted for current BMI and gestational age at delivery.

Results: There was no difference in mean GWG or pregnancy exercise between Black and White women. There was no association of race with GWG, B =-3.9, P=0.55. Pregnancy exercise was not associated with GWG, B= -0.14, P=0.28. However, an association between GWG and BMI was significance, B=-0.92, P= .028.

Conclusion: The results indicated no difference in GWG or pregnancy exercise by race and no associations of race or pregnancy exercise with GWG. However, an association of GWG with BMI approached significance. A future study should consider race differences in Institute of Medicine GWG categories defined by prenatal BMI.

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LIST OF ABBREVIATIONS

ACOG ..... American College of Obstetrics and Gynecology

APOs .....Adverse Pregnancy Outcomes

BMI ..... Body Mass Index

GWG ..... Gestational Weight Gain

HDP .....Hypertensive Disorder in Pregnancy

CHAPTER 1

LIT REVIEW

1.1 OBESITY, PREGNANCY COMPLICATIONS, AND PHYSICAL ACTIVITY

There is an increase in the prevalence of women entering pregnancy obese or overweight from 29.8% to 38.0%, which is a huge public health concern (Chen,2018). Approximately 75% of Non-Hispanic Black women and 50% of non-Hispanic white women of childbearing age are overweight or obese (Whitaker, 2016). Pre-pregnancy health is very important it is a large determinant of the woman and fetus health. There is a direct tie to your pre-pregnancy, pregnancy, and post pregnancy health. Lane-Cordova, et al, performed a study to determine the associations of body mass index and blood pressure trajectories in the 5 years preceding pregnancy and incident hypertensive disorders of pregnancy (HDP). There was a total of 1342 women for BMI analyses and 2266 women for blood pressure analyses. Data was collected from the Northwestern Medicine Enterprise Data Warehouse and data was analyzed using logistic regression. There was an association of higher-normal blood pressure trajectory and pre-hypertensive trajectory with HDP. There was also an elevated risk for HDPs in obese women. This study's findings suggest that pre-pregnancy BMI and blood pressure patterns are associated with HDPs. This data suggests that by maintaining a healthy normal weight prior to pregnancy a woman can have lower odds of HDPs (Lane-Cordova, 2018).

About half of women in their childbearing years meet the 2008 Physical Activity Guidelines for Americans of 150 minutes of moderate-intensity physical activity weekly (Garland, 2019). Being active while pregnant can improve a woman's mental health, reduce discomfort, and reduce risk of complications (Garland,2019). Unfortunately, most women reduce their physical activity during pregnancy (Garland, 2019). Fewer than 15% of pregnant women achieve the recommended levels of physical activity (Garland, 2019). High pre-pregnancy BMI is associated with lower physical activity during pregnancy (Garland, 2019). Physical inactivity is the fourth leading risk factor for early mortality worldwide (ACOG Committee, 2020). Physical inactivity and excessive weight gain while pregnant are independent risk factors for maternal obesity and pregnancy complications (ACOG Committee, 2020). There is an educational gap of women fully understanding the 2008 Physical Activity Guidelines for Americans (Garland, 2019). Some women do not understand the importance of consistency or the different components of physical activity (Garland. 2019). According to the literature, there is a lack of clarity in the guidelines of physical activity, which is leading to a large amount of weight gain and pregnancy complications (Garland, 2019). The women have a different perception of physical activity and weight gain during pregnancy depending on their ethnicity or race (Garland,2019).

1.2 PRE-PREGNANCY HEALTH AND EXCESSIVE GESTATIONAL WEIGHT GAIN SHORT- AND LONG-TERM EFFECTS

The increase in pre-pregnancy BMI can lead to excessive gestational weight gain (Whitaker,2016). Up to 50% of women are currently exceeding the Institute of Medicine pregnancy weight gain guidelines (Whitaker, 2016). Women who are inactive during

pregnancy are more likely to gain excessive weight (Batakat,2016). Excessive gestational weight gain can lead to gestational diabetes, delivery by caesarean section, and risk to their child of childhood obesity (Jiang,2012). Evidence suggests that women that participate in regular physical activity have a reduced risk of developing pregnancy induced hypertension and preeclampsia (Barakat,2016). The origin of pregnancy hypertension is unknown, however there is a link to maternal factors such as: GWG, pre-pregnancy BMI, and maternal obesity that increase the risk of pregnancy hypertension disorders (Barakat,2016). These consequences can also be associated with neonatal birthweight (Barakat, 2016). Barakat et al examined the impact of supervised exercise throughout pregnancy on pregnancy induced hypertension. This was a randomized control study, which included an exercise intervention and usual care control group. The exercise group trained aerobic, muscle strengthening, and flexibility for three days a week from weeks 9-12 through their third trimester. The results of this study indicated that exercise reduced the rate of hypertension, preeclampsia, and gestational diabetes in all women (Barakat,2016). Exercise also prevented excessive weight gain based on their pre-pregnancy BMI. Overall, the exercising women gained less weight than the control women (Barakat,2016). Exercise was also able to decrease the amount of macrosomia babies and increase the amount of normal sized babies. When pre-pregnancy BMI was stratified exercise reduced the incidence of hypertension and macrosomia; it also prevented excessive GWG. These findings indicate that early pregnancy physical activity can reduce the risk of many pregnancy complications and adverse fetal outcomes.

