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**TITLE:** Comparison of standard values of nutrition screening and assessment using BMI percentiles from FNRI-PPS, IRS, CDC 2000, and WHO-MGRS child growth standards in the pediatric population of a tertiary care hospital in the Philippines admitted between years 2000 and 2003.

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**Short Title:** BMI standards comparison using WHO-MGRS, CDC, FNRI-PPS and IRS

**Key words:** BMI, percentiles, WHO-MGRS, CDC, FNRI-PPS, IRS, Philippines

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#### **ABSTRACT**

**BACKGROUND:** Nutrition screening in pediatrics patients commonly uses standards to evaluate the patient's body composition. The nutrition support group in a private tertiary care hospital in the Philippines planned to develop a BMI based nutrition screening form based on existing standards: FNRI-PPS, IRS, CDC, and WHO-MGRS child growth standards.

**OBJECTIVE:** To identify the standard that best reflected the admitted Filipino pediatric population.

**METHODOLOGY:** Data from 24,957 pediatric patients aged 1 month to 18 years (1.25:1 male to female ratio) were collected from years 2000-2003. BMI percentiles (p5, p50, and p95) were developed from all the reference standards and the number of patients who fell into the following categories: below p5, between p5 and p95, and above p95, were counted and compared as to which come closest to the normal distribution.

**RESULTS:** Analysis per age group showed that the CDC standard and WHO-MGRS child growth standards values followed normal distribution patterns with the 5<sup>th</sup> to 95<sup>th</sup> percentile higher (CDC:63%, WHO-MGRS:62%) compared to below 5<sup>th</sup> percentile (CDC:16%, WHO-MGRS:14%) and above 95<sup>th</sup> percentile (CDC:22%, WHO-MGRS:24%), whereas FNRI-PPS and IRS showed a lower distribution in the 5<sup>th</sup> to 95<sup>th</sup> percentile (FNRI-PPS:17%, IRS:38%), but higher in the below p5 (FNRI-PPS:26%, IRS:30%) and above 95 percentile (FNRI-PPS:56%, IRS:32%). The values of the WHO-MGRS child growth standards in the one to 12 month group come closer to standard compared to the CDC (5<sup>th</sup> to 95<sup>th</sup>: WHO-MGRS [57%] versus

CDC [54%]; below 5<sup>th</sup>: WHO-MGRS [19%] versus CDC [15%]; above 95<sup>th</sup>: WHO-MGRS [24%] versus CDC [31%]) while similar results were seen in the 2 to 18 year olds (5<sup>th</sup> to 95<sup>th</sup>: WHO-MGRS [62%] versus CDC [63%]; below 5<sup>th</sup>: WHO-MGRS [14%] versus CDC [16%]; above 95<sup>th</sup>: WHO-MGRS [24%] versus CDC [22%]).

**CONCLUSION:** We conclude that the WHO-MGRS child growth standard is the preferred tool for use in BMI-based nutrition screening of pediatric patients in the 1 to 12 month age group, whereas the CDC and WHO-MGRS growth standards yield similar results for the 2 to 18 year olds.

**ABBREVIATIONS:** FNRI-PPS: Food and Nutrition Research Institute – Philippine Pediatric Society, IRS: International Reference Standards, CDC: Center for Disease Control, WHO-MGRS: World Health Organization – Multicentre Growth Reference Study

## **INTRODUCTION**

Nutrition screening in pediatric patients use anthropometric data, basically height and weight, to get a good evaluation of the patient's body composition and health. Growth curves based on standards from the normal population are used to track the patient's progress in each age group which would determine if they are within normal range or not. Among the commonly used standards in the Philippines are the WHO (World Health Organization) child growth curves (1), NHANES and CDC (Center for Disease Control) in the United States (2), and in the Philippines by the FNRI-PPS (Food and Nutrition Research Institute-Philippine Pediatric Society) (3). Full utilization of the growth curves prepared by the FNRI-PPS since 1993 was not realized due to some questions on its reliability especially by some pediatricians, who preferred to use the CDC growth curves. This issue was partially resolved by the development of the IRS (International Reference Standards) in 2003 (4). Currently new curves based on the WHO-MGRS (Multicentre Growth Reference Study) were made available for use (5).

The nutrition support group in St. Luke's Medical Center needed a simple nutrition screening tool for its pediatric population, which is required for the standards of care for hospitalized patients as mandated by JCAHO (Joint Commission on Accreditation of Health Care Organizations) (6) so it planned to develop its own growth curves adopted from the different existing standards, which would become part of a rapid nutrition screening system for all admitted pediatric patients. To evaluate its reliability, all values from the FNRI, IRS, CDC, and WHO-MGRS were used on a specific sample population from the clinical nutrition database of the center. The objectives of this study were: a) to determine which of these growth standards would yield the pattern closest to the normal distribution and b) to choose which standard will be used for the nutrition screening purposes of this institution.

## **METHODOLOGY**

The normal distribution of the BMI values of the pediatric population would follow this pattern: 90% of the total count would fall within the 5<sup>th</sup> to 95<sup>th</sup> percentile, 5% are within the "below 5<sup>th</sup> percentile", and 5% are within the "above 95<sup>th</sup> percentile", thus forming the normal bell-shaped curve (7). Placing the resulting percentage values of the study population in a graph using the Microsoft Excel 2003 worksheet and enabling the "smooth line" function of the "format data series" for each standard would yield a smooth curve, thus showing a clear picture of the BMI distribution using the different anthropometric standards compared in this study.

The FNRI-PPS and IRS standards did not have BMI (Body Mass Index) values for use so the group derived it from the percentile values of both height and weight per age and sex and computed for the BMI for each percentile to be compared (P5 or 5<sup>th</sup> percentile, P50 or 50<sup>th</sup> percentile, and P95 or 95<sup>th</sup>

percentile). The CDC did not have BMI for the ages 1 month to 12 months so the BMI was also derived from the percentile values of height and weight for the specific age and sex. All reference values are shown in Table 2 for the boys and Table 3 for the girls.

Pediatric patients aged 1 month to 18 years were collected from the St. Luke's Medical Center clinical nutrition database from years 2000 to 2003. The age, sex, height and weight which were converted to BMI values were gathered. Percentile cut off values of the BMI from the different standards were used to segregate the population into lower P5, between P5 and P50, between P50 and P95, and above P95. The lower P5 represents the underweight population, the group within the P5 and P95 values represents the normal population, and the group above the P95 represents the obese population. The percentile grouping was analyzed per age group. Data analyzed were: number and percentages in the different nutritional status groups using the following standards: FNRI-PPS, IRS, CDC, and WHO-MGRS.

## RESULTS

A total of 24,957 patients were gathered with 13,887 males and 11,070 females (male to female ratio of 1.25 is to 1, Table 1). The BMI distribution showed skewness to the right (skewness = 2), with a mean of 18 and standard deviation of 4.95 (Figure 1).

Standards comparison, boys, 1 to 12 months (Figure 2, Table 4 and 6A): The FNRI-PPS standards yielded more patients on the outlying 95<sup>th</sup> percentile (>p95: 1,990 [54%]), while the less than 5<sup>th</sup> percentile and 5<sup>th</sup> to 95<sup>th</sup> percentile have similar numbers (<p5: 899 [25%] and p5\_p95: 785 [21%]). The IRS standards also yielded a similar pattern (>p95:1,373 [37%]; <p5: 1,226 [33%]; p5\_p95: 1,077 [29%]). The WHO-MGRS and CDC standards showed the highest numbers in the 5<sup>th</sup> to 95<sup>th</sup> percentile (WHO-MGRS: 2,020 [55%]; CDC: 1,899 [52%]) with lower numbers in the below 5<sup>th</sup> percentile (WHO-MGRS: 668 [18%]; CDC: 452 [12%]) and above 95<sup>th</sup> percentile values (WHO-MGRS: 986 [27%]; CDC: 1,323 [36%]).

