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The Prevalence of Overweight and Obesity in Under One–Year-Old Infants in Yazd, Iran

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ABSTRACT

Background: Exceeded weight during the first 1000 days of life can lead to adulthood obesity and health-related problems. In the present study, we aimed to find the prevalence of overweight and obesity and their related demographic factors in the first year of life in Yazd. **Methods:** In a cross-sectional study, recorded data of 600 infants were collected from health records of eight health centers of Yazd city using the cluster sampling method. Demographic data and socioeconomic status of the family, breastfeeding duration, and birth order were used. Anthropometrics, including height and weight were interpreted by the categorization developed by WHO as length for age and weight for age. P-value < 0.05 was considered significant. **Results:** The prevalence of overweight and obesity was estimated at 7.3% and 3.5%, respectively. No significant differences were observed between boys (n = 307) and girls (n = 300) (P = 0.15) for weight, while girls had insignificant lower weight (g) (3028.87 ± 496.30 for girls and 3173.72 ± 456.61 for boys). Among different possible determinants, birth order was associated with body mass index status (P = 0.04). **Conclusions:** A relatively high prevalence of overweight and obesity was observed among infants under one year of age. Although only the order of birth was observed as a related factor, other controllable factors should be considered and monitored by parents and the healthcare system. Further studies are suggested to investigate the related controllable factors.

Keywords: *Infant; Body mass index; Obesity; Yazd*

Introduction

The first 1000 days of life, from conception until the end of the second year of life, is known as an important part of the life cycle to achieve optimal body and brain development (Blake-Lamb *et al.*, 2016, Brambilla *et al.*, 2016). Childhood (Polk *et al.*, 2016, Woo Baidal *et al.*, 2016) and adulthood (Simmonds *et al.*, 2016) obesity are believed to be related to this important period of life. Thus, this period represents the best time for obesity prevention and its adverse

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consequences (Blake-Lamb *et al.*, 2016). Exceeded weight gain in the first 1000 days of life can be the beginning of the childhood obesity (Polk *et al.*, 2016, Woo Baidal *et al.*, 2016), which is believed to act as an underlying risk factor for varieties of illnesses (Weihrauch-Blüher *et al.*, 2019) such as diabetes (Bell *et al.*, 2014), cardiovascular diseases (de Koning *et al.*, 2007), kidney disorders (Thomas *et al.*, 2011, Wang *et al.*, 2008), liver cancer (Chen *et al.*, 2012), and consequently, which increase the probability of mortality rate (Blake-Lamb *et al.*, 2016).

Based on the Caspian-IV study (Esmaili *et al.*, 2015), the prevalence of childhood obesity in subtypes of general and abdominal obesity was reported as 11.89% and 19.12%, respectively, which varied from 2.6% in Hormozgan province, up to 19% in Boushehr for general and central obesity. The highest prevalence rate was in Mazandaran (30.2%) followed by Ardabil (29.2%) and Tehran province (27.9%). Although childhood obesity among Iranian children is not prevalent (Kelishadi *et al.*, 2014), its increasing trend is controversial (Jenabi and Khazaei, 2020). Although the data for infant weight status was not available for Yazd, it was found that among the first-grade students of Yazd, 6.3 % were overweight and 2.4 % were obese (Mirzaei and Karimi, 2011).

Many factors are associated with growth in this phase of life, among them nutrition, genetic and epigenetic factors, as well as hormonal regulation were studied. There is always a challenge to utilize these factors in order to have optimal growth and health without incrementing the risk of associated disorders (Pietrobelli and Agosti, 2017). In addition, demographic and lifestyle factors are believed to be related to accelerated weight gain in the first 1000 days and childhood obesity, such as smoker mother, pre-pregnancy body mass index (BMI), exceeded gestational weight, gestational diabetes, child care attendance, inappropriate bottle use (Woo Baidal *et al.*, 2016), low socioeconomic status of the family (Polk *et al.*, 2016, Woo Baidal *et al.*, 2016), and cesarean (Portela *et al.*, 2015, Salehi-Abargouei *et al.*, 2014).

Lifestyle and demographic factors can be considered in predicting the risk of obesity and identify infants at the risk. Unlike the importance of weight status in the first 1000 days of life, based on our knowledge, few data are available on infants' weight status in Iran. So, we aimed to investigate the prevalence of overweight and obesity as well as their possible related factors in infants of Yazd city.

