Examining the Effect of Parental Socioeconomic Capabilities on the Relationship between Childhood Nutrition and BMI using the KiGGS Baseline Study

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Bachelor's Thesis
Human Geography and Planning
University of Groningen
27 January 2023

Word count: 6592

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Summary

Society faces an increasing burden of childhood obesity and the many societal and health-related detriments that comes along with it. Not only does obesity have the potential to negatively affect the overall livelihood of children and adolescents, but when established at a young age, obesity can contribute to negative health effects persisting into one's later years of life. The role that parents play in their children's lives has the potential to establish positive habits and preferences that will aid their children in maintaining a healthy weight and lifestyle. However, the resources and endowments available to the parents vary from family to family as a result of different socioeconomic statuses. As a result, the following research question arises: *"How do parental socioeconomic capabilities influence the relationship between nutrition and BMI in children?"* To answer this question, a quantitative analysis of the KiGGS baseline study (German Health Interview and Examination Survey for Children and Adolescents) was performed with Binary Logistic Regressions, Linear Regressions, and Chi-Square Tests of Independence. The results of this analysis show that typically, children of parents with higher socioeconomic status indicate more healthy nutrition as well as a lower BMI. With these results, it is possible to gain an understanding of the importance of parental capabilities in the relationship between nutrition and BMI. Because childhood is such a crucial time for development, focusing on the improvement of parental capabilities for families of all socioeconomic backgrounds is very important in establishing a healthy population and minimizing the negative health effects of obesity. Nutritional and health equality can be promoted for all children at the societal and political levels, leading to a healthier population for future generations.

Key Words: childhood nutrition, BMI, parental capabilities, health, obesity, socioeconomic status

Introduction

Background

Childhood and adolescent obesity rates have been on the rise globally in recent decades, creating a growing public health crisis with many possible detrimental effects on society (Sahoo et al, 2015). With its pervasive nature, childhood obesity has reached levels high enough to deem it an epidemic and affects the health of both developed and developing countries (Azadbakht et al, 2015). During childhood, being overweight has been proven to cause not only impacts on physical health, but also the psychological health of the individual, damaging one's emotional well-being and self-esteem. These effects have also been shown to negatively affect an individual's performance at school and can contribute to an overall, experienced, lower quality of life (Sahoo et al, 2015). In addition to the negative health effects of obesity during adolescent years, overweight children tend to continue to have trouble maintaining a healthy weight later in life and into adulthood, leading to an increased prevalence of cardiovascular disease as well as diabetes (Devine, 2005). With these current health trends, such non-communicable diseases have become the leading cause of death in the Western world, thus making it a very relevant area for health and nutritional emphasis (Azadbakht et al., 2012). The long-lasting health issues of poor childhood nutrition have the potential to affect the overall health of the population as it ages creating burdens on both the healthcare system and society (Azadbakht et al., 2012).

Many factors play a role in this increased development of childhood obesity across the world. To maintain a healthy body weight, an individual must have a proper balance of energy intake and expenditure, with genetics also playing a contributing role (Sahoo et al, 2015). An individual's ability to maintain this balance occurs as a result of their unique set of lifestyle preferences, culture, and external and environmental elements. Each of these components contributes to the choices one makes when determining their diet, and the likelihood to experience an increase in calories, fat, and sugar intake. Societal changes leading to larger meal portions, fewer meals cooked at home, and decreased physical activity can also be seen as contributing factors to the rise in childhood obesity (Devine, 2005).

Parental choices, capabilities, and preferences play an especially large role in their children's diets and the establishment of their nutritional behaviors (Burchi and De Muro, 2016). In most cases, parents and their capabilities serve as the main determinant of their child's health behavior and nutritional choices which, in turn, affects their physical and cognitive development (Brettschneider et al., 2021). The establishment of these parental capabilities relies on socioeconomic status, where income, employment status, and education level affect a parent's ability to provide for their children (Mathios, 1996). For families of a higher socioeconomic status, this often means that a healthier diet and lifestyle are more easily accessible. In comparison, families of lower socioeconomic status encounter more barriers to maintaining healthy nutrition (Ranjit et al., 2015). As a result, health-related inequalities can occur during the children's development.

Living a healthy lifestyle has been long linked to protecting society from disease, minimizing obesity, and increasing life expectancy, meaning that nutritional capabilities and choices not only affect people at an individual level but also from a societal standpoint (Sisiopiku and Barbour 2014). Due to their early phase in physical and mental development, childhood is considered to be a very sensitive age range where poor health and habits will continue to be experienced and magnified later in life (Burchi and De Muro, 2016). Because of the fragility of this age range, parental capabilities are especially important in ensuring a healthy life for their children (Ranjit et al., 2015). It is necessary that emphasis is placed on the development and execution of proper nutrition during childhood, as the health of future generations rests on the nutritional choices and capabilities of the children of today (Devine, 2005).