The number of cesarean deliveries has continued to increase throughout the last few years, approximately 15% of births worldwide are cesarean delivery

(Davenport,2019). The prevalence of this mode of delivery is higher in minorities, specifically Non-Hispanic Black women (Raper,2021). Thirty-six percent of Non-Hispanic Black women delivery by caesarean section (Raper,2021). This invasive procedure is associated with an increased risk of adverse maternal and fetal outcomes. Studies have suggested that regular exercise during pregnancy reduces the risk of caesarean deliveries (Melzer,2010). Takami's et al study focused on how physical activity and exercise habits before and during pregnancy influence pregnancy outcome. This study included 92,796 pregnant women who completed a physical activity questionnaire in their first, second, and third trimester. Based off the surveys the women were divided into 4 groups: very low, low, medium, and high. When comparing the very low group and high group there was a significant difference between caesarean deliveries and instrumental deliveries. From this study, we can conclude that a low level of physical activity during pregnancy can increase the risk of operative delivery (Takami,2018). Poyatos at el findings are in line with this study stating that physical activity during pregnancy can increase the likelihood of vaginal delivery (Poyatos,2015). Specifically, exercise in the second and third trimester increases the possibility of vaginal delivery and reduces risk of caesarean delivery (Poyatos, 2015).

Macrosomia can be a possible cause of instrumental delivery (Davenport,2019). Prenatal exercise has been proven to reduce fetal macrosomia by 31% (Davenport,2019). Unfortunately, the prevalence of infant macrosomia has steady increased in the US. Maternal BMI is a strong predictor of the infant's birthweight, larger women tend to have larger babies. (McDonald,2019). McDonald at el performed a study to determine the moderating effects of maternal self-reported physical activity in the preconception and

prenatal periods on the risk of infant macrosomia (McDonald,2019). The findings of this study indicated that participation in physical activity during pregnancy significantly modified the association between maternal BMI (McDonald,2019). The study also concluded that low levels of maternal physical activity does increase the risk of delivering a macrosomia infant (Mcdonald,2019).

1.3 PERSPECTIVES OF PHYSICAL ACTIVITY DURING PREGNANCY

Pregnant women want to do what is best for their fetus but are unsure or do not have accessibility to the dietary or physical activity needs to have a healthy pregnancy (Whitaker, 2016). It is important to understand that everyone has a different view of healthy verse nonhealthy and obese verse normal weight. In 2016, Whitaker performed a study to describe African American and White women's perceptions of weight gain, physical activity, and nutrition during pregnancy to explore the differences in perceptions by race (Whitaker, 2016) This study included thirty patients who were recruited by interviews from two South Carolina clinics (Whitaker, 2016). All women had to be African American or Caucasian, 20-30 weeks pregnant, pre-pregnancy BMI of 18.5-45.0 kg/m2, 18-44 years old, singleton pregnancy, and initiated prenatal care for less than 16 weeks' gestation (Whitaker, 2016). Information was gathered through interviews using Theory of Planned Behavior (Whitaker, 2016). In their finding, 43% of the women reported intended weight gain within the IOM guidelines and 37% were above the recommendation (Whitaker, 2016). The women above the weight gain recommendation were obese or overweight. Nine of the 30 women stated the recommendation for pre-pregnancy BMI were too low (Whitaker, 2016). All these women were obese or overweight (Whitaker,2016). The women discussed how excessive weight gain could

negatively impact their personal health but did not think of the negative impact on the fetus (Whiaker,2016). Less than half of the women had an idea of a sufficient physical activity plan, but once informed they thought that the expectations were more than reasonable (Whitaker, 2016). Interestingly, most of the participants in this study said that their partner influenced them to exercise and not their doctor (Whitaker, 2016). This study suggests a lack of awareness of the risk of excessive weight gain for the baby and the benefits of physical activity (Whitaker, 2016). During pregnancy a women's lifestyle behaviors are easily influenced (Whitaker, 2016). This is a time when women are highly motivated to change for the good of their baby (Whitaker, 2016). Properly informing and reminding women of the benefits of pre-pregnancy health could help prevent health and fetus complications.

Even women with the correct concept of recommended physical activity levels during pregnancy may not engage in the appropriate amount of physical activity to benefit both them and their baby (Evenson,2010). Evenson's 2010 study was performed to understand the beliefs on exercise and physical activity among pregnant women. This study included 1306 women with a median age of 30 from the southeast United States. The results of this study indicated that 78% of most woman can continue exercise during pregnancy (Evenson,2010). 68% of them stated that women who never exercised could begin during pregnancy (Evenson,2010). American College of Obstetrics and Gynecology (ACOG) encourages all women to be evaluated before starting a new exercise regiment, so it would be unsafe for a woman who has never exercised before to jump into a program (Evenson,2010). 32 % of the women did not believe that women could continue regularly exercising during pregnancy (Evenson,2010). According

ACOG, women can continue to exercise regularly in pregnancy (Evenson,2010). This guideline also emphasizes that regular exercise is better than irregular exercise during pregnancy (Evenson, 2010). ACOG recommends that pregnant women engage in moderate intensity activity (Evenson, 2010). Women are also encouraged to be evaluated before starting a new exercise program (Evenson, 2010). The guidelines also suggest women avoid exercise lying on their backs during second and third trimester. ACOG also states that women should avoid standing without moving (Evenson,2010).

Seventeen percent of the women agreed that pregnant women should not exercise on their backs in the first trimester, but sixty-four percent agreed for second trimester and eighty-one percent agreed for the third trimester (Evenson,2010). ACOG recommends avoiding exercise lying on your back during second and third, but not first trimester (Evenson,2010). Most of the women agreed that there was a benefit of exercise to the labor and delivery process, but not all thought of the benefits of the child (Evenson,2010). These results indicate that groups of pregnant women are more likely to have misconceptions about exercise according to ACOG.

