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Original Research Article

THE RELATIONSHIP OF BMI ON ACADEMIC PERFORMANCE IN SELECTED PRIMARY SCHOOLS UNDER JAFFNA MUNICIPAL COUNCIL AREA IN ACADEMIC YEAR 2019

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ABSTRACT

Background: Nowadays the academic performance of the students is deteriorating. It is influenced by several factors including the nutritional status. There is limited number of studies carried out regarding this issue. So, this study was carried out to identify whether there are any association between BMI and the academic performance. **Objective:** The aim of this study is to assess the relationship between BMI and academic performance in school nutritional programme implemented primary schools in the Jaffna Municipal Council Area. **Material and Methods:** This is a retrospective institution-based study on academic performance in school nutritional programme implemented primary schools in the Jaffna Municipal Council Area. In this study the data that have already been collected from the respective students in the year of 2019 such as BMI of students, socio demography information, school term marks by the Provincial Department of Education, Northern Province were entered in Kobo collect. The data was analyzed by using the Statistical Package for Social Science (SPSS 21) software.
Results: In this study population females were more than males (females 53%, males 47%). Most of them had normal BMI (63.7%) with skewed distribution. In age 8 and 10 the best performance was obtained in Mathematics (70.6%, 67.4% respectively) meanwhile the performance in Tamil language (71.1%) was best in age 9. Total average performance of all 3 age groups was almost equal where two third of the students had obtained good performance. It was observed that almost there is no statistically significant correlation between BMI and academic performance but very few exceptions are there. Such as in Tamil language females of 8 and 9 years as well as 10 years old male and in Mathematics females of 10 years had statistically significant correlation.
Conclusion: The prevalence of students with normal BMI was more than other BMI categories where there were greater numbers of female students compared to male students. Good performance was observed in overweight and obese male groups while females with normal BMI obtained good performance.
Keywords: BMI, Academic performance, Primary school students, Nutritional status, Mid-day meal programme.

INTRODUCTION

Nutrition is a basic requirement of life where it plays an important role in health promotion and disease prevention. Poor nutrition can lead to reduced immunity, reduced quality of life and prolonged hospital stays. Malnutrition is preventable and mostly reversible with early nutritional therapy. The identification of malnutrition has typically been based on anthropometric, biochemical and physical parameters. However, there is currently no universally accepted gold standard for the nutritional state assessment. So, in this research Body Mass

Index (BMI) which is one of the anthropometric tools was used as a measure of nutritional status.

BMI is a value derived from the body mass and height of a person. The BMI is a person's weight in kilograms(kg) divided by the square of height in meters(m2). It is an inexpensive and easy to perform method of screening for weight categories that may lead to health problems. High amount of body fat can lead to weight related diseases and other health issues. Being underweight can also put one at risk for health issues. High BMI can indicate high body fatness. BMI does not measure body fat directly, but BMI is correlated with more direct measures of body fat (CDC, 2021).[1] The BMI is a convenient rule of thumb used to broadly categorize a person as underweight, normal weight, overweight or obese based on body mass and height. For children and teen, BMI is age and sex specific and is often referred to as BMI for age.

World Food Programme (WFP) started its school mid-day meal programme in July 2003. In 2005, the programme was expanded from 4 districts to 15 districts, feeding approximately 400,000 school students. WFP meals consist of 75grams of rice, 35grams of oil and 30grams of canned fish. Pulses and canned fish are provided on rotational basis for child per day and the funding to purchase vegetables were given by Ministry of Education. The schools under the World Food Programme were assisted with the construction of school kitchens, stoves and kitchen utensils. World Food Programme encourages government and community participation in securing resources and meal preparations with the intention of gradual handover of the programme to the government and the community in the coming years, once the capacity is built to take over such interventions. This programme improved the school attendance and contributed to students who were healthy and active in class (School Meals Programme | World Food Programme, 2021).[2]

School performance means academic achievement, sports performance, personality development and extracurricular activities obtained by each student. It requires healthy physical, mental and environmental factors. The purpose of school performance is to achieve an educational goal and learning. The academic performance involves factors such as the intellectual level, personality, motivation, skills, interest, study habits and self-esteem and school attendance (Lamas H A 2015).[3]

Justification

This study evaluated the influence of nutritional status on academic performance among primary school children using Body Mass Index (BMI) as an indicator. Due to the COVID-19 pandemic, secondary data on BMI and academic scores from schools implementing the mid-day meal programme, collected by the Provincial Department of Education, Northern Province, were analyzed. Given the limited evidence on the relationship between BMI and academic performance and the lack of evaluation of the nutritional adequacy of the mid-day meal programme, this study uses BMI assessment to examine its effectiveness in meeting children's nutritional needs.