Research problem

This research aims to understand the relationship between childhood nutrition and BMI and how their parent's socioeconomic status influences this interaction. While there have been many studies examining the nutritional data from the KiGGS baseline study, there is still a gap in the research regarding the relationship between parental nutritional capabilities and BMI. From this research, we will be able to fill the research gap to understand the effect of certain nutritional habits on childhood BMI as well as how parental socioeconomic factors play a role in this relationship. This information can be utilized to aid in the prevention and maintenance of the development of the childhood obesity epidemic to minimize population health burdens in the future. From the above research problem and research aim, the following research question arises:

"How do parental socioeconomic capabilities influence the relationship between nutrition and BMI in children?"

In order to answer this question, two sub-questions were determined so that the data could be better understood as well as the relationships between the different variables:

"What is the relationship between parental socioeconomic capabilities and, respectively, a) children's nutrition and b) BMI?"

"What is the moderating effect of parental socioeconomic capabilities in the relationship between children's nutrition and their BMI?"

Structure of Thesis

Within this thesis, the reader will find an analysis and explanation of the above research questions with the usage of secondary data from the KiGGS baseline study from Germany. This will begin with an introduction to the theoretical underpinnings that lie at the base of this topic and research problem, which has aided in the creation of a conceptual model. Next, the data and methodology will be explained. This section will be followed by a results section displaying the findings of the quantitative analysis, separated by gender, as well as a discussion of the results. Finally, the reader will find the conclusions of the research concerning the theories along with a reflection and suggestions for future research.

Theoretical Framework

Literature Review

In Ben-Shlomo (2002), chronic disease epidemiology through the lens of the life course approach is discussed. This perspective looks at the "biological, behavioral, and psychological pathways that operate across an individual's life course" with the different phases of life as outlined in the life course approach including gestation, childhood, adolescence, young adulthood, and later adult life (Ben-Shlomo, 2002, p.1). In regards to childhood obesity, this article describes how the life course approach can be used to analyze different health outcomes across a person's life course. By looking at the nutrition of individuals at different points in their life course, it is possible to determine possible health outcomes at varying ages (Ben-Shlomo, 2002). As a result, nutrition during childhood can continue to directly affect an individual's BMI at a later phase in their life course.

In Kuh et al. (2003), different terms and ideas related to epidemiology are discussed regarding the life course theory. Firstly, critical periods are mentioned. These periods refer to times in an individual's life when they undergo essential physical and mental developments. For children, their critical development period is also considered to be a sensitive period of their life. During childhood, exposure or lack of exposure to certain lifestyle aspects, such as a healthy diet, can have a stronger effect on their physical and cognitive development, thus putting them at a higher risk for developing diseases (Kuh et al, 2003). Nutrition can be seen as a crucial exposure in one's childhood and can contribute to many different health outcomes later in life, including BMI.

In Devine (2005), the life course perspective is discussed as a framework to understand how food choices develop with changing temporal, social, and historical contexts. This approach "contributes to understanding the social and biological pathways of health risk and resilience over the life span" while emphasizing the development of the individual within changing contexts (Devine, 2005, p.1). Food course trajectories are dependent on what food is available, contemporary nutrition information and guidelines, as well as how and where people live. In addition to these determinants, social and cultural factors can play a role in a child's nutrition (Devine, 2005). In Hursti (1999), they explain that parental food habits and choices are likely one of the largest predictors of child food preference. By instilling healthy food habits in an individual from a young age, they are less likely to be at risk for chronic diseases later in life. Within the household setting, food preferences are developed in response to their innate food preferences as well as individual, learned food preferences, which are established within mealtime situations (Hursti, 1999).

When examining nutritional choice, being food secure is another large determinant of the range of one's potential food choices. In order to evaluate one's ability to be food secure, Burchi and De Muro, (2016) adapted Sen's Capability Approach model to include parental nutritional capabilities. According to Burchi and De Muro, the capability to be food secure is reliant on three dimensions: access, utilization, and agency (Burchi and De Muro, 2016). In this model, access is reliant on the spatial aspect of distance to healthy food in addition to other basic functions such as having enough money and sufficient transportation means. Utilization is reliant on education and one's capability to be knowledgeable about nutrition and healthy diets as well as cultural and religious beliefs and practices. Agency is reliant on one's ability to participate in household decision-making and empowerment and how much one helps themself when it comes to escaping food insecurity (Burchi and De Muro, 2016). Inequality or impairment in any of these dimensions results in diminished nutritional capabilities of parents, meaning that their ability to provide a well-balanced diet to their children is lower (Ranjit et al., 2015). As a result, lower parental nutritional capabilities have a likelihood to lead to implications on their children's diet and thus, their overall health and BMI. The primary determinant of a parent's capability to provide a nutritious diet to their children is the parent's socioeconomic status (SES) (Lampert et al., 2018). When looking at parental SES, three endowments play an especially large role in determining one's capability to be healthy and food secure: education, employment, and income (Mathios, 1996). Since children's nutrition and BMI are strongly related to their parent's nutritional habits, understanding these capabilities proves to be crucial in understanding this relationship (Brettschneider et al., 2021).