1.4 PRE-PREGNANCY HEALTH AND ACTIVITY DETERMINE MATERNAL AND INFANT HEALTH

There is not just one reason for women not meeting the necessary recommended physical activity according to the Physical Activity Guidelines, Garland's systemic review provided information on demographic, pregnancy, and health determinants to physical health, which allows the readers to better understand barriers of physical activity (Garland,2019). If individuals were older their physical activity was low, in this case "older" was defined as older than 25 years old (Garland, 2019). Educated and employed

individuals are more likely to be active (Garland, 2019). Individuals with higher income were more likely to be active (Garland, 2019). Multiparity women were less likely to be active and especially if the pregnancies were subsequent (Garland,2019). Any discomfort or worries would also lead to a decrease in physical activity (Garland,2019). Mental health is a large component of being physical active during pregnancy (Garland, 2019). Women in good mental health and pre-pregnancy exercisers are more likely to be active (Garland,2019). Women that smoke and have high BMI are less likely to be active (Garland,2019). The findings of this literature suggest that women that are higher risk have higher perceived barriers to being physically active (Garland,2019).

None of the research found significant racial disparities in physical activity. There seems to be a misconception regarding physical activity in all races (Everson, 2010). The issue is that people have different perceptions of physical activity (Whitaker, 2016). These findings suggest that there is a large misunderstanding of the importance of physical activity in pregnant women, but also women in general (Whitaker, 2016). It is not that these women do not want to be active, it is that they are unaware how to approach the process (Evenson, 2004). These findings also show the importance of pre-pregnancy health. There is a large gap in knowledge of physical activity that must be filled by doctors and researchers (Whitaker 2016, Everson, 2004). If the importance of physical activity is stressed earlier, it can hopefully lead to an increase in physical activity pre-pregnancy (Barakat,2016). These findings suggest a decrease in pre and post pregnancy BMI, decrease in blood pressure, which will lead to a decrease in disease.

The benefits of exercise during pregnancy might be especially important for Black mothers. Black individuals struggle with many cardiovascular disease risk factors,

including hypertension. Cardiovascular disease is a major cause of death in the African American community and is the primary cause of life expectancy disparities between African Americans and Caucasians (Carnethon, 2017). Obesity and hypertensions measured at a single-point immediately preceding or during early pregnancy are associated with an increased risk of pregnancy hypertensive disorders (Lane-Cordova, 2018). Overall, the literature has proven the strong benefits of physical activity on pregnancy outcome.

This study was conducted to determine the difference in absolute GWG and mid-gestational physical activity between Black and White participants. Also, we aimed to determine the association of mid-gestational physical activity and gestational weight gain, adjusted for gestational age at delivery, race, and current BMI. We hypothesize that the absolute GWG will higher in Black women and mid-gestational physical activity will be lower in Black women. This hypothesis was supported by the published data We further hypothesize that total mid gestational physical activity and gestational weight gain will be a negatively associated. We believe the correlation will persist after the adjustment and that race will be associated with gestational weight gain.

CHAPTER 2

AIMS AND HYPOTHESIS

The aim of this study is to determine the difference in absolute GWG and mid-gestational physical activity between Black and White participants. Also, to determine the association of mid-gestational physical activity and gestational weight gain, adjusted for gestational age at delivery, race, and current BMI. We hypothesize that the absolute GWG will be higher in black women and mid-gestational physical activity will be lower in black women.

We further hypothesize that total mid gestational physical activity and gestational weight gain will be a negatively related. We believe the correlation will persist after the adjustment.

CHAPTER 3

METHODS

3.1 Study Design and Participants

This is a case-control study conducted in Columbia, South Carolina at the University of South Carolina starting in late 2018. This study measured indices of cardiovascular health in women with adverse pregnancy outcomes. Participants must have had a singleton birth 6 months -3 years ago. Participants were required to attend to one study visit. Participants were recruited through media advertisement, referral from other research studies, and word of mouth. Exclusion criteria consisted of smoking, having type 1or 2 diabetes, or use of steroids or protease inhibitors. All participants provided written informed consent. All research procedures were approved by the University of South Carolina Institutional Review Board.

3.2 Exposure

Exercise levels: Leisure exercise was assessed through the Godin Leisure-Time Exercise Questionnaire. Participants were asked to recall their physical activity during their second trimester of pregnancy. The participants self-reported their pregnancy physical activity based on a seven-day period, ranking it from strenuous, moderate, or mild exercise. They were also asked how long they engaged in regular activity to work up a sweat. The rankings being often, sometimes, or never.

Gestational weight gain and delivery outcomes: Gestational weight gain (GWG) and fetal outcomes (macrosomia and mode of delivery) were self-reported using a medical history questionnaire.

3.3 Covariates

Gestational age at delivery and race were self-reported. Height and weight were measured using a stadiometer and digital scale during their visit. Weight in kg and height in m^2 were used to calculate body mass index (BMI).

3.4 Statistical Analysis

After assessing normality with a Shapiro-Wilk test, the differences in absolute GWG and mid-gestational physical activity by race was assessed using Wilcoxon ranked-sum tests or a t-test, depending on the distribution of data. Simple correlations of physical activity and GWG were assessed with a correlation analysis. The associations of mid-gestational physical activity and GWG (continuous data) were evaluated with linear regression, adjusted for current BMI, race, and gestational age at delivery.