Objectives

1. To examine the relationship between Body Mass Index (BMI) and academic performance in Mathematics, Tamil Language, and Environmental Studies among students in selected primary schools under the Jaffna Municipal Council Area.
2. To assess the relationship between BMI and academic performance, including the influence of socio-demographic factors, among these students.

Review of literature

In this research the literature regarding the relationship of BMI on academic performance in primary school students were obtained through various sources including PubMed and various journals. Key phrases such as BMI, primary school students, academic performance and nutritional status were used. These sources revealed that in Sri Lanka, very few studies have been conducted to assess the relationship of BMI on academic performance in primary school students. This study discussed about prevalence of BMI on gender, nutritional status and academic performance.

1. Prevalence of BMI

In a study conducted among school children from Northern Sri Lanka to identify the prevalence of wasting, stunting, and obesity and associated socio-demographic factors the prevalence of overweight and obesity were 11% and 6.3% respectively and obesity was mainly seen in boys (4.2%) than girls (2.1%) ($p< 0.001$). Obesity in older boys (>10 years) was significantly more than the younger ones ($p< 0.01$). The findings of this study suggested that stunting, wasting, overweight, and obesity were prevalent among 6-16 years old (Sathiadas et al., 2021a).[4]

In North Central Province, there was a study conducted in paediatric population of grade 1 to 5, the prevalence of severe thinness, thinness, overweight and obesity were found to be 8.60%, 2.91%, 2.95% and 2.43% respectively (Naotunna et al., 2017).[5]

According to the study carried out among 8 to 12 years old school children in Colombo Urban area Sri Lanka, the obesity prevalence among boys (4.3%) was higher than girls (3.1%). Thinness among boys was 24.7% and girls 23.1%. 7% of boys and 6.8% of girls were underweight. 66% were obese and 43.5% of students were overweight. This study conclude that the nutritional transition is evident in the city of Colombo and this data does not represent the entire country (Wickramasinghe et al., 2004).[6]

According to the 2019 annual report of Family Health Bureau, Sri Lanka the frequency distribution of grade 4 school children stunting, wasting, overweight and obese were found to be 5.6%, 19.0%, 4.9% and 2.4% respectively (Annual Report, 2019).[7]

There was a study conducted among 12788 students who are under 5 to 15 years old from 8 schools in

Negombo, Sri Lanka. The purpose of this study is to identify the validity of current international cut off relates to Sri Lanka. The validity of internationally developed anthropometric cut offs in South Asian children is unsatisfactory. Hence locally developed anthropometric tools should be used for screening of obesity (Warnakulasuriya et al., 2019).[8]

In India, the school meal program is implemented only in government schools to combat the malnutrition. A study was conducted to assess the prevalence of malnutrition in primary and secondary school children in private schools in Bangalore to assess the relationship between malnutrition and academic performance. Through this study, they have found that 20% had undernutrition, 7% had stunting, 34% had thinness and 1% was found to be obese among the 582 students who were involved in this study. In this study, there was an association between gender and BMI where more number of males were found to have thinness compared to that of females (Rashmi et al., 2015).[9]

There was a research on educational administration unit of Kallin city in Egypt. Two schools were randomly selected- one urban, and one rural school and data was collected from grade 1 to grade 6 totally 433 students are included. As a result, according to the BMI the nutritional status of students varies in rural 14.5% were underweight and 15.5% were stunted while in urban only 4% were underweight and 2.5% were stunted. Regarding BMI, about one third (31.6%), were overweight and 13.1% were obese, where 38.8% of urban pupils were overweight and 22.4% were obese compared to 22.7% and 1.3% respectively among rural children. Only 0.9% were underweight and 1.3% were wasted, where 2% of rural children were under- weight, and 3.1% were wasted while no one of the urban pupils were underweight nor wasted (Koabar et al., 2018).[10]

In Malaysia, a study was conducted to investigate the relationship between gender, birth weight, nutritional status and iron status of children with their academic performance. Academic performance was obtained from their school final examination that consists of four subjects such as Malay language, English, Mathematics and Science. Girls had a significantly higher score in all the academic tests. Nutritional status was found to be correlated significantly with academic performance. Girls performed better academically than boys. Academic and cognitive function were significantly associated with birthweight, parents' educational status, family income and nutritional status too (Al-Mekhlafi et al., 2011).[11]

