The Impact of SNAP Participation on Pregnancy Weight Related Outcomes and Program Participation of Pregnant WIC Participants in Arizona; a Cross Sectional Study

by

Alexandra Stolworthy

A Thesis Presented in Partial Fulfillment
of the Requirements for the Degree
Master of Science

Approved June 2022 by the
Graduate Supervisory Committee:

Meg Bruening, Chair
Corrie Whisner
Devina Wadhera

ARIZONA STATE UNIVERSITY

December 2022

ABSTRACT

Purpose: Although numerous studies exist regarding the health impact of the Special, Supplemental Program for Women, Infants and Children (WIC) and the Supplemental Nutrition Assistance Program (SNAP) on their participants', limited studies have examined how participation in one federal nutrition assistance program, may impact participation or perceived benefit of the other. This study aimed to examine how SNAP participation may impact weight-related pregnancy outcomes and participation of pregnant WIC participants.

Methods: The present study is a cross-sectional, secondary data analysis of data available from the Arizona Department of Health Services. A total of 35,659 pregnant woman participated in the Arizona WIC program during 2018 and were included in the study. Pregnant participants were assigned to Group WIC or Group WIC+SNAP respectively. Data was aggregated to the clinic level and clinics with less than 10 pregnant participants were combined for a total of 101 clinics included in the analysis. Weight-related pregnancy outcomes measures included average pre-pregnancy weight, average gestational weight gain, BMI class, and delivery weight. Participation indicator outcomes included average number of visits during pregnancy, timing of first prenatal and postnatal WIC appointment, and entry into WIC within the first trimester. Race, ethnicity, language, and education were also analyzed.

Results: This study found average pre-pregnancy weight was statistically significant for women in group SNAP+WIC weighing 2.8 kg more than women in group WIC($p<0.001$). Group WIC had a lower delivery weight average ($p<0.001$) and a higher amount of women beginning pregnancy with a normal BMI ($p=0.004$). Group WIC

participants were statistically more likely to not enroll in WIC during the first trimester compared with Group WIC+SNAP (p=0.049). Group WIC was more likely to enroll in the 8th (p=0.045) and 9th month (p=0.009) of pregnancy and attend their first postpartum visit 6 months after delivery (p=0.007) as compared to Group WIC+SNAP.

Conclusions: This study found that pregnant WIC participants, not enrolled in SNAP have a lower pre-pregnancy weight and are more likely not to enroll within the first trimester. Future research should focus on individualized characteristics of WIC participants to further improve prenatal and postnatal support.

DEDICATION

This thesis is dedicated to my wonderful husband. Without your support and willingness to carry ‘our team’ throughout the last year, none of this would have been possible. You have lifted me up, pushed me along, and surrounded me with positivity and light. Thank you for being there for our babies when I could not. Thank you for becoming an expert dishwasher and bed maker Thank you for you inspiring me, by just being the hard-working person that you are. I love you with my whole heart.

ACKNOWLEDGMENTS

There are numerous individuals that worked with and alongside me to complete this thesis and deserve to be acknowledged.

First, I would like to acknowledge my committee chair Dr. Meg Bruening. Despite all that you do and preparing to begin a new chapter, you were always available for support and guidance. From you I learned to step back, breath, and take a true rest. This work seemed manageable with you as a mentor, which is no easy feat. You have been a true inspiration.

To my chairs, Professor Corrie Whisner and Devina Wadhera, PhD, thank you for all your guidance and input. Corrie you are a truly genuine and caring person, and I value the detailed and precise guidance and feedback you have always provided. Devina, thank you for your continual support with my data and analysis. Your ability to communicate and educate on complicated concepts in a way that is easily understood has been invaluable. This would not have been possible without you.

I would also like to acknowledge my parents, Marc and Lisa and my stepparents, Tom and Lilan. I cannot express my gratitude for your continued commitment to my education and career enough. You have all taught me that it is possible to be an amazing parent and partner while pursuing what you love.

Lastly, I would like to acknowledge my husband, Logan, and my children Violet and Sam. Logan your commitment to me, and our family knows no bounds. You do it all and never complain. Violet and Sam, you remind me every day that play is the best

medicine, and sometimes jumping in the pool is more beneficial to the writing process than simply pushing through. You make everything more fun, and I love you.

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CHAPTER 1

INTRODUCTION

The time before, during and following pregnancy are critical periods within a women's life course that will impact her health and the health of her child[1]. By the age of twenty-five, approximately one quarter of women in the United States have conceived one child and data from the Centers for Disease Control (CDC) estimates that 3,605,201 infants were born in 2020 [2] . Unfortunately, 25% of women receive inadequate prenatal care during pregnancy and certain sociodemographic groups are at an increased risk[3]. Black, Hispanic, Native American, less educated, and low-income women are the most likely to receive limited and/or delayed prenatal care beginning in the second or third trimester as a result of limited access to healthcare, inadequate prenatal care providers and lack of transportation[3,4]. Inadequate prenatal care is associated with a multitude of maternal health risks including maternal mortality, maternal morbidity, shortened inter conception intervals, nutrient deficiency, inappropriate gestational weight gain (GWG), weight retention, and subsequent obesity[1,5,6].

Maternal obesity is the most common pregnancy complication in the United States with 38.4% of women conceiving within a body mass index (BMI) category that defines them as overweight (>25) or obese (>30)[5]. Sixty percent of women who are overweight or obese gain excessive pregnancy weight. Pregnant women in other sociodemographic groups such as Black, Hispanic, low income, nulliparous and women below the age of 18 are also at increased risk for obesity [7]. Excessive GWG has been associated with traumatic birth, cesarean delivery, anemia, infertility, maternal weight retention, diabetes mellitus, cardiometabolic conditions and maternal and childhood

obesity[8,9]. Therefore, reducing preconceptional BMI and achieving improved GWG are public health issues, as they may impact global maternal and childhood weight-related outcomes.

Until the 1970's, guidelines for pregnancy weight gain were not well established, with all women being instructed to gain 20 to 25 lbs[10] . Then in 1990, the Institute of Medicine established the first concrete provider guidelines, recommending varying amounts of weight based on pre pregnancy BMI[11]. These recommendations were later revised in 2009 to reflect the current female population in the United States who were more ethnically and racially diverse as well as increasingly overweight and obese[11,12]. The IOM 2009 guidelines recommend that underweight women gain between 28-40 lbs., normal weight 25-35 lbs., overweight between 15-25 lbs. and obese women between 11-20 lbs. to achieve optimal birth outcomes[11]

While providers widely accept the 2009 IOM guidelines, only 26.1% of women report receiving information on GWG, and only 1 in 4 women report that the information provided was consistent with IOM recommendations[13]. Evidence supports that Black, Hispanic, overweight, and obese women are least likely to receive counseling[13]. Lack of counseling is concerning as pregnancy is a distinct time when women may be more receptive to nutrition and dietary recommendations and more focused on achieving improved nutritional quality[14]. According to the Healthy Eating Index for Americans, which assigns a score of 0 to 100 depending on compliance with the Dietary Guidelines for Americans, pregnant women scored a 63, while non pregnant women scored a 54, indicating that nutrition quality may be improved during pregnancy[15].

Two of the most well-known and nutrition assistance programs in the United States are the Supplemental Nutrition Assistance Program (SNAP), formerly known as Food Stamps and The Special Supplemental Nutrition Program for Women, Infants and Children (WIC). SNAP provides eligible participants with a monthly allotment of funds to purchase a wide variety of foods. While participation in SNAP may enhance food security, a growing body of research supports that SNAP participation may decrease the diet quality of participants by encouraging the consumption of energy-dense, nutrient-poor foods[16]. While SNAP does have an educational component (SNAP-Ed), this program only reaches 15% of SNAP participants[17]. SNAP-Ed provides education to SNAP participants on how to make the most of their benefits, cook healthy meals and stay physically active[18].

WIC however, was specifically implemented to improve the nutritional quality of women and children's diets during times of exponential growth, namely infancy, childhood and pregnancy, when nutrition complications are most likely to occur[19]. The program provides nutritionally dense foods, nutrition education, breastfeeding support and community resources and referrals[19]. A WIC eligible woman or child who has qualified for SNAP and is actively participating in the program, is adjunctively eligible for the WIC program. Individuals may participate in both programs simultaneously, and participation in both programs is highly encouraged to maximize benefits.

Unlike other food assistance programs, WIC can provide nutrition counseling to women prior, during and after pregnancy, with women identified as high risk for pregnancy complications receiving enhanced opportunity for counseling and support[20].

Furthermore, WIC utilizes patient-centered counseling to improve behavioral health outcomes which in combination with providing nutrient-dense foods may lead to improved pregnancy outcomes[21]. WIC served 50% of all pregnant women in the United States in 2017 and is uniquely positioned to improve GWG in a large population of low-income and minority women [22].

Current research primarily examines the association of pre-pregnancy BMI and GWG with birth weight and subsequent weight status[21]. Substantially less research focuses on the unintended maternal health implications such as pre-pregnancy weight, GWG and timing of prenatal care. In addition, to our knowledge no studies have examined the impact of SNAP participation on these measures of a healthy pregnancy and participation and utilization of the WIC program.

