JERN Journal of Education and Research in Nursing

Original Article
DOI:10.14744/jern.2023.83009
J Educ Res Nurs. 2024;21(1):11-19

Childhood Obesity: Pathways between Mothers' Health Literacy and Behaviors and Self-Efficacy of Eating and Physical Activity in Their Children

Nebahat Bora Güneş[1], Işın Alkan[2], Rabiye Akın Işık[3], Osman Dağ[4], Hilal Özcebe[5]

[1]Department of Child Health and Diseases Nursing, Hacettepe University Nursing Faculty, Ankara, Türkiye
[2]Department of Nursing, Zonguldak Bülent Ecevit University Health Sciences Faculty, Zonguldak, Türkiye
[3]Department of Obstetrics and Gynecologic Nursing, Hacettepe University Nursing Faculty, Ankara, Türkiye
[4]Department of Biostatistics, Hacettepe University Medicine Faculty, Ankara, Türkiye
[5]Department of Public Health, Hacettepe University Medicine Faculty, Ankara, Türkiye

Abstract

Background: Childhood obesity is a rapidly growing global public health issue. To combat this issue and promote a healthy body weight for children, encouraging children to adopt healthy eating and physical activity (PA) habits is crucial. However, the factors underlying children's eating and PA behaviors are complex, and the health literacy (HL) of mothers, PA habits of parents, as well as self-efficacy.

Aim: The aim of this study was to investigate how mothers' sociodemographic factors, HL, body mass index (BMI), and PA levels affect their children's BMI, nutritional and PA behaviors, and related self-efficacy.

Methods: This cross-sectional study included 320 children aged 8–12 and their mothers. Data were collected using questionnaires for mothers (Sociodemographic Data Form, Türkiye HL Scale-Short Form, International PA Questionnaire) and for children (sociodemographic data form, anthropometric measurement form, nutritional behavior scale, PA Questionnaire, self-efficacy for healthy eating, PA self-efficacy scale). Path analysis was conducted to illustrate the structure of the variables.

Results: The mothers had an average age of 38.0±5.37 years, with approximately half of the participants having two children. The results of the path analysis revealed that mothers' education level and HL were significant predictors of their PA and BMI. In addition, mothers' PA levels had a positive effect on their children's duration of PA. The mother's HL, mother's BMI, and children's PA levels and nutritional behaviors were also identified as factors that affect children's BMI z-scores.

Conclusion: Enhancing the HL of mothers is a potent strategy in preventing childhood obesity, as it can lead to children achieving the recommended BMI z-scores and PA levels. As part of their usual care practices, nurses should adopt a family-centered approach that assesses mothers and children together.

Keywords: Body mass index, health literacy, nutrition, obesity, physical activity

Introduction

Childhood obesity is increasing and becoming an urgent public health problem in the world.[1] The prevalence of overweight and obesity in children and adolescents has increased from 4% to 18% between 1975 and 2016. In 2020, the prevalence of obesity among children and adolescents aged 2–19 years worldwide was 19.7%, affecting around 14.7 million individuals. The prevalence of obesity varied across age groups, with 12.7% among 2–5-year-olds, 20.7% among 6–11-year-olds, and 22.2% among 12–19-year-olds.[2,3] Obesity can cause various social and psychological health problems in children and is also associated with obesity and poor health outcomes in adulthood.[3] As a result of its significant impact on children's general health status, growth and development, and risk of acute and chronic diseases, the prevention of childhood obesity is an urgent public health priority in many countries.[4] Theoretically, childhood obesity can be prevented through multidimensional and multisectoral collaborative strategies and regulations. However, no countries have been successful to decrease childhood obesity, while international-evidence-based data still have continued to accumulate data for improving strategies.[5]

Cite this article as: Bora Güneş N, Alkan I, Akın Işık R, Dağ O, Özcebe H. Childhood obesity: pathways between mothers' health literacy and behaviors and self-efficacy of eating and physical activity in their children. *J Educ Res Nurs.* 2024;21(1):11-19.

Corresponding author: Nebahat Bora Güneş
E-mail: nebahatgunes@gmail.com

Received: January 17, 2023
Accepted: June 21, 2023
Publication Date: March 1, 2024

The cause of obesity is defined as the imbalance between calories consumed and extended. Nutritional behaviors of children have been the most highlighted factor which influences the occurrence of obesity.[6] Many studies have focused on the various demographic[7], social, and psychological factors[8] that affect nutritional behaviors and dietary patterns.[4] In this regard, various factors including parental feeding practices,[9] food preferences, speeding of eating, parental feeding style,[10] economic status, parent income, and sociocultural education[11] are directly or indirectly related to childhood obesity. Parental preferences, attitudes, and behaviors have been also found to be the earliest determinants of healthy eating attitudes and practices in children. More specifically, the knowledge of healthy eating, eating attitudes, and habits of the mothers in the families are the most important determinant to develop healthy nutritional behaviors habits in the children, therefore maternal characteristics have a strong influence on the prevention of obesity in their children.[12] Besides nutritional behaviors, physical inactivity is also considered to be an important risk factor for obesity. It is already known that 23% of adults and 81% of adolescents (aged 11–17 years) do not have enough physical activity (PA) for being healthy according to the World Health Organization global recommendations.[5] One of the most important strategies to prevent childhood obesity is improving PA and healthy nutritional behaviors. It is desired that the families encourage their children to be more physically active and prefer a healthier diet, and the children can adapt and sustain these attitudes and behaviors in their adulthood years. Besides, knowledge on healthy lifestyle, there is a need to promote self-efficiency of healthy nutritional and PA during the childhood years.[13] From birth to starting primary school is a crucial time point for obesity prevention interventions, when diet and activity behavior are being established between parent and child. Lifestyle modification interventions to improve dietary quality, increase PA levels, and reduce sedentary behaviors, often using behavior-changing techniques and involving parents or carers, or both, are the mainstay for interventions in preschool-aged children. By intervening at such an early age, it may be possible to prevent obesity levels continuing to rise for future generations and is crucial to reducing health inequalities.[14]

