

Maternal Education and Childhood Obesity in Türkiye: Is There A Causal Link?

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Abstract

This paper examines the causal impact of maternal education on childhood overweight and obesity using the 2022 Türkiye Child Survey (TCS) microdata provided by the Turkish Statistical Institute (TURKSTAT). We employ an instrumental variable (IV) estimation strategy for children aged 2–17, exploiting the 1997 compulsory schooling reform as an instrument for maternal education. Our results suggest that higher maternal education decreases the probability of a child being overweight or obese; however, the estimated effects are not statistically significant. We further examine the impact of maternal education on children's dietary and exercise habits and time spent using electronic devices to explore potential behavioral pathways. The results indicate that maternal education does not significantly affect these outcomes either. These findings suggest that the additional maternal schooling induced by the compulsory schooling reform does not translate into detectable improvements in the health behaviors examined or into a significant reduction in childhood overweight and obesity. Overall, our findings provide limited evidence of a causal effect of maternal education on childhood overweight and obesity in Türkiye.

Keywords: Childhood Obesity, Maternal Education, Instrumental Variable Estimation, Türkiye
JEL Classifications: I10, I12, C5

ملخص

تبحث هذه الورقة في التأثير السببي لتعليم الأمهات على زيادة الوزن والسمنة لدى الأطفال باستخدام البيانات الجزئية لمسح الطفل التركي (TCS) لعام 2022 المقدمة من المعهد الإحصائي التركي (TURKSTAT). نحن نستخدم استراتيجية تقدير المتغير الآلي (IV) للأطفال الذين تتراوح أعمارهم بين 2-17 عامًا، مستغلين إصلاح التعليم الإلزامي لعام 1997 كأداة لتعليم الأمهات. تشير نتائجنا إلى أن ارتفاع مستوى تعليم الأم يقلل من احتمالية إصابة الطفل بزيادة الوزن أو السمنة؛ ومع ذلك، فإن التأثيرات المقدرة ليست ذات دلالة إحصائية. كما نقوم بدراسة تأثير تعليم الأم على العادات الغذائية والتمارين الرياضية للأطفال والوقت الذي يقضونه في استخدام الأجهزة الإلكترونية لاستكشاف المسارات السلوكية المحتملة. وتشير النتائج إلى أن تعليم الأم لا يؤثر بشكل كبير على هذه النتائج أيضًا. وتشير هذه النتائج إلى أن التعليم الإضافي للأمهات الناجم عن إصلاح التعليم الإلزامي لا يترجم إلى تحسينات يمكن اكتشافها في السلوكيات الصحية التي تم فحصها أو إلى انخفاض كبير في زيادة الوزن والسمنة لدى الأطفال. وبشكل عام، تقدم نتائجنا أدلة محدودة على التأثير السببي لتعليم الأمهات على زيادة الوزن والسمنة لدى الأطفال في تركيا.

1. Introduction

Childhood health is significantly associated with a child's future health status, labor market outcomes, and socioeconomic status (Case et al., 2005). Children who experience poorer health are more likely to suffer from poorer health in adulthood, have lower educational attainment and poorer employment outcomes. Given the adverse effects of poor childhood health on a child's later-life outcomes, it is evident that policies implemented to improve child health represent one of the most valuable human capital investments for a country. In this study, we consider childhood overweight/obesity as proxy for children's health because childhood overweight is a strong predictor of many future diseases, including cardiovascular and metabolic diseases. Childhood overweight is also one of the most important determinants of obesity in adulthood, which in turn results in poor health and early death (WHO, 2020). Therefore, preventing overweight in early childhood will be beneficial for children's health and well-being in both childhood and adulthood, in addition it helps reduce private and public health expenditures (Frederick et al. (2014).

Childhood overweight and obesity have increased substantially worldwide in recent decades. Globally, obesity among children under 5 increased from 5.3% to 5.6% between 2000 and 2022 (COSI-TUR 2022), while overweight and obesity among children aged 5 and older increased from 8% to 20% between 1990 and 2022 (WHO, 2022). In Europe, approximately one-third of children aged 5-9 are overweight or obese (29% of boys and 27% of girls). Türkiye has among the fastest-growing rates, with 32.7% of children aged 5-9 classified as overweight and 14.9% as obese. Among those aged 10-19, the corresponding rates are 27.9% and 9.8%, respectively, both exceeding the European averages of 24.9% and 7.1% (WHO, 2022). Childhood overweight and obesity therefore represent an increasingly important public health concern in Türkiye.

