



AGE AND SEX SPECIFIC BODY MASS INDEX CUT-OFFS AMONG THE SCHOOL CHILDREN OF WEST BENGAL

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Introduction

Though the body mass index (BMI) was developed in long back by Adolphe Quetelet, is still used to see trends in health and illness. It provides an easy way to measure obesity and underweight despite in recent years, many researchers said that BMI is not the accurate way to measure body weight as this cannot estimate the visceral (abdominal) fat. But BMI is still proving useful in public health viewpoint to predict metabolic health disorders as well as malnutrition. Recent studies showed that 'Asian populations have an increased risk of developing cardio metabolic disorders at a lower body mass index (BMI) than other ethnic groups', therefore periodic assessment of BMI in population is important. Moreover, except few reports, BMI cut-offs below 18 years of age are not available. BMI calculation by using percentile chart is not user friendly, particularly in field practice.

Aims

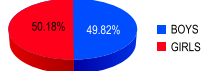
- To develop the age and sex specific cut-offs for BMI to identify the under-weight, normal-weight, over-weight and obesity among the School children of West Bengal.
- To determine the prevalence of under weight, overweight and obesity among children.
- To understand BMI more simply by using this cut-offs in the age group of 5 to 16 years.

Materials and Methods

The present study was conducted both in Panchayet and municipal area of Bardhaman district, West Bengal, India. 15357 children (Boys-7651, Girls-7706) aged between 5 to 16 years were included in this cross-sectional school based study. Students were participated in this study from various government schools. Personnel were specifically trained for different anthropometric measurements in this study. Height was measured by the anthropometric rod and weight measurement was made by standard digital weighing scale. Both the equipments were calibrated at regular intervals. Body mass index (BMI) was calculated using the established formula -

$$BMI = \frac{Weight (kg)}{[Height (m) \times Height (m)]}$$

GENDER DISTRIBUTION IN THIS STUDY



The Cut-off values of BMI was determined by calculating the age and sex specific percentiles of BMI and then by using the standard cut-offs of BMI percentiles.

Result

This study explores age and sex specific BMI cut-off values among the school students of 5-16 years of age (Boys & Girls) in West Bengal.

It is seen that control limit of BMI values for under weight is lesser for boys and girls than suggested by previous reports in all age groups.

It is also found that the cut off values for over weight boys is lower than the CDC cut offs in the age range of 5-16 years and it is higher than WHO cut off s in the age range of 7-16 years.

In the present study it is observed that the cut off values of obesity boys for this particular population is higher than both the CDC 2000 and WHO 2007 cut offs.

The BMI cut off values of over weight girls is found to be higher than WHO and CDC cut off in the age range of 5-16 and 6-9 years respectively while it s lower than the CDC cut off in the age range of 10-16 years.

The cut-off values of obesity for girls is higher than CDC and WHO in the age range of 5 – 12 and 5 – 16 years respectively. But it is lesser than CDC obesity cut-offs for girls in the range of 13 – 16 years.

AGE	UNDER WEIGHT	NORMAL WEIGHT	OVER WEIGHT	OBESE
5	10.10	14.50	15.90	17.30
6	11.10	14.90	16.30	18.50
7	11.40	15.90	17.80	19.80
8	11.60	16.10	18.30	21.40
9	11.90	16.80	20.00	21.95
10	12.60	17.50	20.30	23.30
11	12.80	18.70	22.70	24.60
12	13.00	19.80	24.40	25.95
13	13.60	20.40	24.70	26.20
14	13.80	20.90	24.90	26.50
15	14.20	21.50	25.30	26.90
16	15.20	22.60	25.75	28.70

AGE AND SEX SPECIFIC BMI CUT-OFF VALUES FOR SCHOOL STUDENTS (BOYS)

Table-1: The age specific BMI cut-offs for the boys of West Bengal

AGE	UNDER WEIGHT	NORMAL WEIGHT	OVER WEIGHT	OBESE
5	10.00	16.00	18.00	19.30
6	10.60	17.60	21.10	21.75
7	11.30	18.80	21.80	23.15
8	12.20	19.60	22.60	24.50
9	12.80	19.80	22.80	24.90
10	13.20	19.90	22.90	25.00
11	13.90	20.50	23.10	25.15
12	14.25	20.90	23.65	25.80
13	14.60	21.00	23.80	26.00
14	15.00	21.30	24.10	26.30
15	15.20	21.90	24.50	26.70
16	15.50	22.10	24.90	27.60

AGE SPECIFIC BMI CUT-OFF VALUES FOR SCHOOL STUDENTS (GIRLS)

Table-2: The age specific BMI cut-offs for the girls of West Bengal

Interpretation of BMI cut-offs (Boys & Girls) in accordance with our determined BMI cut-off values.