Standards comparison, boys, 2 to 18 years (Figure 3, Table 4 and 6B): The FNRI-PPS standards showed similar pattern with the 1 to 12 month boys group having more values in the below 5<sup>th</sup> percentile (n=2,509 [25%]) and above 95<sup>th</sup> percentile (n=6,006 [58%]) compared to the central 5<sup>th</sup> to 95<sup>th</sup> percentile (n=1,698 [18%]). The CDC and WHO-MGRS showed highest values for the 5<sup>th</sup> and 95<sup>th</sup> percentile (CDC: 6,396 [60%]; WHO-MGRS: 6,203 [59%]) and lower values for the below 5<sup>th</sup> percentile (CDC: 1,634 [15%] versus WHO-MGRS: 1,230 [14%]) and above 95<sup>th</sup> percentile (CDC: 2,183 [25%] versus WHO-MGRS: 2,780 [27%]). The CDC however had higher values compared to the WHO-MGRS in the 5<sup>th</sup> to 95<sup>th</sup> percentile. The IRS had similar pattern with the CDC and WHO-MGRS, but its values were lower in the central p5-p95 group (n=3,978 [36%]) and higher in the <p5 (n=2,915 [30%]) and >p95 (n=3,320 [34%]).

Standards comparison, girls, 1 to 12 months (Figure 4, Tables 5 and 6A): The FNRI-PPS and IRS standards showed similar patterns of higher values for the below 5<sup>th</sup> percentile (FNRI-PPS: 913 [34%] versus IRS: 1,035 [38%]) and above 95<sup>th</sup> percentile (FNRI-PPS: 1,359 [50%] versus IRS: 941 [35%]) compared to the central 5<sup>th</sup> to 95<sup>th</sup> percentile (FNRI-PPS: 430 [16%] versus IRS: 726 [27%]). The CDC and WHO-MGRS, however, showed highest values for the 5<sup>th</sup> to 95<sup>th</sup> percentile (CDC: 1,528 [57%]; WHO-MGRS: 1,587 [59%]) and lower values for the below 5<sup>th</sup> percentile (CDC: 507 [19%]; WHO-MGRS: 544 [20%]) and above 95<sup>th</sup> percentile (CDC: 667 [25%]; WHO-MGRS: 571 [21%]).

Standards comparison, girls, 2 to 18 years (Figure 5, Table 5 and 6B): The FNRI-PPS standard showed lower 5<sup>th</sup> to 95<sup>th</sup> percentile values (n=1,399 [17%]) compared to the outlying below 5<sup>th</sup> percentile (n=2,229 [28%]) and above 95<sup>th</sup> percentile (n=4,740 [55%]) while the CDC, WHO-MGRS, and IRS showed the opposite (<5<sup>th</sup> percentile: CDC: 1,310 [16%]; WHO-MGRS: 1,001 [14%], and IRS: 2,377 [31%]; >95<sup>th</sup> percentile: CDC: 1,220 [17%]; WHO-MGRS: 1,662 [20%], and IRS: 2,292 [29%]; 5<sup>th</sup> to 95<sup>th</sup> percentile: CDC: 5,838 [67%], WHO-MGRS: 5,705 [66%], and IRS: 3,699 [40%]).

Statistics summary (Table 6, Figures 6 to 8): The CDC and the WHO-MGRS standards showed the highest numbers in the 5<sup>th</sup> to 95<sup>th</sup> percentile groups compared to the outlying below 5<sup>th</sup> percentile and above 95<sup>th</sup> percentile. In males 59% (WHO-MGRS) to 60% (CDC) of the population is within the 5<sup>th</sup> to 95<sup>th</sup> percentile group, 14% (WHO-MGRS) to 15% (CDC) is below the 5<sup>th</sup> percentile, and 25% (CDC) to 27% (WHO-MGRS) is above the 95<sup>th</sup> percentile. In females 66% (WHO-MGRS) to 67% (CDC) of the population is within the 5<sup>th</sup> to 95<sup>th</sup> percentile, 14% (WHO-MGRS) to 16% (CDC) are below the 5<sup>th</sup> percentile, and 17% (CDC) to 20% (CDC) is above the 95<sup>th</sup> percentile. The distribution pattern of the WHO-MGRS in both male and female population in the one to 12 month age group is more symmetrical and well distributed compared to the CDC growth standard, but in the two (2) to eighteen (18) year olds the distribution pattern is similar.

The IRS showed similar pattern as the CDC and WHO-MGRS, but had lower values in the central 5<sup>th</sup> to 95<sup>th</sup> percentile and higher values in the outlying below 5<sup>th</sup> and above 95<sup>th</sup> percentile. In males 36% of the population is within the 5<sup>th</sup> to 95<sup>th</sup> percentile group, 30% is below the 5<sup>th</sup> percentile, and 34% is above the 95<sup>th</sup> percentile. In females 40% of the population is within the 5<sup>th</sup> to 95<sup>th</sup> percentile, 31% are below the 5<sup>th</sup> percentile, and 29% is above the 95<sup>th</sup> percentile.

The FNRI-PPS values are the opposite of the WHO-MGRS, CDC, and IRS based data. In males 18% of the population is within the 5<sup>th</sup> to 95<sup>th</sup> percentile group, 25% is below the 5<sup>th</sup> percentile, and 58% is above the 95<sup>th</sup> percentile. In females 17% of the population is within the 5<sup>th</sup> to 95<sup>th</sup> percentile, 28% is below the 5<sup>th</sup> percentile, and 55% is above the 95<sup>th</sup> percentile.

## **DISCUSSION**

The normal pattern of distribution for all the standards would be a higher 5<sup>th</sup> to 95<sup>th</sup> percentile number compared to a lower below 5<sup>th</sup> percentile and above 95<sup>th</sup> percentile number as would be expected from a normal population (7). The data showed that the FNRI-PPS standards resulted to an opposite pattern while the WHO-MGRS, CDC, and IRS showed the normal pattern. The WHO-MGRS and CDC standards yielded the highest results for the central 5<sup>th</sup> to 95<sup>th</sup> percentile group and lowest in the below 5<sup>th</sup> and above 95<sup>th</sup> percentile compared to the IRS standards. The WHO-MGRS and CDC standards thus come closest to producing the normal distribution pattern for the pediatric population. There was a difference between these two standards in the one to twelve month age group, where the WHO-MGRS standard yielded a more symmetrical distribution (Figure 6). This difference was not seen in the two to eighteen year old age group however (Figure 7).

The different results from the FNRI-PPS and IRS were analyzed by comparing the values of the four standards (FNRI-PPS, IRS, CDC, and WHO-MGRS) in the 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentile groupings. The 5<sup>th</sup> percentile curves (Figure 9, in this instance showing the values from the female population; Table 3) showed the FNRI-PPS and IRS higher compared to the CDC and WHO-MGRS values. This was due to the assignment of higher cut-off values for both the FNRI-PPS and IRS standards, which resulted to higher “total count” values in the below 5<sup>th</sup> percentile and smaller “total count” values in the 5<sup>th</sup> to 95<sup>th</sup> percentile group in both FNRI-PPS and IRS standards compared to the CDC and WHO-MGRS. The 95<sup>th</sup> percentile curves (Figure 10, also showing the data from the female population; Table 3) showed higher “total count” values for the CDC and WHO-MGRS indicating lower cut-off values for the FNRI-PPS and IRS for the 95<sup>th</sup> percentile compared to the CDC and WHO-MGRS, thus assigning more patients in the above 95<sup>th</sup> percentile. This resulted to lower “total count” values in the 5<sup>th</sup> to 95<sup>th</sup> percentile group, but higher “total count” values above 95<sup>th</sup> percentile numbers for the FNRI-PPS and IRS standards.

## CONCLUSION

The 5<sup>th</sup> percentile cut off values for the FNRI-PPS and IRS were higher compared to the WHO-MGRS and CDC standards while the 95<sup>th</sup> percentile cut off values were lower, thus resulting to higher outlying statistics in both below 5<sup>th</sup> and above 95<sup>th</sup> percentile groups.