When analyzing obesity in a population, Body Mass Index, or BMI, is often utilized to provide a more comprehensive overview of an individual's body and size by taking into account both height and weight (Nuttall, 2015). BMI is calculated by dividing one's weight (kg) by their height squared (m^2). The BMI scale starts at 0, which represents the lowest possible BMI, and then increases based on weight and height. A healthy BMI typically falls within the range of 18.5 to 29.9, with lower numbers indicating malnourishment and higher numbers indicating obesity (Nuttall, 2015). In children and adolescents, age can have a strong effect on differences in BMI since the body is growing and developing during that time (Kuh et al, 2003). Similarly, gender also plays a role in an individual's BMI, with different genders regulating stress and metabolic reactions to stress differently (Nuttall, 2015).

BMI in children is directly related to the foods that they consume. Sugary foods and beverages with a high content of saturated fats and sodium are often consumed in amounts that are well above the recommended daily and weekly limits (Sahoo et al, 2015). The consumer may not perceive high amounts of added sugar and salt in processed foods such as snacks and ready meals when in reality, they contain amounts that exceed the daily allowance (Sahoo et al, 2015). On the other hand, experts also recommend 2-3 portions a day of fresh or cooked vegetables and 2 portions a day of fruits (World Health Organization, 2019). These foods provide children with many different micro and macronutrients needed for their development and also are shown to reduce cravings and keep the consumer satisfied for longer amounts of time (Kuh et al, 2003). By limiting added and artificial sugar and salt intake and instead consuming more unprocessed foods, children can see healthy improvements in their BMI (Brettschneider et al., 2021).

Conceptual Model

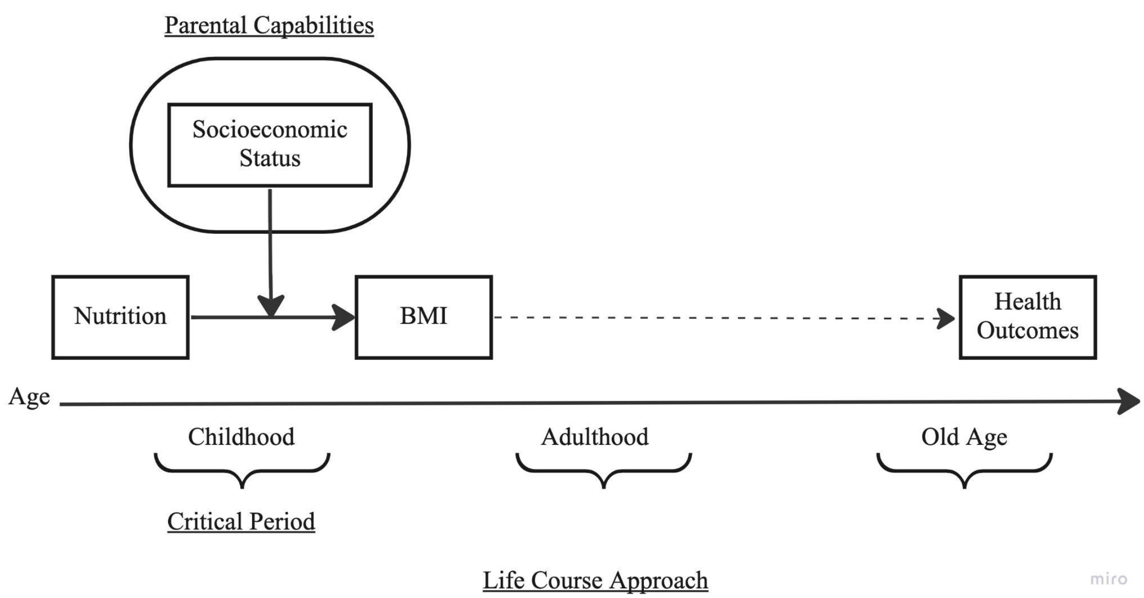

Figure 1.
Conceptual model of the moderating effect of Parental Socioeconomic Capabilities on the relationship between Nutrition and BMI over the life course (Source: Author)

Figure 1 depicts how the relationship between nutrition and BMI has an effect on one's development and health outcomes across the life course. Because childhood is a critical period, the impact of nutrition and BMI during this phase of the life course is especially important. Socioeconomic status plays a large role in determining parental capabilities, and as a result, contributes to the relationship between nutrition and BMI (Figure 1).

Data & Methodology

Background of Dataset

For this study, secondary data collected in the KiGGS baseline study (German Health Interview and Examination Survey for Children and Adolescents) was utilized to perform quantitative analysis. Quantitative research was best suited for this study because it is used to analyze a large dataset and determine statistical significance. Because of the detailed data on parental and child SES, BMI, and nutrition, this secondary data is strongly suited to answer the research questions of this study. The KiGGS study was conducted over the 3 years between May 2003 and May 2006 for the age group of 0-17 years old. The data collected in the study included "objective measures of physical and mental health as well as a parent or self-reported information regarding the subjective health status, health behavior, health care utilization, social and migration status, living conditions, and environmental determinants of health" (KiGGS, 2020, p.1). For children aged 0-10, questions were reported by the parents, and for the remaining ages, these were self-reported (Hölling *et al.*, 2012). Data collection for the KiGGS study took the form of medical examinations completed by doctors and medical personnel. Because of the professional, medical environment in which the KiGGS study was conducted, this dataset lacks a reporting bias and utilized ethical considerations, making it a powerful source regarding child health and nutrition in Germany (Hölling *et al.*, 2012). Since the KiGGS baseline study data was conducted in German, the variables utilized in this study were translated into English using Google Translate.