For Boys

Age (Years)	Under Weight(%)	Normal Weight(%)	Over Weight(%)	Obese(%)
5	8.00	69.09	18.18	4.73
6	14.55	69.37	6.15	9.93
7	17.07	67.94	8.77	6.23
8	13.73	66.76	11.27	8.24
9	15.00	69.26	9.17	6.57
10	19.36	61.83	10.89	7.92
11	12.89	61.75	17.91	7.45
12	10.21	66.38	16.74	6.67
13	11.52	66.46	17.28	4.73
14	8.94	65.88	19.29	5.88
15	7.99	71.88	16.61	3.51
16	7.59	80.00	5.51	6.89

Table-3: Table shows that prevalence of under weight lies between 10% -19% in the age group of 6-13 years, over weight lies between 11% -19% in the age group of 10-15 years and obesity varies from 4% -10% in the age group of 5-16 years. Exceptionally 18.18% boys are over weight at the age of 5 year.

Comparison of under weight status among boys & girls with respect to different age

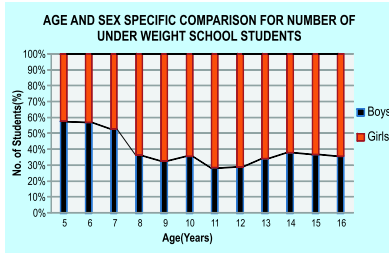
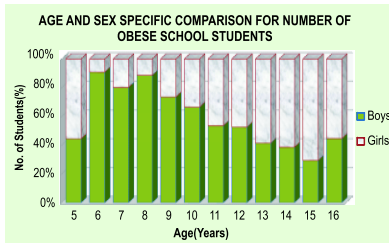


Figure-3: The prevalence of under weight is markedly higher among girls than boys in the age range of 8-16 years while it is slightly higher among the boys than girls of 5-7 years. Moreover it is evident that at the age of 11 and 12 years (at the beginning of adolescent phase) the prevalence of under weight is maximum (>70%) for girls.

Comparison of obesity status among boys & girls with respect to different age groups.



For Girls

Age (Years)	Under Weight(%)	Normal Weight(%)	Over Weight(%)	Obese(%)
5	5.92	83.97	4.18	5.92
6	11.05	83.08	4.90	1.00
7	15.27	80.12	3.08	1.54
8	24.26	71.61	3.07	1.06
9	30.81	62.53	4.28	2.37
10	34.82	56.39	4.79	4.00
11	32.52	54.21	6.80	6.47
12	25.16	60.29	8.44	6.01
13	22.13	57.63	13.55	6.69
14	14.68	64.04	11.93	9.36
15	13.81	66.75	11.00	8.44
16	13.71	65.71	12.00	8.57

Table-4: The prevalence of underweight in 8-13 years of school girls is very high (22-35%) while it lies between 11-13% in 13-16 years of girls. It is also evident that the prevalence of obesity is maximum (5.92%) at the age of 5 years in 5-10 year girls and maximum (9.36%) at the age of 14 years in 11-16 year age range.

Comparison of over weight status among boys & girls with respect to different age

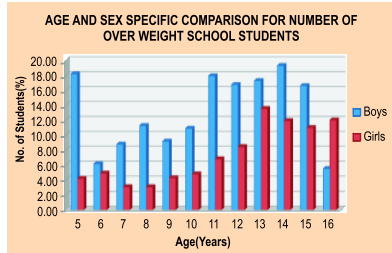


Figure-4: It is apparent from the graph that the prevalence of over weight is comparatively higher for the boys than girls through out the age range of 5-15 years. An important observation from the study is that, the prevalence of over weight among the boys is considerably higher at the age of 5 year where as opposite phenomenon occurred at the age of 16 year.

Comparison of obesity status among boys & girls with respect to different age groups.

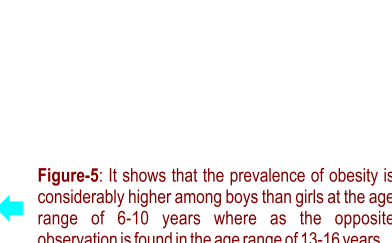


Figure-5: It shows that the prevalence of obesity is considerably higher among boys than girls at the age range of 6-10 years where as the opposite observation is found in the age range of 13-16 years.