Material and Methods

Study design and participants: A cross-sectional study was conducted to assess the prevalence and possible related factors of the weight status in infants under 1-year-old in Yazd in 2017. A cluster sampling method was used to randomly select eight of 14 health centers in Yazd, Iran. Later, health records of infants under 1 year of age were checked to collect the data.

Demographic characteristics of infants, gathered from health records, included birth order (categorized as first, second, and third or later), delivery type (natural or cesarean), breastfeeding duration (less than 6 months or up to 6 months), mother and father education (elementary, middle school, high school, and university), mother occupation (housewife or employee), and father occupation (employee or self-employed or labor).

Anthropometrics: Data for anthropometrics were also collected from health records, which existed in health centers, including birth weight, weight for age, height for the age, and BMI for the age of the infants at the end of the first year of life. Height was assessed, with the accuracy of 1 cm, using a recumbent length method, while the infant had no hat or shoe, had lied down straight, and their feet and head touched the board. Weight was recorded, with the accuracy of 0.1 kg, using a Seca scale (GmbH & Co, Germany) in the lightest possible clothes. The participants' BMI was calculated using the Quetelet index [weight (kg) / (height^2 (m))]. Collected data were categorized using percentile of growth chart developed by WHO (World Health Organization, 2006). The BMI for age status was categorized as underweight (percentile under 5), normal (percentile 5-84), overweight (percentile 85–94), and obese (percentile more than 95).

Data analysis: Descriptive analyses were used to

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report the mean ± SD of birth weight, weight, and height. Categorical data were summarized using the frequency of participants in each category. Chi-square test was run to assess the association between categorized variables with BMI status. A P-value of less than 0.05 was considered significant. All the analyses were performed using SPSS software version 18 (SPSS INC, USA).

Ethical considerations: The study protocol was approved by the Ethics Committee of the Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

Results

A total of 607 one-year-old infants (307 boys and 300 girls) were included in the study. The overall mean for weight and height were 9207.79 ± 1144.59 g and 76.63 ± 27.34 cm, respectively. **Table 1** summarizes the demographic characteristics of the study population.

Boys and girls were significantly different in terms of their birth weight and weight in the first year ($P < 0.0001$ for both). The analysis showed no difference in delivery type in the total population (Natural = 50.8%, Caesarean = 49.2%). Most infants were breastfed up to 6 months (88.1%).

Table 2 sorts the infants in percentiles with regard to weight, height, and BMI in the first year of life. Results show that most infants were in normal status for weight, height, and BMI (80.4%, 79.4%, and 76.1%, respectively). Boys and girls were significantly different for weight ($P < 0.001$) and height ($P = 0.019$), but no significant difference was found for their BMI status ($P = 0.151$).

Table 1. Demographic characteristics of study population

Variables	Total	Boys	Girls	P-value[a]
Birth weight (g)	3103 ± 481[b]	3173 ± 456	3028 ± 496	<0.0001
Weight (g)	9207 ± 1144	9437 ± 1219	8973 ± 1013	<0.0001
Height (cm)	76 ± 27	76 ± 27	77 ± 38	0.57
Birth order				
First	285 (47.3)[c]	136 (44.6)	149 (50.0)	0.13
Second	233 (38.6)	118 (38.7)	115 (38.6)	
Third or latter	85 (14.1)	51 (16.7)	34 (11.4)	
Delivery type				
Natural	287 (50.8)	139 (48.8)	148 (52.9)	0.33
Caesarean	278 (49.2)	146 (51.2)	132 (51.2)	
Breast feeding duration				
Less than 6 months	72 (11.9)	40 (13.1)	32 (10.7)	0.37
Up to 6 months	532 (88.1)	266 (86.9)	266 (89.3)	
Mother education				
Elementary	52 (8.7)	29 (9.6)	23 (7.8)	0.452
Middle School	84 (14.1)	40 (13.2)	44 (15.0)	
High school	246 (41.3)	132 (43.7)	114 (38.9)	
University	213 (35.8)	101 (33.4)	112 (38.2)	
Father education				
Elementary	70 (11.8)	37 (12.3)	33 (11.3)	0.79
Middle School	157 (26.5)	79 (26.3)	78 (26.7)	
High school	223 (37.7)	108 (36.0)	115 (39.4)	
University	142 (24)	76 (25.3)	66 (22.6)	
Mother occupation				
Housewife	55 (9.3)	31 (10.3)	24 (8.2)	0.39
Employee	538 (90.7)	271 (89.7)	267 (91.8)	
Father occupation				
Employee	106 (17.9)	45 (15.0)	61 (21.0)	0.5
Self-employed or labor	485 (82.1)	255 (85.0)	230 (79.0)	