In this study, we examine the causal impact of maternal education on childhood obesity. Our focus on maternal education is due to the fact that it is the most critical factor in a child's development, education, and health outcomes (see Thomas et al. (1991), Assaad et al. (2012), Victora et al. (1992), Chen and Li (2009)). In the context of obesity, research in high-income countries provide mixed evidence on the association between maternal education and childhood obesity. For instance, Madden (2017) shows that children whose mothers have lower levels of education have higher risks of obesity in Ireland. Ruiz et al. (2016) examine the association between maternal education and childhood obesity in 11 European countries and find that lower levels of education are positively associated with higher odds of obesity among children between 4-7 years of age. In contrast, for the USA, Fertig et al. (2009) find that the child's probability of being overweight is positively associated with maternal working hours when the mother has more than 12 years of schooling but not for the children of less educated working mothers. Gibson et al. (2007) do not find a significant association between maternal education and child's BMI levels in Australia. In a recent study Hsu et al. (2022) show that lower levels of maternal education are associated with higher Body Mass Index (BMI) levels for children in Taiwan.

In developing countries, the evidence is also mixed. For instance, Ali and Elsayed (2017) do not find a significant causal impact of maternal education on child's health indicators, including child's overweight status in Egypt. Martorell et al. (2000) show that obesity and overweight is more prevalent in urban regions, for girls and for children with higher educated mothers, using national nutritional surveys from 50 developing countries.

Evidence from Türkiye is limited. A study conducted in Ankara found that higher levels of maternal education is in general positively associated with higher probability of child obesity. Notably, higher maternal education is positively associated with obesity risk in low-to-middle SES groups (Yardımcı et al., 2019). Likewise, Küçükerdönmez et al. (2025) show that higher levels of maternal education is positively related to a child's likelihood of being overweight. The study is conducted for 22 provinces and is not nationally representative. To our knowledge, the only study that investigates the socio-economic determinants of childhood obesity in Türkiye using a nationally representative micro dataset is Düzgün-Öncel and Karaoğlu (2019). The authors find that higher levels of maternal education is negatively associated with the child's likelihood of being overweight/obese however the association is not statistically significant. These studies fail to establish a causal relationship between childhood obesity and maternal education and therefore, it is not clear whether maternal education helps curb childhood obesity.

Studies that investigate other child health outcomes such as birthweight and mortality generally conclude that higher levels of maternal education significantly improve child health (see for instance, Gunes (2015), Dursun et al. (2022)). Gunes (2015) examines the causal effect of maternal education on child's weight-for-age and height-for-age indicators for children under 5 years old, but not child's overweight/obesity status. There are also a limited number of studies that examine the causal relationship between individual's years of schooling and his/her overweight status in Türkiye (see for instance, Dursun et al. (2018), Tansel and Karaoğlu (2019), Baltagi et al. (2019)). Neither of these studies find a significant impact of higher years of education on individual's overweight status.

In this study, we use 2022 Türkiye Child Survey (TCS) micro dataset of the Turkish Statistical Institute (TURKSTAT). We examine the causal impact of maternal education on child's probability of being overweight/obese by implementing an Instrumental Variable (IV) estimation methodology for children between 2 and 17 years old. We instrument maternal education using the 1997 compulsory school reform, which has been shown to significantly increase educational attainment. Our results suggest that higher levels of maternal education decrease the child's probability of being overweight/obese. However, the impact is not statistically significant. In order to understand why maternal education does not play a significant role in reducing children's likelihood of being overweight/obese, we look at dietary and exercise habits of children. In particular, we look at how frequently children consume food with high sugar and fat content such as confectionary, crisps, soda and the like, how often they exercise and the time they spend

watching TV, playing on their tablets and using their cell phones. Our results suggest higher levels of maternal education lead to some improvements in health behaviors among children, however these effects are not statistically significant.

This paper seeks to contribute to literature in two important ways. First, it focuses explicitly on the causal relationship between maternal education and the child's probability of being overweight/obese aged 2-17 in Türkiye, a country characterized by high obesity rates among children. Second, we investigate the causal impact of maternal education on child's overweight status not only for early childhood but also for adolescence years, for which there is very little evidence in Türkiye.

The rest of the paper is organized as follows: Section 2 presents the theoretical framework. Section 3 describes the data, identification, as well as descriptive statistics. Section 4 presents model and empirical results. Finally, Section 5 concludes.