2. Correlation between BMI and academic performance

A study was conducted among 9-10 years old Malaysian primary school students to assess the academic performance with nutritional status. In this study the female: male ratio was 51:49 while the mean age was 9.71. The mean BMI was 17.42kg/m^2. In the study population they got the distribution of the BMI categorization as underweight 0.9%, normal 76.3%, overweight 16.3% and the obese as 6.3%. Academic performance was significantly correlated with BMI. Through this study, they recommended that improving the socio-economic status of the parents will lead to better academic performance of the students (Anuar Zaini et al., 2005).[12]

In Taichung city, Taiwan a study examined the association of childhood obesity, weight status change and academic performance of elementary school. The children are followed up for 6 years from grade 1. Their academic performance was extracted from the school records from end of each year. Weight and height were measured at the beginning of each grade and weight change variable was created based on each child weight difference at grade 1 & 6. The BMI of children increased significantly across years but the rate of increase in BMI is higher in children who have higher baseline BMI than lower baseline BMI. But there is no association between the BMI changes and the academic performance (Chen et al., 2014).[13]

Association between childhood obesity and student academic performance among male students in primary schools was assessed by research conducted in Kuwait. Overweight and obesity of the students are categorized according to BMI. Students' academic performance and socio demographic factors were extracted from school records. As a conclusion this study states that there is no association between obesity and academic performance among the male students (Abdelalim et al., 2012).[14]

Research was conducted in order to examine the relationship between nutritional status with academic performance in primary school students in Tehran, Iran. 88.4% of the participants were in high level, 10.3% in appropriate conditions and only 1.3% of respondents require more effort. This study reveals that there are no correlation between academic performance and nutritional status of participants ($p=0.9$) (Soheilipour et al., 2019).[15]

There was a longitudinal study conducted over seven years to determine the effects of excessive weight and obesity on the academic performance of primary school boys, taking into account of their socio-economic status in varying areas of the North West Province of South Africa. The baseline measurement and two follow up measurements of the 181 participants were taken. The BMI of the participants reported an increase from 2010 to 2016. Only two subjects (English and language) reported medium effects ($r \geq 0.3$), whereas other subjects only reported small effects ($r \geq 0.1$). No statistically significant relationship ($p \geq 0.05$) was observed between the BMI value and academic performance. However, socio economic status and school subject scores reported several statistically significant relationships especially language and mathematics ($p=0.02$). Overweight and obese primary school boys reported a high academic performance compared to boys of normal weight even though socioeconomic status were taken into considerations (Coetzee et al., 2021).[16]

There was research conducted among Canadian school children examining the relationship between obesity and the mathematics performance. The above study was done to know whether obesity during preschool to primary school years was related to mathematics performance independence of other factors. So, the obesity was measured when the children were under 2-5 and 8-11 years. On this two time points the obesity status of children are divided into three main types they are never obese, grew out of obesity, develop obesity or always obese. At the age of 8 to 11, a standard mathematics exam was done to know the outcome of children. According to the performance the children who grew out of obesity score well than the children who never obese and the performance between never obese and always obese or developed obesity remained the same. According to the above results, the researcher concluded that childhood obesity did not lead to poor mathematics performance and the children who grew out of obesity well in mathematics performance (Carter et al., 2010).[17]

A study demonstrated no correlation between BMI and school performance, except for physics results where students with obesity performance was worse than who are normal weight (Alswat et al., 2017).[18]

MATERIALS AND METHODS

A school-based retrospective study was conducted using secondary data from 29 primary schools implementing the school nutritional programme under the Jaffna Municipal Council Area. Computerized records of BMI, age, gender, and term-wise academic marks for Mathematics, Tamil Language, and Environmental Studies were obtained from the Provincial Department of Education, Northern Province. The study covered the period August 2020 to January 2022, using data from January to December 2019. Students in Grades 3–5 were included, yielding 2,063 records, of which 1,776 complete datasets were analysed for BMI–academic performance associations. Academic performance was categorized as good (≥70), average (50–69), or poor (<50) based on mean term scores, and BMI was classified using age-specific CHDR (Child Health Development Record) (2019) standards. Data were entered via KoBo Collect and analysed using IBM SPSS version 21 with descriptive statistics and cross-tabulations to assess relationships between BMI, academic performance, and socio-demographic factors. Confidentiality was strictly maintained throughout the study. Data were used solely for research purposes, with no personal identifiers disclosed, and were stored in a password-protected computer accessible only to the researchers under supervisory guidance. Although school admission numbers were used for data linkage, they were kept confidential. The study posed minimal risk and its findings may contribute to improving the nutritional, health, and educational outcomes of students in school nutritional programme–implemented primary schools under the Jaffna Municipal Council Area.

