Research Article

Glycosylated Haemoglobin Levels among Overweight and Obese Children in Urban Schools

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Abstract

Childhood overweight and obesity related insulin resistance can be evaluated with glycosylated haemoglobin (HbA1c) which would be helpful to prevent the progression from impaired glucose tolerance to Type 2 Diabetes Mellitus (T2DM). This study was aimed to determine the HbA1c level among urban overweight and obese school students in Batticaloa District, Sri Lanka. A cross-sectional descriptive study was conducted among 269 overweight and obese advanced level school children from urban 1AB schools in Batticaloa District. Anthropometric measurements and determinations of HbA1c levels were performed. Information on social and lifestyle variables were obtained using validated pre-tested interviewer administered questionnaires. Statistical analysis was performed with SPSS software version 20. Study consists of 41% males and 59% females. The mean BMI of the participants was 28.98 (± 3.68) Kg/m^2. The mean HbA1c of participants was 5.4 (± 0.44). Nearly 20% and 3.3% of the HbA1c were in the pre-diabetes and diabetes category respectively. The mean HbA1c was significantly higher in male and obese compared to their counterparts ($p<0.05$). ANOVA shows a statistically significant difference in mean HbA1c across the ethnicity [F (2, 267)=10.09, p=0.00]. Simple linear regression model found that participant's predicted HbA1c level is equal to 4.943+0.017 (BMI). The prevalence of pre-diabetes and diabetes among overweight and obese school children was significantly high and BMI showed a weak positive correlation with HbA1c level. Strategies for weight reduction and promotion of healthy lifestyles are necessary to prevent the onset of T2DM during childhood and adolescence.

Keywords: Batticaloa District; Glycosylated hemoglobin; Obese; Overweight; School children; Sri Lanka

Introduction

Obesity is currently a global epidemic. [1] The prevalence of overweight and obesity in children and adolescents has reached epidemic proportions in both developed and developing countries. [2] The World Health Organization (WHO) estimates that the worldwide prevalence of obesity has more than doubled between the years of 1980 and 20143. In the latest estimate in 2014, 1.9 billion adults were expected to be overweight, among whom over 600 million were projected to be obese. [3] Further, WHO reported that 41 million children under the age of 5 years were overweight or obese and over 340 million children and adolescents aged 5-19 years were overweight or obese in 2016. [3].

Obesity in childhood often continues into adolescence and adulthood. Obesity is a risk factor for cardiovascular disorders and metabolic diseases, such as coronary heart disease, hypertension, atherosclerosis, and diabetes mellitus. [4] Eighty percent of patients with Type 2 Diabetes Mellitus (T2DM) in children were overweight, while 60-90% was obese. [5] Insulin resistance is common among overweight and obese children. The earlier onset of obesity in children causes a longer period of insulin resistance, which may explain the concomitant earlier onset of impaired glucose tolerance in children and adolescents. [6].

A large number of studies have shown that insulin resistance is already present in a significant number of overweight and obese children. [7,8] As an earlier onset of overweight and obesity in children is responsible for lengthening the insulin-resistant status, recognition of impaired glucose tolerance in children is important. [6] The American Diabetes Association (ADA) recommends the use of Glycosylated Haemoglobin (HbA1c) levels for pre-diabetes screening in both children and adolescents. [9] HbA1c has the potential to reflect the history of mean insulin sensitivity over the preceding period and it serves as a marker of insulin sensitivity in children who have an abnormal glucose tolerance. [10] Further, HbA1c levels can be used as a diagnostic tool for the early detection of insulin resistance. [6] Insulin resistance has played a major role in dyslipidemia in individuals not only with normal glucose tolerance but also in those with impaired glucose tolerance and T2DM, as well. [6]

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However, there was no any reported study conducted to assess the HbA1c level among urban overweight and obese school students in Batticaloa District up to date. Therefore, this study was aimed to determine the HbA1c level among urban overweight and obese school students in Batticaloa District in order to assess the prevalence of pre-diabetes and diabetes among urban overweight and obese school children.

Materials and Methods

This was a cross-sectional survey study, conducted among both boys and girls in all urban schools situated in Batticaloa District, which is one of the 25 districts of Sri Lanka and one of the 3 districts of Eastern Province. Batticaloa District has fourteen Divisional Secretariat (DS) divisions, out of which only 3 DS divisions are categorized under the Urban Council, namely Manmunai North, Kattankudy and Eravur Town. All 1AB category schools (where all streams of General Certificate of Education (GCE) advanced level students are available) in the urban DS divisions were included in the study; a total of 13 schools were included.

The study population was only overweight and obese students (boys and girls) who were following General Certificate of Education (GCE) Advanced Level (A/L) in all streams (Science, Maths, Commerce, Arts, Agriculture and technology) in the 1 AB category schools located in the Urban Council area (Manmunai North DS division, Kattankudy DS division and Eravur DS division) of Batticaloa district, Sri Lanka. Among overweight and obese students who were not willing to participate in this study were excluded. Overweight and obesity was determined based on student's Body Mass Index (BMI) value. Nearly, a total of 1150 GCE A/L students in all schools were screened to assess their BMI and among them, those who were overweight and obese were recruited after the exclusion criteria. A total of 269 students were recruited in this study.

