Updated Weight and Height-for Age Centiles in a Group of Predominantly Breastfed Turkish Children Aged 0-2 Years

Ağırlıklı Olarak Anne Sütü ile Beslenen 0-2 Yaş Arasındaki Bir Grup Türk Çocuğu İçin Güncellenmiş Ağırlık ve Boy Yüzdelikleri

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ABSTRACT Objective: To update the weight and height centiles for a group of predominantly breastfed children aged 0-2 years from the medium-high socioeconomic status living in Ankara. **Material and Methods:** The study design was prospective cohort. Between 2002 and 2004, height and weight measurements of 0-2 year-old healthy children from the medium-high socioeconomic status were recorded in definite time-intervals in the Healthy Child Clinic of Gazi University Faculty of Medicine. Height and weight percentile curves were constructed using the LMS method for boys and girls. **Results:** In height and weight percentile curves, a steady upward trend was detected until 24 months of age for each gender. The estimated 50th percentiles of height and weight were mostly higher than the 50th percentiles suggested by the World Health Organization (WHO) 2006 and Neyzi 1978. The 50th height and weight percentiles of the present study were closer to those of WHO than those of Neyzi. **Conclusion:** The present study reports the updated percentile values and curves for height and weight in a group of predominantly breastfed children aged 0-2 years from the medium-high socioeconomic status in Ankara. However, since the obtained data does not represent the whole country, it may be more reasonable to use the updated WHO multicenter growth reference curves.

Key Words: Child; growth; growth&development; body height; body weight changes

ÖZET Amaç: Bu çalışmada, Ankara'da yaşayan, orta-yüksek sosyoekonomik düzeyden gelen ve ağırlıklı olarak anne sütü ile beslenen, 0-2 yaş arasındaki bir grup Türk çocuğu için ağırlık ve boy yüzdeliklerini güncellemek amaçlanmıştır. **Gereç ve Yöntemler:** Çalışma, ileriye dönük kohort şeklinde tasarlanmıştır. Orta-yüksek sosyoekonomik düzeyden gelen 0-2 yaş arasındaki Türk çocuklarının ağırlık ve boy ölçümleri, 2002-2004 yılları arasında Gazi Üniversitesi Tıp Fakültesi Sağlıklı Çocuk Kliniği'nde belirli aralıklarla kaydedilmiştir. Ağırlık ve boy yüzdelik eğrileri LMS yöntemiyle oluşturulmuştur. **Bulgular:** Hesaplanan yüzdelik değerleri, erkek çocukların kız çocuklarından daha büyük ağırlık ve boy değerlerine sahip olduğunu göstermektedir. Ağırlık ve boy yüzdelik eğrilerinde erkek ve kız çocuklar için 24 aylık yaşa kadar yukarı doğru bir eğilim vardır. Hesaplanan 50. ağırlık ve boy yüzdelikleri Dünya Sağlık Örgütü (DSÖ) 2006 ve Neyzi 1978 aynı yüzdeliklerinden daha büyük bulunmuştur. Ayrıca hesaplanan 50. ağırlık ve boy yüzdelikleri, DSÖ yüzdelik değerlerine daha yakındır. **Sonuç:** Bu çalışma, ağırlıklı olarak anne sütü ile beslenip Ankara'da yaşayan orta-yüksek sosyoekonomik düzeyden gelen, 0-2 yaş arasındaki bir grup Türk çocuğu için güncellenmiş ağırlık ve boy yüzdeliklerini ve eğrilerini sunmaktadır. Ancak, bu çalışmada elde edilen veriler bütün ülkeyi temsil edemeyeceği için, DSÖ'nün güncellenmiş büyüme eğrilerinin kullanılması daha uygun olabilir.

Anahtar Kelimeler: Çocuk; büyüme; büyüme-gelişme; ağırlık; boy değişiklikleri

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Growth and development of children is a very sensitive indicator of the general health and nutritional status of children in a population. Therefore, the study of the effect of social class differences on

growth and development in a developing society is a crucial issue.[1,2]

One of the major aims of auxological studies is to obtain reference data to be used in the assessment of growth in children of similar ethnic background. The growth charts on Turkish children presently in use in this country were based on measurements of Istanbul children of well-to-do families born in the years 1950–1960. These charts are therefore selective and represent weight and height values of a group of children from the higher strata of the population.[3]