RESULTS

The expected number of study population was 2500 but only 2063 data were obtained from Provincial Department of Education, Northern Province. Among 2063 data, only 1776 data were complete while few of the marks were missing in rest of the data. For the initial part of analysis of socio-demographic factors and BMI distribution, 2063 data were used. For the rest of the analysis 1776 complete data were used.

1.1 Socio-demographic characteristics

Table 1: Socio-demographic pattern of the study population, N = 2063

Socio-demographic characteristics	Socio-demographic factors	N	%
Age in years	8	785	38.0
	9	620	30.1
	10	658	31.9
Gender	Male	969	47.0
	Female	1094	53.0

According to the Table 1, highest number of students were present in eight years age group (N = 785, 38.0%) when comparing to other age groups. When considering the gender females (N = 1094, 53.0%) are more than males.

1.2 Prevalence of BMI among gender

Table 2: Gender distribution of categorization of BMI, N= 2063

BMI categorization	Gender	N	%	Total	%
Underweight	Male	194	52.7	368	17.8
	Female	174	47.3		
Normal	Male	579	44.1	1314	63.7
	Female	735	55.9		
Overweight	Male	124	49.2	252	12.2
	Female	128	50.8		
Obese	Male	72	55.8	129	6.3
	Female	57	44.2		

Out of 2063 students highest number of students have normal BMI (63.7%). Among them females (55.9%) are higher than males. The prevalence of obese population (6.3%) is much lower than the other BMI groups.

1.3 Distribution of BMI with age and gender

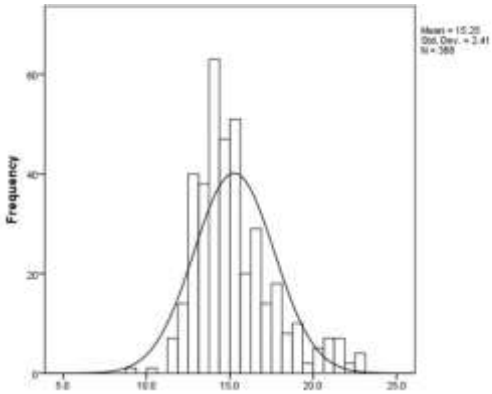

Figure 1: Distribution of BMI of 8 years old male students

The Figure 1 shows skewed right distribution with skewness 1.036. Median of BMI is 14.77 and the interquartile range is 2.75 (IQR =13.70 -16.45).

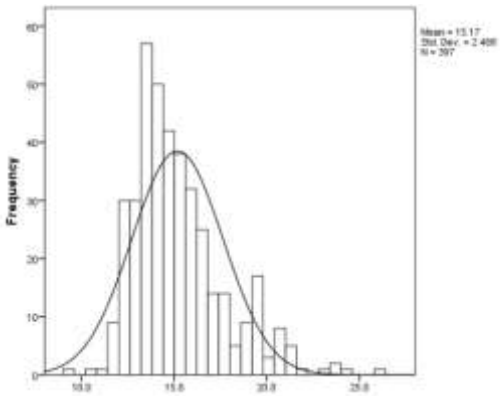

Figure 2: Distribution of BMI of 8 years old female students

This Figure 2 presents with a skewness of 2.4684. Median of BMI is 14.61 and interquartile range is 2.9 (IQR = 13.40 - 16.30).

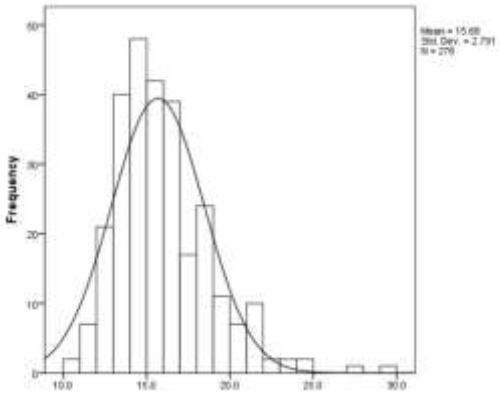

Figure 3: Distribution of BMI of 9 years old male students

The Figure 3 is skewed to the right with a skewness of 1.240. Median of BMI is 15.00 and interquartile range is 3.1 (IQR = 13.89 - 17.00).