Selection of Cases

To examine the relationships between nutrition, BMI, and parental socioeconomic capabilities, certain cases from the data were selected. The data was filtered by age so only cases of participants aged 11-17 were included in the analysis. In this age group, potential bias from parents' responses is eliminated and a holistic overview of the individuals' experienced health and well-being can be obtained (Hölling et al., 2012). The nutritional behaviors of this age group represent the habits and preferences their parents have instilled in them since birth, thus making it a strong representation of their parent's socioeconomic capabilities (Hursti, 1999). Of the full KiGGS study population, we selected only adolescents who had no missing values in the variables listed below. Finally, we obtained a sample of N = 5,320 children aged 11-17 years old with 48.8% females and 51.2% males (Figures 2 & 3).

Variables

<u>BMI</u>

The BMI of each study participant was categorized into 4 categories: underweight, normal weight, overweight, and obese. To make this variable appropriate for a Binary Regression, the variable was recoded into 2 categories, 'normal weight' and 'overweight.' Participants in the original obese category were also included in the 'overweight' category to combine all participants above a normal weight. All cases reporting underweight individuals were excluded from the new variable (Oh et al., 2011).

<u>Social Class</u>

In the KiGGs Baseline study, the variable 'Social Class' was created using the Winkler Index. The Winkler Index is a German index established by Winkler and Stolzenberg to classify Socioeconomic Status (Lampert et al*.,* 2018). Winkler and Stolzenberg created their indexing system based on education, employment, and income to depict one's relative SES. With this index, participants are categorized into 3 groups based on their SES: Lower SES, Middle SES, and Higher SES. For this reason, the variable, 'Social Class' was used in the analysis to represent parental SES.

Nutrition Score

To determine the relative quality of the diet of participants, the following variables were used in the analysis to compute a nutrition score for each case: 'How often are sweets eaten?', 'How much sweets are eaten?', 'How often are snacks eaten?', 'How much snacks are eaten?', 'How often are soft drinks consumed?', and 'How much soft drinks are consumed?' Each of these variables represents a food category that when consumed regularly and in excessive amounts has a high potential of leading to obesity and a higher BMI, especially in children (World Health Organization, 2019). The variables were recoded into 2 categories, 'healthy' and 'unhealthy' based on dietary recommendations from Harvard Medical School ("*The sweet danger,"* 2022). Recommendations suggest that the consumption of sweets be limited to no more than 1-2 times per week. For sodas, experts advise against drinking more than 1 can per week. For salty snacks including chips and crackers, children are recommended to limit their amount of portions to 2-3 per week (Rouhani et al, 2012). Using this information, the variables were recoded and summed to compute a new variable, 'Nutrition Score.' This new variable ranked the children's eating habits from the categories above on a scale of 0-6, with 0 being the most healthy and 6 being the most unhealthy. In the analysis, 'Nutrition Score' represents the overall healthiness of a participant's diet.

Average Parent BMI

For 'Average Parent BMI,' a new variable was computed by taking the average of 'Mother's BMI' and 'Father's BMI' (Briody, 2021). For this new variable, a range of scores from 1-4 was utilized with 1 meaning underweight and 4 meaning obese. This variable was then recoded into a binary variable where all scores > 3 were coded as 0, meaning not overweight, and all scores < 3 were coded as 1, meaning overweight.

Parent Employment Status

To control for parental unemployment, a new variable, 'Parent Employment Status' was computed by recoding the variables 'Mother's Employment Status' and 'Father's Employment Status.' The new variables were recoded into 2 categories, 'employed' and 'unemployed.' The values in these variables were then added together to create a sum so that a ranking for 'Parent Employment' was established. In the ranking, 0 means both parents are unemployed and 2 means both parents are employed (Briody, 2021).

Age Group

To control for age-related differences among the participants, the variable, 'Age group,' was used. Due to the selection of cases aged 11-17 only two age categories were included in the analysis with this variable, 11-13(4) and 14-17(5).

Mother's Age

The variable, 'Mother's Age,' was used to control for differences in parental capabilities concerning participants' mother's ages (Hölling *et al.*, 2012). The ages of mothers included in this analysis ranged from 25-29(2) and ended with 55+(8).

<u>Last Medical Consultation</u>
To control for medical-related differences among participants, the variable 'Last Medical Consultation' was used. This variable provides insight into how recently the participants have been to see a doctor. The data included different time frames ranging from the last consultation being within the last month (1) to more than a year ago (4).

<u>Municipality</u>
To control for location-based disparities among participants, the variable 'Municipality' was used. This variable described the type of area that the participant lives in ranging from rural(1) to metropolitan(4).