Comparison of Age and sex specific body mass index (BMI) cut off values of present study with CDC 2000 and WHO 2007 .

- Centre for Disease Control (CDC) - A
- World Health Organization (WHO) - B
- Present Study - C

Comparison of cut-offs for under weight boys among CDC 2000, WHO 2007 and the present study

Age (years)	A	B	C
5	13.84	13.40	10.10
6	13.74	13.40	11.10
7	13.72	13.50	11.40
8	13.79	13.70	11.60
9	13.95	13.90	11.90
10	14.20	14.10	12.60
11	14.54	14.50	12.80
12	14.96	14.90	13.00
13	15.44	15.40	13.60
14	15.96	16.00	13.80
15	16.52	16.50	14.20
16	17.10	17.10	15.20

Table-5 A: The table shows that cut-off values obtained from this study for under weight boys of different age range (5-16 years) is lower than the Centre for Disease Control (CDC) 2000 and World Health Organization (WHO) 2007 cut-offs.

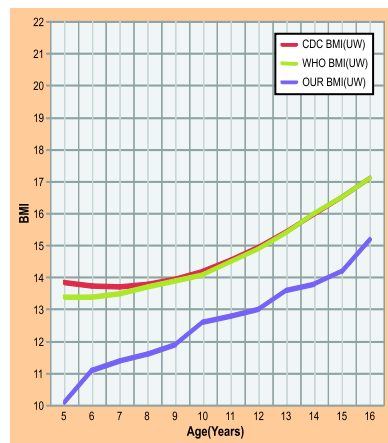


Figure-6

Comparative BMI cut-offs for over weight boys among CDC 2000, WHO 2007 and the present study.

Age (years)	A	B	C
5	17.90	16.70	15.90
6	18.37	16.80	16.30
7	19.10	17.10	17.80
8	20.01	17.50	18.30
9	21.03	18.00	20.00
10	22.09	18.60	20.30
11	23.15	19.30	22.70
12	24.16	20.10	24.40
13	25.12	20.90	24.70
14	25.99	21.90	24.90
15	26.78	22.80	25.30
16	27.51	23.70	25.75

Table-6: Table shows that the cut off values of over weight among the boys of Studied population is lower than the CDC 2000 cut-offs in the age range of 5-16 years, where as it is higher than WHO cut-offs in the age range of 7-16 years.

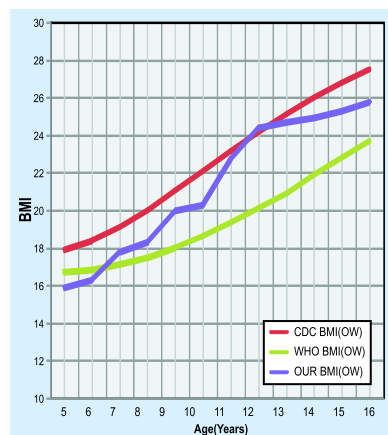


Figure-7

Comparative BMI cut-offs for obese boys among CDC 2000, WHO 2007 and the present study.

Age (years)	A	B	C
5	17.92	17.70	17.30
6	18.38	17.90	18.50
7	19.11	18.30	19.80
8	20.02	18.80	21.40
9	21.04	19.50	21.95
10	22.10	20.20	23.30
11	23.16	21.10	24.60
12	24.17	22.10	25.95
13	25.13	23.10	26.20
14	26.01	24.20	26.50
15	26.79	25.20	26.90
16	27.52	26.10	28.70

Table-7: It is apparent that except at the age of 5, cut-off values of obese for boys of 6-16 years of age is higher in our present study than CDC 2000 and WHO 2007 cut-offs.