The cultural and behavioral patterns of parents have a direct impact on the health and lifestyle of their children. Knowledge about being healthy and maintaining a healthy lifestyle is an indicator of individuals' health literacy (HL) level. Globally, 23% of adults and 81% of adolescents (aged 11–17 years) do not meet the WHO global recommendations on PA for health.[5] Insufficient HL, such as a lack of knowledge regarding healthy lifestyle affects many unhealthy outcomes and can cause reduced self-efficacy, inadequate self-care, and poor disease management. Therefore, to improve individuals' healthy lifestyle such as healthy nutritional habits, being physically active, and self-management, it is necessary to improve their HL. The review conducted by Aslam and Kingdom showed that an increase in the HL level of parents can also improve their children's health.[15] Especially, mothers' HL level has been found to affect the health of their children; the abilities of the mothers increased to obtain solutions for their children's health problems.[16] Asgary et al.[17] also indicated that mothers with lower levels of HL are unable to meet their children's nutritional needs, as they do not fully understand the causes of, or address, nutritional problems such as obesity and malnutrition in their children.

Obesity can affect people of all ages and genders, but it poses greater risks and long-term consequences for children, particularly in relation to their physical, psychological, and social well-being.[2] To gain a better understanding of childhood obesity and its causes, it is crucial to examine factors such as the mother's HL, nutritional status, and level of PA, which are closely linked to obesity and its development in children. It is important to acknowledge the leadership role of community health nurses and other health personnel who have frequent contact with women and children in the community, as they can play a significant role in preventing childhood obesity and promoting healthy lifestyles. Through their efforts, these health professionals can help regulate the lives of women and children and encourage positive changes in behavior. In this context, to prevent obesity in children and help ensure they have a healthy body weight, it is necessary to encourage children to meet recommended PA and healthy nutritional behaviors. Behind the nutritional and PA behaviors of children, there are mothers' HL, nutritional and PA behaviors, and also self-efficacy. A review of associated literature revealed that there have been several studies on mother's HL, nutritional status, and health decisions,[18] as well as the impact of mothers' nutritional status on child health; however, it is important to understand how mother's HL, body mass index (BMI), and PA levels are directly or indirectly related to their children nutritional and PA behaviors through self-efficacy of healthy nutritional and PA. Furthermore, we aimed to explore all the relationships between the factors within the mother's HL and the children's BMI by using structural equation analysis.

Study Questions

1. Is there a relationship between mothers' HL and school-aged children's healthy eating levels?
2. Is there a relationship between mothers' HL and school-aged children's level of PA?
3. Is there a relationship between mothers' HL and school-aged children's self-efficacy levels?
4. Is there a relationship between mothers' HL and school-aged children's of obesity?

Material and Methods

Design

This study is designed as a cross-sectional research to explore the factors affecting childhood obesity using structural equation analysis.

Study Setting

This study was conducted in urban districts in Ankara, the capital city of Türkiye. There are nine central districts in Ankara, four districts from three different socioeconomic levels (low, medium, and high) according to the socioeconomic development district ranking research conducted by the Ministry of Industry and Technology of the Republic of Türkiye.[19] Taking each district's population size into consideration, we aimed to recruit a similar proportion of participants from each district. Considering the population size of each district, we aimed to receive a similar proportion of participants from each district by weighing them according to the population size.

Sample Size

Path analysis was used to determine the sample size of the study. The participants who are the children aged 8–12 and their mothers

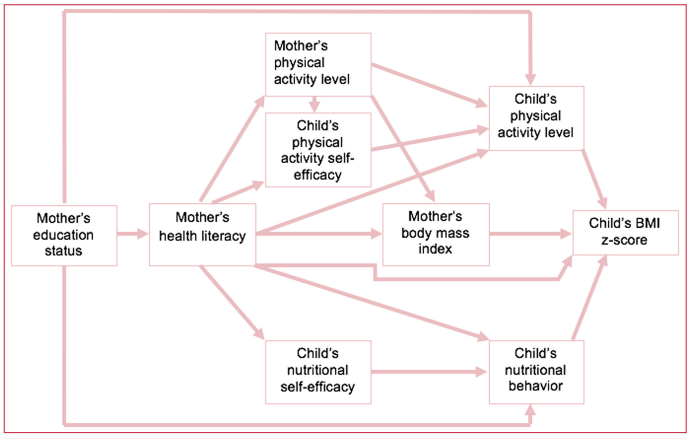

Figure 1. Path Analysis Plan.

were selected from the schools at three different socioeconomic settlements in Ankara. The inclusion criteria for participation in the study were as follows: Students aged between 8 and 12 years, mothers who were literate and had the ability to comprehend written texts, willingness of both mothers and children to participate in the study, and absence of any health problems that could hinder communication. The exclusion criterion for the study was the presence of any health problem that could hinder communication. Path analyses were performed to examine the related structures of the variables. When we examined the paths between the variables (Figure 1), we found 32 estimated parameters across the variables and error terms. Therefore, the target sample size was set to 320 (32×10).[20] The power of the sample reached was found between 0.76 and 1 for the endogenous variables, and it can be said that the sample size is sufficient and explanatory. Due to refusal to participate in the study, missing data, and non-response from some mothers, 26 questionnaires from children/mothers could not be included in the study (Figure 2). Data collection continued until the target number was reached.

Instruments

Data were collected through two series of data collection forms dedicated to mothers and children separately. Table 1 displays information such as the purpose of use, administration time, target group of data collection forms, and scales used to measure each outcome. The questionnaires were admitted to 10 children and their mothers for pretesting.