In Turkey, the percentile growth curves for children aged 0-18 years, reported by Neyzi et al, are commonly used as growth standards based on a sample of healthy well-to-do children.[4] More recently, Neyzi et al created up-to-date reference standards for Turkish children and compared them with growth standards for US children (CDC 2000 Growth Charts) and with previous local data.[3] Gültekin et al compared height and weight of school children aged between 7-17 years of low socio-economic background with available growth data from high socio-economic strata.[2] Few studies on up-to-date reference standards for Turkish children aged 0-2 years have been carried out based on the medium–high socio-economic level. The aim of this study was to update the growth standards of a group of breastfed healthy infants who were longitudinally followed up until 24 months of age. In addition, we evaluated 50th percentile values for height and weight for the present study, World Health Organization (WHO) multicenter growth standards, the WHO 2006 and the Turkish standards reported by Neyzi et al in 1978.[4-6]

MATERIAL AND METHODS

This study was performed between 2002 and 2004 in the Healthy Child Clinic of Gazi University Faculty of Medicine, Ankara, Turkey. The study population was usually from the medium-high socio-economic status in Ankara. The study design was prospective cohort. Ethical approval was granted by the Gazi University Ethics Committee, Ankara, Turkey. The families of patients provided informed consent. The subjects consisted of 466 children (239 boys and 227 girls). The singleton, term infants (38-42 weeks) with a birth weight of 2500-4000 g, born in the year of 2002 and followed-up regularly for two years in the clinic were included in this study. Small for gestational age infants, infants with chronic diseases, and hospitalized infants were excluded. All infants were seen by a pediatrician and a pediatric nurse on the 15th day of life and at 2, 4, 6, 9, 12, 18 and 24 months. On these visits, their feeding histories, growth monitoring (weight, height, etc.), and immunization schedule were noted in the standard forms prepared for this study. In addition, the standard forms including demographic characteristics of the children as well as all information related to the children were recorded in the computer. Weight and height measurements were performed by a nurse working in the Healthy Child Clinic. For the infants, recumbent length was measured with a portable infantometer; weight up to 18 kg was measured on a digital scale (Seca, Vogel&Halke, Hamburg, Germany). The height and weight charts were based on 1700 height and weight measurements for boys, and 1576 height and weight measurements for girls. The mean number of measurements per boys and girls was 7.11 ± 1.31 and 6.94 ± 1.23, respectively.

STATISTICAL ANALYSIS

Height and weight percentile curves were constructed by the LMS method, which was developed by Cole in 1988. The LMS method is based on the assumption that data can be normalized by means of a power transformation, stretching one tail of the distribution and shrinking the other, thereby removing any skewness. LMS technique is one of the most commonly used methods for improving reference centile curves. Box-Cox power, mean or median and coefficient of variation are the parameters of the LMS technique, respectively. A Box-Cox power transformation applied to obtain the data is closely approximated by a normal distribution. In detail, the L curve is the smoothed curve of the Box-Cox power transformation plotted against age; the M curve is the smoothed median of the measurement plotted against age, and the S curve is the smoothed curve of the measurement's coefficient of variation as it changes with age. The three

TABLE 1: Demographic characteristics of the children.

Demographic characteristic	n	%
Gender		
Girl	227	49
Boy	239	51
Mother's education (years of schooling)		
< 5 y	2	0.4
5-11 y	224	52.4
> 11 y	220	47.2
Father's education (years of schooling)		
< 5 y	-	-
5-11 y	214	46
> 11 y	252	54
Mother's occupation		
Housewife	210	45.1
Civil servant (teacher, doctor etc.)	218	46.8
Business owner	16	3.4
Other	22	4.7
Father's occupation		
Civil servant (teacher, doctor etc.)	345	74
Workman	12	2.6
Business owner	81	17.4
Other	28	6

parameters of the method are estimated from the smoothed data curves.[7-9] In the present study, the estimation of L, M and S parameters was organized at one-month age intervals separately for boys and girls. The curves were fitted by maximum penalized likelihood to three smoothed curves: L(t) the Box-Cox power, M(t) the median and S(t) the coefficient of variation. Centile curves at age t can be obtained as $C_{100\alpha}(t)= M(t)[1 + L(t)S(t)Z_{\alpha}]^{1/L(t)}$, where Z_{α} is the normal equivalent deviate for tail area α and $C_{100\alpha}(t)$ is the centile corresponding to Z_{α}. The 3rd, 10th, 25th, 50th, 75th, 90th, and 97th centiles were estimated by using calculated L, M and S values for specific age points. Fitting curves and smoothing were carried out by the software program lmsChartMaker Light v. 2.3. Student's t-test for independent samples was used to compare the mean weight and height measurements according to gender. Repeated measures were analyzed by repeated measures ANOVA. Multiple comparisons were done with the Tukey test. $p< 0.05$ was considered statistically significant.

TABLE 2: The 50th weight and height percentile values of the present study, WHO and Neyzi for boys and girls.