Purpose of Study

The purpose of this study is to examine differences in healthy pregnancy measures including pre-pregnancy BMI, GWG and WIC participation indicators among women participating in WIC only versus WIC and SNAP. We conducted a secondary data analysis of pregnant women enrolled in the Arizona WIC program between Jan 1, 2018, and Dec 1, 2019, who had an actual or expected delivery date in 2018 and were certified on or before Jan 1, 2019.

Research Aims and Hypothesis

To improve understanding of how participation in SNAP impacts pregnancy weight related outcomes and program participation of pregnant women enrolled in WIC, we propose the following two hypotheses:

H1: Pregnant WIC participants also enrolled in SNAP will have a higher pre-pregnancy weight and will be more likely to gain GWG above 2009 recommendations as compared to WIC participants not enrolled in SNAP.

H2: Pregnant WIC participants also enrolled in SNAP will be less likely to utilize WIC services as indicated by timing of first prenatal WIC appointment, number of appointments attended while pregnant and timing of first post-partum WIC appointment as compared to WIC participants not enrolled in SNAP.

Definition of Terms:

BMI: BMI is a person's weight in kilograms divided by the square of height in meters[23]. If BMI is less than 18.5, it falls within the underweight range. If BMI is 18.5 to <25, it falls within the healthy weight range. If BMI is 25.0 to <30, it falls within the overweight range. If BMI is 30.0 or higher, it falls within the obesity range.

Obesity: Weight that is higher than what is considered healthy for a given height is described as overweight or obesity. Obesity is frequently subdivided into categories[23]: Class 1: BMI of 30 to < 35, Class 2: BMI of 35 to < 40, Class 3: BMI of 40 or higher. Class 3 obesity is sometimes categorized as "severe" obesity.

Supplemental Nutrition Assistance Program: The Supplemental Nutrition Assistance Program (SNAP) is the largest federal nutrition assistance program. SNAP provides benefits to eligible low-income individuals and families via an Electronic Benefits Transfer card. This card can be used like a debit card to purchase eligible food in authorized retail food stores[24].

The Special Supplemental Program for Women, Infants and Children: The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides

federal grants to states for supplemental foods, health care referrals, and nutrition education for low-income pregnant, breastfeeding, and non-breastfeeding postpartum women, and to infants and children up to age five who are found to be at nutritional risk[19].

Institute of Medicine: The Institute of Medicine (IOM), renamed The National Academy of Medicine (NAM) in 2015, is one of three academies that make up the National Academies of Sciences, Engineering, and Medicine in the United States. The National Academies are private, nonprofit institutions that work outside of government to provide objective advice on matters of science, technology, and health[25].

Limitations and Delimitations

A central limitation of this study is self-reported pre-pregnancy and post-delivery weight by WIC participants. Participants are asked to verbally state their weight to the best of their ability. Another limitation is that aggregated participant data was used in accordance with stringent WIC data sharing agreements. The results provided are therefore averages provided at clinic level rather than for specific WIC participants. Furthermore, as we did not have gestational weight gain information of pregnant women in Arizona not participating in WIC or SNAP or participating only in SNAP and not WIC, it is difficult to determine a control for this specific study. However, we do believe that any significant differences observed between the two study groups will be beneficial in promoting further research and policy in nutrition assistance programs.

A delimitation of this study is that results only apply to low-income women participating in nutrition assistance programs living in Arizona.

CHAPTER 2

REVIEW OF LITERATURE

Obesity

Obesity, broadly defined as an excess of body fat associated with increased health risks, is a chronic and stigmatizing disease which effects approximately 13% of all adults globally [26,27]. In the United States specifically, approximately 40.2% of all Americans are overweight, a substantial increase from the 30.2% reported in 1999 [23]. Using weight circumference and BMI data collected from 1999 to 2016, Wang et al. determined that despite a short period between 2012-2016 when obesity levels remained relatively stable, obesity will continue to rise across all ages and races and by 2030 approximately 50% of the adults in the United States will be obese[28]. Most shockingly is the increase in individuals with severe obesity (BMI >40 kg/m^2). In the 1970's, 1 in 50 individuals were classified as severely obese, however in 2019 1 in 10 individuals are considered morbidly obese[29].

Like many chronic conditions, obesity follows a gradient in which individuals in certain socioeconomic groups are most at risk for developing the disease. Women with lower income and education levels, are at the highest risk of developing obesity[30].

Associated Risk Factors and Obesity Determinants

Obesity if a multifaceted disease that is often grossly simplified and misunderstood. A common belief is that weight gain is caused simply by 'eating too much and exercising too little', however many factors contribute to a person's body size. Recent research has identified that the food environment in which an individual resides

may be directly related to obesity and nutrition quality[31]. Certain communities and environments are completely void of supermarkets and food distributors and have been deemed 'food deserts' as access to fresh and nutritionally dense foods are limited. Residents of these areas may heavily rely on food available at gas stations or local convenience stores which are often highly processed, high in saturated fat and added sugar[27]. Overrepresentation of convenience and processed items in markets and retailers and technological advances, which reduce daily physical activity, have created 'obesogenic environments', associated with increased rates of obesity[32].

Conversely, certain environments have been deemed 'food swamps' and have an overabundance of fast food and liquor stores, where high fat, calorically dense foods are readily available. One study found that living in food swamps was associated with increased sugar sweetened beverage (SSB) and increased body weight[33]. Furthermore, recent research supports the concept of the food insecurity-obesity paradox in which food insecure individuals are more likely to be overweight or obese[34] . Food insecurity, which is roughly defined as not having adequate access to food, has also been associated with poorer diet quality and health outcomes[35]. Research supports that food insecure women are at the greatest risk for developing obesity, while results are mixed for children as well as men[34].

Of course, individual factors as well as environmental factors are associated with obesity. Genetics is one factor that may account for as much as 40-75% of body size as explored through a classic study where identical twins were separated at birth[36] The correlation coefficient between twins was 0.7, while the significant correlation was found

between each twin in their respective families[36]. Promoting the concept that regardless of environment, an individual may be genetically inclined to develop obesity.

The gut microbiome is also of increasing interest when it comes to exploring the etiology of obesity. Infants born vaginally demonstrate improved gut flora and may be less likely to develop obesity[27]. Moreover, infants born via cesarean section have been found to gain weight more rapidly in the first six months of life, however whether this rapid growth continues into childhood is unclear[37]. A mother's choice to breastfeed may also impact her child's weight later in life, as breastmilk has been associated with decreased risk of obesity and higher body weight[38].

As a child grows, the home food environment may play an important role in the development of obesity[39]. During childhood, many of a child's food choices will be impacted by the choices of adults living in their home and the availability of food. As previously mentioned, food insecurity has been linked to overweight and obesity in adults, and this is also true of children[40]. Children experiencing low food security are more likely to be served highly processed foods and have reduced intake of fruits and vegetables, resulting in a lower overall diet quality score[40]. Childhood obesity is disproportionately high in certain ethnic and racial groups with obesity in Hispanic children five times greater compared with non-Hispanic white children and three times greater in non-Hispanic black children[41]. Recent research also supports that individuals living with chronic stress, such as overt racial or socioeconomic discrimination or daily microaggressions, may be more likely to develop obesity, which may also contribute to overweight and obesity being higher in Hispanic and African American individuals[27].

Furthermore, the parenting style practiced by parental figures may also contribute to the home food environment and subsequent childhood obesity[39]. Birch et al. found that when mother's utilized restrictive feeding patterns, such as removing or hiding foods with high fat and sugar from the home, young girls were likely to eat in the absence of hunger and consume food with less regard for internal hunger and fullness cues[42]. Conversely, the children of parents with an authoritative parenting style, who set clear boundaries around food and mealtimes have been found to consume an increased amount of fruit and vegetables which may contribute to reduced body weight[40]. Numerous studies also support that family mealtimes in which parents and caregivers may also model positive eating behaviors, may be associated with improved diet quality and body weight[43]. Moreover, the amount of screen time allowed in the home is considered a modifiable risk factor for childhood obesity as it may contribute to less physical activity and increase overall body weight[39].

Lastly, a growing body of research supports that weight stigma and weight bias may also contribute to obesity. Individuals with obesity are at increased risk for weight cycling and binge eating disorders which have both been associated with increased weight gain[44]. Individuals living with obesity are also less likely to receive counseling on lifestyle management, including interventions to support healthy living[45]. A large percentage of individuals living with obesity have also been shown to avoid or delay care due to provider stigma of their weight[46]. This delay in care increases the likelihood that weight loss and weight management practices will not occur[46].

Consequences of Obesity

Obesity has been associated with an increased risk of a myriad of detrimental physical health outcomes as well as overall morbidity and mortality [27]. A large body of research supports that obesity may contribute to increase risk of hypertension and cardiovascular disease such as dyslipidemia, congestive heart failure and stroke[47]. In their examination of the Nurses Health Studies, Hruby et al. found that a weight gain of ten kilograms or more after the age of 18 increased the likelihood of developing heart disease by 60%[48]. The same group of researchers found that women with a BMI of 27 were 42% more likely to suffer from a stroke, compared to women with a BMI of 21[48]. Individuals who are overweight or obese may also be at increased risk for developing Type 2 diabetes[47]. Women with a BMI of 35 or more were found to have more than six times the risk of developing Type 2 Diabetes compared to women with a BMI of 22[48]. Furthermore, obesity, especially in adolescent females, has been associated with increased risk of developing asthma[49]. Lastly, obesity has been associated with increased risk of developing numerous cancerous including, but not limited to, ovarian, colorectal, esophageal, breast, and pancreatic cancers[50].

