RESEARCH ARTICLE

THE EFFECTS OF CHILDHOOD OBESITY ON HEALTH SPENDING: EVIDENCE FROM TURKEY

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ABSTRACT

Obesity has become one of the most critical problems faced by health systems worldwide, particularly the increased rate of childhood obesity. The present study investigates the short-run and long-run effects of childhood obesity on total health spending in Turkey. Since obesity may have different effects in the short and long run as a health problem, Autoregressive Distributed Lag (ARDL) method has been adopted to obtain both short and long-run effects in a single model. Separate models have developed for the obesity measures of children from age groups of 5-9 years, 10-19 years and 5-19 years to encompass the different effects based on gender and age groups in the short or long run. Since the increase of income in the short run enables families and the state to make more health expenditures, a positive relationship between income and health spending is found. On the other hand, the rise in long term income provides health infrastructure and preventive and treatment opportunities confirming a negative relationship. The results have revealed the presence of a positive and statistically significant long-run relationship between obesity and health expenditures for all age groups and all gender groups. The findings have confirmed that the increase in the prevalence of obesity in children in the long term would increase health expenditures. Income and obesity have different effects on health expenditures in the long and short run. Therefore, policymakers in the health sector must be aware of these effects. Health status is a long-run phenomenon that changes over a long period. Obesity has a negative relationship with health spending in the short run. In contrast, health spending is expected to increase in the long run due to its adverse effects on adults health in future. The results reveal the positive impact of per capita income on health expenditures in the short run and the reverse impact in the long run. The policymakers at the macroeconomic level should be aware that health infrastructures will decrease society's economic burden in the long run.

Keywords: *Obesity, public health, child health, health spending*

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ARAŞTIRMA MAKALESİ

ÇOCUKLUK ÇAĞI OBEZİTESİNİN SAĞLIK HARCAMALARINA ETKİLERİ: TÜRKİYE'DEN KANITLAR

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ÖZ

Obezite, özellikle çocukluk çağı obezitesinin artan oranı, dünya çapında sağlık sistemlerinin karşılaştığı en kritik sorunlardan biri haline gelmiştir. Bu çalışma, Türkiye'de çocukluk çağı obezitesinin toplam sağlık harcamaları üzerindeki kısa ve uzun vadeli etkilerini araştırmaktadır. Obezite bir sağlık sorunu olarak kısa ve uzun vadede farklı etkilere sahip olabileceğinden, tek bir modelde hem kısa hem de uzun vadeli etkileri elde etmek için Autoregressive Distributed Lag (otoregresif dağıtılmış gecikme-ARDL) yöntemi benimsenmiştir. 5-9 yaş, 10-19 yaş ve 5-19 yaş gruplarındaki çocukların obezite ölçümleri için kısa veya uzun vadede cinsiyet ve yaş gruplarına göre farklı etkileri kapsayacak şekilde ayrı modeller geliştirilmiştir. Kısa dönemde gelirin artması, ailelerin ve devletin daha fazla sağlık harcaması yapmasını sağladığından, gelir ile sağlık harcamaları arasında pozitif bir ilişki bulunmuştur. Öte yandan, uzun vadeli gelirdeki artış, olumsuz bir ilişkiyi teyit eden sağlık altyapısı ve önleyici ve tedavi olanakları sunmaktadır. Sonuçlar, tüm yaş grupları ve tüm cinsiyet grupları için obezite ve sağlık harcamaları arasında pozitif ve istatistiksel olarak anlamlı uzun vadeli bir ilişkinin varlığını ortaya koymuştur. Bulgular, uzun vadede çocuklarda obezite prevalansındaki artışın sağlık harcamalarını artıracağını doğrulamıştır. Gelir ve obezitenin sağlık harcamaları üzerinde uzun ve kısa vadede farklı etkileri vardır. Bu nedenle sağlık sektöründeki politika yapıcıların bu etkilerin farkında olması gerekmektedir. Sağlık durumu, uzun bir süre boyunca değişen uzun vadeli bir olgudur. Obezitenin sağlık harcamaları ile kısa vadede negatif bir ilişkisi vardır. Buna karşılık, gelecekte yetişkin sağlığı üzerindeki olumsuz etkilerinden dolayı sağlık harcamalarının uzun vadede artması beklenmektedir. Sonuçlar, kısa vadede kişi başına düşen gelirin sağlık harcamaları üzerindeki olumlu etkisini, uzun vadede ise tersini ortaya koymaktadır. Makroekonomik düzeydeki politika yapıcılar, sağlık altyapılarının uzun vadede toplumun ekonomik yükünü azaltacağının farkında olmalıdır.

