EXPLORING FACTORS ASSOCIATED WITH FREE AND REDUCED-PRICE LUNCH PARTICIPATION IN MISSOURI SCHOOL DISTRICTS

A Thesis

presented to

the Faculty of the Graduate School

at the University of Missouri-Columbia

In Partial Fulfillment

of the Requirements for the Degree Master of Science

by

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DECEMBER 2020

The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

EXPLORING FACTORS ASSOCIATED WITH FREE AND REDUCED-PRICE LUNCH PARTICIPATION IN MISSOURI SCHOOL DISTRICTS

presented by Gloria Ndindir Mangoni,

a candidate for the degree of Master of Science of Rural Sociology, and hereby certify that, in their opinion, it is worthy of acceptance.

Dr. Hua Qin

Dr. Mary Hendrickson

Dr. Irma Arteaga

To this brave and inspiring woman who believed in her intellectual capacity, fought against early marriage, and experienced community's dishonor but pursued her academic dream.

She could not go beyond her undergrad degree in French and African Linguistics because she found a better goal in life: start and take care of her own family.

Along with her exceptional spouse Vital Mangoni, they sacrifice so much so my siblings Patrick, Lydia, Guyguy, Sylvain, Junior, and I could go beyond their academic limits.

I proudly dedicate you this work as a fruit of your prayers, wishes and sacrifices...

To you my precious Mum, Esther Ndindir Muzinga...

With so much gratitude.

ACKNOWLEDGEMENTS

I cannot claim to have been able to carry out this scientific endeavor and complete this master's program without the inspiration, intelligence, and strength that the Lord Jesus-Christ has never ceased to renew in me. There were many reasons to give up, but He gave me so many reasons to keep up till the end. I am incredibly grateful for this.

I owe the quality of my thesis to my academic advisor Dr. Hua Qin, and to my graduate committee members Dr. Mary Hendrickson and Dr. Irma Arteaga who carefully reviewed and gave constructive feedbacks on the theoretical, methodological and policy implications of my research. I am most grateful to Dr. Hua whose scientific rigor and encouragement throughout the writing of this thesis allowed me to expand my quantitative research skillset. May Dr. Mary Hendrickson find here an expression of my gratitude for encouraging me to step out of my comfort zone and start exploring food security research theme in the United States. Thanks to Dr. Irma Arteaga for bringing a look at the policy implications of this work. Indeed, the research's findings will only be of value if adequate policies and measures are taken to improve the students' food security and household living conditions.

I extend my gratitude to all the Professors and Faculties in the Division of Applied Social Sciences, the Interdisciplinary Centre for Food Security, and the Deaton Institute for sharing knowledge, resources, constructive feedback and encouragement: Dr. Jere Gilles, Dr. Johanna Adams, Dr. Corinne Valdivia, Drs. Anne and Brady Deaton, Dr. Kenneth Schneeberger, Dr. Kerry Clark, Dr. Sandy Rikkoon, Bill Mc Kelvey, Carole Swaim, and Johnette Blair. It is also an opportunity to express my gratitude to the University of Missouri Writing Center, and Social Science Statistics Center staff for their technical support.

I am grateful to Dr. John Mususa Ulimwengu for his continued mentorship over the past few years and his patience in reviewing my research papers. Thank you for believing in my potential and walking with me during the best and worst times of my life. I extend my gratitude to Mr. Matata Ponyo Mapon for investing in my potential and giving me the resources necessary to start this academic journey abroad.

May my beloved Adrien Ngudiankama, my parents Vital and Esther Mangoni, my siblings, nephews, and nieces find here the expression of my gratitude for their prayers, and support they never cease to show me. Thank you for always being there for me.

I acknowledge the support of my friends and colleagues: Clement Pfingu, Barituka Bekee, Vanessa Awa, Adou Kwakou Donatien, Uriel Dembys Jacket, Uchechi Iyege, Yassine Dguidegue, Jennifer Pilz, Yanu Praseyto, Serge Manaswala, Marina and Abel Kutangila, Esther and Jude Kyoore, Max and Bobette Mungyeko, Rokia and Paul Abrogouah, Michael Appenteng, Lina and Marc Terzian, Jaclyn Butler, Dena Lane Bonds, Barbara Bauer, Joinee Taylor, Becca Clay, and Catherine Hurt. Finally, I would like to thank my faith community for the fellowship both in the United States and in Congo, including Jesus House Columbia, Mizzou Chi Alpha, Salem Gospel Ministry, Silo Evangelical Center, and the Pastors Jean Baptiste and Lilian Sumbela, Bisaka, and Femi.

I am convinced that this is a great achievement, and the beginning of an exciting and productive academic career.

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ACS	American Community Survey
AME	Average Marginal Effect
CEP	Community Eligibility Provision
EPOS	electronic point-of-sale
FNS	Food and Nutrition Service
FRAC	Food Research and Action Center
GDP	Gross Domestic Product
GLM	Generalized Linear Model
HHFKA	Hunger Free Kids Act
ISP	Identified Student Percentage
LEP	Limited English Proficiency
NCCP	National Center for Children in Poverty
NSLP	National School Lunch Program

SFAs	School Food Authorities
SNAP	Supplemental Nutrition Assistance Program
SFUSD	San Francisco Unified School District
TANF	Temporary Assistance for Needy Families
USDA	United States Department of Agriculture
VIF	Variance Inflation Factor

Abstract

Participation in school meal programs is critical for meeting the most vulnerable children's daily food requirements while allowing School Food Authorities to get reimbursed for the meal provided and thus continue to run the program in their local entities. The analysis of the Department of Elementary and Secondary Education data during the last decade revealed a 10.3% in the number of reimbursable lunches served in Missouri, with a lower participation level of eligible students from southern lower-income counties compared to Northern counties during the 2018 – 2019 school year.

Previous studies on school lunch participation have shown that students' socio-demographic and socio-economic characteristics, the school's geographical location, and policies implemented at the school, state, or federal level affect students' participation in the program. This research examines the extent to which school districts' place-based variables such as geographical location, implementation of Community Eligibility Provision, as well as socio-economic and demographic variables (proportion of children in poverty, household income, school district size, age, race, gender, household head marital status and English proficiency) influence school districts' levels of participation in Free or Reduced-price lunch in Missouri.

To assess the significance of the association of school districts' place-based characteristics, a Generalized linear model was estimated based on cross-sectional data of Free and Reduced-price lunch from the 2018-2019 school year, and the five-year estimates of socio-economic and demographic (2013 – 2017 American Community Survey data). The findings suggest that economic and demographic factors such as household income, children poverty, school district size, age, and the proportions of single female-headed households and non-

English proficient households significantly influenced school districts' rates of participating in Free or Reduced-price lunch participation in Missouri. However, the school district level of analysis hindered observing the effects of other variables that may be significant at a lower scale of analysis, especially gender and race. An increase of the sampling frame and the use longitudinal data will help better capture the association of school districts' demographic predictors with Free and Reduced-price lunch participation. With the recent outbreak of the COVID-19 pandemic and the subsequent school closure, future studies can also explore the effects of this public health issue on Free and Reduced-price lunch participation.

Chapter 1: Introduction

1.1. Background

School Lunch Programs (SLPs) are target social safety net strategies embraced worldwide to meet children's nutritional needs and improve their cognitive abilities, especially those coming from vulnerable households (Zenebe et al., 2018). SLPs provide students with nutritious meals to eat at school on weekdays or to take at home on weekends. Some schools offer meals at no cost, while others require making payment in kind or cash (Aliyar et al., 2015). In the United States, these programs emerged towards the end of the 19th century in Boston and Philadelphia as a charity movement run by private organizations concerned with child welfare (Avey, 2015). In 1946, the Congress authorized the Richard B. Russell National School Lunch Act (79 P.L. 396, 60 Stat. 230), creating the National School Lunch Program (NSLP) in order to assist schools districts and independent schools with cash subsidies and necessary foods to feed qualified students nutritionally balanced meals each school day (Rude, 2016). The National School Lunch Program became a federal meal assisted program administered by the United States Department of Agriculture (USDA) Food and Nutrition Service in agreement with State agencies and School Food Authorities (Izumi, Bersamin, Shanks, Grether-Sweeney, and Murimi, 2018).

The USDA (2019) defines students' eligibility for Free or Reduced-price meals based on household income level and size. Students are unconditionally eligible for Free meals if they live in families with incomes at or below 130% of the Federal Poverty Line; or if their families participate in Federal Assistance Programs such as the Supplemental Nutrition Assistance Program (SNAP) and Temporary Assistance for Needy Families (TANF); or if they fit the category of a homeless, migrant, runaway, or foster child. Those with incomes between

130 and 185% of the Federal poverty level are eligible for Reduced price meals. Finally, children from families whose income is above the 185% threshold are expected to pay the full price for school meals. Although the United States is the world's largest economy with $65,456 of GDP[1] per capita in 2019, 43% of children live in families whose incomes are below 185% of the federal poverty threshold (NCCP[2], 2020). This means that a little less than half of American school-aged children and adolescents live in households whose income would place them at a Free or Reduced-price lunch status with the National School Lunch Program. Except for kindergarten students, students spend almost a third of their day at school. For many of them, their food consumption depends on their participation in school meal programs. Therefore, participation in SLPs is critical in meeting their daily food and nutrition needs, especially those from low-income households (Arteaga and Heflin, 2014; Izumi et al., 2018).

1.2. Justification of the study

Information on school lunch participation is critical for institutions involved in improving students' food security and health. Since 1969, the USDA- FNS (2020) reported a positive trend in the national SLP participation rate, starting from 15.1% in 1969 to 74.1% in 2019. While the nationwide number of Free lunches served steadily increased from 2.9 million lunches served in 1969 to 20.1 million 50 years later, the number of Full Price lunches served dramatically decreased from 16.5 million meals served in 1969 to 7.7 million in 2019. Meanwhile, the average number of lunches served under Reduced-price was almost even (1.9 million) over the last 50 years (figure 1). Despite the nationwide increase in the 5 to 17 years old population over the past sixty years, from 69.3 to 73 million[3], participation in Free and

[1] United States (USA) GDP - Gross Domestic Product 2019. (2020). Retrieved 03 March 2020, from https://countryeconomy.com/gdp/usa
[2] http://www.nccp.org/publications/pub_1194.html
[3] U.S. Census Bureau, Current Population Reports (https://www.childstats.gov/americaschildren/tables/pop1.asp)

Reduced-price lunch remains a persistent challenge for School Food Administrators, especially in rural counties and school districts (Dunifon, Kowaleski, and Jones, 2003).