The WHO-MGRS child growth standard is the preferred tool for use in BMI-based nutrition screening of pediatric patients in the 1 to 12 month age group, whereas the CDC and WHO-MGRS growth standards yield similar results for the 2 to 18 year olds.

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## TABLES

Table 1: Patient Profile (age and sex distribution)

Age group	Number	Male	Female
1 month old	407	223	184
2 month old	187	124	63
3 month old	201	130	71
4 month old	243	153	90
5 month old	262	153	109
6 month old	255	151	104
7 month old	291	190	101
8 month old	293	165	128
9 month old	306	166	140
11 month old	311	193	118
12 month old	292	165	127
1 year old	3328	1861	1467
2 year old	2567	1470	1097
3 year old	1946	1090	856
4 year old	1845	1013	832
5 year old	1591	896	695
6 year old	1354	784	570
7 year old	1196	688	508
8 year old	998	562	436
9 year old	911	527	384
10 year old	805	443	362
11 year old	715	391	324
12 year old	669	372	297
13 year old	570	332	238
14 year old	622	345	277
15 year old	564	307	257
16 year old	668	328	340
17 year old	739	323	416
18 year old	821	342	479
<b>Total</b>	<b>24957</b>	<b>13887</b>	<b>11070</b>
<b>Male to female ratio</b>	<b>1.25:1</b>		

Table 2: BMI Reference Values: Boys (1 month to 18 years)

Age	FNRI			IRS			CDC			WHO		
	p5	p50	p95	p5	p50	p95	p5	p50	p95	p5	p50	p95
1m	14.21	14.57	15.42	12.55	14.42	15.73	7.54	9.85	13.83	12.80	14.90	17.30
2m	14.91	15.52	16.37	13.08	15.40	16.75	8.50	10.86	14.60	14.10	16.30	18.80
3m	15.35	16.10	16.92	13.64	16.07	17.25	10.20	12.60	15.20	14.70	16.90	19.40
4m	15.66	16.44	17.12	14.50	16.51	17.68	11.20	13.60	16.40	15.00	17.20	19.70
5m	15.65	16.60	17.27	15.07	16.81	18.01	11.80	14.28	17.00	15.10	17.30	19.80
6m	15.60	16.56	17.19	15.42	16.97	18.03	12.70	15.10	17.80	15.20	17.30	19.90
7m	15.45	16.60	17.13	15.81	16.56	18.31	13.40	15.30	18.20	15.20	17.30	19.90
8m	15.38	16.65	17.06	16.23	17.46	18.52	14.00	16.00	19.00	15.10	17.30	19.80
9m	15.41	16.81	17.06	16.44	17.60	18.53	14.40	16.53	19.40	15.10	17.20	19.70
10m	15.37	16.85	16.97	16.45	17.54	18.57	15.00	16.70	19.50	15.00	17.00	19.50
11m	15.27	16.80	16.88	16.50	17.65	18.45	15.30	17.10	19.80	14.90	16.90	19.40
12m	15.30	16.78	16.84	16.58	17.61	18.52	15.20	17.00	19.70	14.80	16.80	19.20
2yr	15.27	15.81	15.99	16.24	16.79	18.31	14.70	16.60	19.40	13.90	15.70	18.00
3yr	14.98	15.36	15.64	15.25	16.21	17.25	14.30	16.00	18.20	13.70	15.60	17.80
4yr	14.98	15.16	15.65	14.79	15.77	16.61	14.10	15.60	17.80	13.40	15.30	17.60
5yr	14.82	14.96	15.44	14.50	15.48	16.37	13.90	15.40	18.00	13.30	15.20	17.70
6yr	14.56	14.74	15.20	14.38	15.36	16.56	13.80	15.40	18.40	13.39	15.31	17.85
7yr	14.33	14.61	15.12	14.41	15.46	17.10	13.70	15.50	19.10	13.50	15.48	18.26
8yr	14.36	14.65	15.21	14.46	15.69	17.89	13.80	15.80	20.00	13.67	15.74	18.80
9yr	14.52	14.81	15.52	14.52	16.08	18.88	14.00	16.20	21.10	13.87	16.05	19.45
10yr	14.69	15.06	16.01	14.64	16.61	19.92	14.20	16.60	22.00	14.13	16.44	20.23
11yr	14.86	15.39	16.66	14.93	17.19	20.83	14.50	17.20	23.10	14.47	16.94	21.11
12yr	15.03	15.78	17.39	15.44	17.76	21.45	15.00	17.80	24.10	14.89	17.53	22.09
13yr	15.25	16.44	18.10	16.11	18.37	21.88	15.40	18.50	25.10	15.40	18.23	23.14
14yr	15.57	17.10	18.65	16.98	19.10	22.42	15.90	19.10	26.00	15.98	19.01	24.22
15yr	16.51	17.91	19.26	17.70	19.85	23.23	16.60	19.80	26.80	16.55	19.77	25.23
16yr	17.53	18.53	19.88	18.28	20.63	24.26	17.00	20.60	27.60	17.08	20.50	26.13
17yr	18.40	19.04	20.58	18.90	21.36	25.28	17.60	21.20	28.20	17.54	21.14	26.90
18yr	19.05	19.46	21.10	19.63	22.04	26.11	18.20	21.90	28.90	17.93	21.71	27.54

Table 3: BMI Reference Values: Girls (1 month to 18 years)

Age	FNRI			IRS			CDC			WHO		
	p5	p50	p95	p5	p50	p95	p5	p50	p95	p5	p50	p95
1m	13.18	13.87	14.51	12.10	13.98	14.92	8.98	11.81	15.12	12.40	14.60	17.00
2m	14.27	14.96	15.24	12.91	14.57	15.74	10.42	13.02	15.63	13.50	15.80	18.40
3m	14.91	15.62	15.77	13.64	15.25	16.56	11.20	13.60	16.00	14.00	16.40	19.00
4m	15.25	16.00	16.26	14.07	15.61	16.89	12.20	14.05	16.64	14.30	16.70	19.40
5m	15.30	16.15	16.38	14.82	16.31	17.31	13.03	15.09	17.49	14.50	16.80	19.60
6m	15.27	16.26	16.48	15.29	16.58	17.60	13.39	15.31	18.18	14.60	16.90	19.60
7m	15.34	16.36	16.61	15.52	16.85	17.94	13.67	16.05	18.73	14.60	16.90	19.60
8m	15.41	16.42	16.67	15.82	17.17	18.14	13.90	16.40	19.10	14.60	16.80	19.60
9m	15.47	16.42	16.67	16.07	17.35	18.18	14.17	16.75	19.45	14.50	16.70	19.40
10m	15.51	16.50	16.72	16.17	17.26	18.21	14.57	16.65	19.51	14.40	16.60	19.30
11m	15.55	16.50	16.63	16.20	17.22	18.05	14.65	16.60	19.78	14.30	16.50	19.10
12m	15.61	16.49	16.58	16.10	17.21	17.95	14.69	16.99	19.74	14.20	16.40	19.00
2yr	15.52	15.98	15.72	15.78	16.53	17.49	14.40	16.40	19.10	13.50	15.40	17.80
3yr	14.94	15.37	15.44	15.18	15.99	17.30	14.00	15.70	18.30	13.50	15.40	17.80
4yr	14.73	14.97	15.22	14.63	15.50	16.97	13.80	15.30	18.00	13.20	15.30	17.90
5yr	14.43	14.69	15.05	14.19	15.06	16.58	13.50	15.20	18.20	13.10	15.30	18.10
6yr	14.17	14.47	14.98	13.93	14.85	16.61	13.40	15.20	18.80	13.09	15.27	18.37
7yr	13.98	14.36	14.84	13.89	14.99	17.09	13.40	15.40	19.60	13.13	15.40	18.81
8yr	13.90	14.40	14.86	14.07	15.52	18.14	13.60	15.80	20.60	13.29	15.68	19.44
9yr	13.96	14.62	15.08	14.43	16.31	19.44	13.70	16.30	21.80	13.57	16.10	20.23
10yr	14.26	15.14	15.63	14.73	16.99	20.64	14.00	16.80	23.00	13.92	16.61	21.14
11yr	14.71	15.99	16.56	15.00	17.65	21.72	14.40	17.40	24.10	14.36	17.25	22.15
12yr	15.25	16.87	17.71	15.19	18.08	22.48	14.80	18.10	25.20	14.90	18.00	23.28
13yr	15.79	17.89	19.20	15.67	18.68	23.11	15.30	18.70	26.20	15.44	18.74	24.33
14yr	16.47	18.61	20.03	16.62	19.55	23.90	15.80	19.30	27.20	16.04	19.57	25.47
15yr	17.36	19.21	20.67	17.75	20.51	24.72	16.30	19.90	28.10	16.49	20.21	26.34
16yr	17.86	19.73	21.00	18.63	21.20	25.34	16.80	20.40	28.90	16.82	20.70	26.97
17yr	18.14	20.05	21.33	18.94	21.31	25.61	17.20	20.90	29.60	17.03	21.04	27.39
18yr	18.33	20.24	21.67	18.87	21.12	25.55	17.60	21.30	30.30	17.15	21.26	27.65