Month	Height (cm)			Weight (g)		
	Present	WHO	Neyzi	Present	WHO	Neyzi
Boys						
0	50.8	49.9	50.6	3411	3300	3400
1	54.9	54.7	-	4540	4500	-
3	62.1	61.4	60.5	6495	6400	5900
6	69.5	67.6	66.5	8350	7900	7800
9	74.1	72.0	71.0	9422	8900	9000
12	77.4	75.7	74.7	10.267	9600	10.000
15	80.6	79.1	78.0	11.023	10.300	10.800
18	83.7	82.3	81.5	11.711	10.900	11.500
24	90.0	87.8	84.0	12.959	12.200	12.650
Month	**Height (cm)**			**Weight (g)**		
	Present	**WHO**	**Neyzi**	**Present**	**WHO**	**Neyzi**
Girls						
0	50.4	49.1	50.2	3289	3200	3400
1	54.3	53.7	-	4285	4200	-
3	61.0	59.8	58.5	6037	5800	5400
6	68.1	65.7	64.5	7793	7300	7400
9	72.6	70.1	69.5	8873	8200	8600
12	76.0	74.0	73.0	9713	8900	9600
15	79.3	77.5	76.5	10.478	9600	10.400
18	82.6	80.7	79.5	11.205	10.200	11.000
24	89.2	86.4	85.5	12.605	11.500	12.200

WHO, World Health Organization

TABLE 3: The estimated LMS parameters for weight and height by age and gender.

	Weight						Height					
	Boys			Girls			Boys			Girls		
Age (month)	L	M	S	L	M	S	L	M	S	L	M	S
0	0.85	3411.05	0.12	0.47	3289.32	0.11	-2.01	50.81	0.04	1.36	50.46	0.04
1	0.74	4540.67	0.12	0.41	4285.13	0.11	-1.60	54.91	0.04	1.10	54.30	0.04
2	0.64	5592.48	0.12	0.36	5219.13	0.11	-1.17	58.74	0.04	0.86	57.88	0.04
3	0.56	6495.93	0.11	0.31	6037.94	0.11	-0.72	62.13	0.04	0.66	61.04	0.04
4	0.48	7245.40	0.11	0.28	6733.23	0.11	-0.26	65.04	0.04	0.49	63.78	0.04
5	0.43	7854.73	0.11	0.25	7311.56	0.11	0.17	67.48	0.04	0.36	66.11	0.04
6	0.38	8350.36	0.11	0.23	7793.68	0.11	0.56	69.54	0.04	0.25	68.09	0.04
7	0.34	8760.79	0.11	0.22	8202.69	0.11	0.91	71.27	0.04	0.15	69.78	0.04
8	0.32	9110.31	0.11	0.22	8556.94	0.11	1.20	72.75	0.04	0.05	71.25	0.04
9	0.29	9422.13	0.11	0.22	8873.59	0.11	1.44	74.05	0.04	-0.07	72.57	0.04
10	0.28	9715.90	0.11	0.23	9167.71	0.11	1.62	75.23	0.04	-0.20	73.79	0.04
11	0.27	9996.95	0.11	0.23	9446.11	0.11	1.74	76.33	0.04	-0.34	74.94	0.04
12	0.26	10267.04	0.10	0.24	9713.52	0.11	1.82	77.39	0.04	-0.48	76.06	0.04
13	0.25	10527.71	0.10	0.24	9974.00	0.11	1.86	78.45	0.04	-0.60	77.16	0.04
14	0.25	10779.70	0.10	0.24	10228.87	0.11	1.86	79.51	0.04	-0.69	78.25	0.04
15	0.25	11023.58	0.10	0.25	10478.82	0.11	1.84	80.57	0.04	-0.76	79.33	0.04
16	0.25	11259.88	0.10	0.25	10724.50	0.11	1.81	81.62	0.04	-0.80	80.41	0.04
17	0.26	11489.15	0.10	0.26	10966.58	0.11	1.78	82.68	0.04	-0.81	81.49	0.04
18	0.25	11711.94	0.10	0.27	11205.71	0.11	1.76	83.73	0.04	-0.80	82.58	0.04
19	0.25	11928.87	0.10	0.27	11442.52	0.11	1.77	84.78	0.04	-0.77	83.67	0.04
20	0.25	12140.85	0.11	0.28	11677.43	0.11	1.79	85.83	0.04	-0.71	84.77	0.04
21	0.24	12348.87	0.11	0.29	11910.82	0.11	1.83	86.87	0.04	-0.63	85.87	0.04
22	0.23	12553.93	0.11	0.30	12143.07	0.11	1.89	87.92	0.04	-0.54	86.97	0.04
23	0.22	12757.01	0.11	0.32	12374.56	0.11	1.95	88.96	0.04	-0.44	88.08	0.04
24	0.21	12959.10	0.11	0.33	12605.68	0.11	2.02	90.01	0.04	-0.34	89.19	0.04

TABLE 4: Predicted percentile values of weight for Turkish children aged 0-2 years.