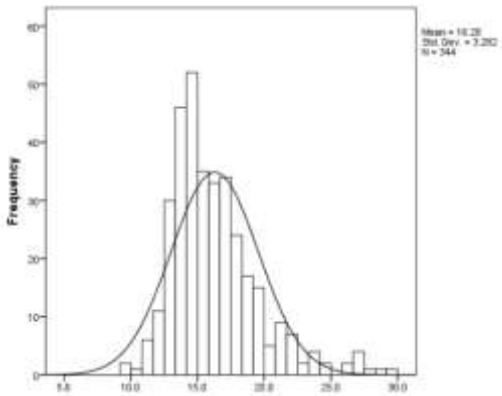

Figure 4: Distribution of BMI of 9 years old female students

The Figure 4 presents with a skewness of 1.280. Median of BMI is 15.50 and interquartile range is 4.0 (IQR = 14.00 - 18.00).

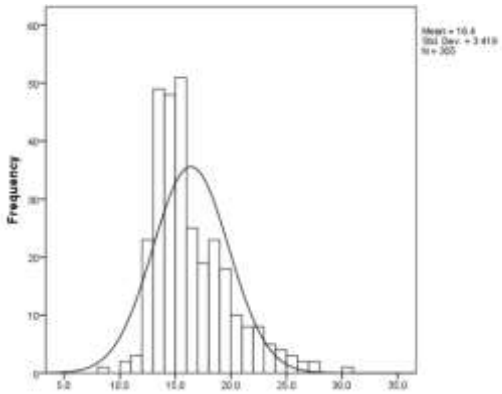

Figure 5: Distribution of BMI of 10 years old male students

This Figure 5 shows skewed distribution with a skewness of 1.114. Median of BMI is 15.40 and interquartile range is 4.6 (IQR = 13.90 - 18.54).

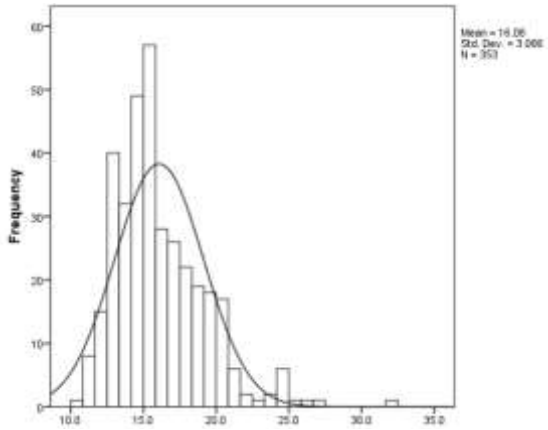

Figure 6: Distribution of BMI of 10 years old female students

The Figure 6 is skewed to the right with a skewness of 1.224. Median of BMI is 15.40 and interquartile range 3.8 (IQR = 14.00 - 17.80).

1.4 Academic performance of students

Table 3: Academic performance of the students in percentage, N= 1776

	Grading of Tamil language			Grading of Mathematics language			Grading of Environmental science			Total average		
Age	P	A	G	P	A	G	P	A	G	P	A	G
8	14.0	21.5	64.5	10.7	18.7	70.6	11.1	22.4	66.5	11.1	22.5	66.3
9	10.5	18.4	71.1	13.6	19.9	66.5	18.0	28.5	53.5	13.0	22.2	64.8
10	13.8	22.4	63.8	15.8	16.8	67.4	13.6	23.3	63.1	14.3	21.2	64.5

(P = Poor, A = Average, G = Good)

According to the Table 3, in all 3 age groups, highest percentage of students obtained "Good" grading in all 3 subjects. In age 8 and 10 the best performance was obtained in Mathematics (70.6%, 67.4% respectively) meanwhile the performance in Tamil language (71.1%) was best in age 9. Total average performance of all 3 age groups were almost equal where two third of the students had obtained good performance.