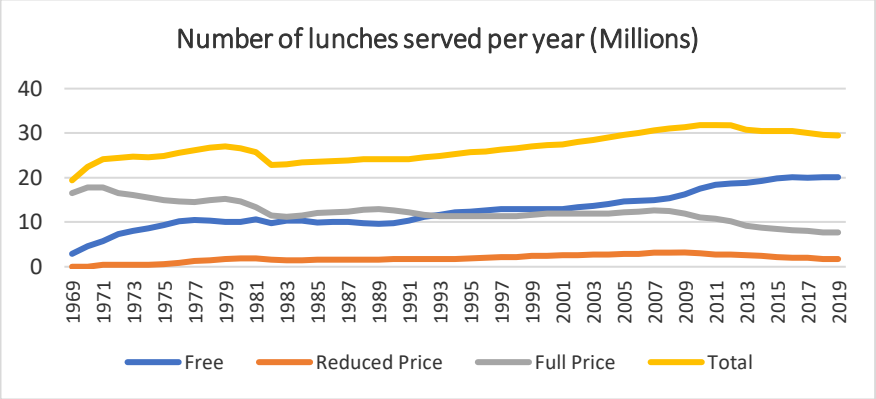


*Figure 1.*Historical trends of school lunch participation in the US

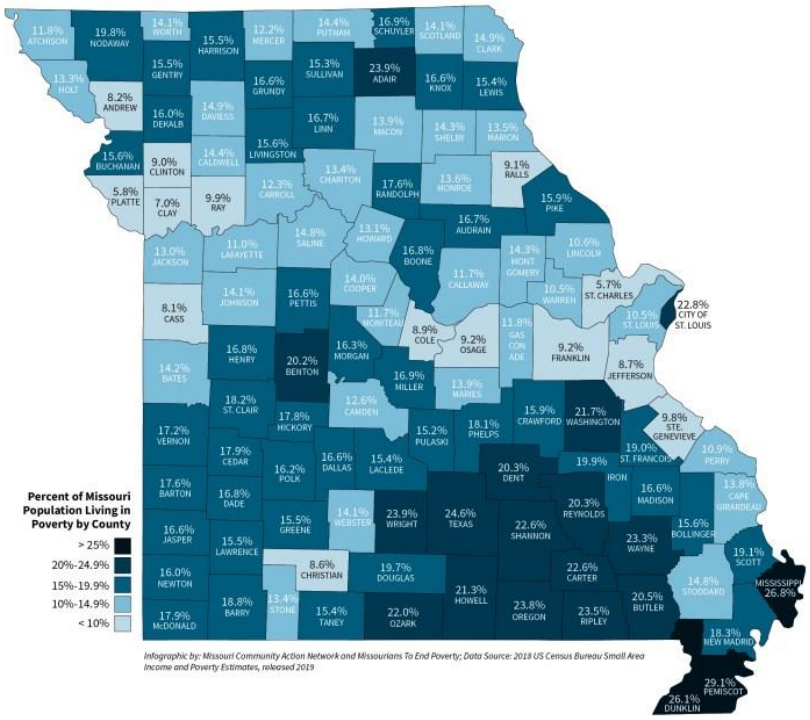
Source: Author's, data from Fiscal Year 2019 preliminary data (USDA – FNS, 2020)

The Department of Elementary and Secondary Education data on school lunch participation shows 10.3% in the number of reimbursable lunches served between 2011 and 2018 school years in Missouri. Such a decline in school lunch participation could reflect either a statewide improvement in households' socio-economic conditions or weakness in reaching the neediest school-age communities in the state (Gleason, 1995). The 2016 Missouri Hunger Atlas revealed a spatial disparity in Free and Reduced-price lunch. Southern poorer[4] counties have a lower rate of eligible students participating in Free and Reduce-price lunch programs than Northern counties (see figure 2). This raises major interconnected questions: i) What are the drivers or barriers of Free and Reduced-price lunch participation in Missouri? ii) Does participation in Free and Reduced-price lunch depend on place-based factors or socio-economic and demographic contextual characteristics? This study will answer these two questions by analyzing Free and Reduced-price lunch participation in Missouri school districts.

[4] 30 to 50% of child poverty rate according to the American Community Survey (2017)

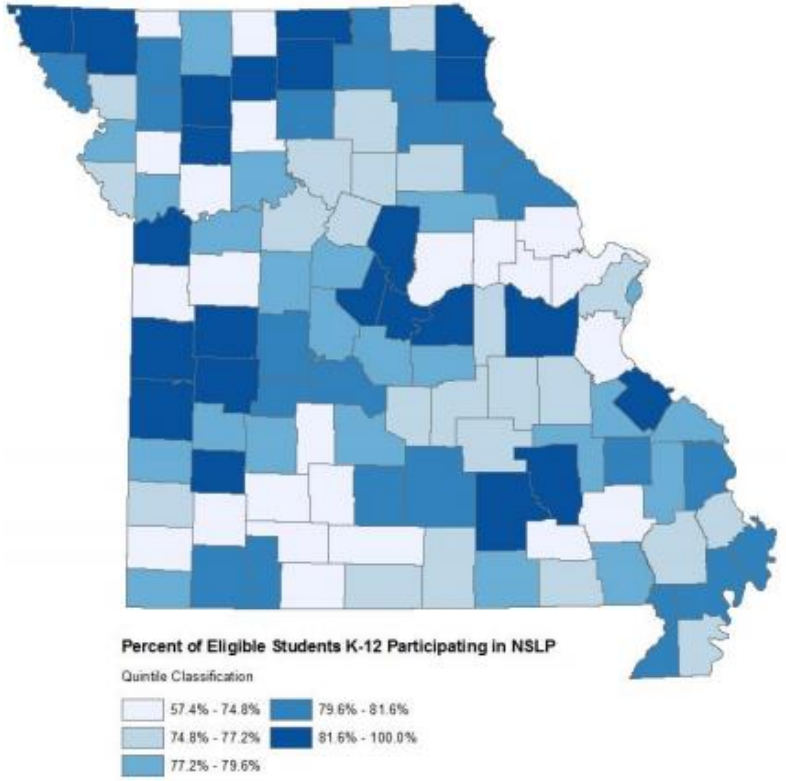
Figure 2. Spatial Disparity in School Lunch Participation (County Level)

Missouri Poverty Rate by County



Source: Missouri Community Action Network. (2018).

Percent of Eligible Students K-12 participating in NSLP



Source: (Cafer, A., Chapman, A., Freeman, K., and Rikoon, S., 2016)

1.3. Research Question

The literature on school lunch in the United States revealed sets of individual and place-based factors that influence students' participation in the program. These include socio-demographic and socio-economic characteristics of the school lunch's participants, the school's geographical location, and policies adopted at the school, state, or federal level.

Certification type (Free, Reduced, or full price) represented a major determinant of students' consumption of school meal, especially for students from households with an income below the established Federal Government income level (Gleason, Tasse, Jackson, Nemeth, and States, 2003;Gleason, 1995). Kjosen (2015) argued that school lunches are the only affordable and nutritious lunch alternative low-income students would have access to in many cases. For this reason, it is crucial to ensure their participation in the School Lunch Program.

Regarding parental employment status, Moore, Hulsey, Ponza, and States(2009) argued that students living with an employed parent have more chances to eat a school lunch. They argue that full-time employed parents have less time to cook meals for their children at home than unemployed parents. Mirtcheva and Powell (2009)

found an inverse association between students' participation in school lunch and their parents' education level. They argued that students' participation in school lunch is likely to decline as their parents are more educated. This can be because less-educated parents have lesser access to decent job opportunities relative to well-educated parents.

Few studies have explored the association between gender and participation in the school lunch program. While studying the contextual factors surrounding school lunch participation in the United States,, Mirtcheva and Powell (2009) noticed that male students were more likely to participate in the school lunch program than female ones.

Students' age, often measured by school grade, influenced school lunch participation. Indeed, elementary and middle school students tend to have a higher school lunch participation rate than high school students (Gleason, 1995; Mirtcheva and Powell, 2009). Some qualitative studies explained high school students' non-participation in the school lunch program using several reasons such as attitudes and perceptions on the quality of meals, cost, social influence, stigmatization from peers, and open-campus policies enabling students to buy food outside (Asperin et al., 2008; Bartfeld and Kim, 2010; Keller, 2013; Moore et al., 2009; Tsai, Ritchie, Ohri-Vachaspati, and Au, 2019).

Regarding ethnicity and race characteristics, Gleason (1995) found that African Americans and Hispanic students were more likely to eat school lunch than other ethnicities/races. Foreign-born students participate in school lunch more than U.S. born students. However, limited English proficiency (LEP) constitutes a barrier to non-English proficient students' participation in school meal programs in some U.S. regions (Center on Budget and Policy Priorities[5]).

There are diverse opinions concerning the relationship between geographic location and school lunch participation. Gleason (1995) argued that rural students were more likely to eat school meals than urban and suburban students, as they have less available food options. However, other scholars claim that school lunch participation rates are higher in cities than in rural settings (Carson and University of New Hampshire, 2015; Rank and Hirschl, 1993; Rogus, Guthrie, and Ralston, 2018). They allege that rural schools face several challenges such as lower enrollment, longer distances to urban centers limiting their access to food distributors, labor, equipment, and stigmatization of participation in food assistance programs.

[5] Food Research and Action Center, Migrant Legal Action Program (2014).

In response to the stigmatization of low-income students' participation in the school lunch program and the childhood obesity crisis, many schools introduced new school meal policies such as the use of electronic point-of-sale (EPOS) technology, elimination of competitive foods through *a la carte* menu or vending machines, and improving school menu items (Bhatia, Jones, and Reicker, 2011; Long, Luedicke, Dorsey, Fiore, and Henderson, 2013; Moore et al., 2009; Wojcicki and Heyman, 2006). The Federal government adopted a few mechanisms for increasing school lunch participation and access to healthy and nutritious food to children throughout the country, including the adoption of the Healthy Hunger-Free Kids Act (HHFKA), the introduction of the Community Eligibility Provision (CEP), and the adoption of Farm to School Program currently implemented in 5,254 US school districts (Libby et al., 2017). Several scholars conducted longitudinal studies to assess the CEP impact on school lunch participation (Pokorney, Chandran, and Long, 2019; Rogus et al., 2018; Turner et al., 2019; Vaudrin, Lloyd, Yedidia, Todd, and Ohri-Vachaspati, 2018).

The existing knowledge on school lunch programs has addressed school lunch participation questions by exploring student, household, and school-level data. Little research uses school district-level data to investigate the influence of place-based characteristics on Free and Reduced-price lunch participation. Moreover, few studies have examined school lunch participation per certification type Free, and Reduced-price (Wojcicki, 2006; Bhatia, 2011; Vaudrin, 2018; and Pokorney, 2019). Nevertheless, the existing literature provides solid ground to study school lunch program trends and participation dynamics across a geographic space such as school districts, counties, or states.

This thesis will draw on the existing literature and will expand it by conducting a state-wide analysis of structural drivers underlying Free and Reduced-price lunch participation for

school districts in Missouri. I intend to address the following research questions: (i) How are school district's geographic location (rural, city, town, urban) associated with Free or Reduced-price lunch participation rates in Missouri? (ii) Which economic and socio-demographic characteristics are most significantly related with Free or Reduced-price lunch participation? (iii) To what degree does Community Eligibility Provision influence Free or Reduced-price lunch participation throughout Missouri's school districts?