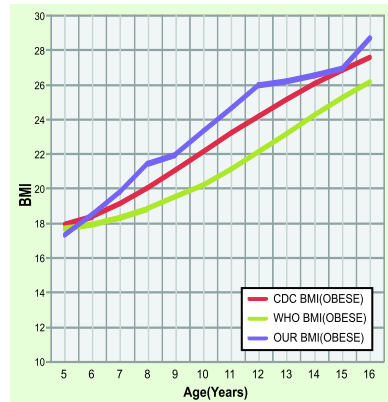


Figure-8

Comparison of cut-offs for under weight girls among CDC 2000, WHO 2007 and the present study

Age (years)	A	B	C
5	13.52	13.10	10.00
6	13.42	13.10	10.60
7	13.43	13.10	11.30
8	13.53	13.30	12.20
9	13.73	13.60	12.80
10	14.01	13.90	13.20
11	14.38	14.40	13.90
12	14.81	14.90	14.25
13	15.28	15.50	14.60
14	15.78	16.00	15.00
15	16.28	16.50	15.20
16	16.76	16.80	15.50

Table-8: The table shows that the cut-off values of under weight for CDC 2000 and WHO 2007 is higher than the cut off values obtained in our present study in the age range of 5-16 years.

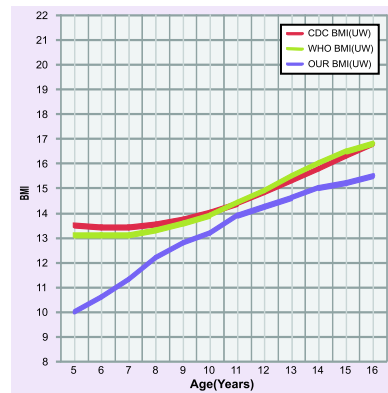


Figure-9

Comparison of cut-offs for under weight girls among CDC 2000, WHO 2007 and the present study

Age (years)	A	B	C
5	18.23	16.90	18.00
6	18.79	17.10	21.10
7	19.63	17.40	21.80
8	20.64	17.80	22.60
9	21.76	18.40	22.80
10	22.93	19.10	22.90
11	24.09	20.00	23.10
12	25.20	20.90	23.65
13	26.25	21.90	23.80
14	27.21	22.90	24.10
15	28.08	23.70	24.50
16	28.87	24.20	24.90

Table-9: The result shows that cut-offs for over weight in our study is higher than CDC cut-off in the age range of 6-9 years while it is lower in the age range of 10 – 16 years. It is also evident that the determined cut-off is higher than WHO cut-off in the age range of 5 – 16 years.

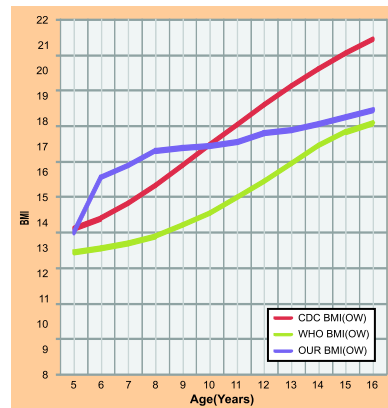


Figure-10

Comparative BMI cut-offs for obese girls among CDC 2000, WHO 2007 and the present study

Age (years)	A	B	C
5	18.25	18.10	19.30
6	18.81	18.40	21.75
7	19.65	18.80	23.15
8	20.66	19.40	24.50
9	21.77	20.20	24.90
10	22.94	21.10	25.00
11	24.11	22.20	25.15
12	25.21	23.30	25.80
13	26.27	24.40	26.00
14	27.23	25.50	26.30
15	28.11	26.30	26.70
16	28.89	27.00	27.60

Table-10: It Shows that our cut-off values of obesity for girls is higher than CDC in the age range of 5 – 12 years and WHO in the age range of 5 – 16 years. But it is lesser than CDC obesity cut-offs for girls in the range of 13 – 16 years.

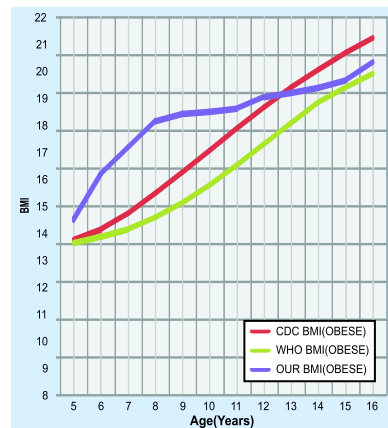


Figure-11

Conclusion:

- The suggested BMI cut-off values of under weight, normal weight, over weight and obese in this present study can be used in the field as a easy predictor of health disorder.
- Still now there was not so much study have been done on BMI cut-off values for the children of aged between 5 to 16 year, therefore this cut-off values of BMI can be used as a reference for the children aged between 5 to 16 years.
- It can be used to compare the BMI status of our children with other population.