1.5 Association among BMI, academic performance and the socio-demographic factors

Table 4 Correlation between BMI and academic performance of 8 years old male students, N= 356

		Tamil Language			Mathematics			Environmental studies			Total average		
		P	A	G	P	A	G	P	A	G	P	A	G
UW	N	10	20	34	6	16	42	9	13	42	7	21	36
	%	15.6	31.3	53.1	9.4	25.0	65.6	14.1	20.3	65.6	10.9	32.8	56.3
N	N	45	49	141	37	44	154	30	53	152	37	52	146
	%	19.1	20.9	60.0	15.7	18.7	65.6	12.7	22.6	64.7	15.7	22.1	62.2
OW and Ob	N	7	12	38	3	11	43	4	14	39	3	15	39
	%	12.3	21.0	66.7	5.3	19.3	75.4	7.0	24.6	68.4	5.3	26.3	68.4
		X = 4.790 df = 4 P = 0.309			Fisher's exact test X = 6.302 P = 0.174			Fisher's exact test X = 1.838 P = 0.772			Fisher's exact test X = 7.262 P = 0.120		

(UW – underweight, N- normal, Ow and Ob – overweight and obese)

Table 4 shows that highest numbers of overweight and obese students (66.7%) were graded as good in Tamil language. But underweight students with 53% and students with normal BMI with 60% got good grade in Tamil language. In Mathematics highest number of underweight students (25%) was graded as average, meantime 18.7% normal BMI students and 19.3% overweight and obese students obtained average grade in Mathematics. The overall performance of Environmental studies is similar to the performance of Tamil language. There is an observable difference between BMI and academic performance in all 3 subjects but not statistically significance.

Table 5: Correlation between BMI and academic performance of 8 years old female students, N= 354

		Tamil Language			Mathematics			Environmental studies			Total average		
		P	A	G	P	A	G	P	A	G	P	A	G
UW	N	9	16	36	7	11	43	9	14	38	7	13	41
	%	14.8	26.2	59.0	11.5	18.0	70.5	14.7	23.0	62.3	11.5	21.3	67.2
N	N	21	41	181	19	37	187	22	50	171	20	43	180
	%	8.5	16.9	74.6	7.8	15.2	77.0	9.0	20.6	70.4	8.2	17.7	74.1
OW and Ob	N	7	15	28	4	14	32	5	15	30	5	16	29
	%	14.0	30.0	56.0	8.0	28.0	64.0	10.0	30.0	60.0	10.0	32.0	58.0
		X = 10.369 df = 4 P = 0.035			Fisher's exact test X = 5.707 P = 0.215			X = 4.181 df = 4 P = 0.382			X = 6.472 df = 4 P = 0.167		

(UW – underweight, N- normal, Ow and Ob – overweight and obese)

According to Table 5, more underweight students (59%) got good grading for Tamil language than overweight and obese students (56%). In Mathematics (underweight -70.5%, overweight and obese - 64%) and Environmental studies (underweight - 62.3%, overweight and obese - 60.0%) also underweight students obtained more good grading than overweight and obese students. But in all 3 subjects, highest numbers of good grading were obtained by students with normal BMI. There is a statistically significant association between BMI and academic performance of Tamil language.

Table 6: Correlation between BMI and academic performance of 9 years old male students, N= 197

		Tamil Language			Mathematics			Environmental studies			Total average		
		P	A	G	P	A	G	P	A	G	P	A	G
UW	N	3	8	23	5	6	23	5	9	20	5	5	24
	%	8.8	23.5	67.7	14.7	17.6	67.7	14.7	26.5	58.8	14.7	14.7	70.6
N	N	12	18	91	13	14	94	14	33	74	10	20	91
	%	9.9	14.9	75.2	10.7	11.6	77.7	11.5	27.3	61.2	8.3	16.5	75.2
OW and Ob	N	2	7	33	2	9	31	3	12	27	2	8	32
	%	4.8	16.7	78.5	4.8	21.4	73.8	7.1	28.6	64.3	4.8	19.0	76.2
		Fisher's Exact test X = 2.445 P = 0.662			Fisher's Exact test X = 4.790 P = 0.303			Fisher's Exact test X = 1.118 P = 0.892			Fisher's Exact test X = 2.439 P = 0.666		

(UW – underweight, N- normal, Ow and Ob – overweight and obese)

According to Table 6, more number of overweight and obese students (78.5%) obtained good grade in Tamil language than underweight (67.7%). 77.7% of students with normal BMI graded as good in Mathematics. They are higher than underweight (67.7%) and overweight and obese (73.8%) students. More underweight students (14.7%) got poor performance in Environmental studies than normal (11.5%) and overweight and obese students (7.1%). The association between BMI and academic performance is not statistically significance in all three subjects (P > 0.05).