CHAPTER 4

RESULTS

Participants. On average the age of the White participants was higher than the Black participants. The Black women had higher BMIs than the White women. The Black women had higher systolic and diastolic blood pressures, Table 4.1.

GWG and Physical Activity. There were no differences in mean GWG or physical activity by race, Table 4.1.

Correlation. There was no correlation between GWG and leisure activity, Figure 4.4. There was also no correlation between GWG and strenuous exercise, Figure 4.5.

Delivery outcomes. There was significance in mode of delivery by race. There was no significance of infant macrosomia by race, Table 4.2.

Regression. There was no association of race with GWG, B =-3.9, P=0.55. Pregnancy exercise was not associated with GWG, B= -0.14, P=0.28. However, an association between GWG and BMI was significance, B=-0.92, P= .028.

Table 4.1: Participant Characteristics of Pregnancy Exercise, Gestational Weight Gain, and Blood Pressure (n=78)

Mean ± SE or %	White (n= 59)	Black (n= 19)
Age (yrs)*	33± 0.7	30± 1.3
BMI (kg/m^2)*	27± 1.1	32± 1.7
Gestational Weight Gain (lb)	30.6± 2.3	23.6± 6.5
Pregnancy Exercise (au)	32.5± 3.2	26.3± 5.2
Systolic Blood Pressure (mmHg)*	109.1± 1.9	118.3± 4.5
Diastolic Blood Pressure (mmHg)*	68.8± 1.4	76.8± 4.0

Table Legend. BMI: Body Mass Index; Gestational Weight Gain: amount of weight women gained while pregnant; Pregnancy exercise: amount and intensity of exercise per week as measured by the Godin Leisure-time exercise questionnaire (a score of at least 24 represents an adequate exercise level), arbitrary unit.

Table 4.2: Mode of Delivery and Infant outcomes

Mean ± SE or %	White (n= 58)	Black (n= 19)
Mode of Delivery: C-Section*	17.2 (10)	47.4 (9)
Infant Birth Weight	123.5 ± 2.56	119.2 ± 3.63
Normal Weight	73.0	92.0
Macrosomia	27.0	8.0

Table Legend: C-section: caesarean delivery; Macrosomia: a baby that is larger than 4000g.

Figure 4.1: Physical Activity of Participants by Race

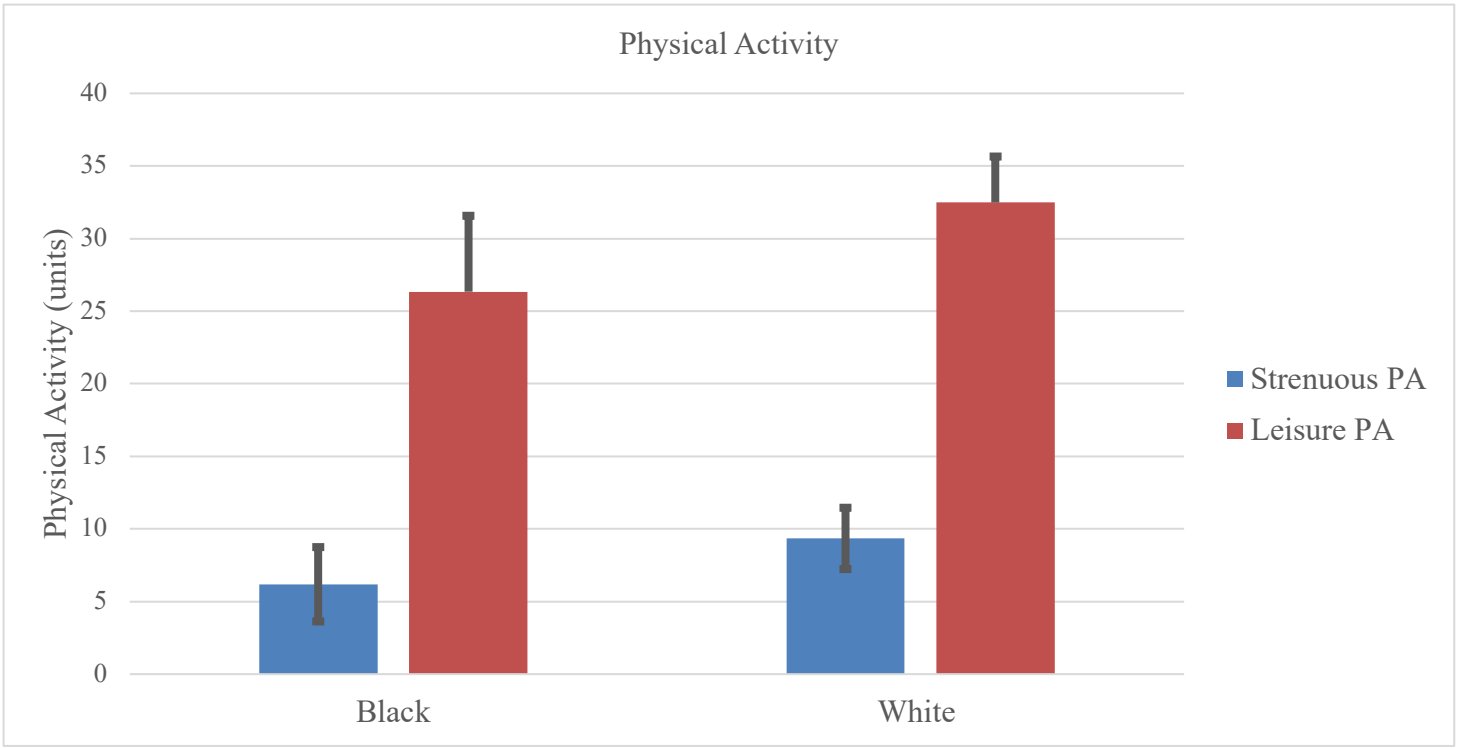

Figure Legend. Mid-gestational activity separated by strenuous and leisure physical activity. The intensity of exercise per week as measured by the Godin Leisure-time exercise questionnaire.

