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## A study to develop a morphological fitness reference values of secondary school children in Sri Lanka

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### Abstract

In recent years, the interest in physical fitness assessment in school children has increased in other countries, but in Sri Lanka it is still very low. There is a dearth of reference values of physical fitness including BMI for secondary school children in Sri Lanka. The objectives of this study are to contribute to the available knowledge concerning the assessment body composition (Body Mass Index), identifying sex and age-related norms of body mass index of the secondary school children in Sri Lanka and to compare BMI values of Sri Lankan children with the values of other countries.

A quantitative approach was used in this study. Physical fitness assessments were implemented to measure BMI of 1229 students (638 boys and 591 girls) which was a randomly selected sample in the Kandy District. All the data were computed and analyzed to formulate test norms as percentile values, stratified by chronological age groups separately for boys and girls. All the calculations were performed using SPSS vs. 17 for windows.

The significant observation is that the BMI percentiles of P5, P10, P90 and P95 of the age groups 11, 12 and 13 of boys are greater than those of the age group 14 years. Reasons may be due to changes occurred in adolescent period. Except this unusual pattern, it is revealed that BMI percentiles of the boys and girls gradually increase according to the age from 11 years age to 17 years. According to the data, the lowest P5 of boys BMI is approximately 13 and the highest P5 is near 17.4. Furthermore, lowest P95 of boys BMI is approximately 18 and the highest P95 is approximately 22.6. Furthermore, the lowest P5 of girls BMI is approximately 14 and the highest P5 is approximately 17. Furthermore, lowest P95 of girls BMI was found in year 18 range and the highest P95 found in 22.9 range.

It can be observed that although the BMI levels of Sri Lankan children (both boys and girls) are not in the range of 'Needs Improvement-Health Risk (NI-HR)' they are in the range of 'Needs improvement'. They are in the margin of very lean level according to the USA norms. However, we cannot say BMI level of Sri Lankan boys and girls are not in a satisfactory level compared to USA standards, because these figures are normative base values. These norms are identical for some specific population.

**Keywords:** Morphological fitness

### Introduction

There are a lot of scientific evidences to demonstrate that physical fitness reduces the risk of morbidity and mortality from a number of chronic diseases (Biddle et al, 2004) [1]. The recognition of the importance of physical fitness for optimal health has led to an increased interest in the study of different aspects of physical fitness. The overweight and obesity prevalence among children in Sri Lanka show different ranges with provincial and gender variations; among boys and girls between 8 and 10 years this was 4.3% and 3.1% respectively and obesity prevalence among primary schoolchildren in Colombo district is 5.1% in 2008 (Thilakarathne and Wijesinghe, 2011; Wickramasinghe *et al*, 2004; Medical Research Institute of Sri Lanka, 2002) [4, 1].

Morphological fitness includes a variety of indicators that reflect the structure and composition of the body (e.g., subcutaneous and visceral adipose tissue, body fat distribution, and bone mineral density). This component has often been referred to as body composition but the term "morphological fitness" is broader and more inclusive. Bone density is another important indicator of morphological fitness in youth since it is most effective to build bone density during adolescence and early adulthood. Body fatness is the most common indicator of morphological fitness and it is known to have important influences on health. Body Composition is a health-related component of physical fitness

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That relates to the relative amounts of muscle, fat, bone and other vital parts of the body (USDHHS 1986). There are different ways in which the body composition can be assessed such as skin fold calipers, under-water weighing, bioelectrical impedance, DEXA scanner, Bod pod and Body Mass Index (Loughborough University Sports Science Service, 2011) [4].

There is a dearth of reference values of physical fitness including BMI for secondary school children in Sri Lanka. The objectives of this study are to contribute to the available knowledge concerning the assessment of body composition (Body Mass Index) and identifying sex and age-related norms of body mass index of the secondary school children in Sri Lanka and to compare BMI values of Sri Lankan children with norms of other countries.

**Materials and Methods**

A quantitative approach was used in this study. Physical fitness assessments were implemented to measure BMI of

1229 students (638 boys and 591 girls) which was randomly selected sample in Kandy District. A Multi-stage sampling method was adopted to select this student sample aged between 11 years and 17 years. To measure the height, local “Stadiometer” was prepared by the researchers. In measuring height the reading was taken to the last complete mm. A beam Seca Alpha weighing scale (Model 1770) with a true zero balance was used to measure body mass to the last 0.1kg. To ensure standardization of data collection, six physical education teachers were thoroughly trained as data collectors through training workshop. All the data were computed and analyzed to formulate test norms as percentile values, stratified by chronological age groups separately for boys and girls. All the calculations were performed using SPSS vs. 17 for windows.

