

RESEARCH ARTICLE

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Changes in Early Childhood Obesity from 2016 to 2019 and Effective Factors

ABSTRACT

Objective: Aim of our study is showing the changes of factors that affecting early childhood obesity from 2016 to 2019 and to ensure that necessary measures are taken about this regard.

Methods: 3 years follow-up information of 388 babies whom born in 2013 and 2016 and registered at the Family Health Centers of Rize (Turkey) included to our study. The family doctors participating in this study examined these babies who were registered to them during their 1st, 3rd, 7th, 9th, 12th, 18th, 24th, 30th, 36th months at the family health centers in accordance with Turkish Health Ministry protocols and recorded their height, weight, head circumference and Body Mass Index (BMI). Descriptive statistical methods were used to evaluate the obtained data.

Results: 388 babies included in study, 177 of them were born in 2013 and 211 of them were born in 2016. Percentage of being overweight or obese was 19.2% in babies born in 2013 and this rate decreased to 18.2% in babies born in 2016. Percentage of being overweight or obese was 16% in girls and 21.2% in boys. We observed that high birth weight (>4000 gr) and excess gestational weight gain (GWG) are risk factors for being overweight or obese at the age of three (p=0.048).

Conclusions: Result of our study showed us that although prevalence of early childhood obesity decreased, but prevalence is still at critical level. We found that GWG and high birth weight are risk factors for early childhood obesity. In future obesity prevention studies, taking these risk factors into account will be beneficial.

Keywords: Obesity, Overweight, Body Mass Index, Child

Erken Çocukluk Çağı Obezitesinde 2016'dan 2019'a Değişiklikler ve Etkili Faktörler

ÖZET

Amaç: Çalışmamızın amacı 2016 yılından 2019 yılına erken çocukluk çağı obezitesine etkili faktörlerin değişimini göstererek bu konuda gerekli önlemlerin alınmasını sağlamaktır.

Gereç ve Yöntem: Retrospektif kohort tipindeki çalışmamıza 2013 ve 2016 yılı doğumlu olan ve Rize ili Aile sağlığı merkezlerine kayıtlı 388 çocuğun 3 yaş izlem bilgileri dahil edilmiştir. Çalışmaya katılan Aile Hekimleri kendilerine kayıtlı olan çocukları Türkiye Cumhuriyeti Sağlık Bakanlığı'nın bebek ve çocuk izlem protokolüne uygun olarak 1, 3, 7, 9, 12, 18, 24, 30 ve 36. aylarında aile sağlığı merkezlerinde izleyerek boy-kilo-baş çevresi ve vücut kitle indekslerini (VKİ) kaydetmişlerdir. Elde edilen verilerin değerlendirilmesinde tanımlayıcı istatistiksel yöntemler kullanıldı.

Bulgular: Çalışmaya 177'si 2013 doğumlu, 211'i 2016 doğumlu toplam 388 çocuk dahil edilmiştir. Fazla kilolu ya da obez olma durumu 2013 yılı doğumlularda %19,2 iken bu oran 2016 doğumlularda %18,2'ye gerilemiştir. Çalışmaya alınan çocuklarda obezite ya da fazla kilolu olma durumu kızlarda %16 iken erkeklerde %21,2 idi. Yüksek doğum ağırlığının (>4000 gr) ve fazla gestasyonel kilo alımının 3 yaş fazla kilolu ya da obez olma durumu için bir risk olduğunu gözlemledik (p=0,048).

Sonuç: Çalışmamızın sonucu bize erken çocukluk çağı obezitesi prevalansının alınan önlemlerle bir miktar gerilese de hala ciddi seviyede olduğunu gösterdi. Gestasyonel kilo alımı ve yüksek doğum ağırlığının erken çocukluk çağı obezitesi için bir risk olduğunu bulduğumuz çalışmamızdan yola çıkarak ileriye yönelik obezite önleme çalışmalarında bu risklerin göz önüne alınması konusunda faydalı olacaktır.

Anahtar Kelimeler: Obezite, Fazla Kiloluluk, Vücut Kitle İndeksi, Çocuk

INTRODUCTION

Obesity is an important public health problem due to its high prevalence and concomitant morbidity and mortality (1,2). BMI, which is the most commonly used measure to diagnose obesity in childhood is highly correlated with BMI measured in later life and there are correlations changing between 0.3 and 0.9 depending on time interval and age (3,4). The World Health Organization (WHO) currently estimates that 42 million children under the age of 5 are obese. The prevalence of obesity in the WHO European Region, including Turkey has increased 3 times in the last 20 years (5). Among the low and middle income countries, the highest prevalence of overweight in children and associated metabolic disorders was found in the Middle East and Eastern Europe countries (6). In a cross-sectional study conducted by Olaya et al. among seven European countries including Turkey, prevalence of obesity in elementary school children has been shown that Turkey ranked second after Romania (7).