	Boys								Girls							
Age (month)	3	10	25	50	75	90	97	SD	3	10	25	50	75	90	97	SD
0	2656.33	2893.65	3137.13	3411.05	3688.37	3940.71	4192.24	559.73	2640.01	2838.63	3047.70	3289.32	3540.81	3775.63	4015.33	501.30
1	3561.51	3866.76	4182.50	4540.67	4906.31	5241.56	5578.03	734.96	3448.15	3703.20	3972.60	4285.13	4611.73	4917.88	5231.55	650.03
2	4416.17	4780.12	5159.24	5592.48	6038.11	6449.55	6865.14	892.63	4209.94	4516.41	4841.14	5219.13	5615.58	5988.52	6371.91	788.01
3	5161.25	5571.68	6001.63	6495.93	7007.54	7482.69	7965.27	1022.07	4880.72	5231.16	5603.42	6037.94	6495.07	6926.35	7370.99	907.65
4	5788.51	6234.38	6703.52	7245.40	7809.05	8335.01	8871.58	1123.78	5451.99	5839.12	6251.19	6733.23	7241.60	7722.37	8219.18	1008.55
5	6305.63	6778.03	7276.69	7854.73	8458.29	9023.58	9602.28	1201.62	5927.35	6344.88	6789.98	7311.56	7862.66	8384.79	8925.31	1092.64
6	6731.35	7223.76	7744.80	8350.36	8984.48	9580.04	10191.38	1261.14	6322.45	6765.70	7238.73	7793.68	8380.78	8937.73	9514.99	1163.55
7	7086.90	7595.04	8133.63	8760.79	9418.91	10038.29	10675.36	1307.92	6655.40	7121.28	7618.73	8202.69	8820.90	9407.76	10016.41	1224.93
8	7391.21	7912.37	8465.42	9110.31	9788.04	10426.84	11084.84	1346.23	6941.48	7427.79	7947.14	8556.94	9202.65	9815.74	10451.74	1279.33
9	7662.89	8195.71	8761.62	9422.13	10117.02	10772.69	11448.79	1379.83	7195.43	7700.63	8240.14	8873.59	9544.29	10181.07	10841.58	1328.86
10	7917.85	8462.07	9040.42	9715.90	10427.08	11098.63	11791.63	1411.84	7430.34	7953.45	8512.01	9167.71	9861.84	10520.74	11204.07	1375.36
11	8160.17	8715.88	9306.66	9996.95	10724.09	11411.07	12120.33	1443.31	7652.09	8192.38	8769.16	9446.11	10162.56	10842.47	11547.41	1419.68
12	8390.93	8958.41	9561.82	10267.04	11010.10	11712.32	12437.54	1474.81	7864.75	8421.65	9016.06	9713.52	10451.49	11151.64	11877.38	1462.44
13	8611.13	9190.81	9807.24	10527.71	11286.91	12004.45	12745.57	1506.81	8071.81	8644.92	9256.51	9974.00	10732.96	11452.86	12198.89	1504.16
14	8821.43	9413.75	10043.58	10779.70	11555.38	12288.47	13045.63	1539.52	8274.43	8863.40	9491.81	10228.87	11008.37	11747.57	12513.43	1544.96
15	9022.44	9627.77	10271.40	11023.58	11816.12	12565.09	13338.61	1573.04	8473.16	9077.70	9722.59	10478.82	11278.39	12036.44	12821.63	1584.86
16	9214.79	9833.45	10491.21	11259.88	12069.74	12835.05	13625.39	1607.45	8668.57	9288.43	9949.50	10724.50	11543.68	12320.10	13124.08	1623.88
17	9399.17	10031.38	10703.58	11489.15	12316.84	13099.02	13906.80	1642.82	8861.21	9496.18	10173.17	10966.58	11804.91	12599.19	13421.39	1662.04
18	9576.31	10222.21	10909.08	11711.94	12558.02	13357.71	14183.71	1679.18	9051.64	9701.57	10394.25	11205.71	12062.73	12874.34	13714.12	1699.33
19	9747.01	10406.63	11108.34	11928.87	12793.90	13611.83	14456.97	1716.56	9240.37	9905.15	10613.33	11442.52	12317.76	13146.17	14002.87	1735.80
20	9912.23	10585.60	11302.31	12140.85	13025.40	13862.24	14727.40	1754.90	9427.70	10107.26	10830.79	11677.43	12570.49	13415.21	14288.22	1771.53
21	10072.99	10760.15	11492.01	12348.87	13253.44	14109.83	14995.81	1794.13	9613.92	10308.21	11046.97	11910.82	12821.35	13681.98	14570.79	1806.66
22	10230.32	10931.30	11678.45	12553.93	13478.95	14355.45	15262.94	1834.15	9799.28	10508.29	11262.18	12143.07	13070.81	13947.01	14851.22	1841.32
23	10385.26	11100.11	11862.68	12757.01	13702.86	14599.92	15529.51	1874.83	9984.06	10707.77	11476.75	12374.56	13319.33	14210.86	15130.16	1875.65
24	10538.86	11267.63	12045.71	12959.10	13926.07	14844.05	15796.20	1916.04	10168.51	10906.95	11691.00	12605.68	13567.35	14474.07	15408.28	1909.80