1.4. Research Objective

To address the research questions, I conducted a quantitative analysis using secondary data collected from the Department of Elementary and Secondary Education (DESE), the National Center for Education Statistics (NCES), and the Food and Research Action Center (FRAC). The purpose of the study is to assess the significance of the association between school districts' geographic, policy, economic and socio-demographic characteristics with Free and Reduced-price lunch participation. I refer to Pokorney et al., (2019) and Vaudrin et al., (2018) to define Free, and Reduced-price lunch participation. That is to say, participation in the Free or Reduced-price lunch is defined as a proportion resulting from the division of the total number of lunches served in each certification category by the total number of lunches served in a school district.

Many empirical studies provide various methodologies (descriptive statistics, regression models) and variables to study Free and Reduced-price lunch participation determinants, including economic variables such as household median income, child poverty, or/and socio-demographic variables including age, gender, race, etc. The individuality of this research is that it assesses Free and Reduced-price lunch participation by regressing the wide

range of factors identified in the literature, the school district's geographic location, and implementation of Community Eligibility Provision.

1.5. Significance of the Study

Declining participation in school lunch is a big challenge for School Food Authorities as it negatively affects school revenue streams (Ralston, Newman, Clauson, Guthrie, and Buzby, 2008). Indeed, Schools receive reimbursement from the U.S. Department of Agriculture for meals they serve in each certification category. For example, during the School year 2018-2019, the National Average Payment Factors in contiguous States was 3 dollars for Free lunch, and 2 dollars and 60 cents for Reduced price lunch[6].

School districts have the flexibility and opportunity to implement more extensive policy reforms and ensure that low-income students gain more access to healthy and nutritious meals (Wojcicki and Heyman, 2006). By conducting this study, I will identify factors likely to explain school districts' level of participation in the Free and Reduced-price lunch program. These factors are critical to inform the design of programs that aim to increase students' food security through school meals in Missouri.

1.6. Organization of study

The rest of the thesis is organized in the following chapters:

- Chapter 2 provides an overview of the literature on school lunch participation determinants.
- Chapter 3 describes the data and explains the methodology applied in this study.
- Chapter 4 presents the results of the study, including descriptive statistics, bivariate analysis, and the regression model, and discusses the findings and their implications.
- Chapter 5 summarizes and concludes the study with recommendations for future research.

[6] Federal Register / Vol. 83, No. 139 / Thursday, July 19, 2018 / Notices, retrieved from https://www.govinfo.gov/content/pkg/FR-2018-07-19/pdf/2018-15465.pdf

Chapter 2: Literature Review

School Lunch Programs have been studied from various perspectives. This study focused on literature identifying sets of determinants of School Lunch Program participation. I classified these drivers into four categories: socio-economic and socio-demographic characteristics of school lunch participants, the school's geographic location, and policies implemented at the school and school district level.

2.1. Socio-Economic Characteristics of School Lunch Participants

Students' eligibility for Free or Reduced-price meals is related to household income level. However, previous studies explained student's likelihood of participation in the School Lunch Program based on additional household characteristics such as parental employment and educational status. The section below describes the economic characteristics of school lunch participants' households.

2.1.1. Students' certification status (Free, Reduced-Price, and Full Price)

Students' certification in Free, Reduced, or Full price lunch is a significant determinant of students' school meal consumption. (Gleason et al., 2003; Gleason, 1995) identified characteristics of school lunch participants using data from the 1992 School Nutrition Dietary Assessment Study. The research found that of the 92% of school lunch program participants, those certified for Free and Reduced-price lunch were more likely to eat school lunch than students from higher-income families. These scholars explained the increasing trend in school lunch participation as a result of the growing number of students certified in Free lunch. Indeed, children who receive Free lunches usually live-in households whose income is below the established Federal poverty threshold. Thus, school lunch becomes the most affordable and nutritious meal option they have access to (Kjosen, 2015).

2.1.2. Parental employment status and Parental Education

Moore et al. (2009) explained parental employment status as a school lunch participation determinant, using Access, Participation, Eligibility, and Certification (APEC) national data collected during the 2005 -2006 school year. They argued that students who lived in households with an unemployed adult were less likely to eat school lunch compared to those who lived in households with an employed adult. Indeed, low-income employed parents have less time to prepare meals for their children at home than parents who are not employed.

Mirtcheva and Powell (2009) associated maternal education with children's participation in the NSLP. They found that children of some college or college-educated mothers were less likely to eat Free lunches compared to children whose mothers had less than high school education. This might be a general fact that more educated parents have access to better paying job opportunities than less-educated parents.

2.2. Socio- Demographic Characteristics of School Lunch Participants

Some scholars focused on students' socio-demographic characteristics that impact School Lunch Program participation. Dunifon et al. (2003) establish a significant association between students' background characteristics such as gender, age, ethnicity, and household head's marital status. The sections below give a detailed description of these associations.

2.2.1. Gender and Age

Mirtcheva and Powell (2009) found that male students were more likely to eat lunch in school. However, the gender differences observed were not significant when analyzed per certification status (Free or Reduced-price lunch).

Age is often quoted in most of the literature determinants of school lunch participation, with students' age measured based on their school grade level. Many scholars argue that

younger students in elementary and middle school had a higher school lunch participation than older high school students (Bartfeld and Kim, 2010; Gleason 1995; Mirtcheva and Powell, 2009; Moore et al., 2009). Several qualitative inquiries were conducted to explore reasons that prevent high school students from participating in the school lunch programs. In their studies, Asperin et al., (2008), Bartfeld and Kim (2010), Keller (2013), Kjosen (2015), Moore et al., (2009) identified factors such as student's attitudes and perceptions on the quality, taste, appearance, aroma, variety, freshness, and healthfulness of meals served at school. Other reasons related to school policy and practices include meal eating timing constraints; overcrowded or limited dining area capacity; meal cost; social influence and stigma from peers; and open campus policy, allowing students to buy food outside.

Mirtcheva and Powell (2009) identified neighborhood food environments such as proximity to fast-food restaurants or food stores as a factor decreasing high school students' participation in school lunch programs. Schools located in lower-income neighborhoods have more fast-food restaurants (Bhatia et al., 2011). While studying disparities in the food environment surrounding US middle and high schools, (Sturm, 2008) noticed a high proportion of Hispanic students attending schools surrounded by convenience stores. As a result, Hispanic students were less likely to participate in school lunch because of being exposed to more snacks, commercial food items, and fast-food options rather than healthy food items.

2.2.2. Students' Race, English proficiency and Household head marital status

Gleason (1995) indicates that minority students (African Americans followed by Hispanics) were more likely to have school lunch than other ethnic groups (Whites, Asians, etc.). He also found that foreign-born students participate in school lunch more than U.S. born students. Although not widely explored, a report prepared by the Center on Budget and Policy

Priorities (2014) suggests that limited English proficiency (LEP) constitutes a barrier to participation of non-English proficient students in school meal programs in U.S. regions that have not traditionally had substantial LEP populations (Southeast, Midwest, Pacific Northwest, and Mountain West). The report states that these students live in households with limited access to translation assistance or information about school-based programs in their primary language or a manner they can easily understand. Regarding household head marital status, Dunifon et al., (2003) found that married couples have more time to devote to learning about programs such as the NSLP. They may also have more information about school lunch programs, leading to increased participation among their children.

2.3. School Geographic Location and School Lunch Participation

Few studies predicted meal participation variation as related to schools' geographic location characteristics. While describing school lunch participants' characteristics, Gleason (1995) and Arteaga and Heflin (2014) noticed that rural students were more likely to eat school meals than urban students, as there are less available food options for children in poor rural areas beyond the NSLP. Other scholars observed a higher school lunch participation rate in cities than in rural settings. Rogus et al. (2018) explained lower rural participation in school lunch by the fact that rural districts face several challenges, including lower enrollment rates and disparity from urban centers hindering access to food distributors, labor, equipment, and technology.

While studying school lunch and breakfast participation by region and place type in the United States, Carson and the University of New Hampshire (2015) found a higher school lunch participation rate in cities (70%) than rural (63%) and suburban areas (59%). This finding aligns with (Askelson et al., 2017; Ohri-Vachaspati, 2014), whose results associated low

participation in school meal programs in some rural states with parents' perception of the quality of meals served at school as well as on the value of family meals. The subcultural theory[7] of urbanism explored by Hirschl and Rank (1999) better explains the pattern of participation in welfare programs between urban and rural settings. This theory stipulates that population size or density affects the decision to participate in welfare programs. Since the population density implicitly contains social class composition, an increased interaction among low-income households in regions with high population density contributes to reducing some of the stigma and the adverse attitudes surrounding the use of public assistance programs. Also, proximity to other low-income individuals who receive welfare contributes to reducing one's reluctance knowing that others also need assistance. In contrast, low-density areas (rural areas) have a mixture of social classes more than urban areas so that participation in public assistance programs is more visible and stigmatized.

2.4. School, State and Federal Policies and School Lunch Participation

Increasing participation in NSLP, especially for low-income students, remains a persistent challenge faced by School Food Authorities (SFAs). Indeed, it requires serving nutritious food at an affordable cost in an environment free from any form of discrimination (Keller, 2013; Turner et al., 2019). Limiting factors to low-income participation in the school lunch program are related to school cafeteria operational factors. These include shaming practices enabling peer stigmatization of students who are unable to pay for their meals; physical demarcation of paying and nonpaying students in the lunchroom; selling of

[7] Subcultural theory is a social interactionist-style approach to the city that credits urbanism for strengthening social groups by promoting the formation of diverse subcultures. This theory proposes that the size, population, and heterogeneity of cities strengthen social groups, and encourage the formation of subcultures, which are much more diverse compared to the general culture.

competitive food[8] through *a la carte* menu or vending machines; poor customer service (Dunifon, 2003; Asperin et al., 2008; Pogash, 2008; Keller, 2013; Karnaze, 2018).

To decrease stigma and inconvenience associated with low-income students' consumption of school lunches and subsequently increase their participation in the NSLP, many schools introduced electronic point-of-sale (EPOS) technology to automatically identify students' eligibility for Free or Reduced-price lunch (Moore et al., 2009; Lee et al., 2017). To increase NSLP participation and access to healthy and nutritious food for American children throughout the country, the state and the federal government adopted policies such as the Healthy Hunger-Free Kids Act (HHFKA), the Community Eligibility Provision (CEP), and the adoption of farm to school programs currently implemented in 5,254 US school districts (Libby et al., 2017). In response to the childhood obesity crisis and parental pressure to change nutrition standards of school meals, the Federal Government introduced a legal provision eliminating the sale of unhealthy foods, snacks, and beverages from lunch lines, snack bars, and vending machine locations in all public elementary, middle, and high schools.