Anahtar Kelimeler: *Obezite, halk sağlığı, çocuk sağlığı, sağlık harcamaları*

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I. INTRODUCTION

Obesity is a social dilemma that costs a great deal to many countries in the world every year. Obesity is a multifactorial chronic disease caused by a chronic positive energy imbalance in which energy intake exceeds consumption (Chooi et al., 2019). According to the World Health Organization (WHO), overweight and obesity are defined as abnormal or excessive fat accumulation that poses a health risk. Obesity is defined as being overweight rather than excess body fat because it is not easy to determine body fat percentage (Türkiye Endokrinoloji ve Metabolizma Derneği, 2014). Body mass index (BMI) is commonly used to classify adults' weight status (underweight, overweight, obese). BMI is defined by dividing a person's weight in kilograms by the square of his/her height in meters (kg / m2). A person with a BMI of 30 or greater is considered obese, and a person with a BMI of 25 is deemed to be overweight (WHO, 2020). In addition, it is also challenging to develop a simple index for the measurement of overweight and obesity, as a number of physiological changes occur as the body develops in childhood and adolescence, so BMI should be considered a rough guide (WHO, 2016). BMI for children and adolescents is calculated differently than adults. Estimates of BMI in children and adolescents are explained by differences in adiposity, growth, and other factors specific to developing youth. WHO defined development reference values for children and adolescents aged 5-19 years in 2007. According to this scale, we use today, children and adolescents are classified as underweight, normal weight, overweight and obese by looking at the distribution of BMI Z-scores by age and gender (Lee et al., 2011).

The rapid increase in the rate of childhood obesity poses serious health risks for children. It hinders opportunities to participate in educational and recreational activities, along with the increased economic burden at family and societal levels (WHO, 2016). For this reason, states should take the necessary measures to control this disease and reduce its harmful effects. The increasing prevalence of obesity in children and adolescents leads to various comorbidities and complications stemming from overweight and obesity. These complications can occur in the short and long run. Previously thought to only find in adulthood, some complications have now been diagnosed in children and adolescents (Daniels, 2009).

There are numerous causes of childhood obesity with various pathological features. It is generally believed that increasing childhood obesity results from long-term positive energy imbalance due to the Western lifestyle (polygenic obesity); some cases may be of genetic origin and are caused by disorders related to the endocrine system. Although the number of these cases is more limited, physicians should not ignore these other causes (Martos-Moreno et al., 2014).