TABLE 5: Predicted percentile values of height for Turkish children aged 0-2 years.

	Boys								Girls							
Age (month)	3	10	25	50	75	90	97	SD	3	10	25	50	75	90	97	SD
0	47.12	48.20	49.39	50.81	52.36	53.88	55.52	3.06	46.55	47.81	49.07	50.46	51.84	53.06	54.26	2.81
1	50.97	52.14	53.41	54.91	56.53	58.10	59.76	3.20	50.23	51.53	52.85	54.30	55.75	57.06	58.34	2.95
2	54.57	55.83	57.17	58.74	60.42	62.01	63.68	3.32	53.68	55.01	56.36	57.88	59.39	60.76	62.12	3.08
3	57.75	59.09	60.49	62.13	63.84	65.45	67.11	3.41	56.74	58.10	59.49	61.04	62.61	64.03	65.45	3.17
4	60.49	61.90	63.36	65.04	66.77	68.38	70.02	3.47	59.40	60.78	62.19	63.78	65.39	66.85	68.32	3.25
5	62.81	64.27	65.78	67.48	69.23	70.83	72.45	3.51	61.67	63.06	64.49	66.11	67.75	69.25	70.75	3.31
6	64.75	66.26	67.80	69.54	71.29	72.88	74.47	3.54	63.59	65.00	66.45	68.09	69.76	71.28	72.82	3.36
7	66.39	67.94	69.52	71.27	73.03	74.61	76.18	3.57	65.24	66.66	68.12	69.78	71.47	73.03	74.59	3.41
8	67.78	69.37	70.98	72.75	74.52	76.10	77.65	3.60	66.67	68.10	69.58	71.25	72.97	74.55	76.14	3.45
9	69.00	70.62	72.25	74.05	75.82	77.41	78.95	3.63	67.93	69.38	70.87	72.57	74.31	75.92	77.55	3.50
10	70.09	71.75	73.41	75.23	77.02	78.61	80.16	3.67	69.10	70.55	72.06	73.79	75.56	77.21	78.87	3.56
11	71.10	72.79	74.48	76.33	78.14	79.75	81.31	3.72	70.19	71.66	73.19	74.94	76.75	78.44	80.14	3.63
12	72.06	73.79	75.52	77.39	79.23	80.86	82.44	3.78	71.22	72.71	74.27	76.06	77.91	79.64	81.40	3.71
13	73.01	74.78	76.54	78.45	80.33	81.98	83.59	3.85	72.23	73.74	75.33	77.16	79.06	80.83	82.65	3.80
14	73.95	75.76	77.56	79.51	81.42	83.11	84.75	3.94	73.21	74.75	76.37	78.25	80.20	82.02	83.90	3.89
15	74.88	76.73	78.57	80.57	82.53	84.26	85.94	4.03	74.17	75.75	77.41	79.33	81.34	83.22	85.16	4.00
16	75.80	77.70	79.58	81.62	83.63	85.40	87.13	4.12	75.11	76.73	78.43	80.41	82.48	84.42	86.42	4.12
17	76.72	78.65	80.58	82.68	84.74	86.55	88.32	4.23	76.05	77.71	79.46	81.49	83.62	85.62	87.69	4.24
18	77.62	79.61	81.58	83.73	85.84	87.70	89.52	4.33	76.97	78.68	80.49	82.58	84.77	86.83	88.96	4.37
19	78.52	80.55	82.58	84.78	86.94	88.85	90.71	4.44	77.90	79.66	81.51	83.67	85.92	88.05	90.24	4.50
20	79.40	81.49	83.57	85.83	88.04	89.99	91.89	4.55	78.82	80.63	82.55	84.77	87.09	89.27	91.52	4.63
21	80.28	82.43	84.56	86.87	89.14	91.14	93.07	4.66	79.74	81.61	83.58	85.87	88.26	90.50	92.81	4.76
22	81.15	83.36	85.55	87.92	90.23	92.27	94.25	4.77	80.65	82.58	84.62	86.97	89.43	91.73	94.09	4.90
23	82.02	84.29	86.53	88.96	91.33	93.41	95.42	4.88	81.56	83.56	85.66	88.08	90.60	92.96	95.38	5.04
24	82.88	85.22	87.52	90.01	92.42	94.55	96.60	4.99	82.46	84.53	86.69	89.19	91.78	94.20	96.67	5.18