Figure 4.2: Gestational Weight Gain by Physical Activity

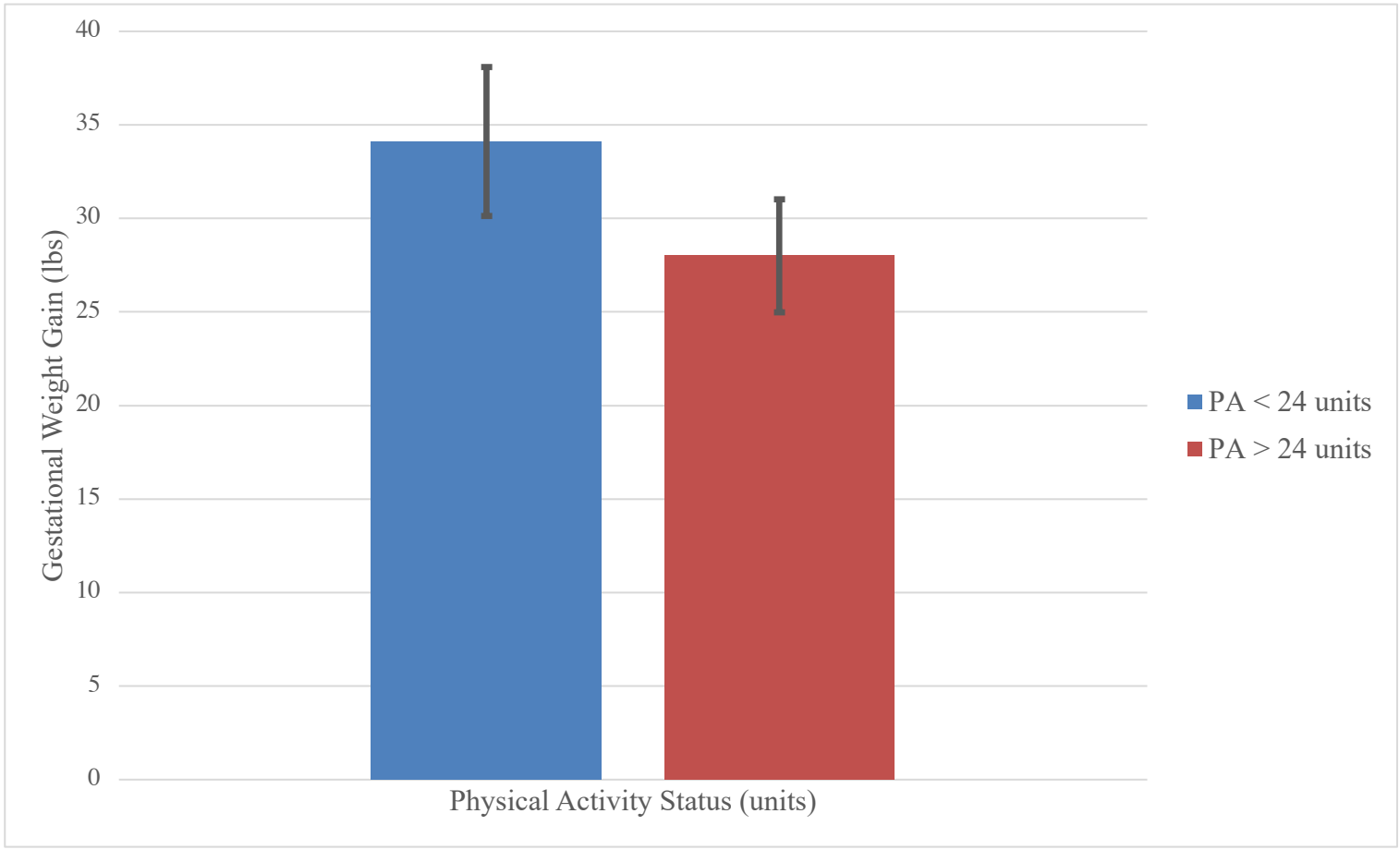

Figure Legend: Midgestational activity behaviors and gestational weight gain. PA: physical activity