Data Collection

This study was conducted between September 2019 and March 2020. After obtaining the families' consent, children's data were collected from the children at their schools. This was performed by administering self-evaluation forms during lesson breaks to the 320 children whose families had provided consent. Children read and filled out the forms given to them during a break time of approximately 15 min. Anthropometric measurements of the children were obtained from records of measurements taken at the beginning of the term. For the mothers who agreed to participate, questionnaire forms were sent to their homes from the schools, the mothers returned the questionnaire in the envelope.

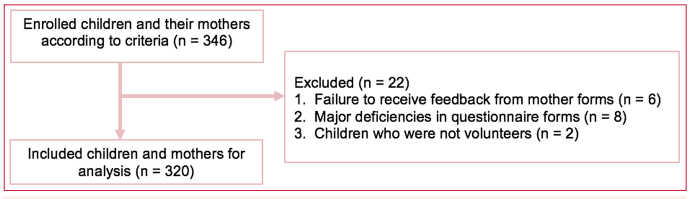

Figure 2. Study Sample Enrollment Diagram.

Data Analysis

The data were analyzed using SPSS version 23 (SPSS Inc., Chicago, IL, USA). The demographic characteristics of the participants were analyzed using means and percentages. Mothers' child feeding attitudes and behaviors, BMI and HL levels, PA, and healthy eating self-efficacy of children's were assessed using means and standard deviations.

The data obtained from the IPAQ were evaluated in accordance with the guidelines for data processing and analysis of the IPAQ.[21-24] The weekly activity was measured using metabolic equivalent minutes per week (MET-min/week); after omitting extreme values in the data, participants were categorized in terms of the level of PA. Participants who scored under 600 MET-min/week were considered to be inactive, those who scored 600–3,000 were considered to have a low, and those who scored over 3,000 MET-min/week were considered to have a sufficient level of activity.

A standardized index score is used to calculate the total THLS-32 score (index=(mean−1) * (50/3)).[25,26]

Path analysis was performed to examine the relationship mothers' HL that has with mothers' PA index and sociodemographic characteristics, and with children's nutritional self-efficacy, nutritional behaviors, BMI z-scores, and durations of PA. Path analysis was also conducted to illustrate the structure of the variables. When assessing the model fit, we expected the following indices: A low root mean square error of approximation (RMSEA) of ≤0.08, a Satorra–Bentler scaled Chi-square/degrees of freedom ratio (CMIN/DF) of ≤2.0, a goodness-of-fit index (GFI) of ≥0.90, an incremental fit index (IFI) of ≥0.90, and a comparative fit index (CFI) of ≥0.90. We obtained the following indices: RMSEA=0.053, CMIN/DF=1.906, GFI=0.977, IFI=0.911, and CFI=0.901.

Ethical Considerations

Written permission to perform this study was obtained from Ankara Provincial Ministry of National Education and the schools affiliated with the Ministry that served as study settings for this research. Mothers who agreed to participate provided written informed consent, and the non-interventional clinical research ethics committee of Hacettepe University approved the study (Approval Number: 16969557-943, Date: May 07, 2019). This study was also performed in accordance with ethical principles of the declaration of Helsinki for research involving human subjects. The necessary permissions for the scales used in the study were obtained from their authors.

Results

The mothers had an average age of 38.0 ± 5.37 years (min–max: 26–56), with approximately half of the participants having two children (n=175, 54.7%). Of the total, 71.6% of the mothers had graduated from secondary school (n=111), and 64.1% of them were not employed

Table 1. Data Collection Forms and Questionnaires

Form/Questionnaire	Validity and reliability	Evaluation and scoring
Datas collected by mothers		
Sociodemographic data form	This form was created following a literature review[5,10,13] and pre-tested with 10 women who were not part of the study. The form consisted of two sections, with the first section containing five questions about the sociodemographic characteristics of the mothers of the recruited children. The second section of the form asked for weight and height measurements of the mothers to calculate their BMI.	The closed-ended survey questions are composed of questions that enable access to the necessary sociodemographic information. Most of the data was used descriptively and did not enter path analysis. The researchers used the weight and height information to calculate the BMI of the mothers using the formula BMI=kg/m2 in Microsoft Excel.
International physical activity questionnaire	IPAQ was developed by Craig et al.[21], and Sağlam et al.[22] adopted the Turkish version and confirmed its validity and reliability. Spearman's correlation coefficients for the original questionnaire show that IPAQ reliability was very good (r=0.8); the short and long versions produce comparable results (r=0.67); and the criterion validity (r=0.30) is, at least, comparable to most other self-report questionnaires.[21,23] For the Turkish version of the questionnaire, caltrac accelerometer data were compared with IPAQ scores in 80 participants with good agreement (r=between 0.34 and 0.93) for the short and long forms.	It comprises seven items, focusing on the frequency and duration of respondents' engagement in low, moderate, and vigorous physical activities over the past week; the survey also collects time spent sitting (minutes/day) during weekdays in the past week. According to the scores obtained from the questionnaire, the activity level of the individuals is classified into three levels: inactive (under 600 MET-min/week), low (600–3,000 MET-min/week), and sufficient (3,000 MET-min/week) level of activity.
Türkiye HL scale short form	It was developed by Okyay and Abacıgil (2016)[27] to evaluate adults' HL levels. The Cronbach's alpha value of the original scale was 0.92, and the scale's Cronbach's alpha value for the present study was 0.89. The scale consists of 32 items, each of which is answered on a five-point Likert scale.	There are a total of eight components: four dimensions (treatment, service, disease prevention, and health promotion) and four processes (accessing health-related information, understanding health-related information, evaluating health-related information, and using/applying health-related information). The total score ranges from 0 to 50 points. The higher the total score, the higher the respondent's HL level. Scores of 0–25 indicate "insufficient HL," scores of 26–33 indicate "problematic-limited HL," scores of 34–42 indicate "adequate HL," and scores of 43–50 indicate excellent HL.[22]
Data collected by children		
Anthropometric measurement form	Anthropometric measurements including height, body weight, and BMI were obtained from the school records. A surveillance system developed by the Ministry of Health and the Ministry of National Education was used to monitor the growth of school-age children. Physical education teachers received training on the methodology of anthropometric measurements, and all necessary measurement scales were provided. The measurement staff in schools was standardized by a dedicated team from the ministry.	The children were assessed twice a year, during the fall and spring semesters. In our study, we only collected measurements from the fall semester. To calculate the children's BMI, their birth dates (day, month, and year) were obtained from school records. Anthropometric measurements were analyzed using the WHO's AnthroPlus software for the 5–19 age group and compared to established BMI reference values for specific age groups.
Child nutritional behavior Scale	The scale was first developed by Edmundson et al. (1996)[24] and adapted to Turkish society by Öztürk and Erdoğan (2010).[44] This scale measures children's healthy heart-promoting (low-fat and low-salt) food consumption habits. Cronbach's alpha coefficient (r) was calculated as 0.63.	The instrument contains 14 illustrated items that depict low-fat/low-salt and high-fat/high-salt foods to identify children's food consumption. Children are thus shown comparable food items and asked to select which one of two foods they most frequently eat. The items are rated as -1 for unhealthy foods and +1 for healthy foods; the total possible score is between –14 and +14. Higher scores on the scale indicate healthier eating habits.