RESULTS

Demographic characteristics of the children were given in Table 1. Mean ages of mothers and fathers were 28.9 ± 5.05 years and 33.1 ± 5.24 years, respectively. In the first 4 months, exclusively breastfeeding (EBF) rate was 53.7%. None of the infants was fed with formula alone. Complementary foods were started at a mean time of 4.4 ± 2.8 months. The infants were still fed with breast milk in addition to complementary foods with a rate of 86% at 6 months, 66% at 12 months, and 22% at 24 months.

The 50th weight and height percentile values of the present study, WHO and Neyzi for boys and girls were shown in Table 2. In boys and girls, the estimated 50th percentile values of height and weight were mostly higher than the 50th percentile values of WHO and Neyzi, and the 50th height and weight percentile values of the present study were closer to those of WHO than those of Neyzi.

The estimated LMS parameters for height and weight by age and gender were presented in Table 3. These parameters were used to obtain the required centiles for each gender. Predicted percentile values of weight and height for children aged 0-2 years were given in Tables 4 and 5, respectively.

As can be seen in Table 3, the estimated M parameters for weight and height in boys were higher than the parameters in girls for each month. Mean weight and height measurements for boys were significantly higher than those for girls on the 15th day of life and at 2, 4, 6, 9, 12, 18 and 24 months based on the results of the Student's t-test ($p< 0.05$). Therefore, percentile curves for girls and boys were plotted separately. The highest M parameters for weight and height were determined at 24 months. When the repeated measures for weight and height were analyzed, boys and girls seemed to have different weight and height levels ($p< 0.05$). The correlation between time and gender was not statistically significant ($p> 0.05$).

Figures 1 and 2 depict weight percentile curves estimated from the LMS parameters. Height percentile curves derived from LMS parameters were described in Figures 3 and 4. In both height and weight percentile curves, there appeared a steady upward trend until 24 months of age for each gender.

Figures 5-8 demonstrate the 50th weight and height percentile curves of this study, Neyzi and WHO standards for both genders. As seen in these figures, the 50th weight and height percentile curves found in this study were higher than the curves of WHO and Neyzi.

DISCUSSION

The percentiles of weight and height change markedly from one country to another and from one city to another, particularly in childhood. Therefore, countries have to create, revise or improve their own weight and height centiles periodically for the assessment of individual growth.[10,11] In addition, growth standards should be updated according to study design, socio-economic status, certain ages, type of feeding, genders etc. for more accurate growth evaluation. The present study improves and updates the weight and height centiles for a

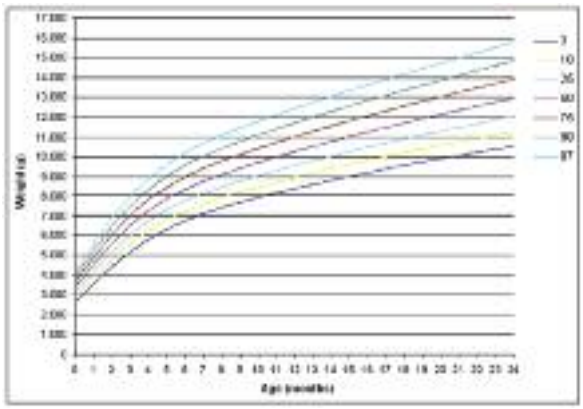

FIGURE 1: Weight percentile curves for boys.

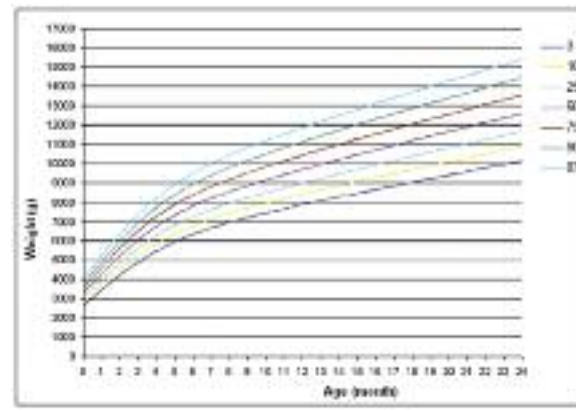

FIGURE 2: Weight percentile curves for girls.