Table 4: Statistics: Boys (1 month to 18 years)

Age	FNRI			CDC			IRS			WHO			total
	<p5	p5_p95	>p95	<p5	p5_p95	>p95	<p5	p5_p95	>p95	<p5	p5_p95	>p95	
1m	94	27	102	2	101	120	56	76	91	58	106	59	<b>223</b>
2m	44	24	56	4	45	75	20	54	50	27	65	32	<b>124</b>
3m	47	18	65	4	55	71	23	48	59	35	64	31	<b>130</b>
4m	42	29	82	6	64	83	22	59	72	30	82	41	<b>153</b>
5m	55	24	74	17	77	59	43	51	59	43	70	40	<b>153</b>
6m	36	28	87	15	70	66	34	50	67	31	83	37	<b>151</b>
7m	41	41	108	23	104	63	50	56	84	36	109	45	<b>190</b>
8m	45	33	87	26	86	53	55	47	63	42	73	50	<b>165</b>
9m	31	37	98	28	95	43	50	60	57	28	97	41	<b>166</b>
10m	44	32	117	42	106	45	62	59	72	38	104	51	<b>193</b>
11m	33	31	101	32	91	42	56	42	67	28	91	46	<b>165</b>
12m	387	461	1013	253	1005	603	755	475	632	272	1076	513	<b>1861</b>
2yr	389	203	878	267	910	293	655	398	417	159	841	470	<b>1470</b>
3yr	280	161	649	163	680	247	345	381	364	99	705	286	<b>1090</b>
4yr	326	117	570	173	541	299	292	292	429	95	605	313	<b>1013</b>
5yr	294	129	473	155	518	223	236	293	367	89	575	232	<b>896</b>
6yr	228	113	443	131	464	189	212	321	251	93	482	209	<b>784</b>
7yr	188	87	413	107	406	175	197	269	222	94	383	211	<b>688</b>
8yr	123	79	360	77	347	138	133	220	209	73	314	175	<b>562</b>
9yr	94	78	355	59	340	128	94	228	205	56	288	183	<b>527</b>
10yr	88	66	289	65	280	98	88	219	136	62	251	130	<b>443</b>
11yr	77	64	250	65	245	81	80	198	113	60	223	108	<b>391</b>
12yr	57	98	217	57	236	79	74	171	127	53	200	119	<b>372</b>
13yr	46	89	197	52	231	49	67	164	101	52	206	74	<b>332</b>
14yr	31	112	202	39	259	47	71	175	99	39	234	72	<b>345</b>
15yr	43	79	185	46	208	53	73	139	95	45	192	70	<b>307</b>
16yr	85	76	167	67	237	24	113	154	61	69	220	39	<b>328</b>
17yr	80	73	170	54	241	28	91	170	62	50	234	39	<b>323</b>
18yr	80	74	188	57	253	32	94	186	62	42	250	50	<b>342</b>
<b>Total</b>	<b>3408</b>	<b>2483</b>	<b>7996</b>	<b>2086</b>	<b>8295</b>	<b>3506</b>	<b>4141</b>	<b>5055</b>	<b>4693</b>	<b>1898</b>	<b>8223</b>	<b>3766</b>	<b>13887</b>

Table 5: Statistics: Girls (1 month to 18 years)

Age	FNRI			CDC			IRS			WHO			Total
	<p5	p5_p95	>p95	<p5	p5_p95	>p95	<p5	p5_p95	>p95	<p5	p5_p95	>p95	
1m	58	34	92	4	97	83	44	54	86	47	91	46	<b>184</b>
2m	19	11	33	3	29	31	12	22	29	13	40	10	<b>63</b>
3m	19	9	43	4	27	40	11	24	36	13	44	14	<b>71</b>
4m	26	14	50	5	39	46	16	30	44	18	55	17	<b>90</b>
5m	34	16	59	14	44	51	30	27	52	29	55	25	<b>109</b>
6m	30	21	53	13	60	31	30	40	34	24	67	13	<b>104</b>
7m	33	17	51	18	57	26	37	29	35	27	55	19	<b>101</b>
8m	44	20	64	23	72	33	51	30	47	31	71	26	<b>128</b>
9m	52	20	68	26	87	27	62	37	41	32	79	29	<b>140</b>
10m	45	15	58	36	64	18	52	31	35	35	61	22	<b>118</b>
11m	46	12	69	26	74	27	52	30	45	23	68	36	<b>127</b>
12m	507	241	719	335	878	254	638	372	457	252	901	314	<b>1467</b>
2yr	400	36	661	201	684	212	440	273	384	92	671	334	<b>1097</b>
3yr	258	73	525	128	529	199	284	287	285	82	547	227	<b>856</b>
4yr	271	78	483	134	505	193	260	298	274	85	551	196	<b>832</b>
5yr	228	69	398	122	417	156	188	254	253	88	440	167	<b>695</b>
6yr	175	91	304	103	380	87	149	242	179	80	385	105	<b>570</b>
7yr	140	76	292	89	354	65	140	215	153	72	346	90	<b>508</b>
8yr	84	54	298	67	312	57	90	229	117	56	298	82	<b>436</b>
9yr	76	52	256	65	281	38	98	199	87	60	252	72	<b>384</b>
10yr	59	75	228	52	268	42	80	202	80	47	243	72	<b>362</b>
11yr	55	57	212	47	242	35	60	196	68	45	221	58	<b>324</b>
12yr	49	82	166	35	245	17	47	198	52	36	218	43	<b>297</b>
13yr	28	94	116	22	193	23	26	168	44	24	180	34	<b>238</b>
14yr	44	98	135	30	230	17	47	181	49	37	210	30	<b>277</b>
15yr	68	77	112	35	205	17	80	141	36	41	191	25	<b>257</b>
16yr	88	102	150	50	272	18	115	164	61	50	255	35	<b>340</b>
17yr	86	130	200	46	351	19	129	204	83	39	334	43	<b>416</b>
18yr	120	155	204	84	370	25	144	248	87	67	363	49	<b>479</b>
<b>Total</b>	<b>3142</b>	<b>1829</b>	<b>6099</b>	<b>1817</b>	<b>7366</b>	<b>1887</b>	<b>3412</b>	<b>4425</b>	<b>3233</b>	<b>1545</b>	<b>7292</b>	<b>2233</b>	<b>11070</b>