Obesity may also contribute to a variety of negative mental health consequences. In recent years, research supports that an association between obesity and depression may exist, and that the association is strongest in women with higher socioeconomic status[51]. This could be a result of depression being associated with increased food intake and decreased physical activity leading to increased overall body weight[46]. Studies have also shown that when individuals with obesity experience stigma, they are more likely to overeat as a result[52]. Increased risk for overt stigma and discrimination due to a person's

size may also lead to increased depressive symptoms as well as anxiety and even post-traumatic stress disorder[27,53].

Maternal Obesity

Maternal obesity effects many women worldwide and in the United States. From 2016 to 2019, the prevalence of maternal obesity rose from 21% to 29% in non-Hispanic white, Hispanic and African American women[54]. However, the percentage of Black women with obesity is significantly higher than that of non-Hispanic white women. In 2019, 39.1% of Black women were considered obese in comparison with 26.1% of non-Hispanic white women[54]. These percentages of consistent with findings from Wang and colleagues who found that although prevalence of obesity was higher in men than in women, racial disparities were significantly higher in women[55].

Maternal obesity is associated with a multitude of negative health consequences. Women with obesity have been shown to be at increased risk for depression and anxiety. In a study of 544 women, women BMI >30 was associated 5.25 increase in developing major depressive disorders and significant increases in general anxiety disorders[56].

Maternal obesity is associated with less-than-optimal pregnancy outcomes. This is concerning as approximately 1/3 of all women will begin their pregnancy as overweight or obese[57]. More specifically, 21% of pregnant women begin their pregnancy as overweight, while 9% begin their pregnancy as obese[58]. Research supports that woman who begin their pregnancy in an overweight or obese category are more likely to suffer from traumatic delivery, gestational diabetes, and post-partum weight retention. Obesity during pregnancy has also been associated with a sustained increase in body weight following the pregnancy which may continue through the remainder of a women's life[5].

Interventions that aim to reduce prenatal maternal obesity may increase maternal health by decreasing the likelihood of subsequent overweight and obesity following pregnancy.

Pregnancy

Gestational Weight Gain

Achieving appropriate GWG is an essential aspect of a healthy pregnancy. Notably, the first GWG recommendations were provided in 1970 instructing all women, regardless of weight, to gain between 20-25 lbs. [10]. In 1990, the Institute of Medicine (IOM), developed guidance for pregnancy weight gain based on pre-pregnancy weight, generally acknowledging that 'underweight' and 'normal' weight women should gain more weight than 'overweight' or 'obese' women[12]. The 1990 IOM guidelines were lacking recommendations in several key areas. Recommendations did not include sufficient evidence to support an upper weight limit for obese women, guidance regarding multiple gestation, nor was it inclusive of women with short stature or women in minority groups [12]. New recommendations were developed by IOM in 2009 and remain the standard for GWG recommendations [59]. The 2009 IOM revision recommends that for singleton pregnancies, underweight women (BMI <18.5 kg/m^2) gain between 28-40 lbs, normal weight women (18.5-24.9 kg/m^2) 25-35 lbs., overweight women (25-29.9 kg/m^2) gain between 15-25 lbs., and obese women (>30 kg/m^2) gain between 11-20 lbs. [60].

Differences in gestational weight gain have been observed between different racial groups. White, non-Hispanic women, considered to be within normal or overweight BMI range may be the most susceptible to gain above recommended amount of weight, while several studies have shown that Hispanic women are the most likely to gain within

the recommendations for their specific BMI[8,59]. In regard to black women, Rothburg et al. reported mean weight gain of less than white counterparts, however Siega-Riz et al. demonstrated through their systematic review that black women consistently gained more than white women[8,61]. It should be noted however that, more inclusive research is needed to examine whether the IOM 2009 guidelines are appropriate for all races and ethnicities as well as how culture and socioeconomic status impact weight gain.

Components of Weight Gain During Pregnancy

Maternal and fetal growth contribute to the cumulative amount of weight gained during gestation. A study conducted in 1991 by Hytten and Chamberlain, identified the general weights of various tissues and products of pregnancy by examining the GWG of normal weight women who delivered infants with optimal birth weight[58]. They determined that the fetus (7.5 lbs.), placenta (1.43 lbs.) and amniotic fluid (1.76) pounds accounted for slightly less than half of total weight gain[58]. Maternal tissues (3.04 pounds), increase in blood volume and fluid (4.36 pounds), maternal fat stores (7.4 pounds) and possible edema (4.7 pounds) contributed to the remaining weight gain[58]. These measurements, equating to roughly 30 lbs., are important as they provide helpful insight into the minimum amount of weight gain required by a woman with normal BMI during pregnancy. It is the weight gained in excess of these metabolic processes that is concerning when it comes to GWG, as excess weight can be attributed to excessive calorie intake and fat storage.

Research examining GWG for women who are overweight and obese is limited. When the 1990 IOM recommendations were first published, for example, there was insufficient evidence to provide an upper weight recommendation for obese women. An

upper limit was provided in the updated guidance in 2009, however some research supports that the provided limit may be liberal, and lower recommendations would provide improved birth outcomes. Numerous studies suggest that roughly 48-62% of women gain more than the recommended amount of weight during pregnancy[8]. Overweight and obese women are at an increased risk of gaining an excessive amount of weight during pregnancy. It is estimated that only one in four women with obesity gain within the GWG recommendation[58]. This is concerning as more women than ever are considered overweight or obese at conception and sound guidance is still not available for providers to discuss pregnancy weight gain recommendations [9,61].

Physical Health Risks Associated with Excessive GWG

Excessive wait gain during pregnancy, exceeding the 2009 IOM recommendations is associated with adverse health outcomes to both mother and infant. One of the greatest concerns is that increased gestational weight gain may lead to subsequent weight retention which can contribute to the development of obesity[62]. A recent study found that 68% of women lose insufficient weight following pregnancy and shift upwards into the next BMI category[8,63]. Weight retention in the first trimester has been associated with insulin resistance and infant loss[64]. Excessive weight gain prior to delivery is associated weight retention, traumatic delivery, cesarean delivery, maternal anemia and macrosomia[8,9,59.] Weight retention following pregnancy has been associated with increased risk of infertility, cardiometabolic risk, venous thromboembolism and diabetes mellitus[8,64] .

Breastfeeding may decrease weight retention, however overweight and obese mothers are statistically less likely to breastfeed [64,65]. One study found that breastfeeding for 20 weeks, significantly lowered weight retention leading into subsequent pregnancies[62]. Breastfeeding may offer protective mental health benefits as well, however women who are overweight or obese may be less likely to experience the positive effects.

Maternal Dietary Recommendations

Pregnancy is a unique time when a woman's behaviors and dietary patterns are susceptible to change and may have lasting impacts on health status. Some research exists to demonstrate that women may be more open to improving diet quality and health behaviors during pregnancy creating an opportune time for improved acceptance of clinician education[14]. According to the Healthy Eating Index for Americans, which scores eating patterns with a maximum score value of 100 points, based on how well an individual meets the Dietary Guidelines for Americans (DGA) non-pregnant women obtained an overall score of 54, while pregnant women achieved an improved score of 63, highlighting that pregnancy may be an opportune time to provide dietary counseling as women are more likely to improve dietary behavior during this time[66].

Nutrient status before and during pregnancy is critical to support the health of mother and child. An important aspect of maternal nutrition is consuming an appropriate amount of calories to meet the increasing need of the infant and maternal nutrient and protein stores. Women with a normal BMI are encouraged to consume an additional 350-452 kcal/day in the second and third trimesters[67]. Increased energy intake for women with obesity are not as well researched. A recent prospective, observational study found that

the recommended weight gain of 5-9 kg was achieved for obese women when they consumed 125 +/ 52 kcal per day[68].

Key nutrients have been identified to support maternal and child health outcomes, including folic acid, choline, iron, iodine and calcium[15]. However, people do not consume single nutrients, they consider whole foods containing these nutrients, so studies which capture the relative intake of pregnant women can be most useful in determining diet quality. A recent study using data from the National Institute of Child Health and Development Fetal Growth Studies-Singleton Cohort, found that less than 1/3 or participants were meeting recommendations for whole grains and vegetable intake and were exceeding empty calorie intake[69].

Research widely suggests that no safe limit of alcohol consumption has been identified for pregnant women. Caffeine consumption should also be limited to no more than 300 mg/day to avoid increased risk of preterm labor and low birth weight infants. As a woman's ability to defend against illness is decreased during pregnancy, women are also advised to follow stringent food safety protocols. Avoidance of uncooked or undercooked meat, eggs and seafood and thoroughly washing produce, especially lettuce, are widely recommended[15].

Access to Prenatal Care

In 2020, 74.7% of women received early and adequate prenatal care[70]. One of the goals of Healthy People 2030, is to increase the percentage of women receiving prenatal care to 80.5%[70]. In Arizona specifically, 68.9% of women in 2019 began prenatal care within the first trimester, with only 2.9% receiving no prenatal care[71]. Additionally, in

Arizona, 89.9% of all women received ≥5 prenatal visits[71]. Females below the age of 15 have some of the highest rates of inadequate prenatal care utilization, as do American Indian women[72]. Additionally, low income women, and women living in rural areas are more less likely to participate in prenatal care services due to lack of insurance and access to healthcare[73].