Many factors, including behavioral, genetic and environmental factors, may be relative to childhood obesity. Previous studies have revealed that various prenatal and early life factors, including maternal BMI, maternal cigarette smoking, infant birth weight, GWG and gestational diabetes, are effective in early childhood obesity (8,9).

Current studies show that overweight up to 2 years of age in early childhood can predict overweight/obesity after 10 years (10). Despite all pharmacological and non-pharmacological efforts, treatment of obesity remains difficult and usually fails. Therefore, prevention of obesity is essential and patients can be informed by determining the risk factors of obesity in early life (11).

Although there are studies about early childhood obesity, there are very few studies in recent years showing the change in the prevalence of factors affecting obesity. Risk factors in obese or overweight children at 2016 and risk factors in obese or overweight children at 2019 were evaluated in our study which is the first study showing change of 3 years old childhood obesity from 2016 to 2019 in Turkey. Aim of our study is showing the changes of factors that affecting early childhood obesity from 2016 to 2019 and to ensure that necessary measures are taken about this regard.

MATERIAL AND METHODS

Three years follow-up information of 388 babies whom born in 2013 and 2016 and registered at the Family Health Centers of Rize (Turkey) included to our retrospective cohort study.

The family doctors participating in this study examined these babies who were registered to them during their 1st, 3rd, 7th, 9th, 12th, 18th, 24th, 30th, 36th months at the family health centers in accordance with Turkish Health Ministry protocols

and recorded their height, weight, head circumference and BMI.

Baby weight measurements were made with scales sensitive to 0.01 kg. Before taking the measurement, the baby's clothing and diaper, if any, were removed and baby's weight recorded when they were not moving. In children over 2 years of age, height measurement was done by removing shoes while standing. Height measurements were made with a sensitivity of 0.1 cm.

BMI Classification: Body mass index (BMI) was calculated by dividing the child's weight in kilograms by the square of their height (kg/ m²). Reference growth chart of the Centers for Disease Control and Prevention (CDC) 2000 was used to classify the children into one of three categories using their weight status. Children under 85 percentile are classified as having a healthy weight status. Children with a BMI percentile between 85 and 94 were considered overweight and children 95 and above 95 percentile were categorized as obese. The BMI percentile of all 3 years old children were calculated and categorized according to the reference values suggested by the CDC.

Gestational Weight Gain (GWG): All of mothers participating in the study had attended at least three pregnancy follow-up visits with their family physician (at least one visit in each trimester). Weight of the mothers before pregnancy recorded and weight and height measurements of the last trimester (between 36th and 40th weeks) were made. The weight gain of mothers during pregnancy was calculated. Besides that weight, height and BMI measurements of the mothers made when children were 3 years old. GWG described as the difference between mother's weight a week before birth and mother's weight before pregnancy. Suggested GWG is 12.5-18 kg for underweight women, 11.5-16 kg for normal weight women, 7-11.5 kg for overweight women and 5-9 kg for obese women according to WHO. After that, GWG was divided into three categories. Weight gain is classified as low if it is below the recommendation, classified as enough if it is appropriate to recommendation and it is classified as high if it is above the recommendation.

Neonatal Characteristics: Babies were divided into 3 groups according to their birth weights. While birth weight between 2500-4000 g for a term baby is accepted as "normal", over 4000 g accepted as high and below 2500 g accepted as low birth weight (12).

Ethical Procedure: Ethics committee approval for this study was taken from the Ethics Committee of Recep Tayyip Erdoğan University Faculty of Medicine with protocol number 2020/01. In addition, informed consent forms were obtained from the mothers.

Statistical Analysis: SPSS 23.0 program was used for statistical analysis. Descriptive statistics of the evaluation results given as numbers and percentages for categorical variables, given as mean and standard deviation for numerical variables. Normal distribution of groups was determined by One Sample Kolmogorov Smirnov test. Student-t Test used for comparison of independent two groups when normal distribution condition is provided and Mann Whitney U used when normal distribution condition is not provided. We accepted $p < 0.05$ value as statistically significant.