(*Continued*)

Table 1. Data Collection Forms and Questionnaires (Continued)

Form/Questionnaire	Validity and reliability	Evaluation and scoring
The physical activity questionnaire for children	It is developed to assess physical activity levels in children. It was created by Kowalski, Crocker, and Kowalski[42] in the United States of America in 1997. Its validity and reliability have been studied in Türkiye by Emlek Sert and Bayık Temel in 2014.[43] Cronbach's alpha values for the PAQ-C range from 0.70 to 0.92, indicating good to excellent internal consistency.[38,42,43]	The questionnaire consists of nine items, which assess physical activities performed by the child within the last 7 days and their frequency. The items include questions about activities such as hopscotch, football, basketball, gymnastics, attendance to physical education classes, activities during breaks, lunchtime, after school, evenings, and weekends, and spare time activities such as sports, dance, or games during the last 7 days. The questions are answered using a 5-point Likert scale, ranging from "never did" to "7 or more times." The first item includes 21 different activities, and an average score is calculated by dividing the frequency by the number of activities.[42] The ninth item is a table where students indicate the frequency of physical activities for each day of the week, considering the previous week. The average score for this item is calculated by dividing the score obtained from the ninth item by 7.
Self-efficacy for healthy eating scale	It was developed by Story et al. (2003)[28], and Kabasakal et al. (2015)[29] developed a valid and reliable version for Turkish populations. The Cronbach's alpha value of the original scale was 0.6223, while the Cronbach's alpha values of the Turkish scale were 0.677 for boys and 0.674 for girls. For the present study, Cronbach's alpha value of the scale was 0.71.	The scale comprises nine items and one dimension. All items are scored using a three-point Likert-type scale (0="not at all difficult," 1="a little difficult," 2="very difficult"). The total scale score is calculated by summing the scores for each item. Total scores range from 0 to 18. High scores indicate low self-efficacy in terms of healthy eating.
PA self-efficacy scale for children	It aims to evaluate children's self-efficacy in relation to PA. The scale was developed by Saunders et al. (1997)[30] and later modified by Sherwood et al. (2004)[28]; the Cronbach's alpha value of the original scale was 0.67; the test-retest reliability (r) was 0.56. A valid and reliable Turkish version of the scale was developed by Güzel et al. (2020).[32] The Cronbach's alpha values were 0.84 for boys and 0.81 for girls.[30] For the present study, the Cronbach's alpha value for the scale was determined to be 0.77.	The scale comprises nine items and one dimension. All items are scored using a three-point Likert-type scale (1="not at all difficult," 2="a little difficult," 3="very difficult"), and there are no reverse-coded items. The total scale score is calculated by summing the scores for each item, giving a range of 9–27. Higher scores indicate lower self-efficacy.

(n=205). The children had an average age of 9.7 ± 1.17 years (range: 8–12), and over half of them were girls (n=170; 53.1%). The nuclear family constituted 83.4% of the participants (n=267), and 65.0% of them (n=208) described their economic level as "income level is equal to their expenses" (Table 2).

The mean score for children's nutritional self-efficacy was 6.2 ± 4.76, and the average score for their PA self-efficacy was 12.3 ± 3.21. The mean score for their nutritional behavior was 2.6 ± 3.78, and for their PA, it was 24.6 ± 5.89. Meanwhile, the mean score for mothers' HL was 35.1 ± 10.28, and their MET scores were 1109.91 ± 1318.54 as shown in Table 3.

Mothers' mean BMI was 25.6±3.97 (min–max: 17.2–40.4), the children's weight-for-height z-scores for their weights were 0.31 ± 1.26 (min–max: −2.91–3.92), and their weight-for-age z-scores were 0.87 ± 1.13 (min–max: −2.96–4.12). The percentages of overweight and obesity were 31.9% and 17.2 in children; these percentages for the mothers were 38.4% and 13.8%, respectively (Table 4).

The education levels of mothers had a significant impact on their HL scores ($P < 0.005$, coefficient [coef]=2.089; standardized [std.] coef=0.233). Moreover, mothers' HL scores had a significant effect on their MET scores ($P < 0.005$, coef=0.018; std. coef=0.242) and BMI ($P < 0.005$, coef=−0.067; std. coef=−0.172). However, the study found that mothers' education levels and MET scores did not affect their BMI ($P=0.874$, $P=0.664$, respectively) (Table 5).

Mothers' HL did not have a significant effect on their children's PA self-efficacy ($P > 0.005$, coef=−0.018; std. coef=−0.057), their children's healthy eating self-efficacy ($P > 0.005$, coef=0.025, std. coef=0.052), their children's PA level ($P > 0.005$, coef=0.011; std. coef=0.097), or their children's nutritional behaviors ($P > 0.005$; coef=−0.005; std. coef=0.083). However, mothers' HL showed a significant effect on their children's BMI z-scores ($P < 0.005$, coef=−0.298; std. coef=−0.198) (Table 5).