2. Theoretical Framework

Our theoretical framework builds on the health capital model developed by Grossman (1972). In this framework, health is treated as a durable capital stock that produces healthy time. Individuals are endowed with an initial stock of health, which depreciates over time but can be maintained or increased through investments in health. Unlike most goods, health is not directly purchased in the market. Rather, individuals produce health by combining market inputs, such as medical care, nutritious food, and other health-related goods, with their own time and knowledge. Health is therefore both a consumption good, as better health directly increases utility, and an investment good, as it increases the amount of healthy time available for productive and other activities.

Education plays an important role in the Grossman framework because it may increase the efficiency of health production. More educated individuals may obtain more health from a given amount of health inputs by using available information and resources more efficiently. In this sense, education can increase the productivity of health investments and reduce the effective cost of producing a given level of health. Applied to child health, this framework suggests that maternal education may affect children's health by influencing both the choice and effective use of health-related inputs.

The household production model of Rosenzweig and Schultz (1983) provides a more direct framework for understanding this relationship. They conceptualize child health as an outcome produced within the household through a combination of behavioral health inputs and family-specific health endowments. More formally, child health can be represented as:

$$H = F(Y, I, \mu)$$

where H denotes child health, Y represents goods or behaviors that both enter household utility and affect child health, I represents health inputs that affect utility primarily through their contribution to health, and μ captures family-specific health endowments, including genetic and environmental factors (Rosenzweig and Schultz, 1983). Importantly, households choose these health inputs subject to prices, income, preferences, and the health endowments they face. The model therefore treats health-related behaviors not as exogenously determined characteristics but as outcomes of household decision-making.

This framework is particularly useful for examining the relationship between maternal education and childhood overweight and obesity. Maternal education may influence the household's demand for and allocation of health inputs and, consequently, children's health-related behaviors. In the context of childhood obesity, these inputs can include the nutritional composition of children's diets, physical activity, and sedentary behaviors. Higher maternal education may facilitate the acquisition and processing of health information and improve mothers' ability to choose and allocate inputs that contribute to healthier weight outcomes. Thus, maternal education may affect childhood obesity not only directly through greater efficiency in health production but also indirectly by altering the behavioral inputs through which child health is produced.

An important implication of the household production framework is that observed relationships between health inputs and child health outcomes need not represent causal effects, since families may differ in health endowments that are observed by the household but unobserved by the researcher. Because parents can adjust their health-related choices in response to these endowments, behavioral inputs may be endogenous to child health. Consequently, correlations between parental characteristics, health inputs, and child health may combine the underlying health-production technology with household preferences and unobserved heterogeneity rather than identifying causal relationships. This provides an additional theoretical motivation for addressing the potential endogeneity of maternal education in our empirical analysis.

These considerations can be summarized in a simplified child health production framework:

$$H_c = H(E_m, X, C, \mu)$$

where H_c represents the child's health or weight status, E_m denotes maternal education, X represents health-related behavioral inputs, C captures observed child and household characteristics, and μ represents unobserved health endowments and other unobserved determinants of child health. Within this framework, maternal education may influence child weight both through the efficiency of health production and through its effect on the choice of X . At the same time, the potential correlation between maternal education and unobserved determinants of child health implies that the observed education-health gradient cannot necessarily be given a causal interpretation.

Guided by this framework, our empirical analysis proceeds in two steps. First, we estimate the causal effect of maternal education on children's probability of being overweight or obese. Second, we examine whether maternal education affects three behavioral inputs that are closely related to children's weight outcomes: consumption of foods and drinks high in sugar or fat, physical inactivity, and time spent using electronic devices. The latter analysis allows us to investigate whether maternal education operates through observable health behaviors that constitute important inputs into the production of child health.

3. Data set and identification

Our empirical analyses are based on the 2022 Türkiye Child Survey (TCS). TCS is a rich nationally representative micro-data set, gathered by the Turkish Statistical Institute (TURKSTAT). The survey includes a rich set of questions regarding children, parents and household characteristics. TCS contains four modules. The first module involves questions on household members' demographic and socio-economic characteristics, such as age, gender, marital status, completed education level, and labor market status. The second module includes questions related to household characteristics, for instance, household income and dwelling characteristics. The third module comprises questions on child's (aged 0-17) demographic characteristics, education level, health status and development indicators. This module is answered by the primary caretakers of children. Finally, the fourth module includes questions that are directly addressed to 13-17-year-olds and mainly include questions on their perceptions about a variety of issues that concern their relationship with their parents and friends, self-worth, future aspirations and abstract concepts such as children's rights. We employ the first three modules of TCS.