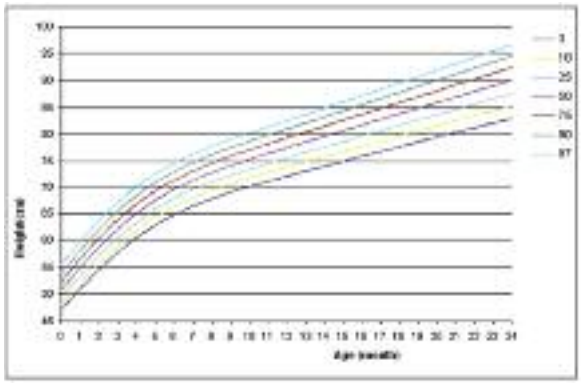

FIGURE 3: Height percentile curves for boys.

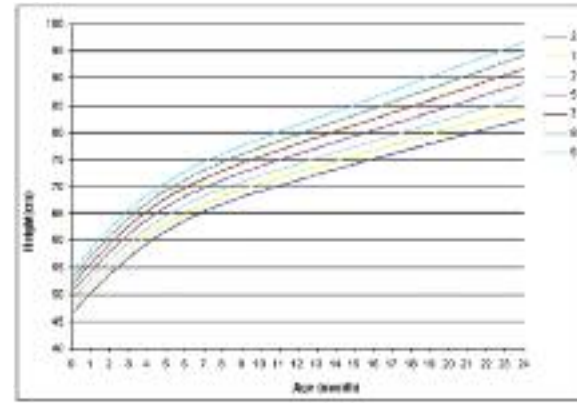

FIGURE 4: Height percentile curves for girls.

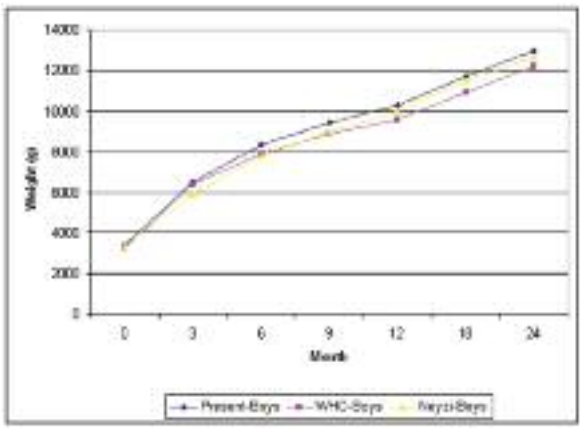

FIGURE 5: The 50th weight percentile values of the present study, WHO and Neyzi for boys.

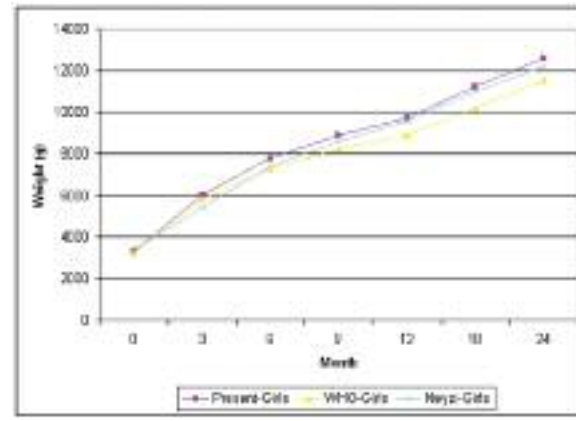

FIGURE 6: The 50th weight percentile values of the present study, WHO and Neyzi for girls

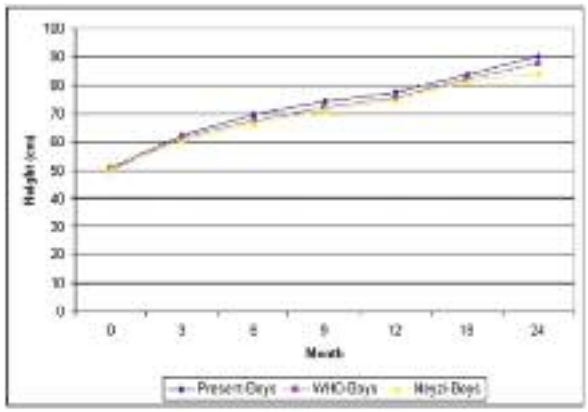

FIGURE 7: The 50th height percentile values of the present study, WHO and Neyzi for boys