Figure 4.3: Gestational Weight Gain and Physical Activity by Race

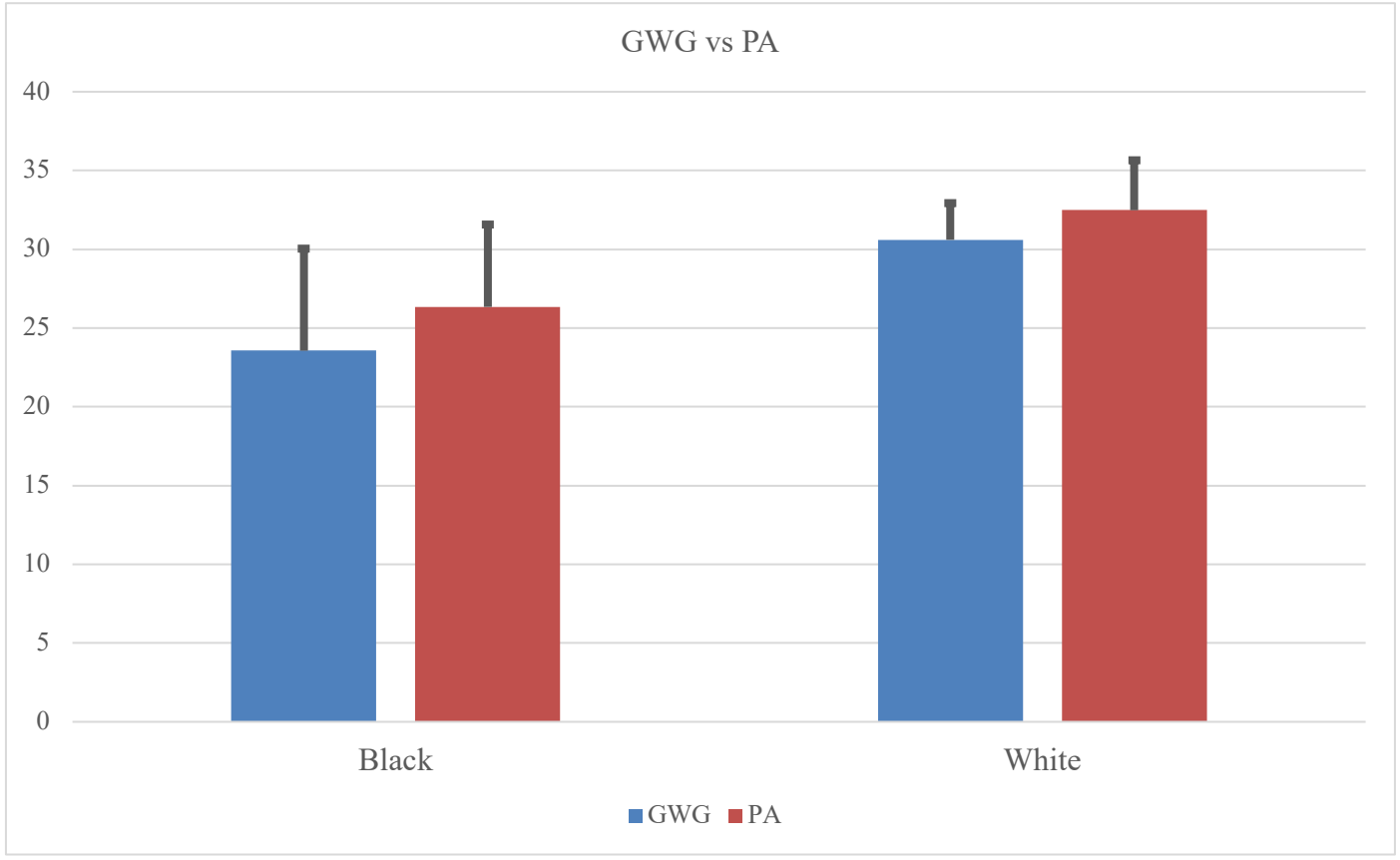

Figure Legend: Midgestational activity behaviors and gestational weight gain by race. The left bars represent the black participants GWG and PA. The right bars represent the white participants GWG and PA. PA: physical activity GWG: Gestational Weight Gain