II. THE PREVALENCE OF OBESITY IN THE WORLD AND TURKEY

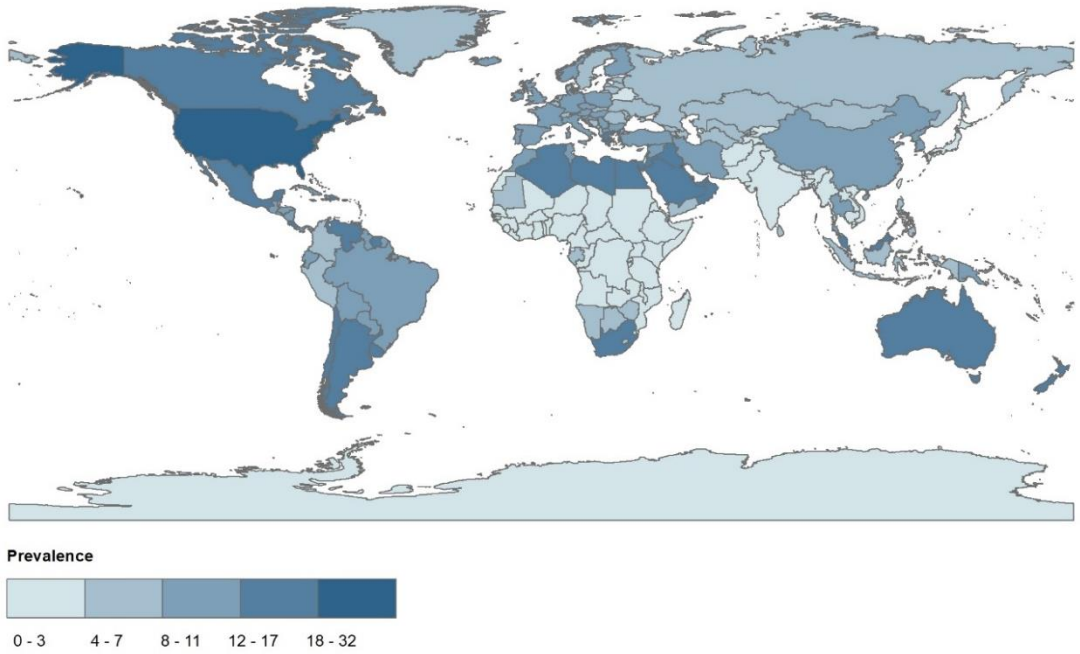
At the global level, 8% of total deaths in 2017 were due to obesity. There is an increase of more than 4.5% in the number of deaths associated with obesity from 1990 to 2017. This rate varies significantly according to different regions around the world. In many middle-income countries, especially in Eastern Europe, Central Asia, North Africa and Latin America, more than 15% of deaths in 2017 were associated with obesity. In most high-income countries, this rate ranges from 8% to 10% (Ritchie and Roser, 2020).

The prevalence of obesity worldwide nearly tripled between 1975 and 2016. In 2016, 39% of adults aged 18 and over were found to be overweight. An estimated 38.2 million children under the age of 5 were affected by obesity in 2019. Although it was once seen as a high-income country problem, overweight and obesity rates increase in low- and middle-income countries, especially in urban settings in present days (Ritchie and Roser, 2020). In Africa, the number of children with obesity has nearly doubled from 5.4 million in 1990 to 10.3 million in 2014. Besides, the number of overweight children (under the age of 5) in the same category has increased by about 24% since 2000 (WHO, 2016; WHO, 2020).

In the WHO report, more than 340 million children and adolescents between the ages of 5-19 were reported to be affected by obesity in 2016. According to this report, the prevalence of overweight and

obesity among children and adolescents between the ages of 05-19 increased from 4% in 1975 to over 18% in 2016 (Ritchie and Roser, 2020).

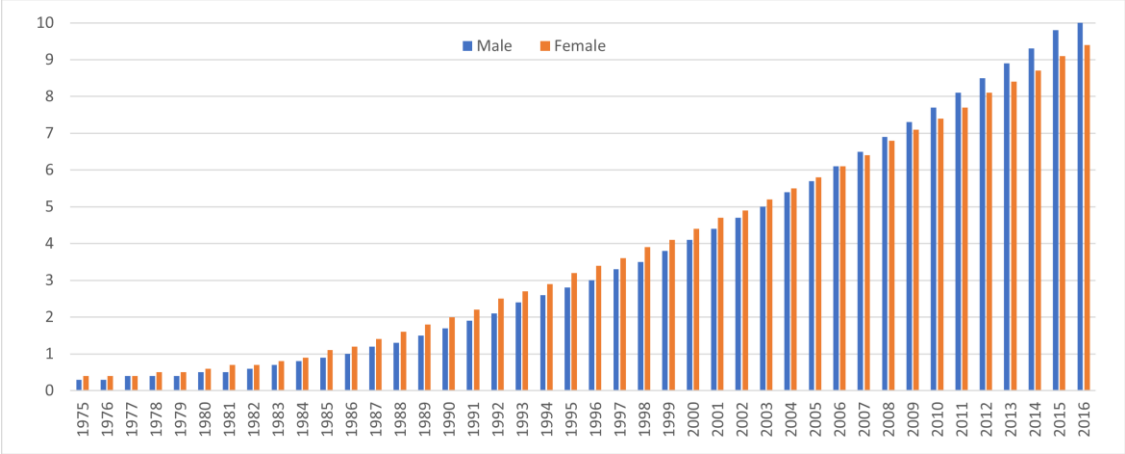
Figure 1. Prevalence of Children Aged 10-19 Affected by Obesity in 2016