Research supports that prenatal care, when initiated early, with regularly scheduled appointments, provides the most benefit to the mother and child and can reduce the risk of developing excessive gestational weight gain, gestational diabetes, and maternal mortality and morbidity[3]. Since 2009, the number of women with gestational diabetes has increased from 3.9 to 8.7% and the amount of women who have gained excessive gestational weight gain has increased from 26.8% to 47.0% in Arizona[74]. Although roughly half of pregnant women initiate early and adequate prenatal care services, maternal mortality and morbidity continue to rise, demonstrating the continued need for improved healthcare services for, especially for low-income women.

Provider Impact on Gestational Weight Gain

Obstetricians and gynecologists (OBGYN) along with other medical and community healthcare works, play an essential role in informing clients of appropriate GWG to achieve optimal maternal health outcomes. However, a study conducted in 2002 found that approximately 41.5% of women reporting never receiving weight gain recommendations by their health care providers and 26.1% of women received recommendations that were inconsistent with 2009 IOM guidelines [13]. These findings are consistent with findings from a more recent study, conducted by Morris et al, which

found that only 21% of women received personalized GWG recommendations from medical providers[75]. The same study found statistical significance (P<0.001) that midwives were more likely to provide weight gain recommendations and focus recommendations on health behaviors rather than weight[75].

Certain sociodemographic groups of women are more likely to receive prenatal counseling than others. A recent qualitative study examining potential barriers to achieving appropriate weight gain during pregnancy in low income, overweight and obese women found that the majority of women received conflicting information regarding weight gain recommendations [76]. This is consistent with findings from Anderson et al who found that only 41% of pregnant women received guidance regarding their weight, with overweight, obese, young and women carrying multiples being the least likely to receive guidance[77] . Furthermore, research suggests that women who are overweight and obese are more likely to delay or reject prenatal care due to feeling stigmatized by providers who lack the training and supplies to appropriately care for women living in larger bodies[78].

Prenatal counseling on weight and health behaviors was associated with improved GWG in the FIT for Delivery Study[79]. In the Fit for Delivery Study conducted by Phelan et. all, statistically significant improvements in GWG were perceived in an intervention group who were delivered information on the importance of physical activity, low fat foods and recommended GWG targets[79].

Nutrition Assistance Programs

Overview

Despite increasing rates of obesity, food insecurity continues to effect families in the United States. Since 1996, the United States has gathered data on food insecurity in the US through the Core Food Security Module (CFSM) particularly through the Current Population Survey (CPS)[80]. The two most utilized surveys, The U.S. Household Food Security Module and The Adult Food Security Module utilize 18 and 10 questions to determine a measurement of food security ranging from High Food Security to Very Low Food Security. High Food Security indicates no issues with food access, while Very Low Food Security indicates that an individual or family reports numerous hardships accessing food resulting in hunger and potential weight loss[81].

The United States Department of Agriculture (USDA) houses Food and Nutrition Services which oversees 15 programs to combat food insecurity in the United States[82]. The goal of these fifteen programs, which impact one out of every four Americans, is to reduce food insecurity and hunger for people of all ages[83]. This study will focus on two of the largest nutrition assistance programs, The Supplemental Nutrition Assistance Program (SNAP) and The Special Supplemental Nutrition Program for Women, Infants and Children (WIC) as they serve a relatively diverse population of low-income women.

The Supplemental Nutrition Assistance Program

Program Overview

The Supplemental Nutrition Assistance Program (SNAP), formerly known as Food Stamps was formally enacted in 1964 with the passing of the Food Stamp Act under

President Johnson to improve nutrition quality and to combat food insecurity in low-income houselholds[84]. Today, SNAP is the largest food assistance program in the United States serving approximately 42.8 million individuals and distributing roughly 79.8 billion dollars in benefits in fiscal year 2021[24]. SNAP is operationalized at the state level with federal oversite from USDA's Food Nutrition Services (FNS) branch.

Eligibility and Benefits

Potential participants must meet income eligibility standards, determined by the state in which they apply. Gross income must not exceed 130% of the poverty line, and households may not possess more than $2,500.00 in assetts[80]. Eligibility criteria is less stringent for families with members who are disabled or senior citizens[85]. Previously, able bodied participants were required to provide proof of work to continue receiving benefits, however this requirement has been suspended due to COVID-19[85].

SNAP differs from other food assistance programs in that participants receive varying monthly sums of money depending on their income, rather than receiving the same amount, regardless of income, once they are eligible like the NSLP or WIC programs. Benefit amounts are based on the Thrifty Food Plan which evaluates the current cost of food[86]. Prior to the pandemic, the average monthly benefit per participant was $129.83 and $258.03 per family[87]. Initial data has found that this amount increased to roughly $213.95 per individual and $408.00 per family in 2021[87].

SNAP participants can purchase a wide variety of foods, with minimal exclusions. Alcohol, tobacco products and hygiene supplies may not be purchased. Participants are also not allowed to purchase hot prepared foods such as rotisserie chickens or premade

meals such as hamburgers or pizza. While the wide variety of allowable foods provides food purchasing freedom to participants, concern has arisen in recent years to whether allowable purchases such as foods containing high amounts of sugar and saturated fats may be detrimental to participant health.

Impact of SNAP on Diet Quality and Weight

Although SNAP has been shown to alleviate food insecurity, evidence is mixed on whether the program improves diet quality and the overall health of participants. Excluding alcohol, and hot prepared foods such as a rotisserie chicken, participants can purchase almost any other food available to them including sugar sweetened beverages (SSB)[80]. Sugar sweetened beverages such as soda, have been readily associated with poorer health outcomes including obesity and cardiovascular disease[31]. SSB are the second largest SNAP expenditure behind meat, poultry and seafood with SNAP eligible participants purchasing more SSB than SNAP eligible non-participants. Moreover, Liu et al. found that children in Los Angeles County enrolled in SNAP were significantly more likely to consume SSB than children not participating in SNAP[88]. A growing body of research supports that participation in SNAP increases intake of foods high in added sugar, fat and salt but has little impact on increasing fruit and vegetable consumption, therefore reducing overall diet quality[16].

Food purchases made by SNAP participants are likely to be heavily influenced by the participants food environment. Many participants do not have access to reliable transportation and as such are limited to purchasing foods at gas stations, convenience stores and small grocery stores[89]. Access to more nutrient food options may be further

limited by the number of stores accepting EBT[89]. In addition, Jones et al. found that increased stress caused by food insecurity may increase the risk of obesity and increased body weight[90]. Increased stress may also contribute to lack of wanting to prepare meals at home and increase the intake of convenience food which has also been associated with obesity[90]. More research is needed to evaluate the impact of SNAP on obesity, as it is difficult to determine whether associations are due to the program itself, or to the population with which the program serves.

SNAP-Ed is the nutrition education component of SNAP and focuses on assisting participants in stretching their SNAP dollars and improving the overall nutritional quality of their food purchases. Participation in SNAP-Ed is not mandatory, and it has been estimated that the program reaches only 15% of SNAP participants[17]. Adedekon and Plonski found that SNAP-Ed participants did have improved food resource management skills, including utilizing a shopping list and reading nutrition labels, which was associated with improved diet quality. In contrast, Rivera et al. found that SNAP-Ed eligible female participants had an average HEI score of 4.83 points less than their food secure counterparts[91].

SNAP and Pregnancy Outcomes

Limited research exists on the ways in which the SNAP program may impact pregnancy, however research is available on the ways in which SNAP may impact female participant health. SNAP has been positively associated with increased obesity in women[92]. Differences in BMI may be related to total amount of SNAP dollars received. Jilcott et al. found evidence that mean BMI was greater in women receiving $\geq$ \$150 dollars a month in benefits compared with the mean BMI of women receiving $\leq$ \$150

dollars a month of benefits[92]. This study potentially highlights two crucial concepts in how SNAP may impact participant health. Firstly, it highlights that monthly allotment of benefits may be insufficient to meet the needs of participants to truly improve food security and nutritional quality. Secondly, as women receiving < $150 a month in benefits had increased incidence of BMI, this could provide evidence of the theory of feast and famine in which individuals purchase more calorie dense foods at the beginning of the month after food reserves decrease and are limited by the end of the month[93]. As previously stated, women with a BMI > 25 are at increased risk for pregnancy complications and retaining additional weight after pregnancy[94]. Additional research is needed to determine the impact of SNAP participation on BMI and pregnancy related outcomes.

The SNAP program may also reduce overall diet quality in women. In low-income Hispanic women, participation in SNAP was associated with reduced intake of calcium and Vitamin D and increased sodium intake[95]. Reduced diet quality and intake of essential nutrients is essential for pregnancy, especially in the first trimester to promote successful birth outcomes[69]. Additional research is needed to investigate the impact of SNAP participation on diet quality and essential nutrients for pregnancy.

The Special Supplemental Nutrition Program for Women, Infants and Children

Program Overview

The Special Supplemental Nutrition Program for Women, Infants and Children (WIC) was established in 1974 to protect and improve the health of women and children during critical times of growth and development[19]. WIC is the third largest food

assistance program in the United States serving approximately 6.2 million participants annually[19]. WIC is federally funded through USDA's Food and Nutrition Service (FNS) and provides nutrition education, breastfeeding counseling, healthy foods, smoking cessation support and health care and community referrals to qualifying participants[96].