For the purposes of this study, the TCS offers two main advantages over other datasets that provide information on children's health such as the Turkey Demographic Health Survey (TDHS) or the Turkish Health Survey (THS) of TURKSTAT. First, neither TDHS nor THS provide information on the weight or the height of primary and middle school aged children. THS provides this information for only 15-17-year-olds, namely high-school aged children, whereas TDHS provides health indicators from which overweight status can be computed for children less than 5 years of age only. Second, TCS provides information on the birthdate of children and their mothers, which allows us to use the 1997 compulsory school reform as an instrument for maternal education.

For the empirical analysis, we match children to their mothers. This is made possible through a mother identifier in the dataset. A mother may have more than one child in the target group. To have unique observations of mothers, we have matched the eldest child in the target group to their mothers. There are two reasons why we consider the eldest child. First, the eldest child represents the longest exposure to maternal educational resources and health-related behaviors. Second, we drop children under 2 years of age from our analysis since BMI is not a good indicator of health for this age group. We also keep children with both parents present in the household. In addition,

we exclude a small number of observations with implausible BMI values (i.e. children whose BMI levels are higher than 50). Finally, we drop observations of underweight children from the estimation sample since being underweight indicates other health problems for children, such as stunting or wasting, which is not the scope of this study. After applying these restrictions our operational sample consists of 5,421 mother-child matched pairs.

3.1. Outcome and control variables

Our main dependent variable is whether the child is overweight (including obese) or not. We determine the weight status of a child by calculating his/her Body Mass Index (BMI) by dividing the child's reported weight (in kilograms) by the square of child's reported height (in meters). Following Cole et al. (2000), we use different threshold values of BMI to categorize children by weight status based on their gender, age and calculated BMI level. For instance, if the child's BMI is greater than or equal to 30, then the child is referred as obese. The child is defined as overweight if his/her BMI is greater than 25 and smaller than 30.³ Because being overweight is a strong predictor of obesity in both childhood and adulthood, we combine overweight and obese individuals into a single category. Table 1 shows the percentage distribution of children aged 2–17 across two weight categories by age group.

Table 1. Distribution of children by age group and weight status (%)

	Age Group:2-17	Age Group:2-5	Age Group:6-12	Age Group:13-17
Normal Weight	66.18	57.49	59.54	74.21
Overweight/Obese	33.82	42.51	40.46	25.79
N	5,421	773	2,131	2,517

Source: TCS 2022. Authors' calculations. Sampling weights are applied.

Table 1 presents the distribution of children by weight status across different age groups. Overall, 33.82% of children aged 2–17 is classified as overweight or obese, while 66.18% have normal weight. However, the prevalence of overweight/obesity varies considerably across age groups. It is highest among children aged 2–5, at 42.51%, followed closely by children aged 6–12, at 40.46%. In contrast, the prevalence declines substantially to 25.79% among adolescents aged 13–17. Correspondingly, the proportion of children with normal weight increases to 74.21% in the oldest age group, compared with 57.49% among children aged 2–5 and 59.54% among those aged 6–12. These descriptive patterns indicate substantial age-related variation in children's weight status, with overweight and obesity being considerably more prevalent among younger children than among adolescents.

³ We use the user written STATA command “zbmocat” in categorizing children as underweight, normal weight, overweight and obese (See Vidmar et al. (2013)).

The second key variable for this study is mother's completed education level. The TCS data set has questions regarding each individual's highest schooling level attended and whether they have completed that level. Using these two questions, we classify mothers into two education categories: "Lower secondary or more" and "Less than lower secondary". Table 2 examines how children's weight status varies according to their mothers' educational attainment.

Table 2. Distribution of children's weight status by mother's education level (%)

Mother's Completed Education Level	Lower secondary or more	Less than lower secondary	p-value for the difference between normal/overweight prevalence by maternal education
Normal weight	63.44	69.10	0.000
Overweight/Obese	36.56	30.90	0.000

Source: TCS 2022. Authors' calculations. Sampling weights are applied.

Among children whose mothers have completed at least lower secondary education, 36.56% are overweight or obese, compared with 30.90% among children whose mothers have less than lower secondary education. These descriptive patterns may indicate a positive association between maternal education and childhood overweight/obesity. However, this relationship should be interpreted with caution, as children whose mothers have more schooling, particularly those affected by the 1997 education reform, are younger than those whose mothers have less education. As shown in Table 1, younger children are more likely to be overweight, suggesting that the higher prevalence of overweight/obesity among children of more educated mothers may partly reflect differences in their age composition.