Figure 4.4: Gestational Weight Gain and Leisure Activity

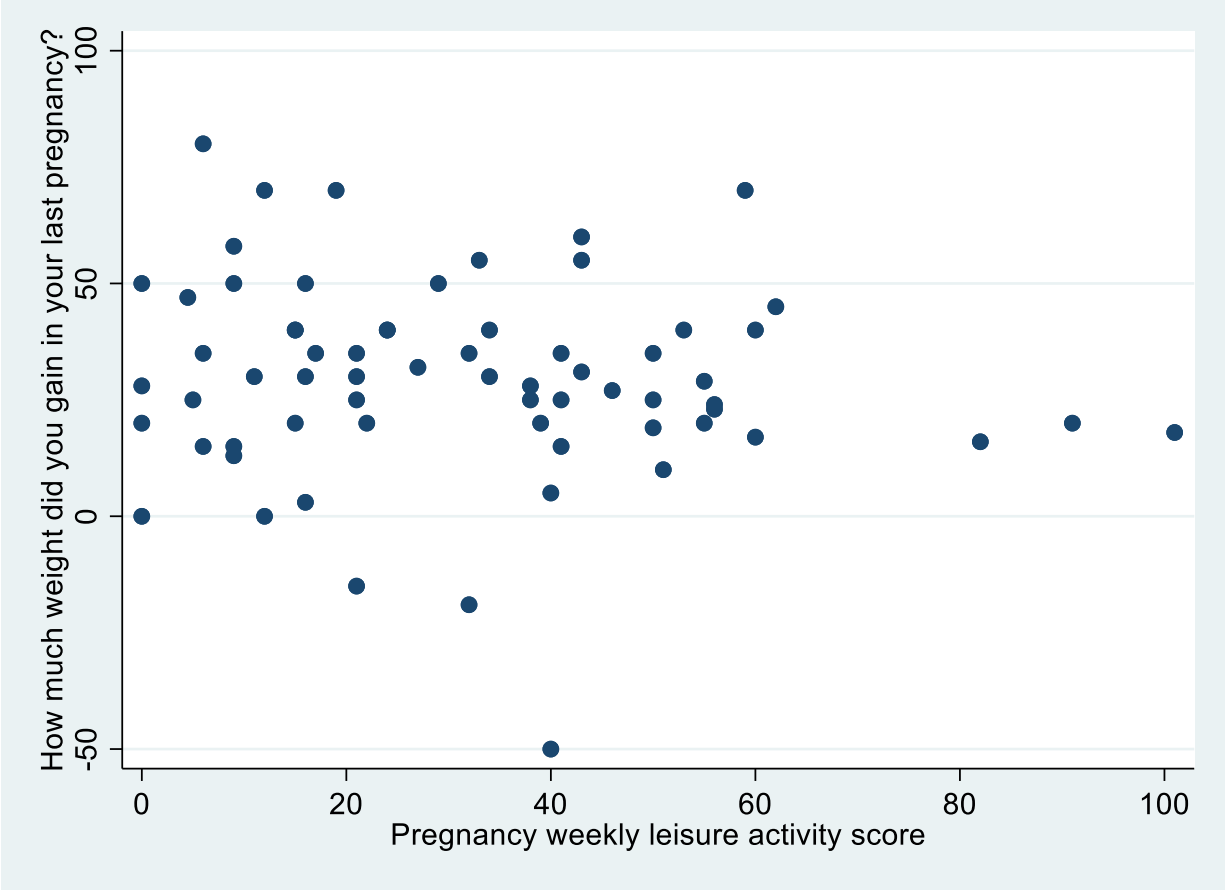

Figure Legend: Gestational weight gain and leisure activity. Leisure activity was determined by Godin Leisure-time exercise questionnaire

Figure 4.5: Gestational Weight Gain and Strenuous Activity

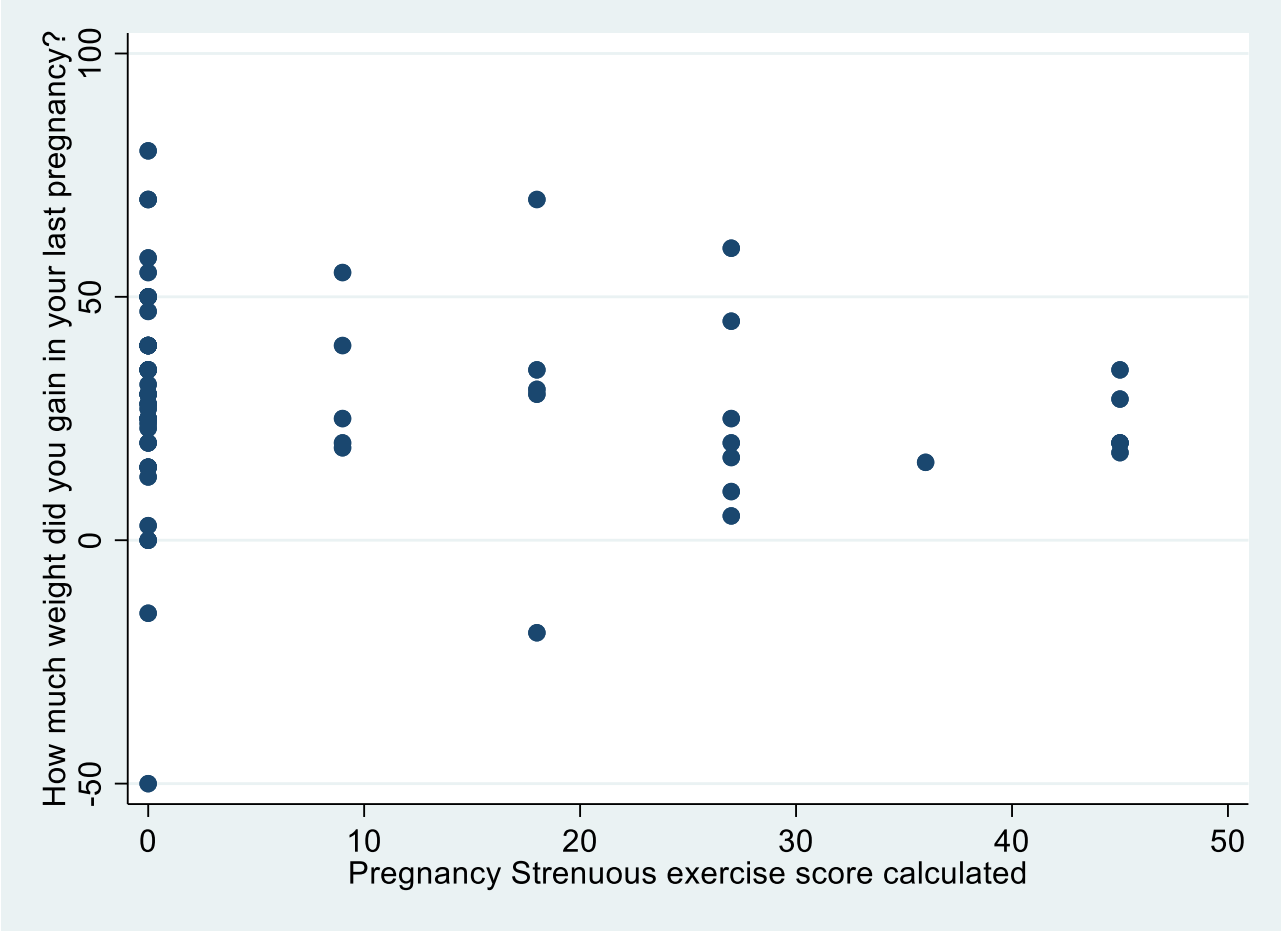

Figure Legend: Gestational Weight Gain and strenuous exercise score. The intensity of exercise per week as measured by the Godin Leisure-time exercise questionnaire.