Eligibility and Benefits

In order to qualify, potential participants must fall below 185% of the income poverty guidelines or be actively enrolled in SNAP, Medicaid and/or Temporary Assistance for Needy Families (TANF) and reside in the state in which they are receiving services [82]. Participants must also be categorically eligible meaning that they are pregnant or post-partum women (up to 1 year) and a child under the age of five. Qualifying participants must be determined to be at 'nutritional risk' by an enrolling WIC staff member.

Participants receive monthly food benefits through checks or EBT cards which they can use to purchase approved WIC food items. The foods offered on the program are meant to meet 50% of an individual's needs as determined by the Dietary Guidelines for Americans. Foods include dairy products, whole grains, fresh fruits and vegetables, formula for infants and canned fish for pregnant women. Foods are required to contain protein, calcium, iron, and vitamins A and C[97]. Packages differ depending on the established category of the participant and their differing nutritional needs. As an example, one year old children are provided whole milk to increase the overall fat content of their diet to support appropriate brain development, while exclusively nursing mothers

receive skim milk, an increase in the overall amount of food provided as well as canned fish to improve the DHA transmitted through breastmilk[98].

The Impact of WIC on Diet Qualify and Weight

The WIC program was implemented to improve the nutritional status of women, infants and children during times of peak growth and development when nutritional status was most likely to be compromised. Women living below the federal poverty line are at an increased risk of developing pregnancy complications and therefore may benefit from increased support[99]. Since its inception in 1972, WIC has supported nearly 8 million women and currently supports roughly 29% of all pregnant women and 30% of postpartum women in the United States[83]. WIC impacts health through 4 essential mechanisms; increasing access to nutrient dense foods, nutrition education, breastfeeding support, and healthcare referrals[100].

Access to Nutrient Dense Foods

The provision of nutrient rich foods to participants monthly through a personalized EBT card or check is central to WIC's success in improving health. The WIC food package was revised in 2009 and per federal regulations, WIC foods are required to meet 50% of a participant's nutritional needs as defined by the Dietary Guidelines for Americans[101]. WIC food packages must contain 100% whole grains, low fat dairy products and foods rich in vitamins A and C. Following the 2009 revision, Andreveva et al. found that access to healthy foods, specifically whole grains and low-fat dairy products increased by as much as 39% in low-income areas of Connecticut[102]. In a

separate study conducted in Massachusetts, Andreyeva and Tripp found that the volume of healthful foods improved by 3.9% and reduction of full fat milk and juice was reduced by 24%[103]. Furthermore, Hamad et al. found that the food package revision in 2009 significantly improved total fruit consumption and HEI scores during pregnancy[98].

In January of 2017, the National Academies of Science, Engineering and Medicine, formerly IOM, completed a new review of the WIC food package. They recommended that the food package better align with the 2015 Dietary Guidelines for Americans, increase culturally appropriate foods, reduce purchasing burdens of participants and vendors and further meet nutritional needs of WIC families[104]. Increasing the amount of culturally relevant foods, to a diverse, national WIC population and reducing burdens for participants to purchase WIC foods, such as online shopping, has the potential to greatly improve the nutritional quality of women and children utilizing the program.

Recently the WIC program substantially increased the amount of money allotted to participants to purchase fruits and vegetables. Prior to the ruling in 2020, pregnant women received $11.00 dollars, however currently, pregnant women are receiving $43.00[105]. A congressional vote is needed to "extend the bump" and continue supporting an increase for fruits and vegetables. Additional research will be needed to determine whether increasing funds to purchase fresh fruits and vegetables has a positive impact on HEI scores and overall diet quality of WIC participants.

However, some studies have concluded that WIC may not actually benefit diet quality. Rojhani et. al found that pregnant WIC participants had an average HEI score of

56 at approximately 28 weeks gestation which is 7 points lower than the national average of 63 for pregnant women in the United States[106].

Nutrition Education

Per the Federal WIC Regulations, nutrition education is a benefit and should be delivered 'free of cost to all [WIC] participants'[107]. Furthermore, WIC utilizes patient-centered education (PCE) to tailor the education to the specific needs of the participant. Staff are trained by local, state and federal employees on how to craft clear nutrition messages that are easily understood by participants to support in achieving self-selected goals. According to the WIC Nutrition Education STUDY 100% of all participants received nutrition education when appointments were conducted in person[107].

Breastfeeding Support

The following quote is largely displayed on the FNS WIC website: 'Breastfeeding provides infants a healthy start in life. But it's not just good for babies- it's good for mom too'[19]. Breastfeeding has been associated with improved maternal health. One of the primary benefits, is that breastfeeding has been associated with enhanced weight loss following delivery[22]. Breastfeeding appears to be dose dependent in that the longer a woman breastfeeds, the more weight loss may occur[62]. Research supports that dose dependency is true for other health measures other than weight loss including immunological benefits for infants and improved uterine contraction after delivery[108].

Healthcare Referrals

WIC staff provide healthcare referrals to participants based on their specific health needs. Types of referrals include Head Start, smoking cessation programs, physicians, dentists, food banks and substance abuse centers. Referrals are also made to healthcare providers when a postpartum woman exhibits any signs of post-partum depression. This is critical as approximately 50% of low-income women may suffer from post-partum depression, and women with less education and income are at increased risk of having post-partum depressive symptoms 'overlooked'[109].

Impact of WIC on Pregnancy Outcomes

A substantial body of evidence supports that participation in WIC is associated with improved pregnancy outcomes. In a quasi-experimental study conducted by Hamad and colleagues in 2018 assessing the revision of the WIC food package in 2009, participation in WIC was associated with a 3.2% reduction in excessive GWG and a 2.3% increase in likelihood of gaining within recommended amount of GWG[101]. Additionally, Hamad and Collin found that WIC participation reduced risk of preeclampsia by 17% and reduced risk of gaining excessive gestational weight by 8%[101].

Another way in which WIC supports pregnancy outcomes, is by providing referrals to prenatal healthcare services. El-Bastawissi et al. found that women participating in WIC were less likely to have received inadequate prenatal care compared to their non-WIC counterparts[21]. In addition, WIC may further benefit the health of pregnant participants by reducing smoking. A recent study found that pregnant WIC participants were more likely to smoke less than 10 cigarettes per day[21]. This is essential as smoking has been associated with pre-term labor and low birth weight[110].

WIC has come under scrutiny in the past by organizations claiming that the 'positive' effects of the WIC program are not accurate, as women who are more health conscious and more motivated to participate in pre and post-natal care enroll in the program[96]. However, a study published in 2005 using PRAMS data and multiple controls for selection bias into the program, found that participation in WIC improved early initiation of prenatal care, birth weight, and gestational weight gain for women, with the most positive effects in teen and increasingly low-income women[96]. In their study of 4,126 WIC participants in Massachusetts, Kotelchuck et. al found that women participating in WIC had longer gestational periods compared to their non-WIC counterparts[111].

Participation in WIC may also contribute to significant national healthcare savings. Devaney et al. found evidence to that for every dollar spent in WIC an average of $1.77 to $3.13 in healthcare costs within the first 60 days of birth[112]. Similarly, Buescher et. al found that for every dollar spent in WIC, a dollar was saved in Medicare costs[113].

WIC is also unique within nutrition assistance programs in that it is potentially able to provide nutrition focused, participant centered education to women before, during and after pregnancy. The WIC Nutrition Education Study found that 69% of all pregnant WIC participants received appropriate and well-timed prenatal counseling[107]. Enrollment in WIC within the first trimester is associated with increased birth weight in infants[112]. WIC is uniquely positioned to provide counseling to a large population of low-income women that may promote behavior change. Lifestyle modifications are seen as the front

line of GWG improvements. Additional research is needed to assess the benefit of WIC participation on GWG, and whether GWG is negatively impacted by SNAP participants.

Literature Review Summary

Maternal health is at the forefront of public health initiatives; however, a clear gap exists in research specifically designed to assess maternal health outcomes of pregnancy, particularly with low-income and underprivileged women. Currently, no studies exist to determine the potential impact of SNAP participation on pregnancy weight related outcomes and program participation indicators of women participating in the WIC program. Research does support that pregnancy is a critical time in which interventions to support maternal health have the potential to impact future health outcomes of the mother and child. As WIC provides four fundamental areas of health including access to healthy foods, nutrition education, breastfeeding promotion, and healthcare referrals nationally to millions of women, it has the potential to improve maternal health. Understanding the potential impact of SNAP participation for these women can help initiate improved program collaboration and referrals.

CHAPTER 3

METHODS

Study Design

We used a descriptive, cross-sectional study design to examine secondary data of pregnant women enrolled in the Arizona WIC Program in 2018. Data obtained from the Bureau of Nutrition and Physical Activity (BNPA) with the Arizona Department of Health and Human Services (AZDHS was imported from the Health and Nutrition Delivery System (HANDS) database of all pregnant women participating in the Arizona WIC program between 2018 and 2019. Participants provided consent to have anthropometric and biochemical data collected at the time of enrollment into the WIC program. Per federal regulations, additional participant consent for this study was waived. This study was deemed to be IRB exempt by the Arizona State Review Board.