Table 6: Summary of Statistics

<b>Table 6A: Summary of Statistics; 1 to 12 months</b>						
<b>Girls</b>	<b>Numbers</b>			<b>Percent</b>		
N = 2,702	<p5	p5_p95	>p95	<p5	p5_p95	>p95
FNRI	913	430	1359	34%	16%	50%
IRS	1035	726	941	38%	27%	35%
CDC	507	1528	667	19%	57%	25%
WHO-MGRS	544	1587	571	20%	59%	21%
<b>Boys</b>	<b>Numbers</b>			<b>Percent</b>		
N = 3,674	<p5	p5_p95	>p95	<p5	p5_p95	>p95
FNRI	899	785	1990	25%	21%	54%
IRS	1226	1077	1373	33%	29%	37%
CDC	452	1899	1323	12%	52%	36%
WHO-MGRS	668	2020	986	18%	55%	27%
<b>Total</b>	<b>Numbers</b>			<b>Percent</b>		
N = 6,376	<p5	p5_p95	>p95	<p5	p5_p95	>p95
FNRI	1812	1215	3349	28%	19%	53%
IRS	2260	1802	2314	35%	28%	36%
CDC	959	3427	1990	15%	54%	31%
WHO-MGRS	1212	3607	1557	19%	57%	24%
FNRI = Food Nutrition Research Institute - Philippine Pediatric Society (1993) CDC = Center for Disease Control data (2000) based IRS = International Reference Standard (2003) based WHO-MGRS = World Health Organization Child Growth Standards, Multicenter Growth Reference Study						

<b>Table 6B: Summary of Statistics; 2 to 18 years</b>						
<b>Girls</b>	<b>Numbers</b>			<b>Percent</b>		
N = 8,368	<p5	p5_p95	>p95	<p5	p5_p95	>p95
FNRI	2229	1399	4740	28%	17%	55%
IRS	2377	3699	2292	31%	40%	29%
CDC	1310	5838	1220	16%	67%	17%
WHO-MGRS	1001	5705	1662	14%	66%	20%
<b>Boys</b>	<b>Numbers</b>			<b>Percent</b>		
N = 10,213	<p5	p5_p95	>p95	<p5	p5_p95	>p95
FNRI	2509	1698	6006	25%	18%	58%
IRS	2915	3978	3320	30%	36%	34%
CDC	1634	6396	2183	15%	60%	25%
WHO-MGRS	1230	6203	2780	14%	59%	27%
<b>Total</b>	<b>Numbers</b>			<b>Percent</b>		
N = 18,581	<p5	p5_p95	>p95	<p5	p5_p95	>p95
FNRI	4738	3097	10746	26%	17%	56%
IRS	5292	7677	5612	30%	38%	32%
CDC	2944	12234	3403	16%	63%	22%
WHO-MGRS	2231	11908	4442	14%	62%	24%
FNRI = Food Nutrition Research Institute - Philippine Pediatric Society (1993) CDC = Center for Disease Control data (2000) based IRS = International Reference Standard (2003) based WHO-MGRS = World Health Organization Child Growth Standards, Multicenter Growth Reference Study						

<b>Table 6C: Summary of Statistics; 1 month to 18 years</b>						
<b>Girls</b>	<b>Numbers</b>			<b>Percent</b>		
N = 11,070	<p5	p5_p95	>p95	<p5	p5_p95	>p95
FNRI	3142	1829	6099	28%	17%	55%
IRS	3412	4425	3233	31%	40%	29%
CDC	1817	7366	1887	16%	67%	17%
WHO-MGRS	1545	7292	2233	14%	66%	20%
<b>Boys</b>	<b>Numbers</b>			<b>Percent</b>		
N = 13,887	<p5	p5_p95	>p95	<p5	p5_p95	>p95
FNRI	3408	2483	7996	25%	18%	58%
IRS	4141	5053	4693	30%	36%	34%
CDC	2086	8295	3506	15%	60%	25%
WHO-MGRS	1898	8223	3766	14%	59%	27%
<b>Total</b>	<b>Numbers</b>			<b>Percent</b>		
N = 24,957	<p5	p5_p95	>p95	<p5	p5_p95	>p95
FNRI	6550	4312	14095	26%	17%	56%
IRS	7553	9478	7926	30%	38%	32%
CDC	3903	15661	5393	16%	63%	22%
WHO-MGRS	3443	15515	5999	14%	62%	24%
FNRI = Food Nutrition Research Institute - Philippine Pediatric Society (1993) CDC = Center for Disease Control data (2000) based IRS = International Reference Standard (2003) based WHO-MGRS = World Health Organization Child Growth Standards, Multicenter Growth Reference Study						