[a]: Chi-square test; [b]: Mean ± SD; [c]: N (%)

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Table 2. Weight, height and body mass index for age status of study participants at the first year of life based on WHO percentiles

Variables		Total	Boys	Girls	P-value[a]
Weight	Under 5th	37 (6.1)[b]	31 (10.2)	6 (2)	<0.001
	5 - 84	485 (80.4)	235 (77.0)	250 (83.9)	
	85 - 94	55 (9.1)	21 (6.9)	34 (11.4)	
	95 <	26 (4.3)	18 (5.9)	8 (2.7)	
Height	Under 5th	19 (3.2)	13 (4.3)	6 (2)	0.019
	5 - 84	460 (76.4)	243 (79.9)	217 (72.8)	
	85 - 94	64 (10.6)	25 (8.2)	39 (13.1)	
	95 <	59 (9.8)	23 (7.6)	36 (12.1)	
Body mass index	Underweight	79 (13.1)	48 (15.8)	31 (10.4)	0.151
	Normal	458 (76.1)	222 (73.0)	236 (79.2)	
	Overweight	44 (7.3)	21 (6.9)	23 (7.7)	
	Obese	21 (3.5)	13 (4.3)	8 (2.7)	

[a]: *Chi-square test;* [b]: *N (%)*

The association between demographic characteristics and BMI status is showed in **Table 3**. Among the demographic characteristics, birth order showed a significant association with BMI status (P = 0.04), but the others were not significantly associated (P > 0.05).

Table 3. The association between demographic characteristics and body mass index status among the total population

Variables		Underweight	Normal	Overweight	Obese	P-value[a]
Total population	Boys	48 (60.8)[b]	222 (48.5)	21 (47.7)	13 (61.9)	0.15
	Girls	31 (39.2)	236 (51.5)	23 (52.3)	8 (38.1)	
Birth order	First	38 (48.1)	204 (44.9)	28 (63.6)	13 (61.9)	0.04
	Second	27 (34.2)	191 (42.1)	9 (20.5)	4 (19.0)	
	Third or latter	14 (17.7)	59 (13.0)	7 (15.9)	4 (19.0)	
Delivery type	Natural	41 (55.4)	220 (51.9)	15 (35.7)	8 (40.0)	0.13
	Caesarean	33 (44.6)	204 (48.1)	27 (64.3)	12 (60.0)	
Breast feeding duration	Less than 6 months	9 (11.4)	55 (12.1)	3 (6.8)	5 (23.8)	0.27
	Up to 6 months	70 (88.6)	400 (87.9)	41 (93.2)	16 (76.2)	
Mother education	Elementary	6 (7.7)	41 (9.2)	2 (4.5)	2 (9.5)	0.61
	Middle School	8 (10.3)	64 (14.3)	6 (13.6)	5 (23.8)	
	High school	38 (48.7)	184 (41.2)	15 (34.1)	7 (33.3)	
	University	26 (33.3)	158 (35.3)	21 (47.7)	7 (33.3)	
Father education	Elementary	11 (14.3)	52 (11.7)	3 (6.8)	2 (10.0)	0.74
	Middle School	19 (24.7)	114 (25.6)	14 (31.8)	8 (40.0)	
	High school	28 (36.4)	172 (38.6)	18 (40.9)	4 (20.0)	
	University	19 (24.7)	108 (24.2)	9 (20.5)	6 (30.0)	
Mother occupation	Housewife	9 (11.5)	42 (9.4)	3 (6.8)	1 (4.8)	0.72
	Employee	69 (88.5)	403 (90.6)	41 (93.2)	20 (95.2)	
Father occupation	Employee	14 (18.2)	83 (18.7)	6 (13.6)	3 (14.3)	0.82
	Self-employed or labor	63 (81.8)	361 (81.3)	38 (86.4)	18 (85.7)	

[a]: *Chi-square test;* [b]: *N (%)*

Discussion

To our knowledge, this is the first study that investigated the prevalence of infants' overweight and obesity based on weight and BMI

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status in Yazd city. Our findings showed that the prevalence of overweight and obesity were 7.3% and 3.5%, respectively. The probability of overweight was higher in girls than boys (7.7% for girls and 6.9% for boys), but obesity was more prevalent in boys (4.3% for boys, and 2.7% for girls).