Participants and Data Collection

Pregnant women may enroll into the WIC program at any time during their pregnancy. In Arizona, there are a total 107 WIC clinics operating within twenty-one Local Agencies (LAs). Participants enroll in the clinic that is closest to their address and are asked to provide proof of identification, income and residency. During enrollment, client information is entered into HANDS and a unique family identification number (FID) as well as a unique client identification number (CID) for each member of the household are generated. If a client transfers to a new clinic or elects to enroll in WIC in the future, their CID remains the same. Additionally, during certification, a trained WIC staff member enters the following information into the client record in HANDS: age,

race, ethnicity, education level, income, participation in federal assistance programs, anthropometric, biochemical, nutrition assessment and risk code information.

WIC staff members receive extensive training in accurately documenting client anthropometric and biochemical data. Stadiometers are used to collect height and staff are trained to instruct the participant to remove their shoes, place their heels against the backboard, and remove any hairstyle or hair accessories that may interfere with a precise measurement. Standing scales are utilized to collect weight and entered into the database. Devices used to collect data are not standardized throughout the clinics, however digital scales are required, at minimum, to be calibrated annually.

Heights and weights are required at time of enrollment for all participating pregnant women. If a woman declines, medical documentation of recent measurements, obtained within the last 60 days, must be provided. Weight is collected at every subsequent prenatal WIC visit. Pre-pregnancy and delivery weights are self-reported by participants and documentation is not required. Evidence from a study conducted by Park and colleagues supports that self-reported weight by WIC participants is accurate within 1.93 kg $\pm$ 0.04 kg and consistently does not place a participant in an incorrect BMI category[114].

All enrolled pregnant women participating in WIC between Jan 1, 2018 and Dec 1, 2019, with a certification start date on the day of and before Jan 1, 2019 were included in this study. As delivery weight is only documented at the first post-partum WIC appointment, only women who attended at least one postpartum WIC appointment were included in the sample. Weight and height were converted to kilograms and meters in order to calculate BMI. Women whose pre-pregnancy weight was <34.1 kg and >159.1

kg were excluded. Height was converted from inches to meters and only women with a height between >= 1.016 and <= 2.129 m were included.

Measures

The independent variable of this study was whether the pregnant participant was participating in SNAP. The dependent variables are the following health measures: pre-pregnancy weight and BMI, gestational weight gain, delivery weight and BMI, timing of first prenatal WIC visit, number of prenatal WIC visits and timing of first postpartum WIC appointment. Data was aggregated at the clinic level to maintain participant confidentiality per federal data sharing regulations. Small clinics, with less than 5 pregnant participants, were combined to maintain client confidentiality. Sociodemographic data including age, race, ethnicity and education level were assessed. Participation in SNAP was determined based on whether 'Participant Proof' in SNAP was selected at time of enrollment. Women participating in WIC only were assigned to 'Group WIC'. Women participating in both programs were assigned to 'Group WIC + SNAP'. This study aims to compare pregnant participants enrolled in SNAP and WIC versus WIC alone on the several health measures outlined below.

Health Measures

Average Pre-Pregnancy Weight. We obtained pre-pregnancy weights for all pregnant participants in 2018. To eliminate any impossible data, only the last recorded weight which was greater than '0' was collected. Pre-pregnancy weight in pounds (lbs.) was then converted to kilograms and ounces.

Pre-Pregnancy BMI. Pre-pregnancy weight in pounds (lbs.) was converted to kilograms (kg) and selected only if the pre-pregnancy weight was ≥ 34.1 kg or ≤ 159.1 kg. Pre-pregnancy height (in) was then converted into meters. Only heights ≥1.016 and ≤ 2.129 meters were included in the data set. Pre-pregnancy BMI was then calculated. Participants with a BMI < 18.5 were categorized as underweight. A participant with a BMI between 18.5 and 24.9 was categorized as normal weight. A BMI between 25.0 and 29.9 placed participant in the overweight category and a BMI greater than 30 categorized the participant as obese.

Gestational Weight Gain. To determine gestational weight gain, only women who delivered in 2018 and had a delivery weight greater than '0', were included in the analysis. Weight gain in pounds was calculated by subtracting pre-pregnancy from delivery weight and dividing by 16 (delivery weight-pre-pregnancy weight/ 16). Only women with a weight gain greater than -30 lbs. and less than 97 pounds were included in the cohort.

Weight gain (lbs.) was categorized as 'less than ideal' if it fell below the 2009 IOM weight recommendations for the following pre-pregnancy BMI categories: Total weight gain of less than 28 lbs. for an 'underweight' woman. Total weight gain of less than 25 lbs. for a 'normal-weight' woman. Total weight gain of less than 15 lbs. for an "overweight" woman, and total weight gain of less than 11 lbs. for an 'obese' woman. Weight gain (lbs.) was categorized as 'more than ideal' if it exceeded the 2009 IOM weight recommendations for the following pre-pregnancy BMI categories: Total weight

gain of more than 40 lbs. for an ‘underweight’ woman. Total weight gain of more than 35 lbs. for a ‘normal-weight’ woman. Total weight gain of more than 25 lbs. for an ‘overweight’ woman and more than 20 lbs. total weight gain for an ‘obese’ woman. Pregnancy weight gain was categorized as ‘ideal’ if it fell between the weight ranges described above.

Average Delivery weights. Self- reported delivery weights, greater than ‘0’, were collected for pregnant female participants who delivered in 2018 and attended at least one post-partum appointment. Delivery weight in pounds was converted to ounces.

Enrollment in WIC in the First Trimester. The first trimester begin date was calculated by subtracting the expected delivery date from a 40-week gestational period. The first trimester end date was calculated by adding 14 weeks to the trimester begin date. A pregnant woman who was certified as pregnant before the end of the first trimester end date was coded as “entered in first trimester”. Women who did not enroll in WIC within this time frame were coded as “not entered in first trimester”.

First Prenatal WIC Visit. The first prenatal WIC visit was calculated through a series of steps. Any day in which a pregnant woman was issued benefits was classified as a ‘visit’ to the clinic. The ‘first visit’ was determined to be the first date the participant was issued benefits that fell between the first trimester begin date and before her delivery date. Next, the number of days that elapsed between the first trimester begin date and the ‘first visit date’ were calculated and classified as “prenatal days”. Finally, the prenatal month of the first visit was determined using the following procedures: If the first appointment

occurred before 32 days of the first prenatal month visit, this was determined to be in the first month of pregnancy. If the first appointment occurred more than 32 prenatal days, but less than 63 prenatal days this was determined to be in the second month of pregnancy. If the first visit occurred on or after 63 prenatal days, but less than 94 prenatal days, this was determined to be in the third month of pregnancy. If the first appointment occurred on or after 94 prenatal days, but less than 125 prenatal days, this was considered to be in the fourth month of pregnancy. If the first appointment occurred on or after 125 prenatal days, but before 156 prenatal days, this was considered to be in the fifth month of pregnancy. If the first appointment occurred on or after 156 prenatal days, but before 187 prenatal days, this was considered to be in the sixth month of pregnancy. If the first appointment occurred on or after 187 prenatal days, but before 218 prenatal days, this was considered to be in the seventh month of pregnancy. If the first appointment occurred on or after 218 prenatal days, but before 249 prenatal days, this was considered to be in the eighth month of pregnancy. If the first appointment occurred on or after 249 prenatal days, but before 280 prenatal days, this was considered to be in the ninth month of pregnancy.

Average Number of WIC Visits During Pregnancy. As previously outlined, any day that a pregnant woman was issued benefits during her enrollment was classified as a 'visit' to the clinic. The number of visits that a pregnant woman made between the first trimester begin date and expected delivery date or delivery date was then summed to give total number of WIC visits during pregnancy

Timing of first postpartum visit. The timing of the first postpartum WIC visit was determined using the following series of steps. First, the initial date that a woman was

issued benefits following their delivery date was determined to be the ‘first post-partum visit’. Next, the number of days that elapsed between their actual delivery date and their ‘first post-partum visit’ were calculated. Finally, days were converted to weeks.

Statistical Analysis

Participant sociodemographic information were analyzed using descriptive statistics and reported in percentages. Linear regressions were conducted to examine the association by enrollment status (WIC vs. SNAP+WIC), adjusted for clinic. The alpha value was set to 0.05 and all data were analyzed using Stata Version 15.

CHAPTER 4

RESULTS

Descriptive Characteristics

A total of 35,659 pregnant women participated in WIC in 2018 and were included in this analysis. A breakdown of study participants within the two assigned groups is provided below in Figure 1. The sample was racially and ethnically diverse with 61.2% of the study sample identifying as Hispanic. A noticeable difference between groups was observed between the women who identified as Hispanic, with 61.6% (n=13455) belonging to group WIC. English was the most common language, with 82.3% of participants indicating this as their primary language. A majority of the sample selected 'White' during enrollment, with 8.5% (n=3031) identifying as Black or African American and 2.7% (n=959) identifying as more than one race. Nearly half, 44.31% (n=15799) completed High School and 32.80% (n=11693) indicating some college or graduate level studies. Of the women that completed more than high school, 64.7% (n= 7,567) were in group WIC, while 35.3% (n=4126) were in group SNAP+WIC.