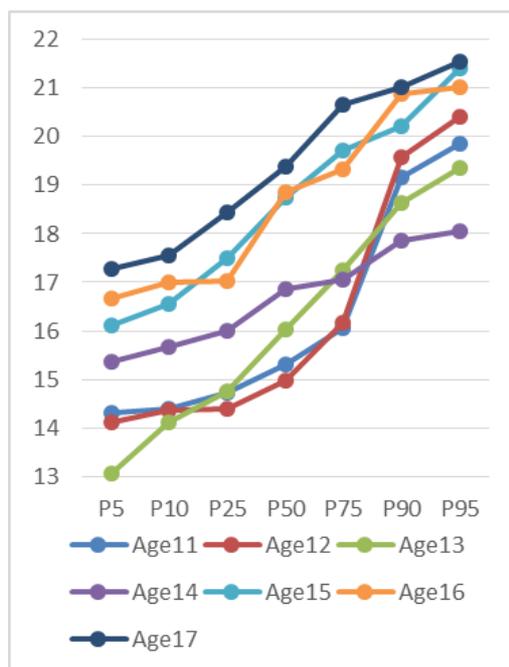
**Results**

Normative values of BMI of the secondary school children in Kandy district are shown in table 1.0.

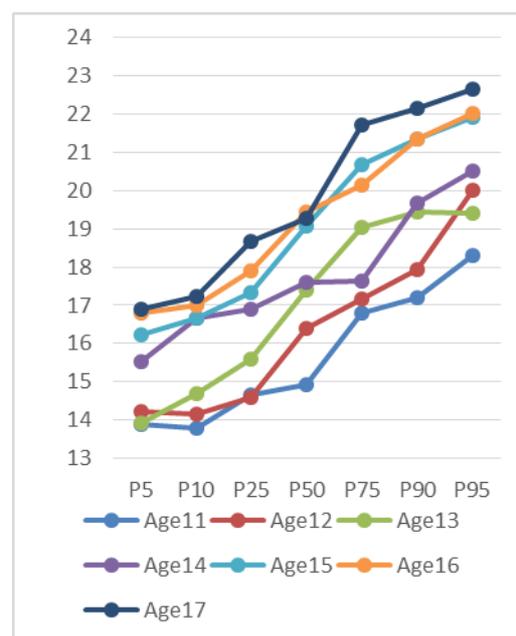
**Table 1:** Normative values of BMI of the secondary school children

Age group	Gender	Percentile Values						
		P5	P10	P25	P50	P75	P90	P95
11 yrs	Boys	14.31	14.40	14.71	15.30	16.06	19.17	19.85
	Girls	13.61	13.78	14.67	14.94	16.80	17.21	18.30
12yrs	Boys	14.12	14.35	14.38	14.97	16.17	19.58	20.42
	Girls	14.24	14.16	14.58	16.39	17.18	17.95	20.00
13yrs	Boys	13.05	14.10	14.75	16.03	17.25	18.65	19.36
	Girls	13.44	14.68	15.60	17.40	19.05	19.42	19.44
14yrs	Boys	15.35	15.67	16.00	16.87	17.06	17.85	18.06
	Girls	15.53	16.66	16.89	17.59	17.64	19.66	20.49
15yrs	Boys	16.12	16.56	17.50	18.76	19.72	20.22	21.40
	Girls	16.22	16.68	17.34	19.06	20.68	21.34	21.90
16 yrs	Boys	16.66	16.99	17.02	18.85	19.34	20.89	21.03
	Girls	16.79	17.01	17.89	19.44	20.14	21.33	22.01
17 yrs	Boys	17.27	17.56	18.45	19.40	20.65	21.02	21.59
	Girls	16.69	17.25	18.67	19.27	21.70	22.13	22.65

Figures 1.0 and 2.0 illustrate the percentile patterns of BMI value changes according to the age groups of research sample.