In the empirical analysis, we also examine whether maternal education has an impact on children's health behaviors that encompass dietary and exercise habits. First, we examine whether the child frequently consumes food that includes high sugar or fat content. For high-sugar, high-fat food consumption, we define a dummy variable that is equal to 1, if the child consumes such foods more than once a week. Second, we examine whether the child exercises frequently or not. Regarding child's exercise behavior, we define a dummy variable which equals to 1 if the child has not exercised at least one hour in the past seven days. Finally, we examine the duration the child spends watching TV, playing on his/her tablet or cellular phone during a week (in terms of hours) as a proxy for leading a more sedentary life style. Table 3 compares the health behaviors of normal weight and overweight/obese children.

Table 3. Child's health behaviors by weight status (%)

	Normal Weight	Overweight/Obese	p-value for the difference between normal weight and overweight/obese children
Food/drink with high sugar or fat content (%)	76.04	78.33	0.0374
Not exercising (%)	57.46	57.56	0.6081
Time spend with electronic devices (hours during a week in logarithms)	12.41	13.38	0.0400
Number of Observations	3,581	1,857	

Source: TCS 2022. Authors' calculations. Sampling weights are applied.

Table 3 indicates that the prevalence of consuming high-sugar or high-fat food and drinks is slightly higher among overweight/obese children compared to those of normal weight, while the share of children who do not exercise is nearly identical across the two groups. Overweight/obese children also display marginally higher levels of screen time, and the difference is statistically significant. Overall, these results indicate that unhealthy dietary habits and greater sedentary time are somewhat more common among heavier children, whereas physical inactivity appears widespread regardless of weight status.

3.2. Identification

Identifying the causal effect of maternal education on child health is complicated by endogeneity issues discussed in Section 2. Therefore, ordinary least squares may give biased estimates for the relationship between mother's education level and child's probability of being overweight/obese. Hence, to identify the causal impact of mother's education on childhood obesity, we use an Instrumental Variable (IV) methodology. An external shock that can be an instrument for mother's years of schooling is the 1997 education reform that increased the duration of compulsory schooling from five to eight years. The policy required that mothers born on January 1987 or later stay in school for at least 8 years to complete lower-secondary school. In contrast, those born before 1987 were subject to 5 years of compulsory schooling. Since the reform can only affect children's health status indirectly by changing maternal education, it fulfills the exclusion restriction and can serve as a valid instrument for maternal education.

Our observation window includes mothers born within 10 years before or after the January 1987 cutoff, covering the 1977–1997 birth cohorts. We do not extend the observation window beyond 1997 because mothers born in January 1998 were exposed to a different education reform that increased compulsory schooling from 8 to 12 years. We also consider narrower windows to assess the sensitivity of our results to the choice of observation window.

In our widest observation window, 35.93% of mothers with children in the target group are found to be affected by the reform. Table 4 compares child's overweight/obesity status, demographic characteristics, as well as maternal education based on whether the mother was affected by 1997 compulsory schooling law change. Table 4 shows that prevalence of overweight/obesity is

significantly higher among children whose mothers are exposed to the compulsory schooling law change. The table also suggests that children whose mothers are affected by the reform are younger (mean age 8.14) compared to those whose mothers are not affected (13.21). Hence, the difference between the child's overweight/obesity status may stem from the child's age rather than maternal reform exposure. To examine this issue, we estimate a probit model of childhood overweight/obesity controlling for the child's age and age squared and then compute predictive margins by maternal reform exposure. The resulting age-adjusted incidence of overweight/obesity is also reported in Table 4.

Table 4. Descriptive statistics by maternal reform exposure

	Exposed to the reform	Not exposed to the reform	p-value (Difference between exposed and not exposed group)
Overweight/obese (%) (crude value)	38.96	30.44	0.0000
Age Corrected Incidence of Overweight/Obesity			
Overweight/Obese (%)	33.31	33.62	0.8563
Child's Control Variables			
Age (Mean)	8.14 (3.88)	13.21 (3.44)	0.0000
Female (%)	50.21	48.02	0.2450
Mother's Education Level			
Less than lower secondary	28.46	60.10	0.0000
Lower secondary or more	71.54	39.90	0.0000
Number of Observations	1,902	3,399	

Source: TCS 2022. Authors' calculations. Sampling weights are applied. Standard errors for continuous age variable are shown in parenthesis.