Following the adoption of the Healthy Hunger-Free Kids Act[9], many schools embraced more nutritious menu options and removed alternative food options in school. Several studies measured the impact of this federal policy on participation in the NSLP. (Vaudrin et al., 2018) conducted a longitudinal study in four cities in New Jersey. Their study compared Free and Reduced-price lunch participation rates of low-income and high minority public K-12 schools over seven years, from 2008 to 2014 (before and after implementing of the 2010 HHFKA). They noticed a substantial increase in NSLP participation rates (up to 82%) during the 2008–

[8] Competitive foods are defined as "any foods and beverages not part of the federal school lunch program sold during the school day" (Lizzy et al., 2018). These foods which compete with the NSLP tend to be high in calories, carbohydrates, and fat, and are believed to be a contributing factor to childhood obesity rates (Fox, Meinen, Pesik, Landis, and Remington, 2005).

[9] aligns the meal patterns and nutrition standards for the National School Lunch Program (NSLP) and the School Breakfast Program (SBP) to align with the 2010 Dietary Guidelines for Americans (Vaudrin et al., 2018).

2012 recession period, resulting from the growing number of students eligible for Free or Reduced-price meals. This rapid rise was followed by a sudden drop in NSLP participation rate (71%) at the first year of the HHFKA implementation (school year 2012–2013) due to an early lack of acceptance of the new meal standards, especially among students eligible for Free or Reduced-price meals. Finally, the continued student exposure to healthy meals led participation rates in NSLP to jump back up and continue to increase in subsequent years (school year 2014–2015).

To increase school lunch participation and internal revenue, schools stopped selling competitive foods through *a la carte* menus and vending machines and subsequently improved their school menu items. Bhatia et al. (2011) and Wojcicki and Heyman (2006) studied school lunch participation rates before and after the implementation of the progressive nutrition policy[10] and the elimination of *a` la carte* options in the San Francisco Unified School District (SFUSD). Wojcicki and Heyman (2006) noticed a 67.5% participation increase in the Free lunch program and a 50.0% participation decrease in the Reduced-price lunch program in the whole SFUSD. Bhatia et al. (2011) noticed an increase in the average daily participation in Free and Reduced-price lunch of qualified students in all school sites at the SFUSD. Long et al. (2013) came up with the same observation while analyzing the impact of Connecticut legislation incentivizing voluntary school district elimination of unhealthy competitive foods on NSLP participation. They noticed that this policy helped increase middle school and high school students' lunch participation by 7% and 23%, respectively, but they observed a 2.5% decrease in elementary school lunch participation.

[10] The SFUSD has developed district-wide nutrition policies requiring elimination of foods not meeting the federal nutrition standard (artificially sweetened foods and foods that provide less than 5% of the recommended dietary intake of each of 8 specified nutrients per 418 J or per serving)

The nationwide introduction of the Community Eligibility Provision (CEP) during the 2014-2015 school year boosted overall NSLP participation. This was seen mainly in terms of the number of meals served, as many schools enrolled certified Free meal students through the direct certification process (Izumi et al., 2018). The state of Missouri implemented CEP for the first time in 2015 in 62 school districts. The CEP expanded during the 2016-2017 school year, with 31.4% eligible school districts implementing the program. In 2018, 46.5% of eligible school districts implemented the program. The Community Eligibility Provision, described in section 104(a) of the Healthy, Hunger-Free Kids Act, authorizes school food authorities to offer free meals to all of their students without collecting school meal applications in schools and school districts that meet a certain threshold of poverty as measured by their identified student percentage (ISP) (Harkness, Logan, Shivji, Nisar, and Connor, 2015). A school can participate in CEP if 40% or more enrolled students participate in other federal assistance programs such as the Supplemental Nutrition Assistance Program or Temporary Assistance for Needy Families (Rogus et al., 2018). Studying the impact of CEP on school lunch participation in Pennsylvania and Maryland National 2013 and 2017 school years, Pokorney et al. (2019) found a significant association between school-level implementation of CEP with an increase in total school lunch participation. They observed a lower Free and Reduced-price meal participation and a substantial increase in paid meal participation. In their research on the impact of the Community Eligibility Provision on school lunch participation from 2013 to 2017 in California's public schools, Turner et al. (2019) came across a more extensive participation rate in NSLP among eligible schools that implemented CEP. This was mainly among those with predominantly Hispanic students and in rural areas. Therefore, schools'

adoption of CEP in high poverty schools boosted overall school lunch program reach among students most likely to suffer from food insecurity.

2.5. Conclusion

The literature explored in this study revealed that determinants of school lunch participation had been thoroughly studied. School lunch participation is driven by several factors, including economic, socio-demographic, geographic location characteristics, and as policies implemented at the school level. Most of the literature studied school lunch participation drivers at the student or school level, but little research explored Free and Reduced-price lunch participation at the school district or county level. Moreover, there were divergent opinions regarding rural and urban school lunch participation, where some scholars argue that SLP participation is higher in cities, and others disagree.

In response to these gaps in the literature, I have proposed a study that will identify structural determinants of Free and Reduced-price lunch participation in Missouri school districts. This study will emphasize the moderating effect of school geographic location characteristics and implementation of the Community Eligibility Provision. Such a study is critical for policymakers as it will allow them to identify the most significant factors driving Free and Reduced-price lunch participation in school districts.

Chapter 3: Methodology

Building on existing literature, I formulate the hypothesis that school district participation in Free and Reduced-price lunch programs is not homogenous throughout the state of Missouri. As suggested by Mirtcheva and Powell (2009), Free and Reduced-price lunch participation will be higher within urban or suburban school districts, or in areas with a high proportion of male, African American or Hispanic, younger students, or a high proportion of single-headed households or parents whose income is below, or at the poverty line. However, I expect to observe lower participation in rural school districts, with a high proportion of female, older students, or parents whose median income is above the poverty line. Moreover, eligible school districts implementing Community Eligibility Provision (CEP) will have higher participation in Reduced price lunch relative to school districts not implementing CEP, as indicated by Pokorney et al. (2019); Ruffini (2018) and Turner et al. (2019).

3.1. Conceptual framework

The conceptual framework used in this study draws heavily on findings from Asperin et al., (2008); Dunifon et al., (2003); Hirschl and Rank (1999); Keller (2013); Mirtcheva and Powell, (2009); Pokorney et al., (2019); Rank and Hirschl (1993); and Turner et al., (2019). These studies helped identify two dependent variables (school district's Free, and Reduced-price lunch participation rate) and a series of independent variables related to school districts' characteristics.

As described in figure 3, this study considers four major drivers of school district's Free and Reduced-price lunch participation: policy, geographic location, economic characteristics, and socio-demographic characteristics.

*Figure 3.*Conceptual framework of Free and Reduced-price lunch participation drivers in Missouri school districts

Source: Author's, based on previous studies[11]

[11] Amelia Estepa Asperin et al., (2008); Dunifon et al., (2003); Hirschl and Rank (1999); Keller (2013); Mirtcheva and Powell, (2009); Pokorney et al., (2019); Rank and Hirschl (1993); and Turner et al., (2019)

3.2. Design and Methods

To implement the conceptual framework described in section 3.1., I estimate a Generalized Linear Model to assess the effect of school districts' economic, socio-demographic, policy, and geographic characteristics on Free and Reduced-Price lunch participation. I used Stata 16.1 to conduct the regression analysis based on secondary data collected from DESE, NCES, and FRAC (see the list of commands in the appendix). The dataset comprises two dependent variables and eleven independent variables.

3.3. Sampling Frame

According to the National Center for Education Statistics (2019), the United States had 1,313,598 school districts in the 2018 – 2019 school year, including 98,158 public schools and 30,597 private schools. According to the West's Encyclopedia of American Law[12] (2008) "school districts are quasi-municipal corporations created and organized by state legislatures and charged with the administration of public schools within the state."

Many institutions provide school districts level information. However, their datasets do not always have a similar size. During the 2018–2019 school year, the Missouri Department of Elementary and Secondary Education (DESE) counted 822 school districts. Public and Non-Public school districts represent 97.5% of the total number of schools in the state; Additional types of school districts include Gillis schools, blind and deaf schools, lab schools, and state schools, counting for 2.5% (see Table 1).

[12] https://legal-dictionary.thefreedictionary.com/Schools+and+School+Districts

Table 1

Category of School Districts in Missouri

School type	Schools	Schools (%)	School districts	School districts (%)
Public	2162	88.5	631	76.8
Charter	75	3.1	37	4.5
Gillis	36	1.5	17	2.1
Non-Public	125	5.1	115	14.0
Blind and Deaf	3	0.1	2	0.2
Lab	1	0.0	1	0.1
State	17	0.7	1	0.1
RCCI Non-Public	24	1.0	18	2.2
Total	**2443**	**100.0**	**822**	**100.0**

NOTE. Author's, data from DESE school (USDA – FNS, 2020)

The U.S. Census Bureau's Small Area Income and Poverty Estimates (SAIPE) and the National Center for Education Statistics (NCES) school district datasets provide child poverty records, socio-demographic and socio-economic, as well as location data on 515 school districts in Missouri. Finally, the Food and Research Action (FRAC[13]) provides data on Community Eligibility Provision implementation for 576 school districts in Missouri. For convenience, this study's sampling frame keeps only non-missing value cases restricting the dataset to 462 school districts.

3.4. Variable Selection

The selection of the variables included in this study derives from the conceptual framework described in Figure 3. The following section describes the dependent variables and their predictors.

[13] 2018-2019 school year data

3.4.1. Dependent variables: Free and Reduced-Price Lunch Participation

As mentioned earlier, the dependent variables – Free, and Reduced-price lunch participation – were obtained from the Missouri Department of Elementary and Secondary Education (DESE). Each school year the DESE collects school building administrative data on enrollment and participation in Free and Reduced-price lunch and organizes the data per school district. Enrolment data provides a snapshot of the number of students registered in the program in each school building, whereas participation data provides an overview of students' meal consumption patterns.

Moore et al. (2009) define the term "participation" as the number of reimbursable school meals eaten on a given day or over a given period. In this study, School Lunch Participation (Free / Reduced-Price) was measured by dividing the total number of lunches served in each certification category (Free, and Free and Reduced) by the total number of lunches served in a school district, as described by Pokorney et al. (2019) and Vaudrin et al. (2018). Thus, Free and Reduced-Price lunch data are proportions between 0 and 1. This study is conducted based on the 2018 October's school lunch participation data. This is the period of the school year when the level of participation in school lunch is the highest (Moore et al., 2009).