In terms of children's PA level, mothers' HL ($P > 0.005$, coef=0.011; std. coef=0.097), mothers' education ($P > 0.005$, coef=−0.074; std. coef=−0.075), and children's PA self-efficacy ($P > 0.005$, coef=0.037; std. coef=0.107) did not have significant effects. However, mothers' MET scores had a significant effect on children's PA level in this regard ($P < 0.005$, coef=0.798; std. coef=0.289). Further, children's PA level also significantly affected children's BMI z-scores ($P < 0.005$, coef=−0.307; std. coef=−0.306) (Table 5).

Finally, children's nutritional behaviors were examined, and it was found that mothers' HL ($P > 0.005$, coef=−0.005; std. coef=−0.083), mothers' education ($P > 0.005$, coef= −0.024; std. coef=−0.047), and children's eating self-efficacy ($P > 0.005$, coef=−0.007; std.

Table 2. Sociodemographic Characteristics of the Mothers and Children (n=320)

	n	%
Mothers' characteristics		
Age group (years)		
29 and under	12	3.8
30–39	187	58.4
40 and above	121	37.8
Education level		
Primary	91	28.4
Secondary (high school)	118	36.9
University	111	34.7
Working status		
Working	119	37.2
Professional	64	20,0
Worker-servant	37	11,6
Artisan	18	5,6
Not working	201	62.8
Children's characteristics		
Age (years)		
8	64	20.0
9	68	21.25
10	119	37.2
11	41	12.8
12	28	8.75
Gender		
Girl	170	53.1
Boy	150	46.9
Family characteristics		
Family type		
Nuclear family	267	83.45
Divorced	27	8.45
Extended family	26	8.1
Perceived economic situation		
Income does not meet expenses	76	23.8
Income is equal to expenses	208	65.0
Income exceeds expenses	36	11.2
Number of children		
1	47	14.7
2	175	54.7
3	73	22.8
4 and above	25	7.8

Table 3. Scale Scores for Both Mothers and Children

	Scales	n	Mean	±SD	Min–Max
Children	Nutritional self-efficacy	320	6.2	4.76	–11–15
	Physical activity self-efficacy	320	12.3	3.21	1–27
	Nutritional Behavior	320	2,6	3.78	–14–14
	Physical Activity	320	24,6	5,86	9–44
Mother	Physical activity (MET)	320	1109,91	1318,54	0–8910
	Health literacy	320	35.1	10.28	6.77–50

SD: Standard deviation.

coef=–0.055) did not significantly affect children's nutritional behaviors. However, children's nutritional behaviors had a significant effect on children's BMI z-scores ($P < 0.005$, coef=–0.366; std. coef=–0.185). Mothers' HL and BMI did not affect children's healthy eating self-efficacy ($P=0.349$ and 0.699, respectively) (Table 5).

Discussion

To prevent obesity among children and help ensure they have a healthy BMI, it is necessary that they perform the recommended levels of PA and adherence healthy nutritional habits.[27] To help achieve this, the variables that affect these behaviors must be identified and appropriate interventions developed to improve the behaviors where necessary. The previous studies have shown that mothers' HL levels affect both their own and their children's health.[19,21,28] In this study, it was found that mothers' HL levels affect both their own BMI and their children's BMI; while mothers' HL affects their own BMI through their PA, also the mothers's MET scores affect their children's PA level.

The study found that mothers' HL is influenced by their level of education, which in turn affects their BMI. However, the study also revealed that mothers' education levels and MET scores do not have a significant impact on their BMI. The previous research has consistently demonstrated a strong link between low education levels and poor health outcomes.[18,21,29-32] but the underlying mechanisms by which education affects health outcomes remain unclear.[33] Recent studies have suggested a potential pathway between HL, education level, and health outcomes.[21,34] In line with these findings, the results of this study confirm that low education is linked to low HL, which in turn is associated with adverse health outcomes. This study goes further by examining whether a mother's HL plays a critical role in the relationship between her children's nutrition, PA self-efficacy, and BMI.

When the effects of mothers' HL on children's nutrition and physical activities were examined, it was found that a mother's HL did not affect their children's PA self-efficacy, healthy eating self-efficacy, PA level, or nutritional behaviors. However, it affected the children's BMI z-scores. Thus, mothers' HL affected their children's BMIs without affecting their eating and PA self-efficacy. The previous studies have shown a strong association between low education levels and poor health outcomes, and in recent years, a potential pathway between

Table 4. Distribution of Mothers' Body-Mass-Index Status and their Children's Body-Mass-Index z-Scores

	Children's BMI z-scores									
Mothers' BMI	Low		Ideal		Overweight		Obese		Total	
	n	%*	n	%*	n	%*	n	%*	n	%**
Low	1	25.0	3	75.0	-	-	-	-	4	1.2
Ideal	12	8.1	86	57.7	35	23.5	16	10.7	149	46.6
Overweight	4	3.2	52	42.3	50	40.7	17	13.8	123	38.4
Obese	-	-	5	11.4	17	38.6	22	50.0	44	13.8
Total	17	5.3	146	45.6	102	31.9	55	17.2	320	100.0

*row percentage, ** column percentage, BMI: body mass index.

HL, education level, and health has been suggested. The results of this study confirm that low education is an indicator of low HL, which is also an indicator of adverse health outcomes.[35,36] There was also a relationship between children's PA level and nutritional behaviors and BMI, and the influence of mothers' HL on children's BMI can vary across individuals.[35,37] Thus, further studies examining the relationship between HL and children's BMI should also aim to evaluate the influence sociocultural and economic characteristics of the parents and cognitive processes such as social learning have in this regard.