Table 1: Study Participant Demographics

Variable	Total % (n)	WIC %(n)	SNAP+WIC % (n)
Education			
Completed Less than High School	22.8% (8118)	51.0% (4115)	49.3% (4003)
Completed High School	44.3% (15799)	58.6% (9266)	41.4% (6533)
Completed More than High School	32.8% (11693)	64.7% (7567)	35.3% (4126)
Unknown Education Level	0.01% (49)	51.0% (25)	49.0% (24)
Language			
English	82.4% (29366)	57.40% (16843)	42.7% (12523)
Spanish	15.7% (5580)	68.8% (3837)	31.2% (1743)
Other Language	2.0% (713)	41.1% (293)	58.9% (420)
Ethnicity			
Hispanic	61.2% (21817)	61.6% (13455)	38.4% (8372)
Non-Hispanic	38.8% (13843)	54.4% (7528)	45.6% (6314)
Race			
Asian	1.6% (566)	65.5% (371)	34.5% (195)
Black or African American	8.5% (3031)	45.4% (1377)	54.6% (1654)
Indian American or Native Alaskan	2.64% (943)	50.70% (478)	49.30% (465)
Native Hawaiian or Other Pacific Islander	0.05% (179)	57.00% (102)	43.00% (77)
White	84.08% (29981)	60.50% (18136)	39.50% (11845)
More than One Race	2.69% (959)	53.10% (509)	46.90% (450)

Weight Related Pregnancy Variables

During 2018, there were 111 WIC clinics in operation in Arizona (Table 2). Ten of these clinics served less than 10 pregnant women and were combined to maintain participant confidentiality resulting in a total of 101 clinics being considered in the analysis. The clinic site was not a statistically significant predictor for any outcome variable. The average pre-pregnancy weight, in ounces and kilograms, between groups was statistically significant with women in group SNAP+WIC weighing 2.8 kg more than women in group WIC($p<0.001$). Moreover, average delivery weight was also statistically significant with group SNAP+WIC weighing an average of 425 oz more than women in group WIC ($p<0.001$). No statistically significant differences were found between the average number of women in each clinic considered to be underweight, overweight or obese prior to pregnancy. Counts of women with less than ideal, ideal, and more than ideal GWG were also not statistically significant. However, a statistically significant difference was found for the average number of women per clinic who began their pregnancy with a Normal BMI($p=0.004$). No statistically significant differences occurred between groups for average gestational weight gain.

Table 2: Differences in Pregnancy-Related Variables Among Women participating in WIC vs those in WIC+SNAP

Description	WIC	SNAP+WIC	Difference	95% CI	P Value
Before Pregnancy					
Average Pregnancy Weight (oz)	2565.1	2665.6	100.5	62.1, 139.0	**<0.001**
Average Pregnancy Weight (kg)	72.7	75.5	2.8	1.7, 3.9	**<0.001**
During Pregnancy					
GWG During Pregnancy (lbs.)	28.3	28.5	0.2	-1.1, 1.4	0.762
Underweight Pre-Pregnancy BMI (count)	10.8	9.1	-1.7	-4.36, .86	0.188
Normal Pre-Pregnancy BMI (count)	84.5	55.1	-29.4	-49.5, -9.4	**0.004**
Overweight Pre-Pregnancy BMI (count)	62.1	47.0	-15.1	-32.1, 1.9	0.081
Obese Pre-Pregnancy BMI (count)	76	66.6	-9.4	-30.7, 11.9	0.386
Less than Ideal GWG (count)	31.6	27.9	-3.7	-13.1, 5.8	0.444
Ideal GWG (count)	40.7	32.8	-7.9	-19.0, 3.2	0.164
More than Ideal GWG (count)	70.4	60.4	-10.0	-28.3, 8.5	0.289
After Pregnancy					
Average Delivery Weight (oz)[a]	1717.9	2142.9	425	316.2, 533.7	**<0.001**

[a] Women who did not return for a postpartum WIC appointment and therefore had a delivery weight of '0' were included in analysis resulting in a lower delivery weight average.

WIC Participation Related Variables

Women belonging to group WIC were more likely to not enroll in WIC within their first trimester (Table 3; p=0.049). Women exclusively enrolled in WIC were more likely to attend their first appointment during month eight (p=0.045) and month nine (p=0.009) compared with group SNAP+WIC. The number of WIC visits during pregnancy was not statistically significant between groups. While a consistent trend was not identified regarding the timing of the first postpartum WIC visit, attendance during weeks 3-4 (p=0.039), weeks 11-12 (p=0.022) and 6 months or more (p=0.007) were all statistically significant.

Table 3: Differences in Participation-Related Variables Among Women participating in WIC vs those in WIC+SNAP

Description	WIC	SNAP+WIC	Difference	95% CI	P Value
Number of Visits During Pregnancy					
Average no. of visits made during pregnancy	2	1.99	-0.01	-.08, .1	0.764
Timing of First Prenatal WIC Appointment (count of women)					
Month 1 of pregnancy	4.2	4.49	0.29	-.9, 1.5	0.633
Month 2 of pregnancy	25.9	20.6	-5.3	-12.3, 1.8	0.143
Month 3 of pregnancy	30.1	23.6	-6.5	-15.2, 2.2	0.144
Month 4 of pregnancy	28.6	22.5	-6.1	-13.7, 1.4	0.113
Month 5 of pregnancy	27.6	21.1	-6.5	-13.7, 0.8	0.081
Month 6 of pregnancy	24.3	19.2	-5.1	-12.0, 1.9	0.15
Month 7 of pregnancy	24.4	18.4	-6	-12.4, 0.4	0.066
Month 8 of pregnancy	22.3	16.5	-5.8	-11.5, -.14	**0.045**
Month 9 of pregnancy	14.9	10	-4.9	-8.5, -1.2	**0.009**
Entered WIC During First Trimester					
Did not enter WIC during first trimester	135.3	100.4	-34.9	-69.6, -.09	**0.049**
Entered WIC during first trimester	96.9	71.5	-25.4	-50.9, .13	0.051
Timing of First Postpartum WIC Appointment (count of women)					
1 to 2 weeks after delivery	116	94.7	-21.3	-53.9, 11.3	0.199
3 to 4 weeks after delivery	45.1	33.2	-11.9	-23.1, -.63	**0.039**
5 to 6 weeks after delivery	23.9	17.3	-6.6	-13.4, .16	0.056
7 to 8 weeks after delivery	12.4	10.2	-2.2	-5.7, 1.25	0.208
9 to 10 weeks after delivery	6.8	5.3	-1.5	-3.3, .25	0.091
11 to 12 weeks after delivery	4.43	3.33	-1.1	-2.1, -.17	**0.022**
4 months after delivery	3.9	3.7	-0.2	-1.2, .75	0.064
5 months after delivery	2.5	2.2	-0.3	-.90, .31	0.33
6 months or more after delivery	3.5	2.5	-1	-1.8, -.30	**0.007**

CHAPTER 5

DISCUSSION

The purpose of this study was to examine potential differences in pregnancy weight-related outcomes and participation indicators between pregnant WIC participants, residing in Arizona, enrolled exclusively in WIC versus dually enrolled in WIC and SNAP. To date, the authors of this study are unaware of any previous research that examines the impact of SNAP on pregnant WIC participants. The current study found that the average pre-pregnancy weight of participants exclusively enrolled in WIC was significantly lower than the average weight of WIC participants also enrolled in SNAP, which is consistent with the original hypothesis. Similarly, a statistically significant difference was found regarding delivery weight, in that delivery weight was lower for those enrolled in WIC only. However, contrary to the initial hypothesis, there was no statistically significant difference in gestational weight gain between group WIC and group SNAP+WIC.

In terms of participation indicators, the findings of this study were not consistent with the original hypothesis. No difference was found between the average number of prenatal appointments attended between groups. Timing of first prenatal WIC appointment was not statistically significant until months eight and nine of pregnancy, in which participants enrolled in WIC only were more likely to initiate services. Moreover, this study indicates that participants exclusively enrolled in WIC were less likely to enroll in the WIC program in the first trimester. While no difference in the first postpartum WIC appointment was seen between weeks one and two, following delivery, more participants in group WIC attended postpartum appointments between weeks 3 and 4, but

were also more likely to enroll after 6 months postpartum. Previous research has provided evidence that pregnant WIC participants are more likely to initiate prenatal care compared with women who qualify for WIC but choose to not enroll[21]. However, previous research has also provided evidence that women may not enroll in WIC in the first trimester due to being unaware of the program, inability to obtain a timely appointment, and feeling as though the program is not a necesscity[115,116]. Additionally, Bitler and Currie found evidence that married women were more likely to utilize WIC services than their unmarried counterparts, while suburban and women of Asian descent were least likely to utilize services[117]. While this study utilized aggregated data, making characteristics and predictors of WIC participation impossible to determine. These findings may serve as preliminary research to identify the impact of SNAP participation on pregnant WIC participants. Additional and extensive research is needed in this area to understand the true relationship between the WIC and SNAP programs and the potential impact on pregnant participants.

Pre-Pregnancy Weight and BMI

The average pre-pregnancy weight and BMI of participants enrolled in WIC was found to be 100.5 oz or 2.8 kg less than the average weight of participants in group SNAP+WIC. SNAP participants are provided a predetermined monetary allotment to purchase almost any food item, while WIC participants are provided a specific amount and variety of foods specifically identified to improve health outcomes for the participants, depending on their enrollment category[118,119]. While the results cannot demonstrate causation of SNAP increasing the pre-pregnancy weight and BMI of WIC

participants, it does bring in to question the potential impact the program may have on overall health of participants. If SNAP participation potentially has the impact of negatively impacting the positive effect of WIC on pregnancy outcomes, based on the available food allowed for purchase, the SNAP program may benefit from limiting the purchases of foods high in added sugars, salt and fat[92,120]. Previous research conducted by Lazariu-Bauer et al. demonstrate that WIC may serve as a protective factor for pre-pregnancy weight and appropriate gestational weight gain[121]. Additional research is needed to examine the potential impact of SNAP participation on pregnancy outcomes of WIC participants.