3.4.2. Independent Variables:

Theoretical and empirical literature review, and tests of significance helped identify predictors of Free and Reduced-price lunch participation. This section gives an overview of the independent variables included in the study.

a. School districts' geographic location characteristic is a categorical variable defined based on the National Center for Education Statistics' classification (see appendix). In this

study, I created four dummy variables to define school district geographic location (city, suburban, town, and rural areas).

b. School district's Community Eligibility Provision (CEP) Status is a categorical variable defined based on school districts' eligibility and CEP implementation. It includes three groups of variables: school districts eligible and implementing CEP, those eligible but not implementing CEP and, those not eligible and not implementing CEP.

c. School district's Economic Characteristics are continuous variables comprising the proportion of children in poverty, parents in the labor force or parents' employment status, and household median income.

d. School district's Socio-Demographic Characteristics are continuous variables comprising:

- **School district size**: the total number of students enrolled in Public and Private schools.
- **Household head's marital status** is the proportion of single-headed households per school district**.** This variable comprises single male and single female-headed households.
- **Gender:** the proportion of female and male population aging from 5 to 19 years old.
- **Race / Ethnicity:** population proportion in each racial group (African American, white, Hispanic, and Asian).
- **Language proficiency** is the proportion of households that do not speak English well or at all.
- **Age** refers to the proportion of female and male population per age group, as classified by the Education Demographic and Geographic Estimates[14]. This proportion results from grouping population per age intervals (5 to 9 years, 10 to 14 years and, 15 to 17 years) and dividing each group by the total 5 to 17 years population.

[14] https://nces.ed.gov/programs/edge/TableViewer/acsProfile/2017

3.5. Analytic Procedures

Before conducting the multivariate regression analysis, I conducted both descriptive statistics and bivariate analysis. Descriptive statistics helped characterize the distribution of dependent variables - check outliers and the normality of the distribution kurtosis and skewness - and identify the appropriate regression model. Skewness and Kurtosis analysis indicate that Free and Reduced-price lunch participation distributions are not normal. Free lunch distribution has a light tail (0.2229) and is skewed to the right, whereas Reduced-price lunch distribution has a light tail (0.8742 <3) and is skewed to the left (see table 6 and figures 5 in appendix). The bivariate analysis helped identify significant predictors to include in the Generalized Linear Model, based on the study's conceptual framework described in figure 3. It included Pearson pairwise correlation between continuous variables and ANOVA analysis between continuous and categorical variables.

As Free and Reduced-price lunch participation data do not meet the normality assumption, it is important to transform data to ensure that they better fit the assumptions underlying linear regression. Chen et al. (2017) suggested the Generalized Linear Model (GLM) as an alternative to the transformation methods and a way to handle the non-normality of the distribution and variance heterogeneity issues. According to Glen (2014), GLM are maximum likelihood estimators that are based on a density in the linear exponential family. They help to estimate the linear relationship between transformed response variables in terms of the link function and the explanatory variables[15]. The Generalized Linear Model was implemented to estimate the determinants of Free and Reduced-price lunch participation in Missouri school districts (continuous variables). A binomial distribution and a logit function

[15] Penn state University, Department of Statistics. https://online.stat.psu.edu/stat504/node/216/

were specified to ensure that the fitted values will be exactly within the desired range [0, 1]. The full GLM of Free / Reduced-price lunch participation takes the following form:

$$\text{FR Lunch participation} = \beta_{0+}\beta_1 X_{Geog} + \beta_2 X_{CEP+}\beta_3 X_{Pov} + \beta_4 X_{Empl+}\beta_5 X_{Inc+}\beta_6 X_{SD\ size} + \beta_7 X_{HH} + \beta_8 X_{Gend} + \beta_9 X_{Race} + \beta_{410} X_{Age++}\beta_{410} X_{HH\ Engl+}\mathcal{E},$$

Where β is the GLM coefficient, Xi is the independent variable, and $\mathcal{E}$ is the error term.

A GLM regressing eleven independent variables on Free and Reduced-price lunch participation was first conducted (see models 1 and 2). Non-significant predictors were systematically removed from the models until all remaining variables were statistically significant (see models 3 and 4). The results helped highlight a set of factors that contributed most to school districts' likelihood of participating in Free and Reduced-price participation. Table 4b presents the average marginal effects of the GLM regression.

3.6. Data Strengths and Limitations of school lunch data

This research's strength resides in the fact that it uses administrative records of school lunch data as provided by the Missouri DESE. Moore et al. (2009) argued that these data types are more objective measures of actual consumption of school meals because they do not derive from self-reports or parental reports of school meal participation, susceptible to carry some reporting error, including a short time reference. However, by classifying school lunch participation per school type (elementary, middle, and high school), DESE school lunch dataset does not provide students' economic and demographic characteristics. Thus, the need to complement the DESE dataset with other sources of socio-demographic and socio-economic information.

Chapter 4: Results and Discussion

This section presents geographic location, policy, socio-demographic, and economic drivers that are likely to influence school districts' Free and Reduced-price lunch participation in Missouri. It starts with a statistical description of each driver, then measures the association between these factors, and ends with the estimation of their influence on school district probability of participating in the Free and Reduced-price lunch program.

4.1. Descriptive Statistics of School Lunch Participation in Missouri

4.1.1. Characteristics of Missouri school districts

According to the Missouri Department of Elementary and Secondary Education (DESE), 83% of school districts in Missouri are public (see Table 1 in section 3.3.). In 2018, the National Center for Education Statistics (NCES) reported an average of 1,711.1 students enrolled per school district in the state of Missouri, with Springfield RXIII having the highest number of students enrolled (25,641). The 2000 classification of the Management and Budget Office shows that most of Missouri's school districts are in rural areas (65%), whereas 17% are in towns, 9% in suburban areas, and 9% in cities (see figure 4).

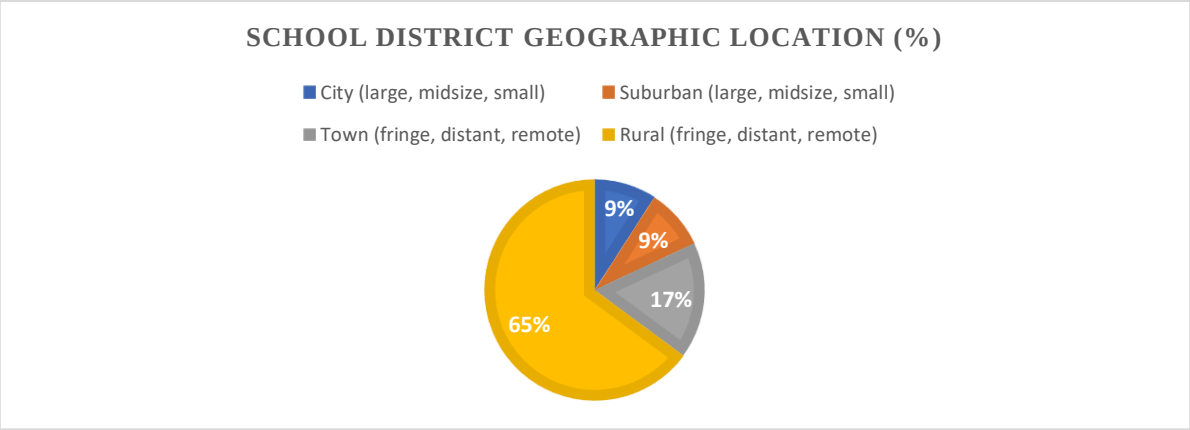


Figure 4. School districts Geographic Location

Source: Author's, data from Fiscal Year 2019 preliminary data (NCES, 2020)

Table 2 provides an overview of the economic and socio-demographic characteristics of Missouri's school districts. Descriptive statistics from the U.S. Census Bureau Small Area Income and Poverty Estimates (2018) indicate that, on average, the child poverty rate is 19.8% in Missouri. School districts such as Winona RIII, Hayti RII, Eminence RI, and North Pemiscot RI in South East Missouri have the highest rate of poverty among children (44 – 47%). However, the children poverty rate in school districts located in central East Missouri is below 5%, especially Kirkwood RVII, Rockwood RVII, and Spring Bluff school districts RXV. The NCCP[16] reported that 21% of Missouri children live in households with an income below the Federal Poverty Line. Furthermore, 24% of children live in families with an income between 100 and 200% of the Poverty line.

The average rate of the active population in Missouri is 91.7%. The active population in this study refers to parents with children aged 6 to 17 years old. Altenburg has the lowest rate of parents in the labor force (50%), while some school districts have all active population in the workforce. However, being in the workforce is not necessarily associated with higher income. Some school districts such as Troy II and Waynesville have more than 90% of the active population but still have the lowest household median income level (less than $ 6,500). As reported in Table 2, the average annual household median income per school district is $60,694; according to the USDA income eligibility guidelines for the 2018 – 2019 school year[17], such income level makes all Missourian students eligible to the Reduced-price lunch program. Still, on average, only 9.3% of lunches served per school district fall into this category and 51.7% fall in the Free lunch category.

[16] National Center for Children in Poverty (http://www.nccp.org/profiles/MO_profile_16.html)
[17] The average household size is 2.45 people per household in the state of Missouri. With an annual income of $38,443, households of 3 people are automatically classified into the reduced-price lunch category. https://www.govinfo.gov/content/pkg/FR-2018-05-08/pdf/2018-09679.pdf

Table 2.

Characteristics of Missouri's School Districts

Variable	Number of school districts	Average per school district	Standard Deviation	Minimum	Maximum
Economic Characteristics					
Proportion children 5 to 17 years old in poverty	462	0.198	0.085	0.0287	0.473
Proportion of parents with 5 to 17 years old in labor force	462	0.917	0.062	0.5	1
Median household income (thousand dollars)	460	60.694	18.840	1.29	158.482
Socio-Demographic Characteristics					
School District size (thousand students)	462	1.848	3.455	0.025	25.641
Proportion of Male single householder with children 5-17 years old	462	0.284	0.184	0	1
Proportion of Female single householder with children 5-17 years old	462	0.716	0.184	0	1
Proportion of Male population (5-17 years old)	462	0.513	0.069	0.047	0.759
Proportion of Female population (5-17 years old)	462	0.485	0.0713	0	0.76
Proportion of Hispanic or Latino population	462	0.054	0.116	0	1
Proportion of African American population	462	0.862	0.174	0	1
Proportion of American Indian population	462	0.0054	0.018	0	0.167
Proportion of Asian population	462	0.006	0.015	0	0.173
Proportion of Native Hawaiian population	462	0.0003	0.002	0	0.019
Proportion of English Proficient Households	462	0.059	0.086	0	0.844
Proportion of 5 to 9 years old population	462	0.334	0.068	0.141	0.613
Proportion of 10 to 14 years old population	462	0.376	0.109	0.165	1.708
Proportion of 15 to 17 years old population	462	0.230	0.073	0.024	0.792

NOTE. Author's (2020)

With respect to socio-demographic characteristics, the descriptive statistics showed that, on average, the proportion of female single-headed households (71.6%) is higher than the proportion of male single-headed households (28.4%) in the state of Missouri. Gender-wise distribution, the state of Missouri has a higher male population compared to females. The results showed that school district's average female population (48.5%) is slightly lower than males (51.4%) in Missouri.

Racial distribution per school district in the state of Missouri follows the same pattern as the country. Descriptive statistics of Missouri ethnicity per school district showed, on average, the proportion of the white population is higher (86.2%). It is followed by Hispanics (5.4%), African Americans (4.2%), and other racial groups (1.2%). On average, the proportion of the population over five years old who speak a language other than English at home is relatively small (5.9%) in Missouri. Concerning population age per school district in Missouri, on average, 33.4% of the population is between 5 and 9 years old, 37.6% between 10 and 14 years old, and 23% is between 15 and 17 years old.