The PA levels of children were affected by their mothers' MET scores, and in turn, their PA levels affected their own BMI z-scores. However, it was found that mothers' HL and MET scores did not have an impact on their children's PA self-efficacy. These results suggest that children's PA levels are influenced by their mothers' role modeling, but not by their own PA self-efficacy. While various factors have been identified to affect participation in PA,[35] some studies have indicated that parents play a significant role in influencing their children's PA levels by serving as role models.[35,38] As we mentioned earlier, mothers'

Table 5. Path Analysis Results for the Paths Across the Mother and Child Variables

	Coef	Std. Coef	SE	CR	*P*
Mother's education level → HL	2.089	.233	.489	4.271	**
Mother's education level → Child's PA level	−0.074*	−0.075*	0.056	−1.322*	0.186
Mother's education level → Child's nutritional behaviors	−0.024*	−0.047*	0.028	−0.828*	0.408
HL → Mother's MET	0.018	0.242	0.004	4.453	**
HL → Mother's BMI	−0.067*	−0.172*	0.022	−3.023*	**
HL→ Child's PA self-efficacy	−0.018*	−0.057*	0.018	−1.012*	0.311
HL→ Child's healthy eating self-efficacy	0.025	0.052	0.026	0.936	0.349
HL → Child's PA level	0.011	0.097	0.006	1.701	0.089
HL → Child's nutritional behaviours	−0.005*	−0.083*	0.003	−1.449*	0.147
HL → Child's BMI z-score	−0.298*	−0.198*	0.086	−3.018*	**
Mother's MET → Mother's BMI	−0.132*	−0.025*	0.000	−0.435*	0.664
Mother's MET → Child's PA level	0.798	0.289	0.662	2.356	**
Mother's MET → Child's PA self-efficacy	0.375	0.087	0.246	1.522	0.128
Mother's BMI → Child's healthy eating self-efficacy	0.026	0.022	0.027	0.387	0.699
Mother's BMI → Child's BMI z-score	0.096	0.344	0.014	7.051	**
Child's healthy eating self-efficacy → Child's nutritional behaviors	−0.007*	−0.055*	0.007	−0.994*	0.320
Child's nutritional behaviors → Child's BMI z-score	0.366	0.185	0.096	3.800	**
Child's PA self-efficacy → Child's PA level	0.037	0.107	0.019	1.939	0.052
Child's PA level → Child's BMI z-score	−0.307*	−0.306*	0.049	−6.284*	**

*(–) values represent the inverse relationship. ***P*<0.005 BMI: body mass index; Coef: coefficient; CR: covariance ratio; HL: health literacy; MET: metabolic equivalent; PA: physical activity; SE: standard error; Std. Coef: standardized coefficient.

PA levels are also affected by their HL levels, and improving the HL of mothers can be beneficial in increasing PA among children.[35] The research findings support the idea that children engage in PA with their families, highlighting the importance of promoting PA in families as a key measure in preventing obesity.

When the effects of various mother and child variables on children's nutritional behaviors were examined, children's BMI scores were found to be related to mothers' HL, BMI, and children's nutritional behaviors. The fact that children's eating behaviors were not directly related to mothers' HL suggests that factors other than HL, such as social learning, may have an effect on habits. Although the literature[39] advocates the development of strategies to increase HL and self-efficacy to improve the nutritional habits and health outcomes of individuals, the eating habits of children can be strongly affected by social, cultural, and economic conditions. Children frequently consume ready-made foods with high salt content, energy drinks, junk food, and fast-food that are easy to consume. Further, children spend most of their days at school and eat at least one meal at school, meaning it is difficult for parents to control their children's nutrition. On the other hand, we found no relationship between children's nutritional self-efficacy and their BMI z-scores; in fact, studies have shown that families' knowledge and attitudes toward children's nutrition are known to shape children's eating characteristics.[24,35,40] A study has shown that children aged 8–12 years, nutritional characteristics were based on family influence.[41] This may mean that such children consume what is offered to them without making cognitive decisions regarding the foods they eat. This finding indicates that the point when children begin making conscious food choices has an important effect.

Strengths and Limitations

This study has notable strengths and limitations that should be taken into consideration. One of the strengths is that it fills a significant gap in the literature by exploring the influence of mothers' HL, BMI, and PA on the physical and nutritional status of their children, which has not been previously investigated in Türkiye or in many other countries. On the other hand, some limitations of the study should also be acknowledged. First, mothers' nutritional behaviors and healthy nutrition self-efficacy were not assessed, which could have provided a more comprehensive understanding of the factors influencing children's health. Second, reliance on self-reported data from mothers regarding their weight and height status may have introduced recall and measurement bias, leading to over- or under-estimation of the results. It is suggested that future studies use more objective measures and methods, such as clinical assessments and measurements, to enhance the accuracy and reliability of the data. Finally, the results of the study may not be generalizable to populations with different sociodemographic characteristics. Therefore, more research with diverse samples from different countries is needed to confirm and extend on these findings.

Conclusion

The findings from this study suggest that mothers' HL plays a crucial role in influencing their children's BMI through various factors, including the mothers' own BMI and PA levels as well as their children's PA behaviors. However, it is important to note that while mothers' HL did have an impact on their own PA levels, other variables such as family dynamics, lifestyle choices, and the role modeling of family members also significantly influenced the children's health outcomes. To improve HL levels in the general population, it is important to have a better understanding of the HL levels of healthcare professionals, particularly nurses, who can play a key role in promoting and improving the health of individuals and families. As such, it is necessary for nurses to assess their own HL levels and develop a deeper understanding of how to increase the HL levels of the people they serve. To achieve this, public health nurses should design regular and easily understandable training programs on HL that focus on long-term benefits. In addition, since children tend to be more physically active when their families engage in activities together, all family members should be encouraged to engage in regular PA routines to improve their overall health and well-being.

