



A STUDY TO INVESTIGATE THE RELATIONSHIP BETWEEN HOUSEHOLD FOOD INSECURITY AND CHILDHOOD OBESITY

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ARTICLE INFO

Article History:

Received 17th July, 2019
Received in revised form
26th August, 2019
Accepted 14th September, 2019
Published online 30th October, 2019

Key Words:

North Carolina Department of Health and Human Services, SNAP, Household Food Insecurity, Childhood Obesity.

ABSTRACT

The food insecurity and the occurrences of childhood obesity are increasingly becoming public health concerns in most households in North Carolina and the world at large. This research study intends to examine the relationship between childhood obesity and the food security status of children from low income households that are taking part in the nutritional supplemental program for the groups that are considered vulnerable in the society such as women, young children as well as infants alike. Anthropometric measurements of 7,545 for children who were between 1 and 59 months of age was undertaken. In addition, food security data was also collected concurrently. The 2 sets of data were grouped according to age and gender and in turn subjected to a regression analysis to demonstrate the likelihood of being Obese with regards to the food insecurity situation of a household, having factored in aspects such as maternal and child health education and ethnicity. The findings of the study show that the prevalence of household food insecurity in North Carolina was 33.1%. On the other hand, the prevalence of childhood obesity was 21.7%. The results and findings of this study demonstrate a significant connection between household food insecurity and childhood obesity among low income households in North Carolina. However, demographic statistics of age and gender appear to tilt the degree and direction of the relationship. The relationship was more apparent in girls who were below 2 years, showing a 64% association at 95% confidence level. In boys and girls who were between 2 years and 5 years, there was no significant relationship between the two parameters.

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Citation: Charletta Hope Barringer-Brown. 2019. "A study to investigate the relationship between household food insecurity and childhood obesity", *International Journal of Development Research*, 09, (10), 30815-30819.

INTRODUCTION

As discussed by Balistreri (2018) there has been an increasing concern on the escalating prevalence of childhood obesity given the long-standing health repercussions that it comes along with. According to the DSS (2019) in the State of North Carolina, the cases of childhood obesity have been on an upward trajectory over the last decade. As argued by Burns, Jones, and Frongillo (2010) the trend has been more prevalent in low income households owing to their vulnerability. The criteria of determining childhood obesity is fundamentally based on the Body Mass Index (BMI) of a child (determined as kg/m^2). If, the BMI is between $18.5\text{kg}/\text{m}^2$ and $24.9\text{kg}/\text{m}^2$, the individual can be considered to be having a normal weight. However, any BMI reading of above $25\text{kg}/\text{m}^2$, the individual is considered to be at risk of obesity.

One of the underlying factors that contribute to childhood obesity is household food insecurity. According to Osei, Pandey, Spiro, Nielson, Shrestha, Talukder and Haselow (2010) household food security can be well-defined as a situation where all the members in a household, at all times have physical and economic access to sufficient, safe and nutritionally adequate food, aimed at meeting their dietary needs and preferences for an active and healthy life. Thus, a deprived access of nutritionally adequate food could lead to poor nutrition status and childhood Obesity. For instance, in 2004, approximately 14% of North Carolina households recorded a food insecurity status and the data showed that the case scenario manifested more in households that had children who below the age of 5 years old and were not native Americans. For this reason, the simultaneous rise in childhood obesity and household food insecurity has elicited the likelihood that there could be a relationship between the two parameters. As suggested by Bertram, D.C. (2013) and Corman, Noonan, and Reichman (2014) prior to this study,

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Question	Answer
1. Were there months that you ever worried your household didn't have enough food in the last 12 months?	
2. How often did this happen in the last 12 months?	
3. Was there a scenario in which you or any other household member was unable to eat the preferred foods due to lack of resources to access them in the last 12 months?	
4. Were there instances when, you or any other family member had to consume at a limited diversity of foods due to a lack of capacity to obtain other kinds of food?	
5. Were there instances when you or any other family member had to consume less numbers of meals/quantitative smaller meals in a single day because there was an insufficiency?	
6. Did your household lack food at any given time in the last 12 years?	
7. Was there a situation when you or any other family member slept hungry at due inadequacy of food?	
8. Were there situations when you or any family member went a single day or night without eating anything because there was not enough food?	

other studies of the same nature have been done with an aim of establishing if there is an association between the prevalence of childhood obesity and food insecurity in a household. Howard (2011) and Ziliak (2014) and Crawford, Lamp, Nicholson, Krathwohl, Hudes, and Townsend (2007) have reported that although the results from these studies were conflicting, there are those particular studies that demonstrated an apparent relationship between childhood obesity and the food security in a household among pre-schoolers and elementary children. According to Kac, Schlüssel, Pérez-Escamilla, Velásquez-Melendez, and da Silva (2012) different studies suggested that there was no significant relationship between childhood obesity and food security. This study is therefore, geared towards building on the previous studies that were done and addressing their limitations, in a bid to provide a deeper insight of the paradox and establish if there is a substantial relationship between the two aspects at hand.