<u>Migrant Status</u>
To control for differences related to a participant's possible migrant background, the variable 'Migrant Status' was used. This variable indicated whether or not a participant was a migrant to Germany, with (1) representing migrants and (2) representing non-migrants.

Data Analysis Scheme

In this analysis, the cases were analyzed separately for males and females due to gender differences in stress regulation and metabolic reactions to stress. Additionally, all statistical analyses in this study were completed using the program IBM SPSS Statistics, Version 27. An alpha level of 0.5 was used for determining statistical significance (Hölling *et al.*, 2012).

To answer the subquestion, *"What is the relationship between parental socioeconomic capabilities and children's nutrition?",* a Chi-Square Test of Independence was utilized (Gomez et al., 2021). For this analysis, the variables 'Social Class' and 'Nutrition Score' were put into the Crosstabs and the Chi-Square statistic was selected. The Chi-Square Test of Independence was selected for this analysis because it is used to evaluate the differences between categorical variables so that their relationship may be determined (Gomez et al., 2021).

To answer the subquestion, *"What is the moderating effect of parental socioeconomic capabilities in the relationship between children's nutrition and their BMI?",* a Linear Regression was performed (Uedufy). The variables 'Nutrition Score' and 'Social Class' were both standardized, and then a new variable was computed by multiplying the two standardized variables together in order to find the intercept. BMI was used as the dependent variable, and the intercept and nutrition score were used as the independent variables in the regression (Uedufy).

To answer the subquestion, "*What is the relationship between parental socioeconomic capabilities and BMI?"* and the main question, *"How do parental socioeconomic capabilities influence the relationship between nutrition and BMI in children?"*, a Binary Logistic Regression was conducted (LOGISTIC REGRESSION). This method of analysis was utilized because the test "is used to predict a dichotomous dependent variable based on one or more continuous or nominal independent variables" (Binomial, 2018). For this analysis, the dependent variable is "BMI."

Multiple independent variables were utilized for the Binary Logistic Regression analysis of the relationship between BMI, parental socioeconomic capabilities, and nutrition. Because parental socioeconomic capabilities are a direct expression of SES, the variable ‘Social Class’ was used as the independent variable to understand the effect of parental socioeconomic capabilities on BMI. Similarly, to determine the relationship between children’s nutrition and BMI, the variable, ‘Nutrition Score,’ was also utilized in the Binary Logistic Regression as an independent variable (Hölling *et al.*, 2012).

To control for other potential factors influencing the relationships between BMI, nutrition, and parental socioeconomic capabilities, the following variables were included in the Binary Logistic Regression analysis: ‘Average Parent BMI,’ ‘Parent Employment Status’, ‘Age Group,’ ‘Mother’s Age,’ ‘Date of Last Medical Consultation,’ ‘Municipality,’ and ‘Migrant Status’(LOGISTIC REGRESSION).

Results

Males

<u>Descriptive Analysis</u>

Of the selected cases for the ‘BMI’ variable, 80.9% fell into the ‘normal weight’ category, while 19.1% were categorized as ‘overweight’ (Table 1). For ‘Social Class,’ 26.2% of male cases fell into Lower SES, 49.3% in Middle SES, and 24.5% in Higher SES (Table 1).

From the Chi-Square crosstable, it is evident that the most prevalent nutrition score was 2.0 with 765 cases (28.1%). On the other hand, the least prevalent nutrition score was 6.0 with 38 cases (1.4%) (Table 2). While 5.47% of Lower SES cases received a nutrition score of 0.00, the healthiest category, 12.12% of Higher SES cases received the same score (Table 7). From the Pearson Chi-square value of 72.222, it can be concluded that the model is significant. The significance level for the analysis was $p<0.000$ which is greater than alpha(0.5), meaning that there is a significant relationship between ‘Nutrition Score’ and ‘Social Class’ for male study participants (Table 2).

Table 1. *Descriptive statistics for males (Source: Author)*

	N	mean	Sd	min	max
BMI	2726	0.1908	0.39297	0.00	1.00
Social Class	2726	1.98	0.712	1.00	3.00
Nutrition Score	2726	2.2817	1.35181	0.00	6.00
Parent BMI Average	2726	0.3162	0.46508	0.00	1.00
Parent Employment Status	2726	1.66	0.559	0.00	2.00
Age Group	2726	4.55	0.498	4.00	5.00
Municipality	2726	2.50	1.076	1.00	4.00
Mother's Age	2726	4.88	1.0630	2.00	8.00
Migrant Status	2726	1.87	0.335	1.00	2.00
Last Medical Consultation	2726	2.32	0.998	1.00	4.00

Table 2. *Chi-Square Test of Independence results testing for an association between social class and child nutrition for males (Source: Author)*

Crosstabulation (male)

	0.00	1.00	2.00	3.00	4.00	5.00	6.00	Total
Lower SES	39	125	183	194	102	51	19	713
Middle SES	107	307	395	307	152	61	16	1345
Higher SES	81	169	187	146	66	16	3	668
Total	227	601	765	647	320	128	38	2726

Chi-Square Tests (male)

	Value	Sig.
Pearson Chi-Square	72.222	<0.001*
Likelihood Ratio	72.056	<0.001*
Linear-by-Linear Association	64.913	<0.001*

Moderation Effect Analysis

The results of the Linear Regression show an R-square value of 0.004, meaning that 'Nutrition Score' only accounts for 4% of the variation in 'BMI' in the model (Table 3). From the 'Intercept' coefficient, it can be concluded that the moderator, 'Social Class,' affects the relationship between 'Nutrition Score' and 'BMI' for males, since the significance is less than 0.5 (Table 3).