Ethics Committee Approval: The non-interventional clinical research ethics committee of Hacettepe University approved the study (Approval Number: 16969557-943, Date: May 07, 2019).

Informed Consent: Mothers who agreed to participate provided written informed consent.

Peer-review: Externally peer-reviewed.

Author Contribution: Concept – N.B.G., I.A., H.Ö., R.A.; Design – N.B.G., I.A., H.Ö., O.D., R.A.; Supervision – N.B.G., H.Ö., Funding – N.B.G., I.A., H.Ö., O.D., R.A.; Materials – N.B.G., H.Ö., R.A.I.; Data Collection and/or Processing – N.B.G., I.A., R.A.; Analysis and(or Interpretation – N.B.G., O.D.; Literature Review – N.B.G., H.Ö., R.A.I.; Writing – N.B.G., O.D.; Critical Review – I.A., H.Ö.

Declaration of Interests: The authors have no conflict of interest to declare.

Funding: The authors reported there is no funding associated with the work featured in this article.

References

1. Wang Z, Xu F, Ye Q, et al. Childhood obesity prevention through a community-based cluster randomized controlled physical activity intervention among schools in china: the health legacy project of the 2nd world summer youth Olympic Games (YOG-Obesity study). *Int J Obes (Lond)*. 2018;*42*(4):625-633. [CrossRef]
2. Di Cesare M, Sorić M, Bovet P, et al. The epidemiological burden of obesity in childhood: a worldwide epidemic requiring urgent action. *BMC Med*. 2019;*17*(1):212. [CrossRef]
3. Stierman B, Afful J, Carroll MD, et al. National health and nutrition examination survey 2017. *Natl Health Stat Rep*. National Center for Health Statistics (U.S.). 2020 *Prepandemic Data Files Development of Files and Prevalence Estimates for Selected Health Outcomes (NHSR No. 158)*;*2021*;158. Available at: https://stacks.cdc.gov/view/cdc/106273:2021.
4. Kerr JA, Loughman A, Knox A, Koplin JJ, Allen KJ, Wake M. Nutrition-related interventions targeting childhood overweight and obesity: A narrative review. *Obes Rev*. 2019;*20*(suppl 1):45-60. [CrossRef]
5. World Health Organization. Global action plan on physical activity 2018-2030: more active people for a healthier world. Available at: https://www.who.int/publications/i/item/9789241514187. Accessed Nov 28, 2023.
6. Shamah-Levy T, Cuevas-Nasu L, Gaona-Pineda EB, et al. Overweight and obesity in children and adolescents, 2016 Halfway National Health and Nutrition Survey update. *Salud Publica Mex*. 2018;*60*(3):244-253. Spanish. [CrossRef]
7. Gökalp C, Yıldız S, Halıcıoğlu Baltalı O. Eating behaviors in early childhood (1-5 years) and their association with sociodemographic characteristics in Turkey. *Cureus*. 2021;*13*(8):e16876. [CrossRef]
8. Jang M, Brown R, Park M. Mediating effect of the parent-child relationship on the association between parenting stress and children's eating behaviors. *BMC Public Health*. 2021;*21*(1):1967. [CrossRef]
9. Jansen E, Williams KE, Mallan KM, Nicholson JM, Daniels LA. Bidirectional associations between mothers' feeding practices and child eating behaviours. *Int J Behav Nutr Phys Act*. 2018;*15*(1):3. [CrossRef]