Table 7: Correlation between BMI and academic performance of 9 years old female students, N= 281

		Tamil Language			Mathematics			Environmental studies			Total average		
		P	A	G	P	A	G	P	A	G	P	A	G
UW	N	4	13	19	5	11	20	8	12	16	5	13	18
	%	11.1	36.1	52.8	13.8	30.6	55.6	22.3	33.3	44.4	13.9	36.1	50.0
N	N	23	25	136	29	37	118	37	53	94	28	42	114
	%	12.5	13.6	73.9	15.8	20.1	64.1	20.1	28.8	51.1	15.2	22.8	62.0
OW and Ob	N	6	17	38	11	18	32	19	17	25	12	18	31
	%	9.8	27.9	62.3	18.0	29.5	52.5	31.1	27.9	41.0	19.7	29.5	50.8
		Fisher's exact test X = 12.764 P = 0.011			X = 4.064 df = 4 P = 0.397			X = 3.799 df = 4 P = 0.434			X = 4.539 df = 4 P = 0.338		

(UW – underweight, N- normal, Ow and Ob – overweight and obese)

Table 7 shows that, in all 3 subjects highest number of students with normal BMI got good grading. In Tamil language almost three fourth of students with normal BMI got good grading. They are the highest population among others. More students with underweight (55.6%) graded good than overweight and obese students (52.5%) in Mathematics. Environmental studies also have more good grades of underweight students (44.4%) than overweight and obese students (41.0%). The students with normal BMI obtained good grade (62.0%) in total average of all 3 subjects. There is an observable difference between BMI and academic performance in all 3 subjects but they are not statistically significance.

Table 8: Correlation between BMI and academic performance of 10 years old male students, N= 271

		Tamil Language			Mathematics			Environmental studies			Total average		
		P	A	G	P	A	G	P	A	G	P	A	G
UW	N	12	11	36	11	8	40	11	8	40	10	9	40
	%	20.4	18.6	61.0	18.6	13.6	67.8	18.6	13.6	67.8	16.9	15.3	67.8
N	N	19	32	91	18	21	103	18	27	97	19	26	97
	%	13.4	22.5	64.1	12.8	14.8	72.4	12.7	19.0	68.3	13.4	18.3	68.3
OW and Ob	N	7	14	49	9	10	51	6	12	52	7	13	50
	%	10.0	20.0	70.0	12.8	14.3	72.9	8.6	17.1	74.3	10.0	18.6	71.4
		X = 3.308 df = 4 P = 0.050			X = 1.347 df = 4 P = 0.853			X = 3.527 df = 4 P = 0.474			X = 1.507 df = 4 P = 0.825		

(UW – underweight, N- normal, Ow and Ob – overweight and obese)

Table 8 explains that highest number of overweight & obese students (Tamil-70%, Mathematics-72.9% and Environmental studies- 74.3%) obtained good grade in all 3 subjects. In all 3 subjects Percentage of underweight students who obtained poor performance is highest while comparing with other BMI groups with poor performance. There is a statistically significant association between BMI and academic performance of Tamil language.

Table 9: Correlation between BMI and academic performance of 10 years old female students, N= 317

		Tamil Language			Mathematics			Environmental studies			Total average		
		P	A	G	P	A	G	P	A	G	P	A	G
UW	N	14	15	34	19	13	31	16	16	31	15	17	31
	%	22.2	23.8	54.0	30.2	20.6	49.2	25.4	25.4	49.2	23.8	27.0	49.2
N	N	22	50	133	29	40	136	22	62	121	26	50	129
	%	10.7	24.4	64.9	14.2	19.5	66.3	10.8	30.2	59.0	12.7	24.4	62.9
OW and Ob	N	7	10	32	7	7	35	7	12	30	7	10	32
	%	14.3	20.4	65.3	14.3	14.3	71.4	14.3	24.5	61.2	14.3	20.4	65.3
		X = 5.951 df = 4 P = 0.203			X = 10.888 df = 4 P = 0.028			X = 8.966 df = 4 P = 0.062			X = 6.174 df = 4 P = 0.187		

(UW – underweight, N- normal, Ow and Ob – overweight and obese)

According to the Table 9 highest number of overweight and obese students got good grade in all 3 subjects. Highest number of students who obtained poor performance in all 3 subjects are underweight (Tamil- 22.2%, Mathematics - 30.2%, Environmental studies-25.4%). When analyzing the total average of all 3 subjects overweight and obese students obtained good performance than others. There is statistically significant observed difference in Mathematics with p = 0.028.