Source: WHO (2016)

This figure shows the obesity prevalence among children worldwide. In this way, the highest rate belongs to the United States of America. A high prevalence of obesity is observed in the Middle East, South America, and Australia, while low prevalence is observed in Central Africa and the Indian subcontinent. The situation in Turkey is similar to Europe and its other neighbours. The prevalence of obesity in Turkey's adult population is high above the critical value of 30% (Türkiye Endokrinoloji ve Metabolizma Derneği, 2018). Figure 2 depicts the prevalence of obesity in children aged 10-19 years in Turkey in 2016. It is found that obesity in both genders between the ages of 10 and 19 is constantly increasing over the years. The rate of obesity was higher in females than males until 2005, while afterwards, it was higher in males than in females.

Figure 2. Prevalence of Children Aged 10-19 with Obesity in Turkey in 2016



Source: WHO (2016)

It is argued that obesity overburdens health expenditures and reduces economic efficiency (Cawley, 2010; Hammond and Levine, 2010). Rosin (2008) reviewed the economic causes of obesity and found strong relationships between those variables. Similarly, Anderson and others (2007), with the help of regression analysis, found that obesity increases health expenditures. Thorpe and others (2004) determined causal links of obesity on health expenditures using data from 1987 to 2001 in the United States. Finkelstein and others (2009) analyzed the data for the period between 1998-2006 using a time series approach and found that obesity significantly contributed to private and public expenditures.

According to John and others (2012) findings regarding the economic burden of childhood obesity are inconclusive. Comparing different cost components and age groups has shown that children with obesity pay more healthcare costs than typical weight peers. The studies of Kinge and Morris (2018) have shown that obesity has a significant contribution to health expenditures, which is also valid for childhood obesity. According to Lehnert and others (2013), while overweight children cause decreased economic efficiency of the parents or related diseases in the short run, the cost of these children's obesity-related diseases in adulthood may increase the health expenses in the long run. Sonntag and others (2016) showed that most of the individuals who were affected by obesity in childhood remained in the same BMI category during adulthood, thus incurring indirect costs over their lifetime. The literature review has revealed that various methods are used to explain the determinants of health expenditures in which the Autoregressive Distributed Lag (ARDL) method has also been used in some studies (Khan et al., 2016; Murthy and Okunade, 2016; Yap and Selvaratnam, 2018).

The present study has employed time-series data to demonstrate the short and long-run effects of childhood obesity on Turkey's total health spending. Since obesity may have different effects in the short term and long term as a health problem, the ARDL method has been adopted to obtain long-term and short-term effects in a single model.

III. MATERIALS AND METHODS

The ARDL model is widely used for cointegration analysis among different variables of interest in the long run. The bound test developed by Pesaran and others (2001) has some advantages over other approaches. For this analysis, all variables need not have the same stationarity level, and series that are the first-order stationery can be used together with stationery series. Besides, the results of short and long-run relationships can be obtained with a single estimate.

The model in equation (1) was used to show whether health expenditures are affected by obesity in the long term. Per capita income is included in the model as a control variable.

$$\mathrm{HS}_t = \alpha_0 + \alpha_1 \mathrm{OBEZ}_t + \alpha_2 \mathrm{GDP}_t + \epsilon_t \qquad (1)$$

In this equation, HS (health spending) refers to the prevalence of children with obesity according to different age and gender groups and GDP (Gross domestic product) per capita national income. Equation (2) was developed by using equation (1) in the framework of ECM (Error Correction Model). The ARDL model is shown in equation (2), and short-term and long-term variables are available in the model.