Additionally, socioeconomic differences between the two defined groups of this study may contribute to the present findings. The income qualifications for WIC are higher than for SNAP: 185% of the poverty line compared with 130%. Women in participating in WIC alone may be at an economic advantage compared with the SNAP+WIC group. Besharov and Germanis provided the argument, that mothers participating in WIC may be more motivated to improve their health status to support healthy pregnancies, creating a false positive for the overall impact of WIC[96]. Research has also found evidence that 50.2% of families enrolled in SNAP were found to be food insecure, compared to 40.6% of WIC families[122]. Furthermore, the same study found that SNAP and WIC efforts were not redundant, and that participation in both programs was associated with improved food security[122]. A large body of research strongly suggested that food insecurity is related to increased incidence of overweight and obesity, and the results of this study may provide further evidence of these findings. As WIC and SNAP serve a large and diverse population of pregnant women, future research should highlight

continued need for collaboration between the two programs to maximize health and nutrition security of participants with various enrollments in federal assistance programs.

Additionally, only WIC data were available for the present study. The authors did not have access to SNAP data to compare weight-related pregnancy outcomes of SNAP participants not enrolled in the WIC program. Nor were we able to compare results against eligible pregnant women choosing not to enroll in either or both federal nutrition assistance programs. The lack of available data to support the current study, highlight the need for interagency collaboration and data sharing agreements. Results of a recent poll suggest that only half of all state WIC programs meet regularly with SNAP to collaborate and roughly the same amount are working on some type of data sharing agreements[123]. Data sharing would improve the understanding of program efforts to positively impact maternal and child health. Furthermore, findings suggest that many participants enrolled in SNAP do not enroll in WIC, and WIC participation has declined in recent years[124]. Including WIC applications with Medicaid and SNAP applications, or creating a universal application between all federal assistance programs, may improve enrollment rates and increase overall health benefits and nutrition status of all qualified individuals.

Timing of First Prenatal and Postnatal WIC Appointment

The current study found a statistical significance that on average, women enrolled exclusively in WIC were more likely not to enroll in WIC within the first trimester. However, both groups had higher counts of women not enrolling in the first trimester, compared with women who did enroll in the first trimester. These findings differ from data provided by the USDA, which demonstrate that 53.8% of pregnant women enroll

within the first trimester, 36.6% in the second trimester and only 9.4% in the third trimester[125]. Additionally, same report found evidence that women with higher eligible incomes were less likely to enroll in WIC in the first trimester, perhaps due to the perception that the program was not a necessity[125].

Research exists to support that prenatal WIC participation in the first trimester is higher in black and Hispanic women, as well as women without medical insurance who have previously participated in WIC[119,121]. As the present study utilizes data aggregated to the clinic level, it is unable to differentiate the race and ethnicity, income or insurance of the women who did or did not enter into the WIC program within the first trimester. Furthermore, the data available through the HANDS is unable to provide insight into whether differences in prenatal participation vary between women enrolling in WIC for the first time, compared with enrollment with additional pregnancies. Additional research is needed to determine differences in enrollment according to race, ethnicity, income, education and initial versus subsequent pregnancies.

An additional explanation for the statistical differences found between the timing of the first postpartum WIC appointment between groups could be, in part, due to the perceived need of formula during those time periods. Previous research suggests that the availability of formula provided through the WIC program may play an important role in a family's decision to enroll in the program[126]. The timing of first visit between weeks 3 and 4, 11 and 12, and 6 or more months following delivery, coincide with common infant growth spurts which often result in breastfeeding cessation or introduction of formula[127]. Women participating in SNAP may use their EBT card to purchase formula, however

women who only meet the income qualifications for WIC would need to enroll in the program to receive additional assistance with formula[128].

Number of Prenatal WIC Appointments Attended

While a statistically significant difference was not observed between groups, the findings regarding the number of WIC appointments attended warrants discussion. On average, both group WIC and group SNAP+WIC attended 2 prenatal WIC appointments. If a woman was to enroll within her first trimester, and consistently attend regularly scheduled WIC appointments, which on average occur every 3 months, at most, the participant would be able to attend three appointments. As the findings of this study suggest that most WIC participants are not enrolling in the first trimester, the opportunity to support nutrition outcomes and support positive behavior change is limited. This has important policy implications as it further conveys the necessity for federal nutrition programs to coordinate services. If funding and outreach efforts were increased for SNAP-Ed, and targeted prenatal nutrition education classes could be provided to SNAP participants in conjunction with education already provided by WIC, to further improve pregnancy outcomes.

Study Strengths and Weaknesses

The strengths and weaknesses of this study must be considered when interpreting the present findings. This secondary analysis included a large sample of pregnant WIC participants. Moreover, the sample was racially and ethnically diverse and included women from both rural and urban communities. With the exception of pre-pregnancy and

delivery weight, measurements were objective, accurate, and obtained by well-trained WIC staff members.

Several weaknesses have also been identified and should be discussed. Firstly, the data for this secondary analysis was aggregated to the clinic level and is therefore not a representation of individual client information. The averaged measurements for all participants within one clinic, make it difficult to determine true associations. Additional research to analyze individual client information is necessary to improve understanding of the impact of SNAP on pregnancy and participation indicators. Secondly, the present study was unable to determine pregnancy indicators not related to weight status. While pregnancy-related health risks may be determined during a WIC appointment, including Gestational Diabetes, history of or active eating disorders, and PICA, to name a few, these are all self-reported and must be entered and coded manually by WIC staff which may be unreliable. Lastly, results only apply to pregnant participants enrolled in the Arizona WIC program and cannot be extended to a national sample. Additional research is needed to consider the impact of enrolling in multiple assistance programs on healthy pregnancy indicators.

CHAPTER 6

CONCLUSION

This is the first study of its kind to examine the impact of SNAP participation on weight related pregnancy outcomes an WIC participation indicators of pregnant SNAP participants. The present study found, in agreement with the original hypothesis, that on average, women enrolled exclusively in WIC had a lower pre-pregnancy weight than those enrolled in both WIC and SNAP. As women who are overweight or obese prior to pregnancy are at increased risk for pregnancy complications and weight retention, these findings highlight the need to further study the mechanism behind these differences. Additional research is needed to further understand the impact of SNAP participation on pre-pregnancy weight and other weight-related outcomes of WIC participants.

The secondary hypothesis of the present study, proposing that participants in the WIC-only group as compared to the WIC+SNAP group would have timelier prenatal and postnatal visits and attend more frequent prenatal WIC appointments, was not upheld. Participants in the WIC-only group were more likely to not enroll within WIC during the first trimester. [110,114]Additionally, this study found that group WIC was increasingly more likely to enroll, when compared with group SNAP+WIC in the last trimester. These results add to the growing belief and understanding that universal applications and data sharing agreements between federal assistance programs are necessary to improve enrollments for all programs. Individuals who qualify for federal assistance should reap the benefits of mutual enrollments to reduce health disparities, and improve nutrition security, rather than feel the burden of navigating a dysfunctional and unhelpful system. As we look to future research opportunities, it is vital to increase the understanding of

how nutrition assistance programs my mutually benefit or hinder the health of their participants. The findings of this study may serve as a catalyst for additional research to better understand the impact of SNAP participation on weight related outcomes and participation indicators of pregnant WIC participants.

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APPENDIX A

WIC ELIGIBILITY AND PROGRAM INFORMATION

Healthy Food.
Healthy Kid.
Happy Mom.

What is WIC?

- Free Nutrition and Breastfeeding Program
- Experts in nutrition for pregnancy, breastfeeding, infants, toddlers and preschoolers
- Personalized nutrition tips and support for parents and caregivers
- Breastfeeding information, support and resources
- Referrals to other community resources
- Healthy foods

Who is WIC for?

- Infants
- Children up to five years of age
- Pregnant women
- Breastfeeding women, until their infant's first birthday
- Women whose pregnancy ended <6 months ago

Arizona WIC is here for you!

Visit **www.azwic.gov** or call **1 (800) 2525-WIC** to find the nearest clinic.

To download the free EzWIC App, go to the App Store or Google Play and search for EzWIC.

Download on the App Store GET IT ON Google Play

Effective Date: April 1, 2021

WIC Eligibility is based solely on your gross income, this chart can help determine your eligibility

Number of Family Members	Income every Two Weeks	Income Monthly
*2	$1,240	$2,686
3	$1,563	$3,386
4	$1,886	$4,086
5	$2,209	$4,786
6	$2,532	$5,486
7	$2,855	$6,186
8	$3,178	$6,886
Each Additional Member	$324	$700
*A pregnant woman is considered a family of 2		

Contact your local WIC agency:

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, sex, disability, age, or reprisal or retaliation for prior civil rights activity in any program or activity conducted or funded by USDA.

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To file a program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, (AD-3027) found online at: http://www.ascr.usda.gov/complaint_filing_cust.html, and at any USDA office, or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by:

(1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

This institution is an equal opportunity provider.

WIC ARIZONA