Inclusion Criteria: Babies whom born in 2013 and 2016 and registered at the Family Health Centers of Rize

Exclusion Criteria: Children who didn't come to their regular control until 36 months of age excluded from the study.

Babies with congenital heart disease, congenital immune system deficiency, malabsorption syndrome and those diagnosed with phenylketonuria were also excluded because these conditions might have an effect on the weight and height percentiles of the babies.

RESULTS

388 babies included in study, 177 of them were born in 2013 and 211 of them were born in 2016. Percentage of being overweight or obese was 19.2% in babies born in 2013 and this rate decreased to 18.2% in babies born in 2016. Percentage of being overweight or obese was 16% in girls and 21.2% in boys. From 2016 to 2019 maternal cigarette smoking percentage was decreased to 6.2% from 13.6% ($p=0.022$). Mean pregnancy age was $29.3 (\pm 5.7)$ in 2013 and this rate was increased to $29.7 (\pm 6.2)$ in 2016 ($p=0.513$) (Table 1).

Table 1. Sociodemographic characteristics of 3 years old children born in 2013 and 2016

	Children born in 2013		Children born in 2016		p
	n	%	n	%	
Gender					
Female	86	48.6	102	48.3	0.961
Male	91	51.4	109	51.7	
Mother's educational status					
≤8 years	116	65.5	109	51.7	0.006
>8 years	61	34.5	102	48.3	
Socioeconomic situation					
Low	18	10.2	14	7.3	0.395
Middle	104	58.8	134	63.5	
High	55	31.1	63	29.9	
Mother smoking					
Yes	24	13.6	13	6.2	0.022
No	153	86.4	198	93.8	
Gestational age (mean)	29.3 ± 5.7		29.7 ± 6.2		0.513
Gestational weight gain	12.9 ± 5.1		13.0 ± 4.8		0.723
Mother's BMI	26.8 ± 5.1		26.3 ± 5.4		0.168
Neonatal birth weight	3340.6 ± 515.5		3304 ± 532.8		0.931
Total breast milk intake(month)	17.6 ± 7.6		17.5 ± 7.7		0.927
Childrens' BMI					
Weak - Normal	143	80.8	171	81.8	0.082
Overweight - Obese	34	19.2	38	18.2	

BMI: Body Mass Index

We showed comparison of the variables that have an impact on obesity of children born in 2013 and 2016 at Table 2. We evaluated the gender, neonatal birth weight, GWG, mother BMI, delivery type, total breastfeeding time, first 6 months exclusive breastfeeding, gestational age,

socioeconomic level like factors that can affect the obesity. We evaluated overweight and obese babies among themselves according to their birth years and also we evaluated normal and underweight babies among themselves according to their birth years.

Table 2. Evaluation of variables on obesity status of children born in 2013 and 2016

	2013		2016		p	2013		2016		p
	Weak - Normal		Weak – Normal			Overweight - Obese		Overweight – Obese		
	n	%	n	%		n	%	n	%	
Gender					0.992					1.000
Female	72	50.3	86	50.3		14	41.2	16	42.1	
Male	71	49.7	85	49.7		20	58.8	22	57.9	
Mother's educational status										
≤8 years	90	62.9	88	51.5		26	76.5	20	52.6	0.063
>8 years	53	37.1	83	48.5	0.041	8	23.5	18	47.4	
Socioeconomic situation										0.406
Low	15	10.5	12	7.0	0.550	3	8.8	2	5.3	
Middle	85	59.4	106	62.0		19	55.9	27	71.1	
High	43	30.1	53	31.0		12	35.3	9	23.7	
Mother smoking										
Yes	18	12.6	11	6.4	0.093	6	17.6	2	5.3	0.138
No	125	87.4	160	93.6		28	82.4	36	94.7	
Way of birth										
C/S	82	57.3	68	39.8	0.002	14	41.2	17	44.7	0.947
NSD	61	42.7	103	60.2		20	58.8	21	55.3	
6 months breastfeeding										
Yes	102	71.3	112	66.3	0.338	27	79.4	26	68.4	0.430
No	41	28.7	57	33.7		7	20.6	12	31.6	
Gestational age	29.2 ± 5.7		29.8 ± 5.9		0.339	30.0 ± 5.5		29.3 ± 7.4		0.459
Gestational weight gain	13.1 ± 5.3		13.0 ± 4.5		0.997	12.1 ± 4.2		13.2 ± 5.8		0.639
Inadequate	25	17.6	31	18.1		5	14.7	3	7.9	
Adequate	50	35.2	56	32.7	0.900	16	47.1	20	52.6	0.648
Excessive	67	47.2	84	49.1		13	38.2	15	39.5	
Mother's BMI	26.7 ± 5.1		26.2 ± 5.5		0.244	27.4 ± 4.8		26.5 ± 5.0		0.321
Neonatal birth weight	3321.7 ± 521.3		3253.7 ± 530.0		0.860	3419.9 ± 489.8		3529.1 ± 498.2		0.892
Total breast milk intake (month)	17.9 ± 7.5		17.5 ± 7.8		0.831	16.5 ± 7.9		17.2 ± 7.3		0.818