4.1.2. School Lunch Participation in the State of Missouri

Free and Reduced-Price lunch participation in Missouri varies from one school district to another. While some school districts have a100% rate of Free lunch participation, the highest rate of participation of eligible students in Reduced-price lunch is 25.8% per school district.

Community Eligibility Provision (CEP) plays a major role in increasing school lunch participation, especially in the poorest school districts (Turner et al., 2019). The Food Research and Action Center[18] stated that during the 2018 – 2019 school year, 63% of school districts in Missouri were not eligible for the CEP. Of the 213 CEP eligible school districts, FRAC (2019) reported that 46.5% implement the program, while 53.5% of eligible school districts had not yet implement CEP because it is a recent policy phased in during the 2011-2012 in seven[19] States before becoming available nation-wide in the 2014 – 2015 school year. Few studies have explored why some CEP-eligible schools do not implement this program. However, during an interview with some school districts' leaders in Wisconsin, Vandenhouten (2019, December) indicated that the requirement to participate in CEP for four consecutive school years is one

[18] https://frac.org/wp-content/uploads/community-eligibility-key-to-hunger-free-schools-sy-2018-2019.pdf
[19] District of Columbia, Illinois, Kentucky, Michigan, New York, Ohio, and West Virginia

reason CEP-eligible school districts do not implement this policy. This obligation increases the financial burden on school districts, mostly when students do not eat lunch. School districts get Federal reimbursement only for the number of free meals served.

4.2. Bivariate Analysis

ANOVA and Pearson's correlation were conducted to check bivariate correlations before running the multivariate regression model for each school lunch participation category. The one-way ANOVA helped compare the significance level of the association between Free and Reduced-price lunch participation with school districts implementing Community Eligibility Provision. The resulting F statistic is high for each category of school lunch participation, respectively 0.03 and 1.07) and is significant at the .001 level ($p = 0.000$).

Table 3 shows the results of pairwise Pearson's correlation based on 462 observations at a significance level of 10%. Although the magnitude of the association is small, economic characteristics are significantly correlated with at least one of these two types of school lunch participation (p-value < 0.001), except for the proportion of parents in the labor force. Most of the socio-demographic characteristics have a significant correlation either with Free or Reduced-price lunch participation, except for gender, race (Hispanic, White. Asian, and Native Hawaiian), and age (5 to 9, and 15 to 17 years old).

A variance inflation factors (VIF) between eleven preliminary independent variables selected for this study was assessed to reduce the multicollinearity effect. The final Generalized Linear Model will include geographic location, CEP implementation, children poverty, household median income, and socio-demographic characteristics such as school district size, single female-headed households, female population, race (minorities), age, and household English proficiency level. These predictors indicated an average VIF of 1.53 (< 10).

Table 3

Pairwise Correlations

Variables	(1)	(2)	(5)	(7)	(8)	(10)	(14)	(15)	(19)	(20)	(21)	(22)
School Lunch Participation												
(1) Free lunch participation	1.000											
(2) Reduced-price lunch participation	-0.340***	1.000										
School Districts Economic Characteristics												
(5) Proportion children 5 to 17 years old in poverty	0.608***	-0.142***	1.000									
(7) Median household income (thousand dollars)	-0.531***	0.026	-0.711***	1.000								
School Districts Socio-Demographic characteristics												
(8) School District size (thousand students)	0.004	-0.173***	-0.222***	0.245***	1.000							
(10) Proportion of Female single householder with children 5-17 years old	0.048	-0.166***	0.077*	-0.075*	0.116**	1.000						
(14) Proportion of White population	-0.066	0.011	-0.041	0.019	-0.054	-0.004	1.000					
(15) Proportion of African American population	0.112**	-0.002	0.072	-0.071	0.044	-0.018	-0.728***	1.000				
(19) Proportion of English Proficient Households	-0.083*	-0.040	-0.010	0.101**	0.106**	0.084*	-0.006	0.012	1.000			
(20) Proportion of 5 to 9 years old population	0.002	-0.016	0.077*	-0.127***	0.050	0.009	-0.016	0.085*	-0.030	1.000		
(21) Proportion of 10 to 14 years old population	-0.042	0.109**	0.019	0.011	-0.069	0.071	-0.033	-0.101**	0.020	-0.289***	1.000	
(22) Proportion of 15 to 17 years old population	-0.030	0.057	-0.088*	0.065	-0.120***	-0.098**	-0.042	-0.001	-0.019	-0.383***	0.326***	1.000

**** p<0.01, ** p<0.05, * p<0.1*

NOTE. Author's, data from DESE, NCES, and FRAC

4.3. Multivariate Regression Analysis: Factors associated with Free and Reduced-price lunch participation in Missouri

Table 4a presents the results of the Generalized Linear Model with all independent variables. Model 1 and 2 estimate the factors associated with Free and Reduced-price lunch participation in Missouri's school districts based on the regression of independent variables identified in the conceptual framework (see figure 3 in section 3.1).

Findings suggest that six independent variables were significantly associated with school districts' likelihood of participating in Free lunch, and five explained Reduced-price lunch in Missouri. Significant correlations among school districts' socio-demographic characteristics (race) did not significantly affect the probability of participating in Free or Reduced-price lunch in Missouri (table 4b). Models 3 and 4 present the results of a Reduced Generalized Linear Model with only significant factors associated with Free and Reduced-price lunch participation in Missouri's school districts.

The results reveal that school districts' geographic location and the implementation of Community Eligibility Provision during the 2018 – 2019 school year did not influence the probability of participating in Free and Reduced-price lunch programs (see table 4a).

Table 4a.

Comparison of Free and Reduced-Price Lunch Participation in Missouri School Districts

	Model 1: Full Free Lunch Participation Model		Model 2: Full Reduced-Price Lunch Participation Model	
VARIABLES	**Coefficient**	**AME**	**Coefficient**	**AME**
Geographic Location Drivers				
City School Districts	0.053	0.013	-0.019	-0.002
Rural School Districts	0.049	0.012	-0.017	-0.001
Suburb School Districts	0.021	0.005	-0.114	-0.009
Policy Drivers: Community Eligibility Provision (CEP)				
Eligible School Districts and implementing CEP	-0.067	-0.017	0.106	0.009
Eligible School Districts but not implementing CEP	0.027	0.007	0.053	0.004
Economic Drivers				
Proportion children 5 to 17 years old in poverty	4.639***	1.158***	-1.913***	-0.159***
Proportion of parents with 5 to 17 years old in labor force	0.141	0.035	-0.088	-0.007
Median household income (thousand dollars)	-0.010***	-0.003***	-0.004*	-0.0003*
Socio-Demographic Drivers				
School District size (thousand students)	0.044***	0.011***	-0.039***	-0.003***
Proportion of Female single householder with children 5-17 years old	-0.077	-0.019	-0.408***	-0.034***
Proportion of Female population (5-17 years old)	0.433	0.108	-0.072	-0.006
Proportion of Hispanic or Latino population	-0.007	-0.002	0.237	0.020
Proportion of White population	0.114	0.029	0.265	0.022
Proportion of African American population	0.470	0.117	0.346	0.029
Proportion of American Indian population	0.989	0.247	-0.684	-0.057
Proportion of Asian population	1.435	0.358	0.525	0.044
Proportion of Native Hawaiian population	-4.921	-1.229	11.340	0.942
Proportion of English Proficient Households	-0.749**	-0.187**	0.034	0.003
Proportion of 5 to 9 years old population	-1.016**	-0.254**	0.216	0.018
Proportion of 10 to 14 years old population	-0.481*	-0.120*	0.648***	0.054***
Proportion of 15 to 17 years old population	0.432	0.108	-0.252	-0.0209
Constant	-0.312		-1.727***	
Observations	460	460	460	460
R squared	0.441		0.112	
Adjusted R squared	0.414		0.069	
Akaike criterion (AIC)	-0.98		-3.196	
BIC	-3159.451		-4179.106	

*** p<0.01, ** p<0.05, * p<0.1

NOTE. Author's, data from DESE, NCES, and FRAC

Regarding economic factors, the proportion of children in poverty has a significant and positive effect on school districts' participation in Free lunch but a negative effect on Reduced-price lunch participation. On average, a one-unit increase in the proportion of children in

poverty per school district is expected to increase the level of participating in Free lunch by 1.148% and decrease Reduced-price lunch participation by 0.155%. By contrast, the household median income is negatively associated with the level of participating both in Free and Reduced-price lunch. Indeed, a marginal increase of a thousand dollars in household median income per school district is expected to reduce the rate of participation in Free and Reduced-price lunch by 0.30% and 0.03%, respectively.

Table 5b.

Comparison of Free and Reduced-Price Lunch Participation in Missouri School Districts

	Model 3: Final Free Lunch Participation Model		**Model 4: Final Reduced-Price Lunch Participation Model**	
VARIABLES	**Coefficient**	**AME**	**Coefficient**	**AME**
Economic Drivers				
Proportion children 5 to 17 years old in poverty	4.596***	1.148***	-1.866***	-0.155***
Proportion of parents with 5 to 17 years old in labor force				
Median household income (thousand dollars)	-0.010***	-0.003***	-0.004*	-0.0003*
Socio-Demographic Drivers				
School District size (thousand students)	0.043***	0.011***	-0.037***	-0.003***
Proportion of Female single householder with children 5-17 years old			-0.413***	-0.034***
Proportion of English Proficient Households	-0.738**	-0.184**		
Proportion of 5 to 9 years old population	-1.119**	-0.279**		
Proportion of 10 to 14 years old population	-0.448**	-0.112**	0.550***	0.046***
Proportion of 15 to 17 years old population				
Constant	0.272		-1.525***	
Observations	460	460	460	460
R squared	0.431		0.1	
Adjusted R squared	0.424		0.09	
Akaike criterion (AIC)	-1.049		-3.275	
BIC	-3274.166		-4301.91	

*** p<0.01, ** p<0.05, * p<0.1

NOTE. Author's, data from DESE, NCES, and FRAC

Socio-demographic factors such as the proportion of the female population, 15 to 17 years old age group, and race did not significantly influence school districts' level of participating in both categories of the School Lunch Program. However, the proportion of single female-headed households, the school district size, the proportion of non-English

proficient households, and the 5 to 14 years old age group are significantly associated with the school district level of participating in Free or Reduced-price lunch. Indeed, a one percent increase in the proportion of single female-headed households is associated with 0.034% decrease in participating in Reduced-price lunch programs but did not significantly affect the probability of Free lunch participation. An increase of a thousand students enrolled in a school district will significantly increase the probability of participating in Free lunch by 1.1% while decreasing the school district's likelihood of participating in Reduced-price lunch by 0.3%.