Descriptive statistics suggest that an adjusted age difference in the probability of being overweight/obese between children of reform-exposed and unexposed mothers is very small (-0.29 percentage points), and it is not statistically significant. Thus, the substantially higher unadjusted overweight/obesity prevalence among children of reform-exposed mothers may primarily reflect differences in the age composition of the two groups rather than a meaningful difference in weight status associated with reform exposure.

Maternal educational attainment differs markedly between mothers who were exposed to the reform and those who were not. Mothers affected by the change in the compulsory schooling law are substantially more likely to have completed lower secondary education or attained a higher degree (71.54%) than unaffected mothers (39.9%). Thus, the reform significantly increased at least lower secondary school completion.

3.3. Empirical specification

We examine the causal impact of maternal education on children's likelihood of being overweight/obese by implementing an IV estimation methodology. We use the 1997 compulsory schooling reform as instrument for mother's completed level of education. Previous studies show that the change in the compulsory schooling law has had positive and substantial effects on women's schooling (see for instance Kirdar et al. (2016) and Kirdar et al. (2018)). Therefore, in

this paper the change in compulsory schooling law is taken as a natural experiment and used as an instrument. The fact that the reform was unexpected and was politically motivated (Kırdar et al. (2016)) supports it as a valid instrument (Angrist and Krueger, (1991)).

Our two-stage least squares estimation is as follows:

First Stage Regression:

$$E_i = \alpha_0 + X' \alpha_1 + \alpha_2 R97 + \varepsilon_i \quad (1)$$

In equation (1), i indexes the mother of the child. E is a dummy variable, indicating whether the mother has completed at least 8 years of schooling. The dummy variable $R97$ indicates whether a mother is affected by the 1997 change in the compulsory schooling law, as determined by her date of birth. Mothers born in January 1987 or later were affected by the reform and are assigned a value of 1 for $R97$; otherwise, $R97$ takes a value of 0. The X vector contains child's gender, age and age squared, as well as mother's year and month of birth.

Second Stage Regression:

$$O_i = \delta + \beta_1 \hat{E}_i + X' \beta_2 + u_i \quad (2)$$

In equation (2), the dependent variable O indicates whether the child is overweight/obese, as determined by the child's BMI relative to age- and gender-specific BMI thresholds. The variable for maternal education (E) is the predicted value obtained from the first-stage regression in equation (1). The vector X is defined as in equation (1). The coefficient of interest, β_1 , captures the change in the probability of child overweight/obesity associated with their mother completing at least lower secondary education. The IV estimate should be interpreted as a local average treatment effect (LATE), capturing the effect of additional schooling among mothers whose educational attainment was affected by the 1997 compulsory schooling reform.

Aside from child overweight/obesity, we examine whether maternal education affects children's dietary and exercise behaviors. To this end, we estimate equations (1) and (2), redefining the dependent variable in equation (2) to capture whether the child consumes foods high in sugar or fat, such as confectionery, crisps, and soda; how frequently the child exercises; and the amount of time the child spends watching TV, using a tablet, or using a cellphone.

4. Results

4.1. First-stage results

Table 5 presents the first-stage regression results and the relevant test statistics for assessing instrument strength. We first implement the IV estimation using a 10-year birth-cohort window around the cutoff value covering mothers born between 1977 and 1997. We then narrow the birth-cohort window such that we consider mothers born 9 and 8 years before and after the reform cutoff. In the 10-year window, exposure to the reform is associated with a 11.7 percentage-point increase in the probability that a mother completes at least eight years of schooling. Although the magnitude of the estimated association declines as the birth-cohort window narrows, its direction and statistical significance remain unchanged. When we use windows narrower than 8 years, however, the number of observations declines and the F-statistic falls below 10, the conventional critical value for assessing instrument strength. Overall, the first-stage results indicate that the reform is a relevant predictor of maternal education, although instrument strength declines with narrower observation windows. The estimates based on narrower windows should therefore be interpreted with greater caution.

Table 5. First stage regression results (dependent variable: mother has at least 8 years of education)

VARIABLES	(1) IV-2SLS (10-year obs. window around the reform cutoff)	(2) IV-2SLS (9-year obs. window around the reform cutoff)	(3) IV-2SLS (8-year obs. window around the reform cutoff)
Policy	0.117***	0.11***	0.102***
F-Statistic	16.86	13.75	11.35
Child's Gender (1: Female)	YES	YES	YES
Child's Age	YES	YES	YES
Child's Age Square	YES	YES	YES
Mother's year of birth	YES	YES	YES
Mother's month of birth	YES	YES	YES
Number of Observations	4,325	4,074	3,762

*Notes: In all regressions, error terms are clustered by mother's birth year and sample weights are applied. *** indicates 1% level of significance, ** indicates 5% level of significance, * indicates 10% level of significance.*

4.2. Second-stage results

Table 6 presents the LPM and second-stage results from the IV estimation. The LPM estimates reported in columns (1), (3) and (6) suggest no statistically significant association between maternal education and child overweight/obesity. The estimated coefficients are close to zero and statistically insignificant. The IV estimates reported in columns (2), (4), and (6) are larger in magnitude and consistently negative, although they are not statistically significant either. In addition, boys have a higher probability of being overweight/obese than girls.