CHAPTER 5

DISCUSSION

5.1 MAIN FINDINGS AND OUTCOMES

Overall, our study found no relationship between GWG and physical activity. The results of this study indicated no difference in GWG or pregnancy exercise by race and no associations of race or pregnancy exercise with GWG. However, an association of GWG with BMI was significant, indicating that women with a higher BMI reported less GWG. Our findings do not align with other research studies.

In contrast, the literature found evidence of the impact of physical activity on gestational weight gain, BMI, and pregnancy outcomes. However, there was not a significance in racial disparities with physical activity (Evenson,2010). The importance of pre-pregnancy health to the maternal and fetal outcome was supported through various studies. Research indicated that a high pre-pregnancy BMI is associated with lower physical activity during pregnancy (Garland, 2019). By maintaining a healthy normal weight prior to pregnancy, a woman can have lower odds of HDPs. The increase in pre-pregnancy BMI can lead to excessive gestational weight gain (Whitaker, 2016). Maternal BMI is a strong predictor of macrosomia. (McDonald,2019) Participation in physical activity during pregnancy significantly modified the association between maternal BMI(McDonald,2019). Evidence suggested that women that participate in regular

physical activity had a reduced risk of developing pregnancy induced hypertension and preeclampsia (Barakat,2016). Pre-pregnancy activity can be very beneficial, but there are also many benefits of prenatal physical activity supported by the literature. Research has proven that physical inactivity and excessive weight gain while pregnant are independent risk factors for maternal obesity and pregnancy complications (ACOG Committee, 2020). In Barkat at el study the findings indicated that exercise reduced the rate of hypertension, preeclampsia, and gestational diabetes in all women (Barakat,2016). Exercise was also prevented excessive weight gain and macrosomia based on their pre-pregnancy BMI (Barkakat,2016). Regular exercise was also able to reduce the risk of caesarean delivery (Barakat,2016). Low levels of physical activity increased the risk of operative deliver (Takami,2018). A lack of awareness of the risk of excessive weight gain and benefits of physical activity was found through in Whitaker at el. Forty-three percent of the women reported an intended weight gain within the IOM guidelines and 37% were above the recommendation (Whitaker, 2016). Nine of the thirty women stated the recommendation for pre-pregnancy BMI was too low (Whitaker, 2016). Less than half of the women had an idea of a sufficient physical activity plan (Whitaker, 2016). In the research there was a common theme of misconception of exercise guidelines by the women. Seventy-eight percent of most woman can continue exercise during pregnancy (Evenson,2010). Sixty-eight percent of them stated that women who never exercised could begin during pregnancy (Evenson,2010). Thirty-two percent of the women did not believe that women could continue regularly exercising during pregnancy (Evenson,2010). Seventeen percent of the women agreed that pregnant women should not exercise on their backs in the first trimester, but 44% agreed for second trimester and 81% percent agreed for the third

trimester (Evenson,2010). Overall, exercise benefited the women These studies proved the importance of physical activity pre and post pregnancy to the maternal and fetus health.

In Raper at el, an exercise intervention was conducted to determine the effects of a prenatal aerobic moderate-intensity exercise intervention on the association between maternal race ethnicity and select delivery and birth outcomes between Non- Hispanic White and Non-Hispanic White pregnant women. This study included an aerobic exercise and non-exercise stretching/ breathing group. This study found that maternal race was significantly associated with neonatal birthweight with Non-Hispanic Blacks delivery smaller infants (Raper,2021). This study also determined that prenatal exercise could prevent the relationship between maternal race and neonatal birth weight (Raper,2021). Our data may have not shown this relationship because of the small amount African American women in the study. There was also a difference in the odds of exercising during pregnancy for Black and White. The literature also yielded a strong correlation of GWG and prenatal physical activity. Barakat et al examined the impact of supervised exercise throughout pregnancy on pregnancy induced hypertension. This was a randomized control study, which included an exercise intervention and usual care control group. The exercise group trained aerobic, muscle strengthening, and flexibility for three days a week from weeks 9-12 through their third trimester. The results of this study indicated that exercise was also prevented excessive weight gain based on their pre-pregnancy BMI(Barakat,2016). Overall, the exercising women gained less weight than the control women (Barakat,2016). Exercise was also able to decrease the amount of macrosomia babies and increase the amount of normal sized babies. When pre-pregnancy

BMI was stratified exercise reduced the incidence of hypertension and macrosomia; it also prevented excessive GWG (Barakat,2016). In our research we were unable to obtain the women's pre-pregnancy BMI, so it difficult to determine the true relationship of GWG and mid-gestational pregnancy. We also did not obtain pre-pregnancy calorie intake. Since we are unaware of their energy balance it is difficult to see the true changes and causes in weight gain or loss during pregnancy. In our study the participants physical activity was measured by a validated survey from recollection. The participants were expected to recall their activity 6 months to 3 years ago, which makes it difficult to be accurately determine their physical activity.

5.2 FUTURE DIRECTION

A future study should consider race differences in Institute of Medicine GWG categories defined by prenatal BMI. A future study should also include a questionnaire to identify the women's caloric intake to better access the changes in physical activity and weight gain throughout their pregnancy. A future study could also include an increase in diverse population to improve the accuracy of the findings. By adding an objective measure like an accelerometer to the study along with the validated surveys would improve the accuracy of physical activity measurements. In conclusion, our study found no relationship between GWG and physical activity. There was also no significant difference in GWG or physical activity by race and no associations of race or physical activity with GWG. However, there was a significant association of GWG with BMI.

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