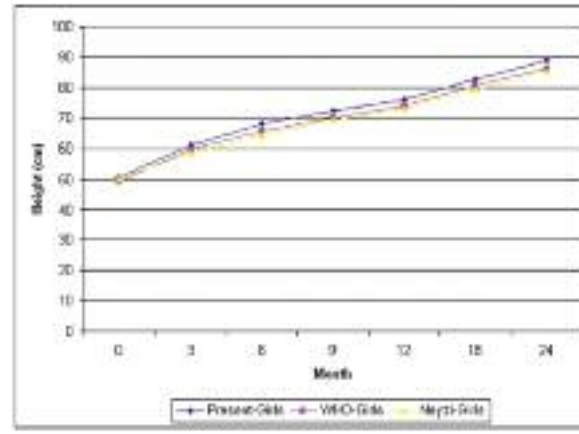

FIGURE 8: The 50th height percentile values of the present study, WHO and Neyzi for girls.

group of 0-2 years old children from the medium-high socio-economic status in Ankara, Turkey, who were predominantly breastfed.

The weight and height 50th percentile values of healthy infants included in our study were higher than the values determined in previous Turk-

ish standard curves.[4] This may be attributed to the higher rate of EBF in the first four months compared to the general Turkish infant population as well as to long-term breastfeeding among infants in our study. Additionally a secular upward trend is normally expected in countries. Our results may be a reflection of this secular trend. Neyzi et al have recently updated the Turkish 6-18 years old children growth curves where this similar upward trend is also visible.[3] More recently, Neyzi et al created reference standards for the growth of Turkish infants and children aged 0-18 years of age.[12] However, all children in the study of Neyzi et al were from well-to-do families and attended schools in relatively economically well off districts in İstanbul.[12] The study of Neyzi et al did not involve children from the medium-high socio-economic status in Ankara, who were predominantly breastfed; therefore, our results may be complementary to theirs.[12] The three-percentile value, which was the lowest level of normal weight and height, was quite similar to WHO values, both in boys and girls in our study, whereas it was higher than the previous values of Neyzi. If growth standards are not updated, we may underdiagnose growth failure cases as they will appear as 3 percentile although their percentile is below normal. It is reported that the time related change in percentile values is especially prominent and important in lower percentiles; therefore, it is mandatory to update the growth curves in each country.[13,14] The differences in the growth patterns in the present study, WHO and Neyzi may be attributed to feeding types, sample size, measurement intervals, diverse place (country or city) and different socio-economic status. Recently, Onis et al compared the WHO and Centers for Disease Control and Prevention (CDC) curves and assessed the growth performance of healthy breast-fed infants according to both.[15] They reported that the WHO standards provided a better tool than the CDC 2000 growth charts for monitoring the growth of breast-fed infants. In addition, this study underlines the significant effect of breast-feeding on growth. In the present study, the sample included predominantly healthy breastfed infants. Similarly, the WHO standards are based on a sample of healthy breastfed infants with high-quality complementary diets.[16,17] Bundak et al presented data and curves for body mass index values in healthy Turkish children aged 6 to 18 years using the LMS method.[18] More recently, Özer developed reference growth centiles for 1.427 (709 boys and 718 girls) Turkish children and adolescents aged 6-17 years in Ankara.[19]

The use of age, gender, and disease specific growth charts is essential in assessing nutritional status and monitoring nutrition interventions. A complete nutritional assessment includes nutritional history including dietary intake, physical examination, anthropometric measurements (weight, length or stature, head circumference, etc.), and laboratory tests of nutritional status.[20] Vigilant nutritional assessment may allow the provision of appropriate nutritional support to children. The strength of this study is that the values were obtained from a group of infants who were monitored in a longitudinal way. In infancy when growth is fast, longitudinally obtained values are considered more reliable.[14] As our study infants were predominantly fed with breast milk in the first 6 months (86%) and then were fed with breast milk in addition to complementary foods, our results may be used as a reference for infants fed with breast milk.

The limitation of our study is related to our study sample, which does not represent the whole country. It is a sample of children who live in medium-high socio-economical level families, are healthy, fed according to recommendations and do not have malnutrition. As the curves obtained in this study are very close to WHO study growth curves, this study also helps us to decide which curves to be used while following-up a healthy breastfed infant.

In conclusion, the present study reports the updated percentile values and curves for height and weight in a group of predominantly breastfed children aged 0-2 years in Ankara. However, since the obtained data does not represent the whole country, it may be more reasonable to use the updated WHO multicenter growth reference curves.

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