In 2011, Mirzaei *et al* reported that the prevalence of overweight and obesity were 6.3% and 2.4% in first-grade students of Yazd, respectively, which are lower than our findings (Mirzaei and Karimi, 2011). This higher rate of obesity can be described by the findings of Kelishadi (Kelishadi *et al.*, 2014). They observed that the exponential rate of childhood obesity was alarming in Iran. Besides, this point should not be forgotten that our findings are for the first year of life; thus, this prevalence can be higher if it is investigated in the primary school.

Obesity and overweight status were significantly more frequent in firstborn infants (P = 0.04). This result is confirmed by previous studies (Martinovic *et al.*, 2015, Ochiai *et al.*, 2012); our data were gathered among the children's first year of life and firstborn children are more likely to be the only child. It was observed that overweight or obesity were more prevalent among the only children (Ochiai *et al.*, 2012). However, in a study conducted on two cohorts, it was found that birth weight is not affecting later weight or BMI (Howe *et al.*, 2014). The differences between studies can be due to the age of assessing the participants' weight. In our study weight was assessed at the age of one, but in the study by Howe (Howe *et al.*, 2014) weight was recorded at 7 and 18 years of life. So, other lifestyle factors could be effective in their results. However, we did not ask for the number of siblings, which could be effective in taking care of infants as well as their weight and growth.

Although the results were not significantly different (P = 0.13), more children in the higher percentile for BMI were born via cesarean operation than natural birth. Among the overweight children, 64.3% were born by cesarean and 35.7% by natural birth. Regarding the children with obesity, this prevalence was 60 to 40% in cesarean and natural birth, respectively. The same association was observed by Salehi-Abargouei (Salehi-Abargouei *et al.*, 2014) and Portela (Portela *et al.*, 2015). Cesarean delivery affects macronutrient metabolism especially fat and glucose as well as factors related to feeding patterns including mothers' hormonal status or problems in the initiation of breastfeeding (Pei *et al.*, 2014). In addition, scientists believe that cesarean can change gut microbiota, which affects the metabolism and energy cycle in the host (Devaraj *et al.*, 2013). The long term results of these changed mechanisms may disrupt the intrinsic regulation of appetite and metabolic control. Thus, the health care system should consider educating parents to deliver their child by natural birth and should prevent conditions that may force pregnant lady to have cesarean.

Mothers' employment did not have any association with child BMI, but the results showed that the percentage of obese children with employer mothers was higher than normal ones. It is also said that lower child care attendance is associated with higher BMI (Woo Baidal *et al.*, 2016). Mother absence in taking care of children may lead to lower quality of the babysitting and feeding them with sugar-sweetened beverages rather than bottled milk. Parents' education also seemed to be associated with normal weight in infants (Gage *et al.*, 2013), but we did not found this relationship.

We just observed a significant association between birth order and obesity. To the best of our knowledge, the present study seems to be the first investigation for BMI status in the first 1000 days of life. The limitation of the present study is the small number of the study population. So, for a better conclusion, we propose future researchers to investigate this relationship in a multicenter study with a higher population. Moreover, since we used the recorded data, we did not have any access to the information of pre-pregnancy and during pregnancy.

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Kelishadi proposed that the prevalence of obesity is higher in a population with lower socioeconomic status (Kelishadi *et al.*, 2014). This can be justified by globalization and transitional periods or lower access to healthy and nutritious foods. In the present study, mother and father's education, and mother and father's occupation were investigated, which affect the socioeconomic status of families. Among these socioeconomic components, no significant results were observed. However, it should be noted that the socioeconomic status in our study has not been investigated precisely.

Thus, it is recommended for further studies to assess factors affecting mother and infant during the pre-pregnancy and pregnancy period as well as to assess the socioeconomic status of families using validated questionnaires.

Conclusions

The prevalence of overweight and obesity in the first year of life among infants residing in Yazd was 7.3% and 3.5%, respectively. Birth order was associated to over weight gain in infants. Further studies are recommended to investigate the prevalence of obesity and its association with the demographic and lifestyle factors more precisely.

Conflict of interest

The authors have no conflicts of interest to disclose.

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Authors' contribution

Jafari F, Nadjarzadeh A, and Mozaffari-Khosravi H were involved in designing and supervising the study. Jafari F and Mohsenpour MA were involved in conducting the study and collecting the data. Mohsenpour MA and Mozaffari-Khosravi H participated in data analysis. All authors participated in writing the manuscript and approved the final version submitted for publication.

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