**Fig 1:** BMI Percentile norms of boys



**Fig 2:** BMI Percentile norms of girls

The significant observation is that the BMI percentiles of P5, P10, P90 and P95 of the age groups 11, 12 and 13 of boys are greater than those of the age group 14 years. Reasons may be due to changes occurred in adolescent period. Except this unusual pattern, it is revealed that BMI percentiles of the boys and girls gradually increase according to the age from 11 years age to 17 years. According to the Figure 1.0 the lowest P5 of boys BMI is approximately 13 and the highest P5 is near 17.4. Furthermore, lowest P95 of boys BMI is approximately 18 and the highest P95 is approximately 22.6. According to the Figure 2.0 the lowest P5 of girls BMI is approximately 14 and the highest P5 is approximately 17. Furthermore, lowest P95 of girls BMI was found for year 18 range and the highest P95 is found in 22.9 range.

### Discussion

"FITNESSGRAM" is a World-famous physical fitness standard produced by Cooper Institute, USA. For each test area, the FITNESSGRAM uses the Healthy Fitness Zone

(HFZ) to evaluate fitness performance. The performance goal for all test areas is to reach the HFZ which represents a level of fitness that offers protection against the diseases that result from sedentary living. If the performance goal is not met, the results are classified as Needs Improvement (NI) or, for Aerobic Capacity and Body Composition, Very Lean (Body Composition only) or Needs Improvement-Health Risk (NI-HR). The FITNESSGRAM and Healthy Fitness Zones (HFZ) are registered trademarks of The Cooper Institute. Meanwhile, Ministry of Youth Affairs & Sports, Department of Sports, Government of India has developed a test battery and physical fitness standard performance for school children and youth in 2012. These two BMI standards and the BMI test norms developed at this study are compared in the following two tables.

(Adapted data from FITNESSGRAM performance standards, The Cooper Institute, USA and Government of India, Ministry of Youth Affairs & Sports, Department of Sports, 2012).

**Table 2:** Comparison of Body Mass Index (BMI) values of this study with Indian and USA norms of Boys

Age	FITNESSGRAM performance standards				Sri Lankan Standards	Indian Standards
	NI-HR	NI	HFZ	Very Lean		
11	≥23.7	≥20.6	20.5-14.9	≤14.8	14.0-19.0	14.0-18.0
12	≥24.7	≥21.4	21.3-15.3	≤14.8	14.5-20.5	15.0-19.0
13	≥25.6	≥22.3	22.2-15.8	≤15.7	13.0-19.0	15.5-21.0
14	≥26.6	≥23.1	23.0-16.4	≤16.3	15.0-18.0	16.0-21.5
15	≥27.2	≥23.8	23.7-16.9	≤16.8	16.0-21.5	16.5-21.5
16	≥27.9	≥24.6	24.4-17.5	≤17.4	16.5-21.0	17.0-22.0
17	≥28.6	≥25	24.9-18.1	≤18.0	17.0-21.5	17.5-22.5

**Table 3:** Comparison of Body Mass Index (BMI) values of this study with Indian and USA norms of Girls

Age	FITNESSGRAM performance standards				Sri Lankan Standards	Indian Standards
	NI-HR	NI	HFZ	Very Lean		
11	≥24.7	≥21.3	21.2-14.7	≤14.6	13.0-18.0	13.5-23.0
12	≥25.8	≥22.2	22.1-15.2	≤15.1	14.0-20.0	14.0-24.0
13	≥26.8	≥23.0	22.9-15.7	≤15.6	14.0-19.5	14.5-24.5
14	≥27.7	≥23.7	23.6-16.2	≤16.1	15.5-20.5	15.0-25.0
15	≥28.5	≥24.4	24.3-16.7	≤16.6	16.0-22.0	15.5-25.5
16	≥29.3	≥24.9	24.8-17.1	≤17.0	17.0-22.0	16.0-26.0
17	≥30.0	≥25.0	24.9-17.5	≤17.4	17.0-22.5	16.5-26.5

According to the Tables 2.0 and 3.0 it can be observed that although the BMI levels of Sri Lankan children (both boys and girls) are not in the range of 'Needs Improvement-Health Risk (NI-HR)' they are in the range of 'Needs improvement'. They are in the margin of very lean level according to the USA norms. However, we cannot say BMI level of Sri Lanka boys and girls are not in a satisfactory level compared to USA standards, because these figures are normative base values. These norms are identical for some specific population.

### Conclusion

According to the Consensus Guidelines Model (Bouchard & Shephard (1994) [2], body composition of children depends on various factors such as heredity, morphological factors leisure, wellness, life style behaviors and physical and social environment. Therefore, this study recommends a set of BMI norms for secondary school children in Sri Lanka to compare their body composition.

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