Table 3. *Linear Regression results testing for the moderating effect of parental SES on the relationship between nutrition and BMI for males (Source: Author)*

	R square	B	Sig.
Model	0.004	-	-
ANOVA (regression)	-	-	0.004*
Constant	-	-	0.000*
Intercept	-	0.025	0.012*
Nutrition Score	-	-0.057	0.003*

Binary Logistic Regression Analysis

The results of the Binary Logistic Regression show a Chi-square value of 129.602 and a significance level of p=<0.001, which is less than alpha=.05 (Table 5). Because of the high Chi-square value and the fact that p<.05, we can assume that this model is statistically significant (LOGISTIC REGRESSION). In Figure 2, the results show significant findings for the variables, 'Social Class,' 'Nutrition Score,' 'Average Parent BMI,' and 'Parent Employment Status' since p<0.05 (Table 4). The remaining control variables included in the analysis all have significance levels greater than 0.05, meaning that they are not significant predictors of a participant's BMI (Table 4). When looking at the Beta coefficients of the independent variables, it is evident that for every one-unit increase of 'Social Class' (B=-0.323), 'Nutrition Score' (B=-0.178), and 'Parent Employment Status' (B=-0.182) the probability of 'BMI' will decrease (Table 4) (LOGISTIC REGRESSION). On the other hand, for 'Average Parent BMI' (B=0.848) the probability of 'BMI' will rise with each one-unit increase (Table 4).

Table 4. *Binary Logistic Regression results testing for a relationship between BMI, parental socioeconomic status, and child nutrition for males (Source: Author)*

	B	S.E.	Sig.	Exp(B)
Social Class	-0.323	0.076	<.001*	0.724
Nutrition Score	-0.178	0.039	<.001*	0.837
Parent BMI Average	0.848	0.102	<.001*	2.335
Parent Employment Status	-0.182	0.088	0.038*	0.834
Age Group	-0.063	0.105	0.550	0.939
Municipality	0.041	0.048	0.399	1.042
Mother's Age	0.094	0.049	0.055	1.099
Migrant Status	-0.134	0.149	0.37	0.875
Last Medical Consultation	-0.02	0.050	0.685	0.98
Constant	-0.435	0.586	0.458	0.647

Table 5. *Binary Logistic Regression model coefficients for males and females (Source: Author)*

Omnibus Test of Model Coefficients

	Chi-square	df	Sig
Model (male)	129.602	9	<.001*
Model (female)	146.219	9	<.001*

Females

Descriptive Analysis

Of the selected cases for the ‘BMI’ variable, 81.6% fell into the ‘normal weight’ category, while 18.4% were categorized as ‘overweight’ (Table 6). For ‘Social Class,’ 26.6% of female cases fell into Lower SES, 49.5% into Middle SES, and 23.9% into Higher SES (Table 6).

From the Chi-Square crosstable, it is evident that the most prevalent nutrition score was 2.0 with 765 cases (29.5%). On the other hand, the least prevalent nutrition score was 6.0 with 18 cases (0.7%) (Table 7). While 12.17% of Lower SES cases received a nutrition score of 0.00, the healthiest category, 24.35% of Higher SES cases received the same score (Table 7). Similarly, From the Pearson Chi-square value of 69.470, it can be concluded that the model is significant. The significance level for the analysis was $p<0.000$ which is greater than alpha(0.5), which means that there is a significant relationship between ‘Nutrition Score’ and ‘Social Class’ for female study participants (Table 7).

Table 6. *Descriptive statistics for females (Source: Author)*

	N	mean	Sd	min	max
BMI	2594	0.1839	0.38747	0.00	1.00
Social Class	2594	1.97	0.710	1.00	3.00
Nutrition Score	2594	1.8173	1.31669	0.00	6.00
Parent BMI Average	2594	0.3234	0.46788	0.00	1.00
Parent Employment Status	2594	1.66	0.551	0.00	2.00
Age Group	2594	4.55	0.497	4.00	5.00
Municipality	2594	2.50	1.072	1.00	4.00
Mother's Age	2594	4.83	1.0540	2.00	8.00
Migrant Status	2594	1.87	0.334	1.00	2.00
Last Medical Consultation	2594	2.18	0.981	1.00	4.00

Table 7. *Chi-square Test of Independence results testing for an association between parental socioeconomic status and child nutrition for females (Source: Author)*

Crosstabulation (female)

	0.00	1.00	2.00	3.00	4.00	5.00	6.00	Total
Lower SES	84	157	207	133	76	27	6	690
Middle SES	221	331	379	225	85	33	10	1284
Higher SES	151	169	179	85	24	10	2	620
Total	456	657	765	443	185	70	18	2594

Chi-Square Tests (female)

	Value	Sig.
Pearson Chi-Square	69.470	<0.001*
Likelihood Ratio	69.427	<0.001*
Linear-by-Linear Association	62.935	<0.001*

Moderation Effect Analysis

The results of the Linear Regression show an R-square value of 0.004, meaning that 'Nutrition Score' only accounts for 4% of the variation in 'BMI' in the model, similar to the results for males (Table 8). From the 'Intercept' coefficient, it can be concluded that the moderator, Social Class, affects the relationship between 'Nutrition Score' and 'BMI' for females since the significance is less than 0.5 (Table 8).