$$\Delta \mathrm{HS}_t = \psi + \eta_0 \mathrm{HS}_{t-1} + \eta_1 \mathrm{OBEZ}_{t-1} + \eta_2 \mathrm{GDP}_{t-1} + \sum_{j=1}^{p} \beta_{1j} \Delta \mathrm{HS}_{t-j} + \sum_{j=0}^{q} \beta_{2j} \Delta \mathrm{GDP}_{t-j} + \sum_{j=0}^{m} \beta_{3j} \Delta \mathrm{OBEZ}_{t-j} + \varphi t + e_t \qquad (2)$$

Here, Δ represents the difference of variables, and t denotes the trend. The coefficient of variables represented by β represents short term estimates, while long term estimation results can be found by using $\alpha_1 = -\frac{\eta_1}{\theta}$ ve $\alpha_2 = -\frac{\eta_2}{\theta}$ relationships in the same model to obtain long term coefficients.

3.1. Data

We have used time-series data of health expenditures and obesity, which are available on the WHO and Organization for Economic Co-operation and Development (OECD) websites. The data about childhood obesity from 1975 to 2016 available in the WHO database were used in the present analysis. Considering that gender and age groups may have different effects in the short or long term, the obesity measures of children between 5-9 years, 10-19 years and 5-19 years were used in separate models. Total health expenditures per capita in dollars were obtained from OECD database, while National income per capita was obtained from the World Bank (WB) database. Table 1 shows the descriptive statistics of the data used in the model.

Table 1. The Descriptive Statistics of Selected Variables

			Mean	Min.	Max.	Std.Dev	Skewness	Stickiness	Jarque-Bera
Obesity	5-9	Girls	6.03	0.7	13.8	4.19	0.33	1.78	3.36 *
		Boys	6.40	0.7	16.0	4.87	0.47	1.91	3.66 *
		Both Genders	6.22	0.7	14.9	4.53	0.40	1.84	3.49
	10-19	Girls	3.79	0.4	9.4	2.87	0.45	1.90	3.52 *
		Boys	3.73	0.3	10.2	3.10	0.62	2.09	4.12 *
		Both Genders	3.76	0.3	9.8	2.97	0.54	2.00	3.77 *
	5-19	Girls	4.55	0.5	10.9	3.29	0.40	1.85	3.43 *
		Boys	4.64	0.5	12.1	3.66	0.55	2.00	3.88 *
		Both Genders	4.59	0.5	11.5	3.48	0.48	1.93	3.61 *
Per Capita Income			4822	1136	12614	3878	0.86	2.14	6.47 **
Health Spending			388	38	1129	342	0.72	2.07	5.14 ***

*, ** and *** show the normal distribution at 10%, 5% and 1% significance levels, respectively.

IV. RESULTS

Unit root test of the selected variables is necessary to avoid any spurious regression calculations. For the analysis based on the ARDL method used in this study, the variables in the model must be zero or first-order stationery. Therefore, variables that are second- or higher-degree stationery cannot be included in the analysis. Table 2 shows the results of the unit root tests.

Table 2. The Unit Root Test Results

			Augmented Dickey-Fuller			Phillips-Perron		
			Level	First Difference	Second Difference	Level	First Difference	Second Difference
Obesity	5-9	Girls	-5.69*	-1.54	-7.88*	-6.96*	-4.38*	-38.23*
		Boys	-5.45*	-1.04	-9.77*	-5.08*	-5.82*	-13.59*
		Both Genders	-5.87*	-3.99**	-9.02*	-6.39*	-4.2*	-35.48*
	10-19	Girls	-4.38*	-4.33*	-6.98*	-5.25*	-6.82*	-11.92*
		Boys	-1.49	-8.89*	-7.12*	-1.31	-8.69*	-19.66*
		Both Genders	-3.46***	-9.85*	-6.56*	-2.85	-9.31*	-33.07*
	5-19	Girls	-4.67*	-6.75*	-3.12	-5.73*	-6.8*	-21.62*
		Boys	-3.82**	-7.39*	-7.03*	-3.87**	-7.31*	-16.93*
		Both Genders	-4.7*	-7.22*	-8.99*	-5.12*	-7.27*	-21.99*
Per Capita Income			-1.77	-6.15*	-7.99*	-1.79	-6.15*	-13.49*
Health Spending			-0.57	-5.77*	-11.08*	-0.57	-5.77*	-13.09*

* and ** show that it is stable at 1% and 5% significance levels, respectively.

Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are widely used for unit root testing. According to the results of Table 2, all variables are stationary at advanced or first difference. Therefore, no problem has been detected in using the ARDL method.

The model's estimated results in equation (2) are given in Table 3 the obesity prevalence values of three different age groups of girls, boys, and both genders.

Table 3. The Estimation Results

	Obesity								
	5-9			**10-19**			**5-19**		
	Girls	**Boys**	**Both Genders**	**Girls**	**Boys**	**Both Genders**	**Girls**	**Boys**	**Both Genders**
Panel A: Results for Long run									
GDP	0.010	0.004	0.006	0.02	-0.09**	-0.06*	0.005	0.006	0.005
OBEZ	126***	115.42**	149.23**	149.58**	244.79	325.69*	185.22**	134.96*	153.42**
Panel B: Results for Short run									
TREND	-2.43	-4.80	-6.93	-2.69	10.14	-13.08*	-4.30	-7.57**	-3.36
Sabit	11.10	13.85	11.18	13.74	-3.53	84.62*	13.86	17.34	10.71
ΔHE_{t-1}	0.15	0.17	0.13	0.21	-0.38***	-0.02	0.12	0.24	0.19
ΔHE_{t-2}				0.36**				0.37**	
ΔGDP_{t}	0.005	0.005	0.004	0.007	0.0005	0.001	0.005	0.006	0.005
ΔGDP_{t-1}					0.02*	0.02*			
ΔGDP_{t-2}					0.02*	0.02**			
ΔGDP_{t-3}					0.03*	0.02*			
ΔGDP_{t-4}					0.02*	0.02*			
$\Delta OBEZ_{t}$	18.98	7.80	50.38	-135.8***	-56.30	-16.70	-64.33	146.68***	-24.21
$\Delta OBEZ_{t-1}$	-150**				-245***				
$\Delta OBEZ_{t-2}$					-423.62*				
$\Delta OBEZ_{t-3}$					-261.2**				
Panel C: Diagnostic test results									
Bound F	2.67	2.48	2.22	3.34	7.37 **	7.33 **	2.28	3.62	1.84
Pesaran t	-0.19	-0.17	-0.15	-0.26	-0.24	-0.20	-0.15	-0.22	-0.16
Adjusted R^2	0.42	0.38	0.37	0.47	0.64	0.57	0.39	0.46	0.36
Jarque-Bera	0.08	0.11	0.15	0.6	2.46	0.33	0.29	0.71	0.19
Cusum	S	S	S	S	S	S	S	S	S
CusumQ	S	S	S	S	S	S	S	S	S
BG LM test	0.09	3.14 ***	1.45	0.22	0.21	0.11	0.52	0.63	5.08 **
RESET test	0.68	1.03	2.45	2.57	0.36	1.49	2.24	1.79	1.08
Harvey test	0.56	1.07	1.29	1.14	1.34	0.91	1.13	1.55	1.21
BPG test	0.65	0.86	1.42	0.52	2.03 ***	0.47	0.91	1.23	0.78
ARCH test	0.94	0.08	0.02	0.65	0.79	0.49	0.16	0.4	0.05

Note: *, **, (***) indicate null hypothesis rejection with 1%, 5% and 10% margin of error, respectively. The critical values of t distribution used in short and long term panels are 2.71, 2.02 and 1.69.

Table 3 shows the long-term, short-term and diagnosis statistics in separate panels. Standardized long-term estimation results are given in Panel A, while Panel B shows the short-term forecast results. The results show that the national income per capita is statistically significant in the short term only for the age group between 10-19 years in the variables including males and both sexes. However, when looked carefully, it seems that the existence of a positive relationship also emerges.