**FIGURES**

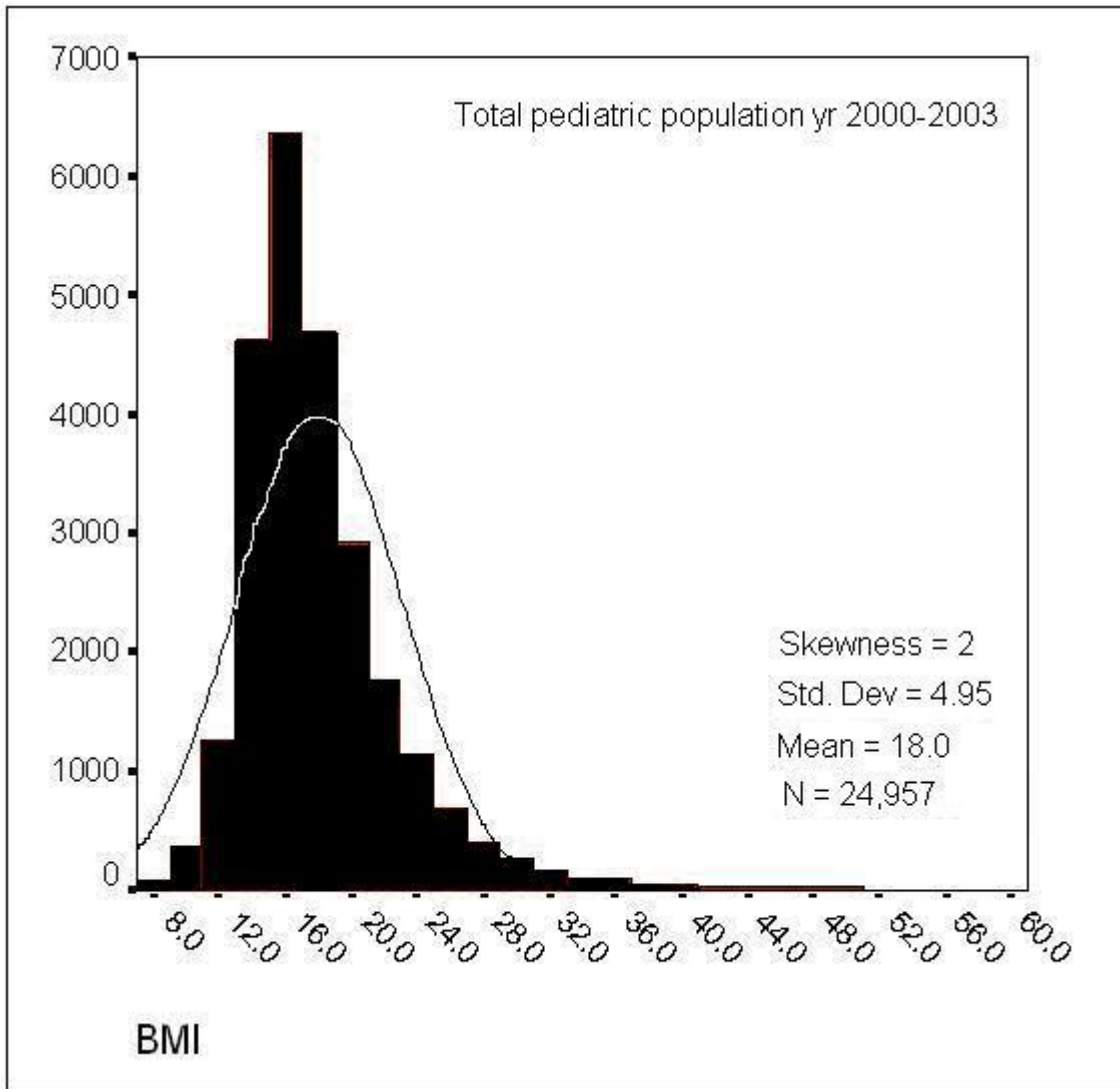


Figure 1: BMI distribution in all age groups

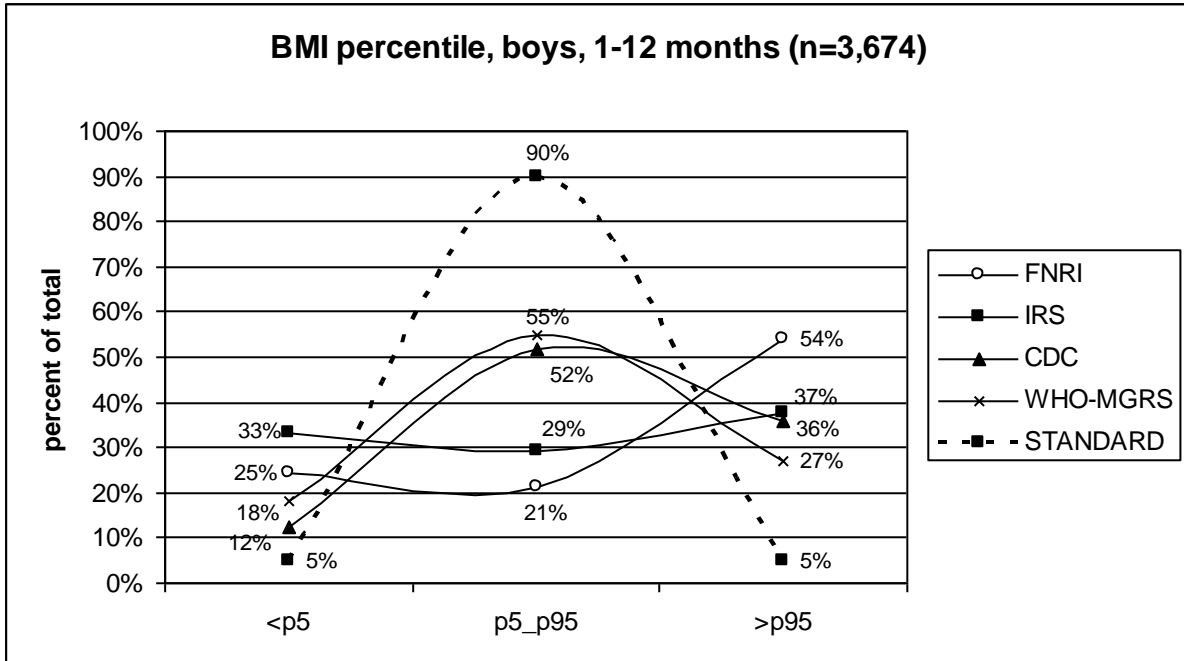


Figure 2: Comparison of results based on FNRI, IRS, CDC, and WHO-MGRS cut off percentile values (Boys 1 to 12 months)

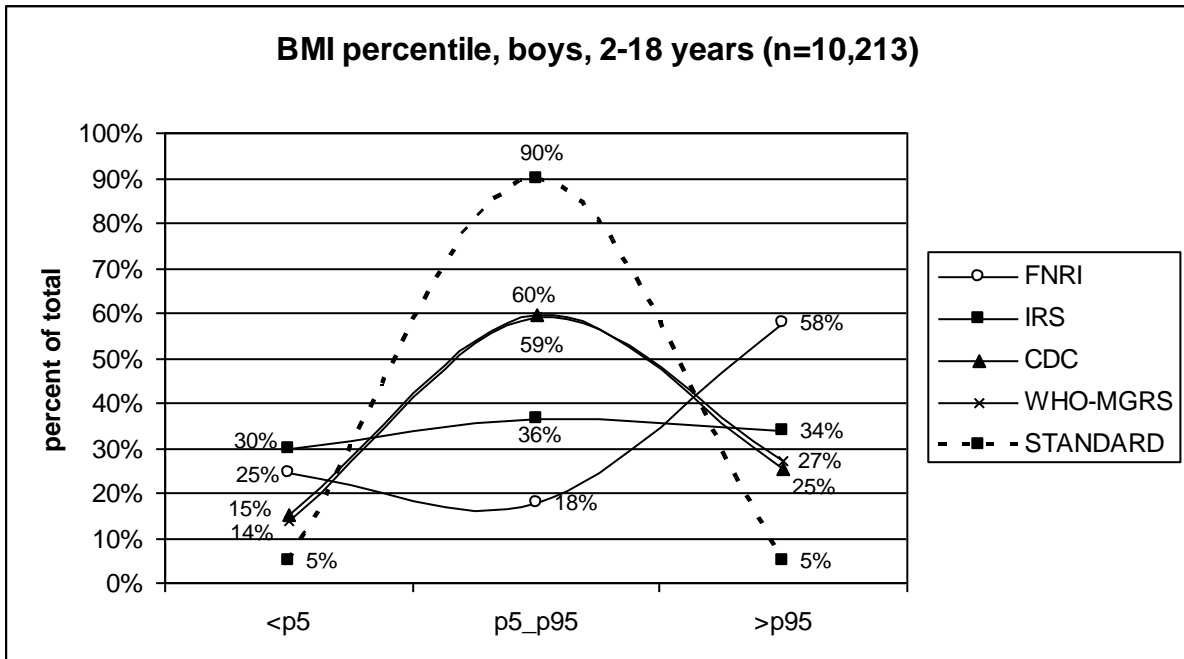


Figure 3: Comparison of results based on FNRI, IRS, CDC, and WHO-MGRS cut off percentile values (Boys 2 to 18 years)

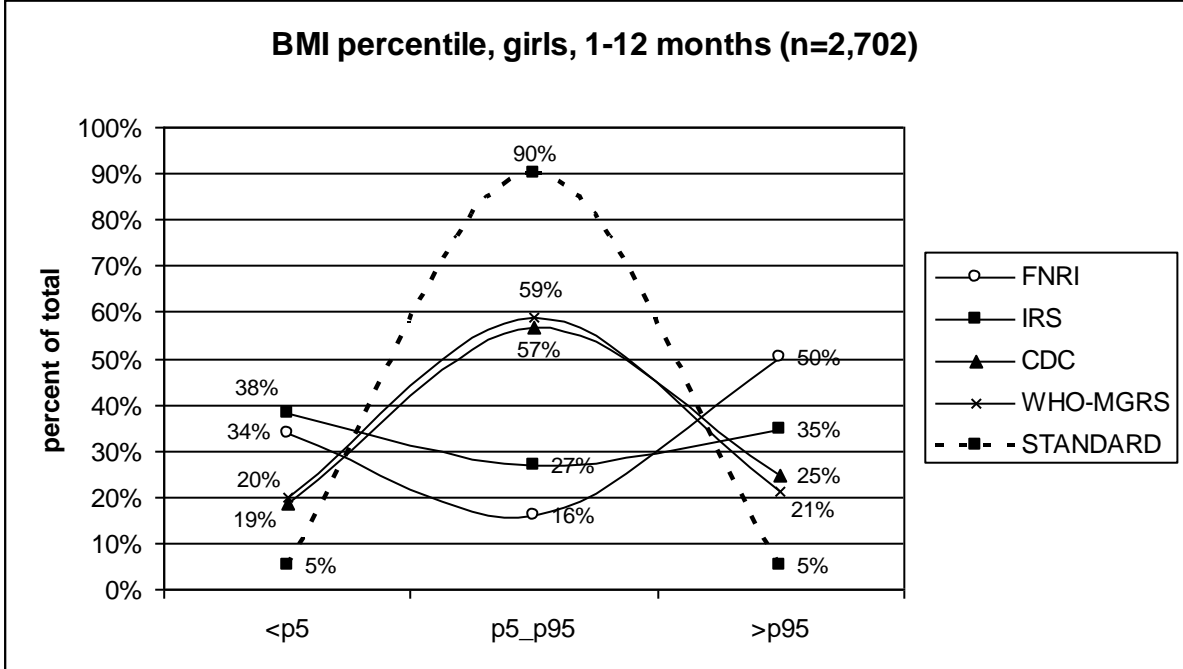


Figure 4: Comparison of results based on FNRI, IRS, CDC, and WHO-MGRS off percentile values (Girls 1 to 12 months)