DISCUSSION

This study helps to correlate the BMI of students of age group 8,9,10 with their academic performance. This study was conducted as a retrospective study based on the data available at Provincial Department of Education, Northern Province. Total number of data was 2063 but for correlating the BMI and academic performance 1776 complete data were used.

1. Prevalence of socio-demographic factors

When considering the prevalence of gender in this study population, females (N = 1097, 53%) were more than males.

2. Distribution of BMI among gender

This study showed that most of the students had normal BMI (N = 1314, 63.7%), among them females were more than males with 55.9%. The prevalence of underweight, overweight and obesity were observed to be 17.8%, 12.2% and 6.3%, where in obese, males (55.8%) were more than females. This study was further supported by research carried out among the school children in Northern Sri Lanka where the prevalence of overweight and obesity were 11% and 6.3% respectively and obesity was mainly seen in boys (4.2%) than girls (2.1%) (Sathiadas et al., 2021b).[19] According to Family Health Bureau 2019 annual report, the prevalence of wasting, overweight and obese among grade 4 students were found to be 19.0%, 4.9% and 2.4% respectively (Annual Report, 2019).[7] This shows the prevalence of overweight and obese groups in Jaffna Municipal Council Area is greater than the prevalence in whole Sri Lanka.

According to a study conducted among school children between age group 8-12 in Colombo, the obesity prevalence among males was higher than that of females (Wickramasinghe et al., 2004).[20] Also another study was conducted in 2011 at Bangalore, India to see the influence of gender on BMI concluded that more males belonged to undernutrition category than females (Al-Mekhlafi et al., 2011).[11]

3. Correlation between BMI and academic performance.

According to the results of this study while discussing about the academic performance regardless of BMI, most of the students got good grade in all 3 subjects.

8-year-old males with overweight and obese got highest number of good grades in all 3 subjects (Tamil 66.7%, Mathematics 75.4% and Environmental studies 68.4%). A Canadian study resulted that student with obese have good performance in Mathematics (Carter et al., 2010).[17] Meantime in this study, highest number of 8 years old female students with normal BMI obtained good grade in all 3 subjects. Also, this study found that there is a statistically significant correlation (p=0.035) between BMI and performance of Tamil language.

According to 9 years old male students' performance, overweight and obese students performed well. Because highest percentage of good grade in all three subjects were obtained by them. Also, least number of them got poor performance in all three subjects. But in 9 years old female students who have normal BMI got highest number of good grades.

Similarly in 10 years old males, highest number of overweight and obese students graded good in all subjects. There was a statistically significant correlation found for Tamil language (p = 0.05). In females also not like other age groups, most of the overweight and obese students performed good in all subjects.

While considering the overall performance, the male students with overweight and obese groups performed well in their academics than students with normal BMI. A similar study conducted among primary school boys supported this result where overweight and obese primary school boys reported a higher academic performance when compared to boys of normal weight (Coetzee et al., 2021).[16] But in females, students with normal BMI performed well than others.

CONCLUSION

According to this study, the prevalence of students with normal BMI was more than other BMI categories where there were greater numbers of female students compared to male students. The prevalence of overweight and obese in this study population is more when compared to that in whole Sri Lanka.

Good performance was observed in overweight and obese male groups while females with normal BMI obtained good performance. No association was observed between the BMI and the academic performance.

Limitations

This study was based on secondary data from schools under the mid-day meal program in the Jaffna Municipal Council Area; therefore, findings cannot be generalized to all primary school students in the area. Records with missing marks were excluded.

BMI measurements were collected by different teachers using non-standardized instruments, and measurement reliability could not be verified. Academic performance was assessed using the average of three subjects and non-uniform term examinations, limiting comparability. Possible data entry errors may have occurred.

The study used bivariate analysis and did not account for other influencing factors such as health status, extracurricular activities, parental education, or family income. Age classification was based on grade level without adjustment for month of birth.

Recommendations

Further multivariate studies are needed to better understand factors affecting academic performance. Since nearly one-third of students were outside the normal BMI range, appropriate health interventions should be undertaken by the concerned authorities.

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List of abbreviations

BMI - Body Mass Index
CDC - Centers for Disease Control and Prevention
CHDR - Child Health Development Record
FHB - Family Health Bureau
IQR - Interquartile range
SPSS 21 - Statistical Package for Social Science software version 21
WFP - World Food Programme

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