C/S: Cesarean, NSD: Normal spontaneous delivery, BMI: Body Mass Index

We showed effects of mother BMI, GWG and neonatal birth weight on three years old obesity of children born in 2013 and 2016. We couldn't find significant effect of mother BMI on three years old overweight or obesity of children born in 2013 and 2016 in Table 3 (p=0.990, p=0.753). When we evaluate GWG, obesity rate is higher in babies of mothers who gain enough weight during pregnancy compared to babies of mothers who gain insufficient weight in 2016 (p=0.05). We observed that high birth

weight (>4000 gr) is a risk factor for being overweight and obesity at the age of three (p=0.048). But neonatal birth weight was not statistically significant for three years old obesity at the babies born in 2013 (p=0.178). We searched the factors that effective for three years old BMI of all participant children at Table 4. We observed that insufficient GWG has a positive effect on overweight or obesity (p=0.033). Effect of other factors was not statistically significant.

Table 3. Children born in 2013 and 2016; effect of maternal BMI, GWG and neonatal birth weight on obesity at 3 years of age

Children born in 2013	All		Weak - Normal		Overweight - Obese		P
	n	%	n	%	n	%	
Mother's BMI (n=174)							
Normal or low <25	68	39.1	55	80.9	13	19.1	0.990
Overweight 25 – 29.9	65	37.4	53	81.5	12	18.5	
Obese ≥30	41	23.6	33	80.5	8	19.5	
Gestational weight gain (n=176)							
Inadequate	30	17.0	25	83.3	5	16.7	0.439
Adequate	66	37.5	50	75.8	16	24.2	
High	80	45.5	67	83.8	13	16.3	
Neonatal birth weight (n=177)							
Low < 2500	6	3.4	4	66.7	2	33.3	0.178
Normal 2500- 4000	160	90.4	128	80.0	32	20.0	
High > 4000	11	6.2	11	100.0	0	0.0	
Children born in 2016							
Mother's BMI (n=207)							
Normal or low <25	92	44.4	76	82.6	16	17.4	0.753
Overweight 25 – 29.9	75	36.2	62	82.7	13	17.3	
Obese ≥30	40	19.3	31	77.5	9	22.5	
Gestational weight gain (n=209)							
Inadequate	34	16.3	31	91.2	3	8.8	0.050
Adequate	76	36.4	56	73.7	20	26.3	
Excessive	99	47.4	84	84.8	15	15.2	
Neonatal birth weight (n=209)							
Low < 2500	13	6.2	13	100.0	0	0.0	0.048
Normal 2500- 4000	186	89.0	152	81.7	34	18.3	
High > 4000	10	4.8	6	60.0	4	40.0	

BMI: Body Mass Index

Table 4. Factors affecting the obesity status of all children included in the study

	All		Weak - Normal		Overweight - Obese		P
	n	%	n	%	n	%	
Gender							
Female	188	48.7	158	84.0	30	16.0	0.185
Male	198	51.3	156	78.8	42	21.2	
Mother's educational status							
≤8 years	224	58.0	178	79.5	46	20.5	0.264
>8 years	162	42.0	136	84.0	26	16.0	
Socioeconomic situation							
Low	32	8.3	27	84.4	5	15.6	0.852
Middle	237	61.4	191	80.6	46	11.9	
High	117	30.3	96	82.1	21	17.9	
Mother smoking							
Yes	37	9.6	29	78.4	8	21.6	0.626
No	349	90.4	285	81.7	64	18.3	
Gestational age							
	29.5 ± 5.9		29.5 ± 5.8		29.6 ± 6.5		0.878
Total breast milk intake (month)							
	17.5 ± 7.6		17.7 ± 7.6		16.9 ± 7.69		0.595
Mother's BMI							
Normal or low <25	160	42.0	131	81.9	29	18.1	0.827
Overweight 25 – 29.9	140	36.7	115	82.1	25	17.9	
Obese ≥30	81	21.3	64	79.0	17	21.0	
Gestational weight gain							
Inadequate	64	16.6	56	87.5	8	12.5	0.033
Adequate	142	36.9	106	74.6	36	25.4	
Excessive	179	46.5	151	84.4	28	15.6	
Neonatal birth weight							
Low < 2500	19	4.9	17	89.5	2	10.5	0.647
Normal 2500- 4000	346	89.6	280	80.9	66	19.1	
High > 4000	21	5.4	17	81.0	4	19.0	