The results suggest that a unit increase in the proportion of 5 to 9 years old and 10 to 14 years old population is associated with a significant decrease in the school district's probability of participating in Free lunch by 0.279% and 0.112%, respectively. However, one unit increase in the proportion of 10 to 14 years old population is expected to increase the probability of participating in Reduced-price lunch by 0.046%. A one percent rise in the proportion of households non-proficient in English per school district will decrease school districts' likelihood of participating in Free lunch by 0.184%, but it does not affect the probability of participating in Reduced-price lunch.

4.4. Discussion and Implications

Student participation in Free and Reduced-price lunch programs is critical to increase food security among low-income children, especially in the United States, where 43% of children live in households whose incomes are below 185% of the federal poverty threshold (NCCP, 2020). Nevertheless, school districts' average participation rate in Free and Reduced-price lunch remains very low, respectively 51.7% and 9.3% in the state of Missouri. The purpose of this study was to examine contextual factors that are likely to increase or decrease school districts' participation in Free and Reduced-price lunch, including geographic location, CEP implementation, economic and socio-demographic characteristics. The findings allow for identifying the factors associated with Free and Reduced-price lunch participation, measured in this study as the proportion of meals served in each certification category.

A significant correlation between independent and dependent variables does not necessarily imply a significant causality (see models 1 and 2 in table 4). Indeed, the significant correlation between the proportion of African American and American Indian with Free lunch participation did not significantly predict school districts' likelihood of participating in Free lunch. Likewise, household median income that did not significantly correlate with Reduced-price lunch participation has a significant effect on school districts' probability of participating in Reduced-price lunch.

School district size, household median income level, the proportion of children in poverty, and the proportion of 10 to 14 years old population significantly influenced school districts' level of participating in Free and Reduced-price lunch. In addition to these predictors, the proportion of female single-headed households significantly influence school districts'

likelihood of participating in Reduced-price lunch. In contrast, the proportion of 5 to 9 years old and Household English proficiency was associated only with Free lunch participation.

Findings from this study suggest that school districts' geographic location does not significantly influence the likelihood of participating in Free or Reduced-price lunch in Missouri. Even though 65% of Missouri school districts are in rural areas, the rural location did not significantly affect the level of participation in both categories of school lunch. Previous scholars established a positive association between students' participation in school lunch and geographic location, especially those living rural areas (Gleason, 1995; Arteaga and Heflin, 2014). To better examine the geographic patterns of Free and Reduced-price lunch at the school district level of analysis, it is crucial to increase the sample size by including other states or explore other statistical and spatial analysis methods.

Economic variables are the common thread explaining school districts' likelihood of participating in the Free and Reduced-price lunch. Indeed, an increase in the proportion of children in poverty is expected to significantly influence school districts' participation in both school lunch certification categories. This study showed a positive association between the rise in the proportion of children in poverty and school districts' level of participating in Free lunch. Childhood poverty is correlated with family income level, which subsequently defines students' certification for Free or Reduced-price lunch (Gleason, 1995; Gleason, 2003; Kjosen, 2015). This study showed a significant decrease in both Free and Reduced-price lunch participation with a thousand dollar increase in household income per school district. This means that there is more chance to uplift students in the Full-price lunch certification status by improving household income. Uplifting students in higher certification categories through

income rise is not a guarantee to increase participation in school lunch programs as many other households' characteristics may prevent participation in school lunch.

Other factors, such as household head status, can hinder participation in the school lunch program, especially for students living in female single-headed households. Neethi (2017) argued that female single-headed families experience more economic hardship than married-couples. A rise in their proportion within a school district is likely to increase participation in Free and Reduced-price lunch. However, this study shows that an increase in the proportion of female single-headed households did not significantly influence Free lunch participation and significantly decreases school districts' level of participating in Reduced-price lunch programs. The issue is, why do we observe such an inverse dynamic? Many factors intersect with the low school lunch participation rate among students residing in single-headed households. Dunifon et al. (2003) explained such a trend by arguing that single headed-parents have less time to devote to learning about school lunch programs than two-parent families. However, there is no study exploring the dynamic of Free and Reduced-price lunch participation of students living in single female-headed households at the school district level. Additional research with a larger sample size (school districts) and at the individual level of analysis may help confirm or refute previous findings.

Besides household head status, limited English proficiency may hinder participation in school meal programs. This study shows a negative association between limited English proficiency and Free lunch participation in Missouri school districts. Indeed, an increase in the proportion of non-English proficient households per school district significantly decreases the likelihood of participating in Free lunch. The Food Research and Action Center (2014) explains such a trend by the fact that students living in households with limited-English

proficiency do not always access information about school-based programs in their primary language or a manner they can easily understand.

Childhood poverty is an economic challenge tied to household income levels. It is crucial to implement more structural policies to decrease the poverty rate at the school district level. Such strategies will improve macro-economic conditions and help create opportunities for decent jobs and increase household income, especially for single female-headed and non-English proficient households. An alternative option to increase Free and Reduced-price lunch participation will consist of implementing universal school meal policies so each child can access food at no cost. The Federal Government championed the Community Eligibility Provision, a policy aiming at increasing school meal participation in the highest poverty schools and districts by removing household meal application collection.

Even though 46.5% of eligible school districts implemented the CEP program during the 2018 – 2019 school year, this study did not find a significant association between CEP implementation and Free or Reduced-price lunch participation in Missouri school districts. Many reasons could explain that, including the fact that CEP is a recent policy implemented in Missouri during 2014 - 2015. The CEP implementation is in progress and varies from one school year to another. It started at 7.5% in 2015-2016 and increased to 31.4% in 2017-2018. A longitudinal study of the CEP impact on Free and Reduced-price lunch participation at the school level or a larger scale (Mid-west region) might better show the relationship between CEP and Free or Reduced-price lunch participation.

Empirical studies did not specify the effect of the school district population size on school lunch participation. However, the findings suggest a significant increase in the school district level of participating in Free lunch and a decrease in Reduced-price lunch, resulting

from an increase in the number of students enrolled in a school district. Does such an increase in Free lunch participation mean a decline in the household's socio-economic living conditions in Missouri? Further research is needed to evaluate the association between school district size and Free or Reduced-price lunch participation in Missouri.

In contrast to previous studies[20] that suggest a higher school lunch participation among younger students, those in elementary and middle school compared to older high school students, this study found a negative relationship between age and Free or Reduced-price lunch participation. Indeed, an increase in the school district's proportion of 5 to 14 years old population is associated with a decrease in the school district's likelihood of participating in Free lunch and an increase in the probability of participating in Reduced-price lunch.

Overall, this study showed that Missouri school districts' level of participation in Free and Reduced-price lunch is associated with several factors. They include the proportion of children in poverty, household income, school district size, the proportion of female single-headed households, and the proportion of 5 to 14 years old population group. Socio-economic factors are the critical drivers of Free and Reduced-price lunch participation. Therefore, policy to improve school district economic characteristics, especially households' income, will positively affect Free and Reduced-price lunch participation and low-income children's food security.

[20] Bartfeld and Kim, 2010; Gleason 1995; Mirtcheva and Powell, 2009; Moore et al., 2009

Chapter 5: Conclusions

This research aimed to identify factors that drive Free and Reduced-price lunch participation in 462 school districts in response to the problem of low participation of eligible students in Free (51.7%) and Reduced-price lunch (9.3%) in the state of Missouri. A Generalized Linear Regression Model was estimated to measure economic, socio-demographic, policy, and geographic characteristics increasing or decreasing school districts' probability of participating in Free and Reduced-price lunch.

Although Missouri school districts are predominantly rural (65%), this study found that geographic location (rural) did not significantly influence school districts' level of participation in Free or Reduced-price lunch programs, as argued by Gleason (1995), and Arteaga and Heflin (2014). Further studies using a different statistical method can help determine the spatial dynamic of Free and Reduced-price lunch participation in Missouri.

School districts' economic characteristics such as poverty and household income played a critical role in defining students' certification and participation in Free or Reduced-price lunch, and subsequently, students' food security status. Findings from this study associated the increase in the proportion of children in poverty per school district with an increase in Free lunch and a decrease in Reduced-price lunch participation. However, a rise in the household's income level slightly decreased in school districts' Free and Reduced-price lunch participation. Improving macro-economic conditions and creating decent job opportunities in Missouri school districts will help enhance household income, thus reduce child poverty and Free or Reduced-price lunch participation.

Implementing structural policies such as Community Eligibility Provision, which provides students free meals without collecting household applications in the highest poor

school districts, is another alternative to ensure low-income students' food security. This study did not find a significant association between the implementation of the CEP program and participation in both categories of school lunch programs in Missouri. Further studies at a larger scale (Mid-west region) or at a school level are needed to assess the effect of CEP implementation on Free and reduced-price lunch participation. Additionally, since CEP is a recent program, a look at potential reasons why eligible school districts do not implement it will help the state and the Federal Government support CEP-eligible schools better.

Except for gender and race, which did not significantly affect school districts' likelihood of participating in Free and Reduced-price lunch, all other socio-demographic characteristics (marital status, age, and household English proficiency) significantly influence the two categories of school lunch participation. Overall, this study suggests the main factors associated with Free and Reduced-price lunch participation in Missouri school districts are household income, children poverty, and demographic factors such as school district size, age (5 to 14 years old population), the proportions of single female-headed households and of the number non-English proficient households.

This study contributes to the existing literature on school lunch programs by providing a general overview of the factors underlying participation in Free and Reduced-price lunch on a higher level of analysis. However, the school district level of analysis hinders the observation of the effects of demographic variables (gender, race) that may be significant at a lower scale, such as the school or the student level. An increase of the sampling frame by enlarging the study's scope at the regional level (Mid-west) may also help to capture better the association of school districts' demographic predictors with Free and Reduced-price lunch participation. Another option will be to improve the school lunch's data collection process by encouraging

DESE to develop a database that combines school lunch data with students' socio-demographic characteristics. Such a dataset will give researchers more flexibility to identify school lunch participation determinants at various scales (student, school, school district, or county). Besides data characteristics, a longitudinal study of Free and Reduced-lunch participation will minimize estimation bias and improve our understanding of the effects of each predictor on Free and Reduced-price lunch participation.

Moreover, this study paves the way for expanding research themes to explore factors associated with food assistance, including spatial spillover of school lunch participation per geographic characteristics (urban versus rural). Given that 65% of Missouri is rural, it is crucial to understand geographical variations in Free and Reduced-lunch participation to guide efforts in improving these programs. The recent outbreak of COVID-19 and the subsequent school closure might have disrupted participation in school lunch program, especially of low-income students. Future studies can explore the effects of additional public health variables such as COVID-19 on Free and Reduced -price lunch participation.