Table 6. LPM and second stage regression results (dependent variable: the child is overweight/obese)

VARIABLES	(1) LPM (10-year obs. window around the reform cutoff)	(2) IV-2SLS (10-year obs. window around the reform cutoff)	(3) LPM (9-year obs. window around the reform cutoff)	(4) IV-2SLS (9-year obs. window around the reform cutoff)	(5) LPM (8-year obs. window around the reform cutoff)	(6) IV-2SLS (8-year obs. window around the reform cutoff)
Mother has at least 8 years of education	-0.008 (0.01)	-0.135 (0.28)	-0.005 (0.02)	-0.086 (0.31)	-0.0007 (0.01)	-0.101 (0.34)
Child's Gender (1: Female)	-0.06*** (0.01)	-0.06*** (0.01)	-0.057*** (0.01)	-0.059*** (0.02)	-0.062*** (0.02)	-0.063*** (0.01)
Child's age and ge squared	YES	YES	YES	YES	YES	YES
Mother's month of birth	YES	YES	YES	YES	YES	YES
Mother's year of birth	YES	YES	YES	YES	YES	YES
Observations	4,325	4,325	4,074	4,074	3,762	3,762

Notes: Robust standard errors are shown in parenthesis. In all regressions, error terms are clustered by birth year and sample weights are applied. *** indicates 1% level of significance, ** indicates 5% level of significance, * indicates 10% level of significance.

Based on the above results, we conclude that there is no significant causal relationship between maternal education and child's probability of being overweight/obese. The absence of a significant impact on overweight/obesity status, however, does not necessarily imply that higher levels of maternal education induced by the reform have no influence on children's health-related outcomes. Education may affect more proximal inputs into child health, including dietary choices, physical activity, and other health behaviors, without producing a sufficiently large effect to translate into differences in weight status. Therefore, next, we examine whether mother's policy exposure has significant impact on the child's health behaviors that may represent potential pathways linking maternal education to children's health. Table 7 presents the second stage results from a series of IV estimations. First stage test statistics confirm that the instrument is strongly valid, namely the F statistics varies from 13.86 to 19.25 for all the dependent variables.

Table 7. Second stage regression results (dependent variable: child's health behaviors)

VARIABLES	(1) Food/drink with high sugar or fat content consumption	(2) Not Exercising	(3) Time Spend with electronic devices (in logs)
Mother has at least 8 years of education	-0.08 (0.23)	0.15 (0.24)	0.54 (0.58)
Child's Gender (1: Female)	YES	YES	YES
Child's Age	YES	YES	YES
Child's Age Square	YES	YES	YES
Mother's year of birth	YES	YES	YES
Mother's month of birth	YES	YES	YES
Number of Observations	4,333	4,333	3,310

Notes: Robust standard errors are shown in parentheses. In all regressions, error terms are clustered by mother's birth year and sample weights are applied. *** indicates 1% level of significance. ** indicates 5% level of significance, * indicates 10% level of significance. The results are obtained using a 10-year birth-cohort window.

Table 7 presents the second-stage estimates of the effect of maternal education on children's health-related behaviors. The results indicate that maternal education has no statistically significant effect on any of the three outcomes examined: consumption of foods and drinks high in sugar or fat, physical inactivity, and time spent using electronic devices. Taken together, these

findings provide no evidence that the additional maternal schooling induced by the compulsory schooling reform significantly alters the health-related behaviors considered in this study. In fact, the findings support the results presented in Table 6. In particular, the absence of a significant effect on these more proximal health behaviors suggests that the null effect of maternal education on childhood overweight/obesity is not simply masking substantial changes in the behavioral pathways examined here. Rather, we find limited evidence that additional maternal education induced by the compulsory schooling reform translates into systematic changes in children's dietary behavior, physical activity, or time spent with electronic devices. Taken together, the results suggest that the reform-induced increase in maternal education alone may not be sufficient to generate detectable improvements in the child health behaviors considered in this study.