Table 8. *Linear Regression results testing for the moderating effect of parental SES on the relationship between nutrition and BMI for females (Source: Author)*

	R square	B	Sig.
Model	0.004	-	-
ANOVA (regression)	-	-	0.005*
Constant	-	2.309	0.000*
Intercept	-	0.019	0.012*
Nutrition Score	-	-0.024	0.006*

Binary Logistic Regression Analysis

The results of the Binary Logistic Regression show a Chi-square value of 146.209 and a significance level of p=<0.001, which is less than alpha=0.05 (Table 5). Because of the high Chi-square value and the fact that p<0.05, we can assume that this model is statistically significant (LOGISTIC REGRESSION). In Table 9, the results show significant findings for the variables, 'Social Class,' 'Nutrition Score,' and 'Average Parent BMI' because p<0.05. The remaining control variables included in the analysis all have significance levels greater than 0.05, meaning that they are not significant predictors of a participant's BMI (Table 9). When looking at the Beta coefficients of the independent variables, it is evident that for every one-unit increase of 'Social Class' (B=-0.601) and 'Nutrition Score' (B=-0.169) the probability of 'BMI' will decrease (Table 9). On the other hand, for 'Average Parent BMI' (B=0.873) the probability of 'BMI' will rise with each one-unit increase (Table 9).

Table 9. *Binary Logistic Regression results testing for a relationship between BMI, parental socioeconomic status, and child nutrition for females (Source: Author)*

	B	S.E.	Sig.	Exp(B)
Social Class	-0.601	0.083	<.001*	0.548
Nutrition Score	-0.169	0.042	<.001*	0.845
Parent BMI Average	0.873	0.106	<.001*	2.395
Parent Employment Status	0.107	0.096	0.265	1.113
Age Group	-0.157	0.109	0.151	0.855
Municipality	0.056	0.050	0.264	1.058
Mother's Age	0.006	0.052	0.915	1.006
Migrant Status	0.08	0.158	0.614	1.083
Last Medical Consultation	-0.104	0.055	0.057	0.901
Constant	0.045	0.634	0.944	1.046

Discussion

Gender Differences and Conclusions

During the theoretical and literature analysis, it became evident that gender differences among adolescents could strongly affect their BMI. From the quantitative results, it is clear that the effect of parental SES and nutrition appears to affect the different genders relatively equally. For the Chi-Square Test of Independence and Linear Regression, all significant categories are the same for males and females. However, for the Binary Logistic Regression, the results for men showed a significant relationship between 'BMI' and 'Parental Employment Status' while the results for females did not. It is unclear what the exact cause of this difference in results is, but it is evident that males in this study population were more affected by differences in 'Parental Employment Status.'

Analysis of the relationship between parental socioeconomic capabilities and nutrition

From the quantitative analysis, the strong relationship between parental socioeconomic status and child nutrition became very clear. Participants whose parents had a lower socioeconomic status were more likely to have a less healthy diet (Mathios, 1996). These results relate similarly to the findings of Brettschneider et al. (2021), where children of lower SES were found to consume 3-5x more soda than children of higher SES. This relationship relates to the parents' capabilities which are strongly based on the endowments and resources available to them such as education, employment, and income. Each of these endowments plays a role in whether or not a parent achieves the capability to provide for their children (Burchi and De Muro, 2016). Lower socioeconomic status also makes it more likely that parents struggle in one of these three categories, thus leading to minimized parental capabilities and increased difficulty to provide a healthy diet for their children (Gómez et al., 2021).

When examining the capability to provide healthy nutrition for their kids, education plays an important role (Rouhani et al, 2012). The importance of parental nutritional education is related to the aspect of utilization in Burchi's model of nutritional capabilities because it is connected to the parent's ability to use the skills and knowledge they have to execute providing a healthy diet to their children (Burchi and De Muro, 2016). Parental socioeconomic status also plays a role in another one of Burchi's factors necessary for parental nutrition capabilities, access. Often, the areas that people of a lower socioeconomic status live in do not have easy access to stores where they can buy nutritious foods (Lampert et al., 2018). In other instances, while they may have physical access to these locations where nutritious food is available, they may not have the financial resources needed to purchase such products (Gómez et al., 2021). As a result, it can be concluded that parental socioeconomic capabilities have a strong relationship with childhood nutrition, with a decrease in these capabilities resulting in a lower quality of nutrition. Further investigation on the specific relationships between childhood nutrition and parental education and financial situation could provide more in-depth insight into this relationship between parental capabilities and nutrition.