Appendix

1. Standards for Defining Metropolitan and Micropolitan Statistical Areas

Table 6

NCES's urban-centric locale categories, released in 2006

Locale	Definition
City	
Large	Territory inside an urbanized area and inside a principal city with population of 250,000 or more
Midsize	Territory inside an urbanized area and inside a principal city with population less than 250,000 and greater than or equal to 100,000
Small	Territory inside an urbanized area and inside a principal city with population less than 100,000
Suburb	
Large	Territory outside a principal city and inside an urbanized area with population of 250,000 or more
Midsize	Territory outside a principal city and inside an urbanized area with population less than 250,000 and greater than or equal to 100,000
Small	Territory outside a principal city and inside an urbanized area with population less than 100,000
Town	
Fringe	Territory inside an urban cluster that is less than or equal to 10 miles from an urbanized area
Distant	Territory inside an urban cluster that is more than 10 miles and less than or equal to 35 miles from an urbanized area
Remote	Territory inside an urban cluster that is more than 35 miles from an urbanized area
Rural	
Fringe	Census-defined rural territory that is less than or equal to 5 miles from an urbanized area, as well as rural territory that is less than or equal to 2.5 miles from an urban cluster
Distant	Census-defined rural territory that is more than 5 miles but less than or equal to 25 miles from an urbanized area, as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an urban cluster
Remote	Census-defined rural territory that is more than 25 miles from an urbanized area and is also more than 10 miles from an urban cluster

NOTE: Office of Management and Budget (2012). Standards for Defining Metropolitan and Micropolitan Statistical Areas; Notice. Federal Register (65) No. 249.

Table 7

Skewness and Kurtosis of Free and Reduced-Price Lunch Participation

Variable	Observations	Pr (Skewness)	Pr (Kurtosis)	adj chi2(2)	Prob>chi2
Free Lunch Participation	462	0.0069	0.2229	8.35	0.0154
Reduced-Price Lunch Participation	462	0.4137	0.8742	0.7	0.7056

NOTE: Author's, data from DESE

2. List of command for the Generalized Linear Model

```
clear
*import excel "C:\Users\gmd6w\Downloads\06272020 Final Data School Lunch Participation Variables X selected Shapefile_GIS.xlsx", sheet("Feuil1") firstrowdestring X19, replace

replace X7=X7/1000
replace X8=X8/1000

*save "C:\Users\gmd6w\Downloads\06272020 Final Data School Lunch Participation Variables X selected Shapefile_GIS.dta"

/* Labelling variables*/

label var X   "District Name"
label var X1 "Free lunch Participation"
label var X2 "Reduced-Price lunch Participation"
label var X3 "School district geographical region 1 = City 2 = Rural 3 = Suburb 4 = Town"
label var X3a        "School district geographical region 1 = City 0 = not City"
label var X3b        "School district geographical 1 = Rural 0 = not Rural"
label var X3c        "School district geographical region 1 = Suburb 0 = not Suburb"
label var X3d        "School district geographical region 1 = Town 0 = not Town"
label var X4 "Participation in CEP 1 = Eligible and Participation in CEP 2 = Eligible but no Participation in CEP 3 = not Eligible and no Participation in CEP"
label var X4a        "Participation in CEP 1 = Eligible and Participation in CEP 0 = not"
label var X4b        "Participation in CEP 1 = Eligible but no Participation in CEP 0 = not"
label var X4c        "Participation in CEP 1 = not Eligible and no Participation in CEP 0 = not"
label var X5 "Number of children 5-17 in poverty related to the householder"
```

```
label var X5a        "% of children 5-17 in poverty related to the householder"
label var X6 "EMPLOYMENT STATUS OF PARENTS: Number of households with all parents in family in labor force"
label var X6a        "EMPLOYMENT STATUS OF PARENTS: % of households with all parents in family in labor force"
label var X7 "Median household income (dollars)"
label var X8 "School District size (number of students enrolled)"
label var X9 "Number of Male householder, no wife present, family"
label var X9a        "% of Male householder, no wife present, family"
label var X10        "Number of Female householder, no husband present, family"
label var X10a       "% of Female householder, no husband present, family"
label var X11        "Number of Male population"
label var X11a       "% of Male populations"
label var X12        "Number of Female populations"
label var X12a       "% of Female population"
label var X13        "Number of Hispanic populations"
label var X13a       "% of Hispanic population"
label var X14        "Number of White populations"
label var X14a       "% of White population"
label var X15        "Number of African American population"
label var X15a       "% of African American population"
label var X16        "Number of American Indian population"
label var X16a       "% of American Indian population"
label var X17        "Number of Asian populations"
label var X17a       "% of Asian population"
label var X18        "Number of Native Hawaiian population"
label var X18a       "% of Native Hawaiian population"
label var X19        "Number Population 5 years and over speaking Language other than English"
label var X19a       "% Population 5 years and over speaking Language other than English"
label var X20        "Number of 5 to 9 years old population"
label var X20a       "% of 5 to 9 years old population"
label var X21        "Number of 10 to 14 years old population"
label var X21a       "% of 10 to 14 years old population"
label var X22        "Number of 15 to 17 years old population"
label var X22a       "% of 15 to 17 years old population"

/* Descriptive statistics */
```

```
sum X1 X2 i.X3 i.X4 X5 X6 X7 X8 X9 X10 X11 X12 X13 X14 X15 X16 X17 X18 X19
X20 X21 X22
outreg2 using "C:\Users\glori\OneDrive\Documents\MSU Master\Spring 2020\Master
thesis\Data\Final data 09222020\Final", sum(detail) eqkeep(N mean sd max min skewness
kurtosis) label replace

sum X1 X2 i.X3a i.X3b i.X3c i.X3d i.X4a i.X4b i.X4c X5a X6a X7 X8 X9a X10a X11a
X12a X13a X14a X15a X16a X17a X18a X19a X20a X21a X22a
outreg2 using "C:\Users\glori\OneDrive\Documents\MSU Master\Spring 2020\Master
thesis\Data\Final data 09222020\Final", sum(detail) eqkeep(N mean sd max min skewness
kurtosis) label replace

/* Normality tests: Kernel density */
kdensity X1
kdensity X2

quantile X1
quantile X2

swilk X1, generate(X11SW)
swilk X2, generate(X22SW)

sktest X2 X3

/* Bivariate Analysis: Correlation, Multicollinearity, ANOVA, VIF */

regress X1 X2 i.X3a i.X3b i.X3c i.X4a i.X4b X5a X6a X7 X8 X10a X11a X12a X13a X14a
X15a X16a X17a X18a X19a X20a X21a X22a
vif

regress X1 X2 i.X3a i.X3b i.X3c i.X4a i.X4b X5a X6a X7 X8 X10a X12a X13a X14a X15a
X16a X17a X18a X19a X20a X21a X22a
vif

correlate X1 X2 X5a X6a X7 X8 X10a X12a X13a X14a X15a X16a X17a X18a X19a X20a
X21a X22a

pwcorr X1 X2 X5a X6a X7 X8 X10a X12a X13a X14a X15a X16a X17a X18a X19a X20a
X21a X22a, print (.05) star(.001)
```

```
set mat size 800
asdoc pwcorr X1 X2 X5a X6a X7 X8 X10a X12a X13a X14a X15a X16a X17a X18a X19a X20a X21a X22a , print (.05) star(.001) label replace
asdoc pwcorr X1 X2 X5a X6a X7 X8 X10a X12a X13a X14a X15a X16a X17a X18a X19a X20a X21a X22a , label append

asdoc pwcorr X1 X2 X5a X6a X7 X8 X10a X12a X13a X14a X15a X17a X19a X20a X21a X22a , star(all) replace nonum

anova X1 i.X4a i.X4b i.X4c
anova X2 i.X4a i.X4b i.X4c

anova X1 i.X4
anova X2 i.X4

/* Generalized linear model: All IVs Reduced-Model (Marginal Effect) */

/* Final Model */

xi: glm X1 i.X3a i.X3b i.X3c i.X4a i.X4b X5a X6a X7 X8 X10a X12a X13a X14a X15a X16a X17a X18a X19a X20a X21a X22a , link(logit) family(binomial) robust nolog
outreg2 using "C:\Users\glori\OneDrive\Documents\MSU Master\Spring 2020\Master thesis\Data\Final09262020", replace ctitle(GLM)
mfx, at(mean)
outreg2 using "C:\Users\glori\OneDrive\Documents\MSU Master\Spring 2020\Master thesis\Data\Final09262020", mfx append

xi: glm X2 i.X3a i.X3b i.X3c i.X4a i.X4b X5a X6a X7 X8 X10a X12a X13a X14a X15a X16a X17a X18a X19a X20a X21a X22a , link(logit) family(binomial) robust nolog
outreg2 using "C:\Users\glori\OneDrive\Documents\MSU Master\Spring 2020\Master thesis\Data\Final09262020", append ctitle(GLM)
mfx, at(mean)
outreg2 using "C:\Users\glori\OneDrive\Documents\MSU Master\Spring 2020\Master thesis\Data\Final09262020", mfx append

xi: glm X1 X5a X7 X8 X19a X20a X21a , link(logit) family(binomial) robust nolog
outreg2 using "C:\Users\glori\OneDrive\Documents\MSU Master\Spring 2020\Master thesis\Data\Final09262020", append ctitle(GLM)
mfx, at(mean)
```

```
outreg2 using "C:\Users\glori\OneDrive\Documents\MSU Master\Spring 2020\Master thesis\Data\Final09262020", mfx append

xi: glm X2 X5a X7 X8 X10a X21a , link(logit) family(binomial) robust nolog
outreg2 using "C:\Users\glori\OneDrive\Documents\MSU Master\Spring 2020\Master thesis\Data\Final09262020", append ctitle(GLM)
mfx, at(mean)
outreg2 using "C:\Users\glori\OneDrive\Documents\MSU Master\Spring 2020\Master thesis\Data\Final09262020", mfx append

/* Pseudo R-Squared */
regress X1 i.X3a i.X3b i.X3c i.X4a i.X4b X5a X6a X7 X8 X10a X12a X13a X14a X15a X16a X17a X18a X19a X20a X21a X22a
fitstat
regress X2 i.X3a i.X3b i.X3c i.X4a i.X4b X5a X6a X7 X8 X10a X12a X13a X14a X15a X16a X17a X18a X19a X20a X21a X22a
fitstat
regress X1 X5a X7 X8 X19a X20a X21a
fitstat
regress X2 X5a X7 X8 X10a X21a
fitstat
```

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VITA

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In 2018, Gloria joined the University of Missouri-Columbia (MU) to complete a master's program in Rural Sociology, with an emphasis in Sustainability and Development. She just started her Ph.D. in the MU Sociology department in the fall of 2020. Gloria has been a member of the Rural Sociological Society, attended the 2019 Borlaug Dialogues and the Deaton scholar program at the University of Missouri. As a graduate Research Assistant, she helped in designing the 2019 Hunger Atlas with the Interdisciplinary Center for Food Security. She is a recipient of the Herbert F. and Vivian S. Lionberger Fellowship in 2020 and is a 2014 Mandela Washington Fellowship alumnus. Gloria is passionate about mentoring the young generation of women in DRC. Currently, she is remotely mentoring a group of three young girls in their academic journey in Kinshasa.