4.3. Robustness checks

4.3.1. Excluding mothers with university or higher degree

To obtain a more homogeneous sample of mothers who were more likely to have changed their schooling behavior in response to the compulsory schooling reform, we exclude mothers with education beyond secondary school. The results of equations (1) and (2), where we exclude children whose mothers have above secondary school education are given in Table 8. The first-stage regression results suggest that the policy increased the probability that mothers completed at least lower secondary education. The estimates indicate that exposure to the reform increased the probability of completing at least lower secondary education by 13-15 percentage points relative to mothers who were not exposed. In fact, for this sample, the estimated effect of the policy on secondary school completion is larger than the effect reported in Table 5.

Despite the stronger first-stage results, the second-stage results do not considerably change: Having at least a lower secondary school degree does not significantly affect the child's overweight/obesity status. We also re-estimate the regressions where the dependent variable is child's health behaviors. The findings do not change either. (Results are available upon request.)

Table 8. IV estimation results on child overweight/obesity (mothers with university or higher degree are excluded)

VARIABLES	(1) IV-2SLS (10-year obs. window around the reform cutoff)	(2) IV-2SLS (9-year obs. window around the reform cutoff)	(3) IV-2SLS (8-year obs. window around the reform cutoff)
First Stage Regression Results			
Policy	0.148***	0.135***	0.125***
First Stage F-Statistic	18.93	14.74	11.65
Second Stage Regression Results on Overweight/obesity			
Mother has at least 8 years of education	-0.09 (0.24)	-0.035 (0.27)	-0.08 (0.30)
Child's Gender (1: Female)	YES	YES	YES
Child's Age	YES	YES	YES
Child's Age Square	YES	YES	YES
Mother's year of birth	YES	YES	YES
Mother's month of birth	YES	YES	YES
Number of Observations	3,382	3,177	2,920

*Notes: Robust standard errors are shown in parenthesis. In all regressions, error terms are clustered by mother's birth year and sample weights are applied. *** indicates 1% level of significance, ** indicates 5% level of significance, * indicates 10% level of significance.*

4.3.2. Maternal employment status and household income

1997 compulsory schooling reform was a broad intervention that could possibly affect child health through channels other than maternal schooling. For instance, the reform likely also changed maternal labor supply, age at first birth or their marriage outcomes such that treated mothers may have partnered with more educated higher-earning men. As a robustness check, we re-estimate equations (1) and (2) using three additional second-stage outcomes: maternal employment status (equal to 1 if the mother is employed and 0 otherwise), age at first birth⁴, and the logarithm of household income. The IV estimates indicate that completing at least lower secondary education does not increase the probability of maternal employment. Higher maternal education is associated with a higher age at first birth and lower household income, although neither effect is statistically significant. Additional IV estimation results are available upon request.

5. Conclusion

This study provides causal evidence on the relationship between maternal education and the likelihood of childhood overweight and obesity in Türkiye using a nationally representative dataset. Although higher levels of maternal education are associated with a lower probability of a child being overweight or obese in the IV estimations, the estimated effects are not statistically significant. Additional analyses indicate that maternal education does not significantly affect children's dietary habits, physical activity, or time spent using electronic devices. These findings suggest that, in the Turkish context, the additional maternal schooling induced by the compulsory

⁴ Age at first birth is approximated by subtracting the age of the oldest child in the household from the mother's age.

schooling reform does not translate into detectable improvements in children's daily health behaviors or weight status.

Our additional analyses provide further support for the empirical findings. In particular, although the unadjusted prevalence of overweight/obesity differs between children of reform-exposed and unexposed mothers, this difference becomes negligible after accounting for differences in the age composition of the two groups. We also find no evidence that exposure to the reform predicts maternal employment, household income or age at first birth. These findings provide some reassurance that the main results are not driven by the alternative channels considered, although they do not rule out other potential pathways through which the reform may operate.

The findings should nevertheless be interpreted with some caution. The IV estimates identify a local average treatment effect (LATE) and therefore capture the effect of additional schooling among mothers whose educational attainment was affected by the 1997 compulsory schooling reform. Accordingly, the results should not necessarily be generalized to the effects of higher levels of maternal education, such as university education. Moreover, although the reform is a relevant predictor of maternal education across the alternative time windows considered, instrument strength declines as the estimation window narrows, resulting in less precise second-stage estimates. The statistically insignificant estimates should therefore not be interpreted as evidence of a precisely estimated zero effect.

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