DISCUSSION

We evaluated obesity which is a risk factor for diseases such as diabetes, hypertension and cancer in adulthood, risk factors and necessary measures about this regard by observing changes of three years old children from 2016 to 2019 with retrospective cohort method (3,13). In our study which is the first study showing three years change at this age group in Turkey, we evaluated criteria that can be a risk factor for childhood obesity.

The WHO announced that the prevalence of obesity, which was 31 million in 1990 for children aged 0-5, increased to 42 million in 2016 (14).

There is evidence about decrease in obesity increase rate in children at recent years: rate increased from 0.4 to 0.7 points between 1978 and 2004 years, after that rate of increase slowed to 0.1 points from 2004 to 2016 (15). Percentage of being overweight or obese was 19.2% in babies born in 2013 and this rate decreased to 18.2% in babies born in 2016. Although this decrease was not enough, most important cause of this can be 'Obesity Prevention and Control Program of Turkey' started by Ministry of Health (16).

There are many studies in the literature showing the relationship between maternal obesity and early childhood obesity (17-19). We didn't find a significant relationship between 3 years old childhood obesity and maternal obesity ($p=0.827$). The reason for this may be the regional feature of the study group. Another reason can be that we don't know the fathers' BMI. It will be more accurate to present the genetic characteristics of the child by knowing the BMI of both the mother and father.

In a study conducted by Werneck AO. et al. (21) it was showed that birth weight was associated with obesity in adolescent period (20). Qiao Y. et al. found that birth weight was effective on childhood obesity in their study that containing participants from 12 different countries. In our study, in accordance with the literature, we found that birth weight over 4000 g was related with obesity at the age of 3 for babies born in 2016 ($p=0.048$).

In our study we found significant relationship between GWG and obesity at the age of 3 ($p<0.033$). This was a consistent result with the literature (22-24). This result can be explained with that mechanism; high GWG indicates more maternal fat accumulation and possibly maternal abnormal metabolism status (25-27). This altered maternal environment can interact with placental factors that cause increased calorie supply in the fetus (28).

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In a study conducted in the USA in 2013 showed a negative relationship between socioeconomic level and childhood obesity (29). In our study, we couldn't find a relationship between socioeconomic level and obesity. The reason for this is when we ask the mothers how their socioeconomic level is; they were marking one of the good, medium or bad options. The absence of household income per capita made the answers given inadequate.

In the literature, there are studies about breast milk preventing early childhood obesity, but its mechanism of action remains uncertain (30-32). One possible explanation for breast milk's benefit; breastfeeding can improve children's ability to control food intake and determine hunger satisfaction (33). On the other hand children who meet the bottle in the early period may not be able to improve their saturation control and may be prone to weight gain (34). In our study, we didn't find a relationship between breastfeeding times and obesity at the age of three. This may be caused by that transition times to supplementary food and daily calorie intake were not calculated in the study group.

Strengths of the study were that we observed children at least 7 times before they reached the age of 3, and all the observation records were conducted were kept in computer. Although there are studies about early childhood obesity, there are very few studies like our study showing the three years change. Besides that another strength of our study is that all mothers participated to our study were observed by the same family doctors at least 4 times during their pregnancies.

That we didn't ask about the nutritional composition of the food given to the babies, did not determine the nutritional values and being a regional study can be considered as limitations. Another limitation can be added that the income status of families cannot be documented.

CONCLUSION

Result of our study showed us that although prevalence of early childhood obesity decreased, but prevalence is still at critical level. We found that GWG and high birth weight are risk factors for early childhood obesity. In future obesity prevention studies, taking these risk factors into account will be beneficial.

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