10. Hughes SO, Power TG, O'Connor TM, Fisher JO, Micheli NE, Papaioannou MA. Maternal feeding style and child weight status among Hispanic families with low-income levels: a longitudinal study of the direction of effects. *Int J Behav Nutr Phys Act*. 2021;*18*(1):30. [CrossRef]
11. De Cosmi V, Scaglioni S, Agostoni C. Early taste experiences and later food choices. *Nutrients*. 2017;*9*(2):107. [CrossRef]
12. Romanos-Nanclares A, Zazpe I, Santiago S, Marín L, Rico-Campà A, Martín-Calvo N. Influence of parental healthy-eating attitudes and nutritional knowledge on nutritional adequacy and diet quality among preschoolers: the SENDO project. *Nutrients*. 2018;*10*(12):1875. [CrossRef]
13. Martin A, Booth JN, Laird Y, Sproule J, Reilly JJ, Saunders DH. Physical activity, diet and other behavioural interventions for improving cognition and school achievement in children and adolescents with obesity or overweight. *Cochrane Database Syst Rev*. 2018;*1*(1):CD009728. [CrossRef]
14. Marmot M, Fair Society. *Healthy Lives: Strategic Review of Health Inequalities in English Post-2010*; 2013:1-74. [CrossRef]
15. Aslam M, Kingdon GG. Parental education and child health-understanding the pathways of impact in Pakistan. *World Dev*. 2012;*40*(10):2014-2032. [CrossRef]
16. Gönenç İM. Kadın sağlığı açısından sağlık okuryazarlığı. In: *Sağlık Okuryazarlığı*. Yıldırım F, Keser A, eds. Ankara: Ankara Üniversitesi Basımevi; 2015:61-74.
17. Asgary R, Liu M, Naderi R, Grigoryan Z, Malachovsky M. Malnutrition prevalence and nutrition barriers in children under 5 years: a mixed methods study in Madagascar. *Int Health*. 2015;*7*(6):426-432. [CrossRef]
18. Stafford JD, Goggins ER, Lathrop E, Haddad LB. Health literacy and associated outcomes in the postpartum period at Grady Memorial Hospital. *Matern Child Health J*. 2021;*25*(4):599-605. [CrossRef]
19. Yilmaz F, Acar S, Bilen Kazancik L, et al. *İlçelerin Sosyo-Ekonomik Gelişmişlik Sıralaması Araştırması SEGE-2017. Kalkınma Ajansları Genel Müdürlüğü Yayını Sayı: 2, Araştırma Raporu Sayı*. Available at: https://www.sanayi.gov.tr/merkez-birimi/b94224510b7b/sege/ilce-sege-raporlari
20. Kline RB. *Principles and Practice of Structural Equation Modeling*. New York: Guilford; 1998.
21. Craig CL, Marshall AL, Sjöström M, et al. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc*. 2003;*35*(8):1381-1395. [CrossRef]
22. Saglam M, Arikan H, Savci S, et al. International physical activity questionnaire: reliability and validity of the Turkish version. *Percept Mot Skills*. 2010;*111*(1):278-284. [CrossRef]
23. Ainsworth BE, Haskell WL, Whitt MC, et al. Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sports Exerc*. 2000;*32*(9)(suppl):S498-S504. [CrossRef]
24. Edmundson E, Parcel GS, Perry CL, et al. The effects of the child and adolescent trial for cardiovascular health intervention on psychosocial determinants of cardiovascular disease risk behavior among third-grade students. *Am J Health Promot*. 1996;*10*(3):217-225. [CrossRef]
25. HLS-EU Consortium. *Comparative Report of Health Literacy in Eight EU Member States: the European Health Literacy Survey (HLS-EU)*. 2012. Available at: http://www.health-literacy.eu
26. Camcı N, Bas M, Buyukkaragoz AH. The psychometric properties of the Child Feeding Questionnaire (CFQ) in Turkey. *Appetite*. 2014;*78*:49-54. [CrossRef]
27. Okyay P, Abacıgil F. Türkiye'de sağlık okuryazarlığı Ölçekleri Güvenirlik ve Geçerlik çalışması. *Turk Halk Sağlığı Derg*. 2016;*14*(3):115-128.
28. Story M, Sherwood NE, Himes JH, et al. An after-school obesity prevention program for African-American girls: the Minnesota GEMS pilot study. *Ethn Dis*. 2003;*13*(1)(suppl 1):S54-S64.
29. Kabasakal E, Arslan UE, Üner S, et al. Çocuklar İçin sağlıklı yeme Öz-Yeterlik Ölçeğinin Türkçe Geçerlik ve Güvenirlik çalışması. *Turk Çocuk Hastalıkları Derg*. 2020;*15*:72-77. [CrossRef]
30. Saunders RP, Pate RR, Felton G, et al. Development of questionnaires to measure psychosocial influences on children's physical activity. *Prev Med*. 1997;*26*(2):241-247. [CrossRef]
31. Sherwood NE, Taylor WC, Treuth M, et al. Measurement characteristics of activity-related psychosocial measures in 8- to 10-year-old African-American girls in the Girls Health Enrichment Multisite Study (GEMS). *Prev Med*. 2004;*38*(suppl):S60-S68. [CrossRef]
32. Güzel A, Üner S, Arslan EU, et al. The Turkish validity and reliability of the physical activity self-efficacy scale for children. *Bezmialem Sci*. 2020;*8*(4):363-370. [CrossRef]
33. Mackenbach JP, Stirbu I, Roskam AJ, et al.; European Union Working Group on Socioeconomic Inequalities in Health. Socioeconomic inequalities in health in 22 European countries. *N Engl J Med*. 2008;*358*(23):2468-2481. Erratum in: *N Engl J Med*. 2008;*359*(12):e14. [CrossRef]
34. Cutler DM, Lleras-Muney A. Education and health: insights from international comparisons. Working paper No. 17738. National Bureau of Economic Research. Available at: http://www.nber.org/papers/w17738. Accessed Nov 28, 2023.
35. Lee SY, Tsai TI, Tsai YW, Kuo KN. Health literacy, health status, and healthcare utilization of Taiwanese adults: results from a national survey. *BMC Public Health*. 2010;*10*:614. [CrossRef]
36. Röthlin F, Pelikan JM, Ganahl K, Diehl-Schmid J. Health literacy and health outcomes in people with dementia: A systematic review. *J Alzheimers Dis*. 2021;*79*(4):1625-1639.
37. Kapucu S, Ünal B. The mediating effect of children's dietary habits on the relationship between mothers' health literacy and children's body mass index. *Int J Environ Res Public Health*. 2020;*17*(18):6698.
38. Güneş B, Alkan I, Bora Güneş N, Keskİn MT, Dağ O. Relationship between physical activity levels of the secondary school students and their safe environment, playing conditions and media usage. *Hacettepe Egitim Derg*. 2023;*38*(1). [CrossRef]
39. Schoeppe S, Vandelanotte C, Bere E, et al. The influence of parental modeling on children's physical activity and screen time: does it differ by gender? *Eur J Public Health*. 2017;*27*(1):152-157. [CrossRef]
40. Aydın D, Aba YA. Annelerin Sağlık Okuryazarlığı Düzeyleri ile Emzirme Öz-Yeterlilik Algıları. *Dokuz Eylül Univ Hemşirelik Fak Electron Derg*. 2019;*12*(1):31-39.
41. Flattum C, Draxten M, Horning M, et al. HOME Plus: program design and implementation of a family-focused, community-based intervention to promote the frequency and healthfulness of family meals, reduce children's sedentary behavior, and prevent obesity. *Int J Behav Nutr Phys Act*. 2015;*12*(1):53. [CrossRef]
42. Kowalski KC, Crocker PR, Donen RM. *The Physical Activity Questionnaire for Older Children (PAQ-C) and Adolescents (PAQ-A) Manual. College of Kinesiology*. University of Saskatchewan. 2004;*87*(1):1-38.
43. Emlek Sert Z, Bayık Temel A. Adaptation of physical activity questionnaire to Turkish community for elementary school students: validity and reliability study. *Dokuz Eylül University Electronic Nursing Faculty*. 2014;*7*(2):109-114.
44. Öztürk M, Erdoğan S. Çocukların beslenme alışkanlıklarının sağlık davranışı etkileşim modeline göre incelenmesi. *Istanbul Univ Sağlık Bilimleri Enstitüsü Doktora Tezi*. 2010.