Purpose of the Study: The core intent of the research study is to primarily investigate the association of household food insecurity and the prevalence of childhood obesity aged between 1 to 59 months who are from low-income households in North Carolina that are part of the SFP program.

METHODOLOGY

Design of the study: The study design adopted by this research study is the cross-sectional design, where various sets of data were collected between February 2016 and December 2017 of children and mothers from the low-income households that were part of the SFP program in the state of North Carolina. Data collected varied from demographic data, food security status data, anthropometrics, health records maternal and child health education, the race and even the economic status. The data was obtained from 7,545 children in the State of North Carolina and all possible identifiers were eliminated to create an independent and anonymous set of data. The set of data collected was analysed and generated at North Carolina's Department of Social Services in conjunction with the approval of the department's Institutional Review Board (IRB).

Food Security Measure: The dimensions of measuring the household food security status are diverse. These dimensions include, availability, accessibility, utilization, stability, preference and most importantly, the safety of the food. As suggested by Knueppel, Demment and Kaiser (2009) for the purposes of this study, the most relevant dimension at household levels was accessibility of food. Determining the food security status of the household was based on the responses given by the parents and guardians towards the questions asked from the Household Food Insecurity Access

Scale (HHFIAS), as developed by Teh, Pirkle, Furgal, Fillion and Lucas (2017). The food security status of a household was determined by the responses given by the mothers who answered the questions on the assessment tool followed up by the frequency of occurrence questions asked afterwards, to determine the diverse comparable measure and ability of a household to get access to food.

Outcome measure: The Body Mass Indices of the 7,545 children who were involved in the study were determined by the weight and height of the children. The heights of the children were measured to the nearest metre using a stadiometer without any shoes or hats. On the other hand, the weights were measured to the nearest kilogram using a well calibrated digital scale for accuracy purposes without any shoes or any clothes.

$$\text{BMI (kg/m}^2\text{)} = \text{Weight (kg)}/\text{Height(m}^2\text{)}$$

The outcome measure for obesity was defined by the BMI – for – Age charts that are gender specific in this case.

Sample Collection: To come up with a relevant population sample for the study, the records of children who visited the hospital that had comprehensive data for household food security status, anthropometric measurements, demographic data such as age, gender and maternal and child health education were selected (n=84,434). Afterwards, the records whose anthropometric measurements were collected in the last two months prior to the study were considered and the rest of the records discarded (n=67,764). Considering the fact that the set of data may have included more than a single visit for each child or multiple siblings in each household, a Statistical Analysis Software (SAS) was incorporated to randomly sample a single visit per child (n=13,633). For the purposes of household specificity, the software then sampled at least 1 child per household (n=10,497). While factoring in the race of the population sample, the study had to consider only the white, black, and Hispanic children (n=9,670) to provide a substantial population sample which would provide an ideal platform for a strong analysis. In conclusion of the sampling, the children who were below the age of 1 month were left out from the study (n=2,125). This is because it would be practically impossible to obtain their anthropometric measurements. The final population sample for this study was (n=7545). Infants between the age of 1 months and 24 months (n=2,316) while those between the age of 2 years and 5 years were (n=5,229).

Statistical Analysis: The set of data collected was scrutinized through a regression analysis that was conducted using computer software known as the Statistical Analysis Software (SAS). The confidence level that was used all through was

95% and odds ratios were also used. During the analysis, variables such as the Race of the children, their age, and also the maternal and child health education were factored in as co-variables of the study in cases when their association with household food insecurity was not too significant. In normal case scenario, the analysis was stratified.

RESULTS AND DISCUSSION

The results of the study showed that, among the 7,545 children who were sampled for the research and had complete data, 34% of them were between the age of 1 month and 2 years. 47.3% of them were female while male children constituted 52.7%. 30.7% constituted of white children, 15.5% consisted of black American children while 53.8% of them had a Hispanic descent. With regards to maternal and child health education, 34.5% of the mothers attested to have received maternal education of less than 10 years. 33.1% of the sampled children came from households that were food-insecure (9.3% with hunger). 21.7% of the sampled children recorded an Obesity outcome. Also, the occurrence of food insecurity in households was substantially negligible having factored in the variables of demographic age, gender or maternal and child health education. One of the major findings of the study showed that there were noteworthy connections that were evident amid food insecurity in households in the State of North Carolina and the age group of the children ($P < 0.05$) and the gender of the children ($P < 0.10$). For this reason, the analyses of the study were aligned according to the age of the children and their gender. In this case, the stratification was as follows; boys < 2 years old, and boys 2 - 5 years old, girls < 2 years old, and girls 2 - 5 years old. Of these 4 models that were used, 2 samples recorded significant results while the other 2 samples did not. For the children who were below 2 years, having factored in race and maternal and child health education, there was a statistical significant relationship between food security status of a household and childhood obesity in girls compared to the boys. For the girls that were less than 2 years of age and came from households that were food insecure, they had a 35% likelihood of being obese.