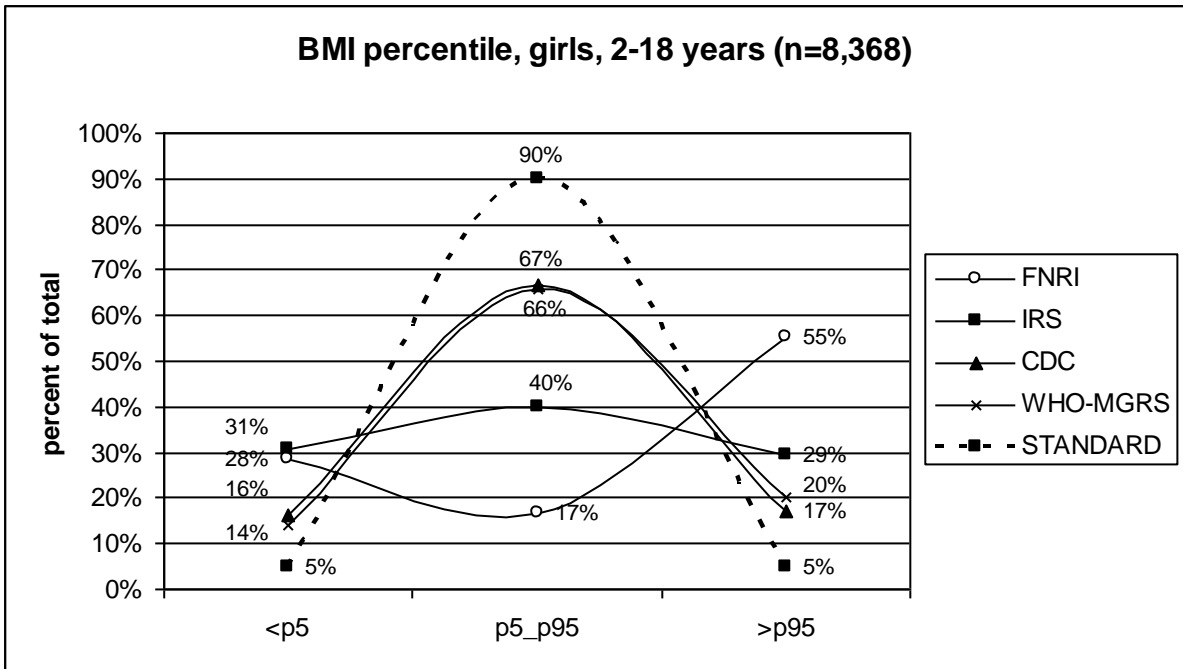


Figure 5: Comparison of results based on FNRI, IRS, CDC, and WHO-MGRS off percentile values (Girls 2 to 18 years)