Analysis of the relationship between parental socioeconomic capabilities and BMI
From the quantitative analysis, it can be understood that a child's BMI is associated with their parent's BMI. Because BMI is related to diet, it is possible to conclude that a child's diet is very similar to that of their parents. Because children are likely to have similar eating habits to their parents, the parents must also be capable of and able to successfully achieve a healthy diet for themselves as well (Hursti, 2009). For families of lower socioeconomic status, certain systemic barriers make this more difficult such as migrant status and residential location type (Lampert et al., 2018). Often, parents of a lower socioeconomic status also grew up in a similar situation (Mathios, 1996). As a result, parents who grew up in a lower SES are likely to continue the same nutritional cycle with their children (Hursti, 2009). This means that their nutritional preferences and habits could be strongly rooted in this lack of utilization and access (Mathios, 1996). Here, Burchi's final factor of agency comes into play, because often, people of lower SES may have restrictions on their agency (Burchi and De Muro, 2016). These limiting factors restrain parents of lower SES from being active participants in the decisions affecting their life and minimize their opportunities for improving their situation, including their children's diet. The barriers affecting parental socioeconomic capabilities create a strain on their children's nutrition, and thus negatively influence their BMI.

From the data, children's BMI is also related to the quality of their diet (Mathios, 1996). Because parental socioeconomic capabilities have a moderating role in the relationship between BMI and nutrition, it can be concluded that poorer nutrition will result in unhealthy changes to BMI. This can be explained by the fact that a poor diet typically leads to a child gaining weight which, as a result, raises their BMI as well (Brettschneider et al., 2021). Families with higher socioeconomic status are more likely to eat a healthier diet which contributes to the finding that these children have a lower BMI (Lampert et al., 2018). On the other hand, according to Gomez et al. (2012), higher SES does not always mean that BMI will be lower. In their study in South America, the diet that families of lower SES could afford resulted in a lower BMI, which could be attributed to the cultural differences between different socioeconomic backgrounds (Gomez et al., 2012). It can be concluded that parental socioeconomic status has an important relation to BMI due to the moderating impact parental socioeconomic capabilities have on the relationship between BMI and nutrition.

Overall, the socioeconomic status of parents results in a significant effect on the quality of diet for their children as well as limits to their nutritional capabilities, which are specifically related to barriers in their access, utilization, and agency (Burchi and De Muro, 2016). In turn, these parental capabilities also greatly impact their children's BMI due to the influence they have on the diet parents can provide (Hursti, 2009). As a result, it is evident that parental socioeconomic capabilities influence the relationship between nutrition and BMI by establishing their ability to provide a healthy diet and create nutritional patterns, which serve as determinants for a child's BMI and health outcomes throughout their life course.

Reflection

This study had strengths and limitations. While the data was conducted in a professional environment, some questions were self-reported, which could lead to a potential recall bias from participants. This bias could affect the nutrition-related questions, because participants may be less likely to report foods they ate in unhealthy categories. In addition, the amounts of food reported were not provided in standard measurements, making these portion indications difficult to compare to professional health recommendations. Conducting a study with precise and uniform data on amounts of macronutrients and sugar could help provide more accurate results about nutrition in the future. Another limitation of the study was that socioeconomic status is a very complex concept, making it difficult to quantify and analyze. Future studies on the relationship between parental socioeconomic status and nutrition and BMI could impose a qualitative aspect to their study to obtain a more holistic perspective on a participant's SES. Nonetheless, the KiGGS study did provide a large and representative sample that took many factors into account to demonstrate food consumption in the study population, thus adding to the strength of this study.

Conclusions

In conclusion, it is evident that there is a strong and important relationship between BMI and nutrition in children, which is influenced by their parent's socioeconomic capabilities. While BMI is directly influenced and regulated by the diet that an individual eats, a parent's capability to provide this diet based on their own socioeconomic situation plays a moderating role in this relationship. High consumption of energy-dense and nutrient-poor food such as sweets, salty snacks, like chips and crackers, and sodas, is associated with a higher BMI, and thus a higher potential for obesity. Because child nutrition and parental socioeconomic status are related, the importance of a parent's capabilities to provide become very important regarding the health of their children. With proper education and assistance from the political and societal level, these health discrepancies among people of lower socioeconomic status can be minimized, ensuring that all children receive the nutrients they need to grow and develop. By focusing on the development of parental socioeconomic capabilities, there is potential to improve the overall health of the population while, at the same time, decreasing health-related inequality and setting children up for a healthy rest of their life course. These relationships have potential public health implications that urgently need to be addressed so that the childhood obesity epidemic can be controlled, and the future of our aging population may even lead to a population that is healthier than today. Overall, this study served as a strong indicator of the power of parental socioeconomic capabilities on the relationship between childhood nutrition and BMI. By focusing the attention on improving the opportunity for parents to achieve their capabilities, the health of the children is directly improved as well as the health of the aging population.

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