Panel C presents diagnostic statistics of the analysis. The LM (Lagrange Multiplier) test was applied for the measure of serial correlation. This test has $\chi 2$ distribution with one degree of freedom, and the critical values at 1%, 5% and 10% were determined as 6.63, 3.84 and 2.71, respectively. RESET Ramsey test was used to assess modelling error. This test also has a distribution of $\chi 2$ with one degree of freedom. The F test is a cointegration detection tool developed by Pesaran and others (2001) through which critical values at 1%, 5% and 10% significance levels were obtained as 7.52, 5.85 and 5.06, respectively,

with two independent variables (k = 2) using the table (Table CI-Case V, page 301). Cusum and CusumQ show the stability of the model. There is no statistical problem in any of the diagnostic tests applied for estimations. Looking at the Pesaran F test, cointegration was found only in the group of males and both genders aged between the ages of 10-19.

V. DISCUSSION

Studies investigating the effect of national income on health expenditures found a strong relationship between national income and health expenditures (Atilgan et al., 2017; Blazquez-Fernandez et al., 2014; Bukhari and Butt, 2007; Kumar, 2013). Analysis of per capita income in the present investigation has shown that a statistically significant association has been found only in males and genders in the age group of 10-19. The presence of an adverse effect draws attention while analyzing the direction of the relationship. This means that as the country's national income increases in the long term, health expenditures decrease. Thus, a contradiction between long term and short term estimation results has been detected. Since the rise in income in the short term enables families and the state to make more health spending, a negative relationship should be expected in the long run because the increase in long-term income provides health infrastructure and the development of preventive and treatment opportunities. With the rise in national income, the development of health infrastructure, and the increase in preventive and treatment possibilities, health expenditures decrease. Considering the short term estimation results, the rise in income increases the health expenditures. This situation can be explained by employing expanding the state and the family's income to increase the health sector's share.

Several studies have found that obesity causes an increase in health expenditures. By reviewing studies conducted in the European region, Müller-Riemenschneider and others (2008) showed that obesity strongly affected health expenditures. Similarly, Withrow and Alter (2011) reviewed studies showing the impact of obesity on immediate costs. Rtveladze and others (2014) also reached the same conclusion in their studies in Mexico. Andreyeva and others (2004) found that the economic burden of excessive obesity is higher for overweight individuals. In another study, Sandalci and Tuncer (2020) examined the direct and indirect costs of obesity in Turkey, advocating the need to tackle this issue.

The liability of childhood obesity on health care payments has also been the subject of many empirical studies (Wang and Dietz, 2002). The present analysis results have found a positive and statistically significant long-term relationship between obesity and health expenditures in all age groups and all gender groups. These findings confirm that the increase in the prevalence of obesity in children in the long term will increase future health expenditures significantly. It appears that there is an inverse relationship between obesity and health expenditures in the short run. According to Thorpe and others (2015) chronic diseases related to obesity have enormously increased health expenditures. Since the negative effect of obesity on health is linked to chronic diseases, and this may explain its significant long-term impact.

The present study results are not statistically significant in all age and gender groups considering the short-term effects of obesity on health care spending and show a negative relationship except males in the 5-19 age group. According to the study of Doherty and others (2017), although obesity and being overweight did not make a difference in healthcare use for 9-year-olds, there was a significant association to 13-year-old children.

VI. CONCLUSION

While there is a positive relationship between the obesity prevalence in children and health expenditures, there is a reverse relationship between national income increase and health spending in the long term. According to the short-term estimation results, a positive association was observed between income and health expenditures. This situation can be explained by the fact that the rise in income increases the family's share and the state of the health sector. There is an inverse relationship between obesity and short term health expenditures. This situation suggests that the negative impact of

obesity on health will be significant only in the long term. A continuous struggle against obesity will provide long-term social and economic well-being in the future. Besides, it is expected that this struggle will help to solve some financial crises too.

Income and obesity have different effects in the long-run and short-run on health spending. Therefore, policymakers should be aware of these effects to make more robust future health strategies. Health status is a long-run phenomenon that changes over a long period. Obesity has a positive relationship with health spending in the short run. In contrast, health spending is expected to increase in the long run due to its adverse effects on adults health in future. The results reveal the positive impact of per capita income on health expenditures in the short run and the reverse impact in the long run. The policymakers at the macroeconomic level should be aware that health infrastructures will decrease the population's economic burden in the long run.

Ethical Approval: The data used in the study were obtained from open sources, therefore, ethics committee approval is not required.

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