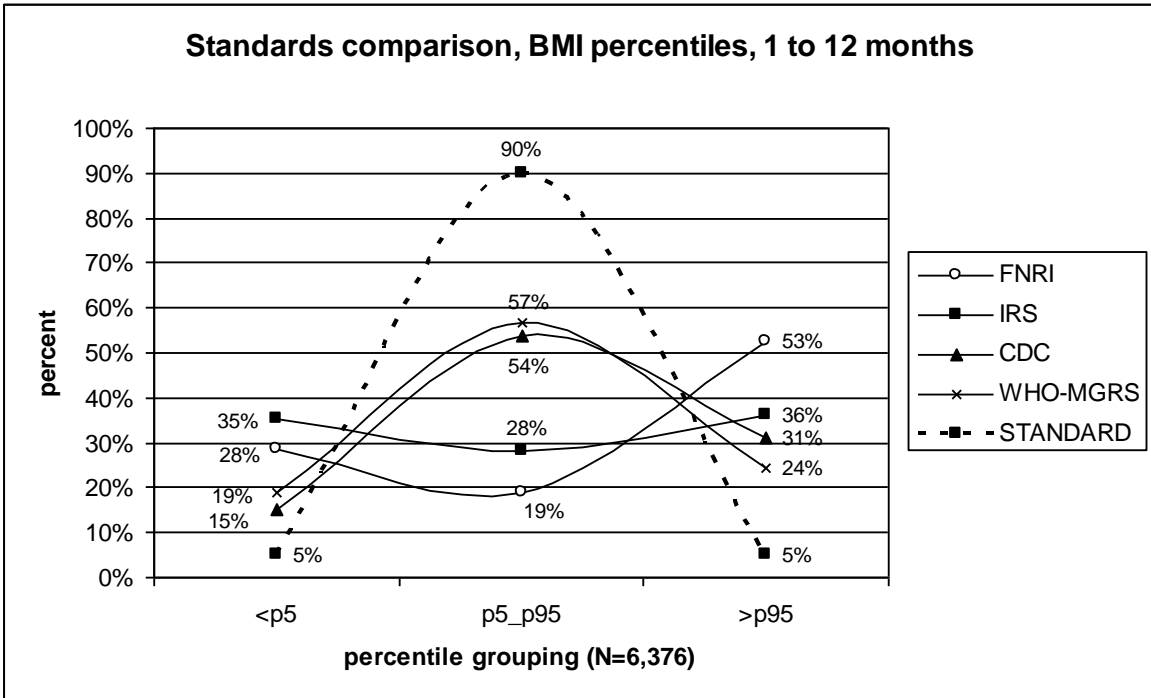


Figure 6: Summary of all percentiles, one (1) to 12 months

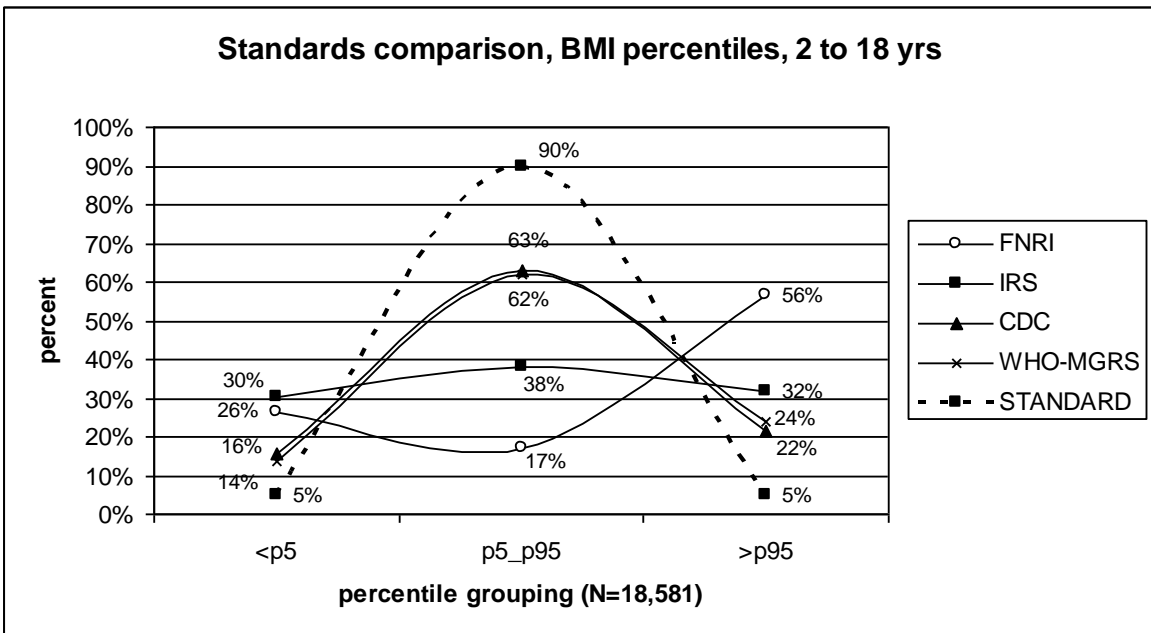


Figure 7: Summary of all percentiles, 2 to 18 years

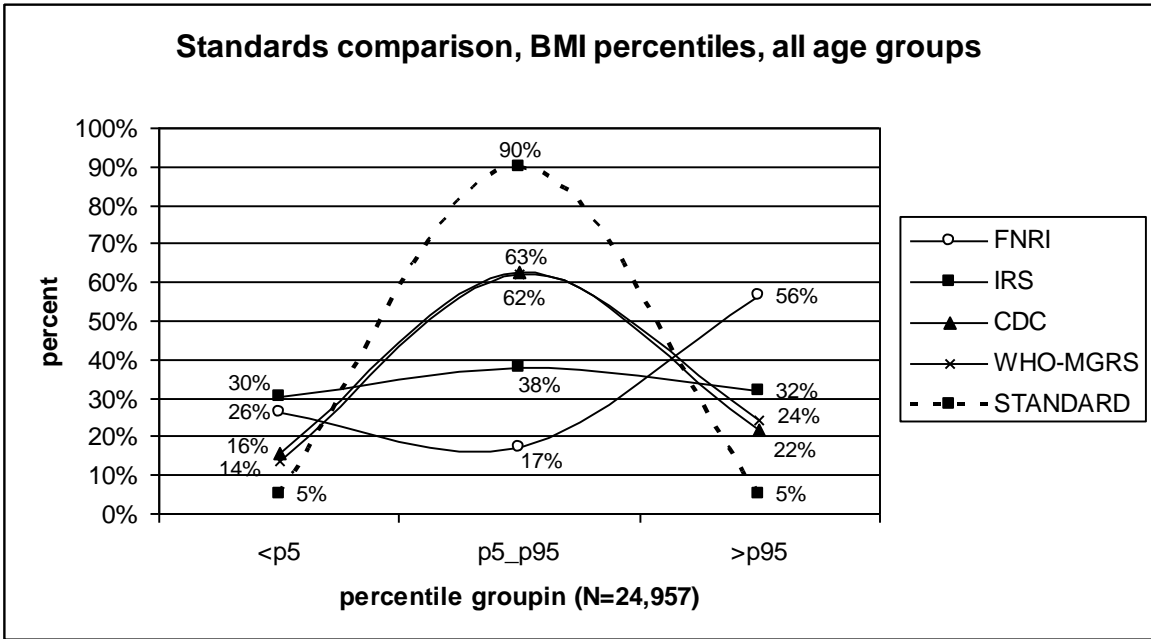


Figure 8: Summary of all percentiles, 1month to 18 years

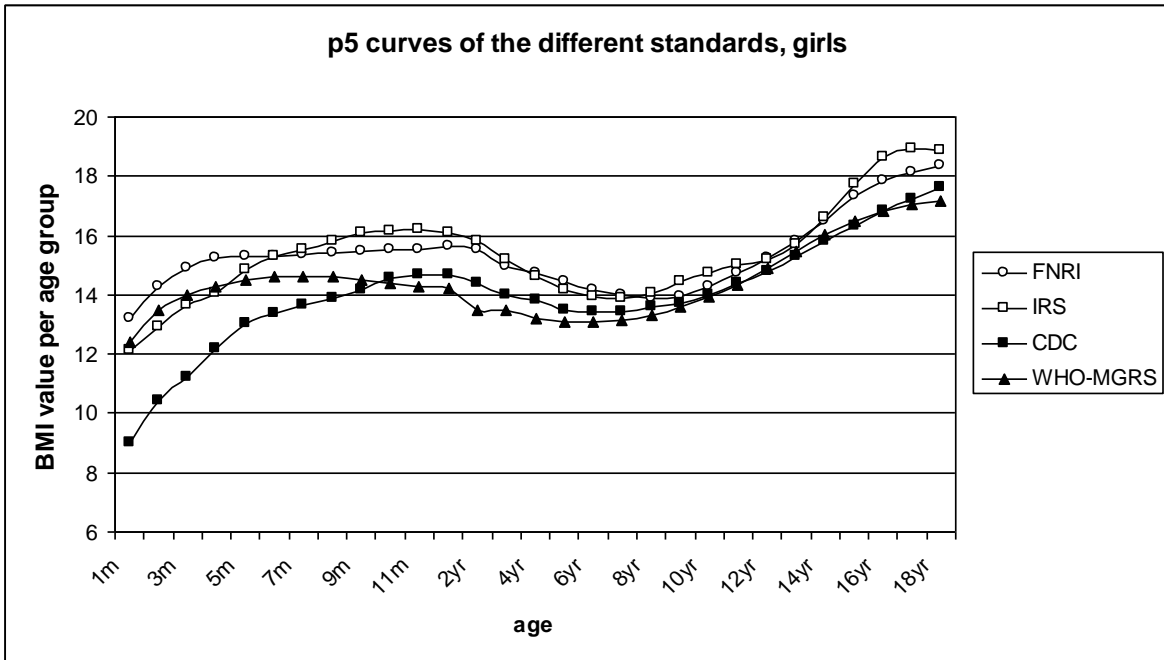


Figure 9: 5<sup>th</sup> percentile curve comparison between standards; all age groups, Girls

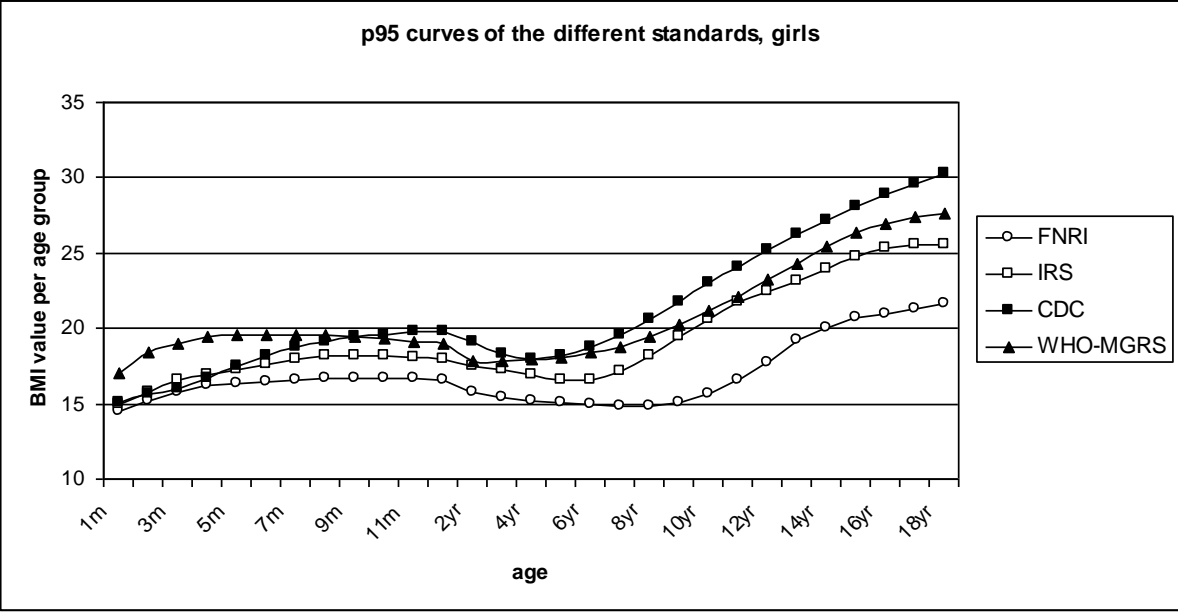


Figure 10: 95<sup>th</sup> percentile curve comparison between standards; all age groups, Girls