Food Security Status	1 month – 24 months		2 - 5 years	
	Girls	Boys	Girls	Boys
	Odds: (95% Confidence Level)			
Household Food Security				
Secure (Ref)	1.0	1.0	1.0	1.0
Insecure	0.64	0.84	1.14	1.04
Household Food Security				
Secure (Ref)	1.0	1.0	1.0	1.0
Insecure (Without hunger)	0.66	0.85	1.04	1.08
Insecure (with hunger)	0.57	0.75	1.46	1.02

This empirical study is ideally the first one that is geared towards investigating the impact of food security in households of low-income on the susceptibility of childhood Obesity among children who are between 1 month and 5 years of age in the racially diverse State of North Carolina. As previously discussed by Shamah-Levy, Mundo-Rosas, Morales-Ruan, Cuevas-Nasu, Méndez-Gómez-Humarán, and Pérez-Escamilla (2017) of the young girls who are less than the age of 2 years, the reduced vulnerability of being obesity related to food insecurity in low income households, could explain the food insecurity of a household during the gestational period of the mother, bearing in mind the impact of maternal and well-baby health education on the outcomes of

the pregnancy. Additionally, as Shamah-Levy et. al. (2017) assert maternal related undernutrition to be precise, is largely associated with the increased susceptibility of pre-term births and a low birth weight. As a result, these factors as reported by Nguyen, Ford, Yaroch, Shuval and Drope (2017) could cause a considerable decrease in the weight of the infant during the early years of life. However, it still remains uncertain as to why there is specifically no substantial association between food insecurity and prevalence of obesity in boys who are younger than 2 years, although this forms a basis for future relevant studies.

The results and findings of this research study appear to be quite similar with those of a recent study that sought to establish whether there is a general affirmative relationship between the insufficiency of food during the first 2 years of life and the prevalence of childhood obesity between the age of four to five years. This is relative to the findings of Metallinos-Katsaras, Sherry and Kallio (2009). Nevertheless, Martin and Ferris (2007) found that in particular that study showed no significant differences between boys and girls worthy of noting. The findings of this study also show significant similarity with two other studies conducted prior to this one, suggesting that the association of food insecurity in a household and childhood weight varies depending on the sex of the child. As asserted by Larson and Story (2011) and Ke and Ford-Jones (2015), the likely underlying explanations for the risen obesity menace among children who are between the ages of 2 to 5 years old with the food insecurity of a household could be argued based on the quality and the quantity of the diet consumed by these children. As such, Neyestani, Omidvar, Zayeri and Salarkia (2015) and Yamborisut, Visetchart, Thasanasuwan, Srichan and Unjana (2018) have argued that energy dense diets and nutrient-restricted diets accompanied by intermittent food supply leading to binge eating whenever food is in adequacy could be reason enough for increased childhood obesity. One of the greatest strong points for this research study is that it is fundamentally grounded and built on a culturally diverse population sample in a low-income section of North Carolina.

As Trappmann, Jimenez, Keane, Cohen and Davis (2015) and El-Sayed, Scarborough and Galea (2012). have discussed, this makes the research analysis to be more feasible and pragmatic, given the wide array of racial settings in the State of North Carolina. In addition, the level of food security in any household is, to a large extent, pertinent to families that are of the lower income economic status making the study more viable. The likely restraint to this research study in the State of North Carolina could be the study design which is largely cross-sectional. The disadvantage of using the cross-sectional design of study in research studies of this nature is that they are restricted in such a manner that they are not able to clearly define and demonstrate the reason behind and the impact due to the fact that the sequential connection of household food insecurity to childhood obesity cannot be substantiated. Nonetheless, as similarly found by Larson and Story (2011) considering the virtue of a recent longitudinal research study generating consistent results and findings. The results and findings of this study could not be attributed to contrary unpremeditated actions. At some point, there was a misclassification of food security data. Nevertheless, there is absolutely no reason whatsoever to anticipate that this error may have jeopardized the imminent results. Also, considering the fact that the association was identified and established in

girls, the fault couldn't have altered the results in considerably manner, but there is a small likelihood that the misclassification altered the results in boys relative to Martin and Ferris (2007).

Conclusion

As suggested by Gundersen and Ziliak (2014), the results and findings of this research study demonstrate that there is a significant relationship between the food insecurity status of a household and childhood obesity in low-income girls. Demographic variables such as age and gender, though, seem to change the degree and direction of the alleged relationship. For the purposes of future research studies, they should be conducted to investigate this relationship by adopting a longitudinal study design.

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