An Interviewer Administered Questionnaire (IAQ) was used to collect the socio-demographic data, dietary habits and exercise details. The IAQ was developed in English by the research team based on the objective of the study after intensive literature review. Then, it was validated judgmentally by the group of relevant experts. The validated questionnaire was pretested for acceptability and comprehension and to assess the clarity and suitability of the wordings used at 1C category school among 15 GCE A/L students who fulfil the inclusion and exclusion criteria. Validated and pre-tested questionnaire was then translated into Tamil language by two bilingual experts. Subsequently, it was back translated to English by another two bilingual experts in order to maintain accuracy of the translation. Necessary modifications were done to the questionnaire in Tamil version after back translations not supporting the original meaning of questionnaire in English. The translated Tamil version of IAQ was used to collect data.

Anthropometric measurements such as weight, height and waist and hip circumference were also measured. Waist and hip circumferences were measured with the participants standing, using a measuring tape. [11] Waist circumference was measured as the horizontal level at the midpoint between lower margin of costal margin and upper margin of iliac crest in the mid axillary line in standing position at the end of normal expiration. [12] Hip circumference was measured around the widest portion of the buttocks, with the tape parallel to the floor. [13]

A venous sample of blood sample was collected from each selected participant for HbA1c measurement. Blood sample was collected by a trained registered Nurse. Fasting status was not necessary for estimation of HbA1c. HbA1c was measured by a NGSP certified method [10] of high performance liquid chromatography. [14] All HbA1c measurements were carried out at a certified laboratory in Batticaloa District.

The administration of the IAQ for the collection of data was carried out at schools among students by the trained data collectors, who are qualified Bachelor degree holders. The written informed consent was obtained from each study participant prior to the data collection after explaining the procedure, purpose of the study and its benefits by using an information sheet.

Definitions and Statistical analysis

According to WHO for Asian population, overweight is defined as 23.0-27.4 kg/m^2 and obesity is defined as ≥ 27.5 kg/m^2. [15] WHO in 2011 officially recommended HbA1c testing for the diagnosis of Diabetes Mellitus [16] and ADA suggested that HbA1c values of <5.7% indicates no diabetes (normal), 5.7%-6.4% indicates pre-diabetes while a value of ≥ 6.5% indicates diabetes 10. In addition, obesity was classified based on the cut off points of waist circumference for most Asians is ≥ 90 cm for males and ≥ 80 cm for females. [17]

Data were coded and entered into statistical software SPSS (Statistical Package for the Social Sciences) Version 20 before analysis. Descriptive statistics were applied to obtain percentage and mean and relevant inferential statistics were also performed. Continuous variables were tested for normality by using skewness and kurtosis value of the distribution which may be relatively reliable in both small samples and large samples. [18] Differences in means of HbA1c values between dichotomous variables of study participants were examined by independent sample t-test, and one-way analysis of variance (ANOVA) was used to assess the mean differences between 3 or more dependent variables. These parametric tests were performed when the dependent variable was normality distributed. Chi-square test was used to determine the association between 2 categorical variables (Glycemic status and other sociodemographic details). A linear regression was used to determine whether participant's HbA1c level is predicted based on their BMI. A value of $p<0.05$ was considered to indicate statistical significance.

Results

Of the 269 participants examined, 41% were males and 59% females. The mean age of the participants was 16.7 (SD ± 1.2) years. Most of the participants (63%) were Sri Lankan Tamil and nearly 46% were Hindu. Majority of them (91%) were living with their parents. Nearly two third of participants were living in the urban area. Nearly 16% of students were suffering from at least one of the given chronic disease, and among them 81% of them had been suffering from bronchial asthma and 50% had been suffering from these chronic diseases for less than 5 years. About two third of participants were obese [Table 1].

Table 1: Socio-demographic characteristics, chronic diseases and obesity of participants based on gender.

Characteristic	Response	Male n (%)	Female n (%)	Total n (%)
Gender		110 (40.9)	159 (59.1)	269 (100.0)
Mean Age (± SD) (years)		16.4 (± 1.3)	17.0 (± 1.2)	16.8 (± 1.2)
Ethnic Background	Tamil	35 (31.8)	133 (83.6)	168 (62.5)
	Muslim	73 (66.4)	24 (15.1)	97 (36.0)
	Burger	2 (1.8)	2 (1.3)	4 (1.5)
Religion	Hindu	22 (20.0)	101 (63.5)	123 (45.7)
	Islam	73 (66.4)	24 (15.1)	98 (36.5)
	Roman Catholic	15 (13.6)	34 (21.4)	48 (17.8)
Living with	Parents	105 (95.5)	141 (88.9)	246 (91.4)
	Mother only	2 (1.8)	4 (2.5)	6 (2.2)
	Father only	1 (0.9)	1 (0.6)	2 (0.7)
	Extended family	2 (1.8)	3 (1.9)	5 (1.9)
	Children Home	0 (0.0)	10 (6.3)	10 (3.8)
Permanent area of residence	Urban	70 (63.6)	108 (67.9)	178 (66.2)
	Rural	40 (36.4)	51 (32.1)	91 (33.8)
Has any chronic disease presently	Yes	9 (8.2)	34 (21.4)	43 (16.0)
	No	101 (91.8)	125 (78.9)	226 (84.0)
Present chronic disease	Allergy	2 (22.2)	0 (0.0)	2 (4.7)
	Bronchial asthma	6 (66.7)	29 (85.3)	35 (81.4)
	Type 1 Diabetes	0 (0.0)	1 (2.9)	1 (2.3)
	Type 2 Diabetes	0 (0.0)	1 (2.9)	1 (2.3)
	Seizure	1 (11.1)	0 (0.0)	1 (2.3)
	Migraine	0 (0.0)	3 (8.9)	3 (7.0)
Duration of suffering from chronic disease	From birth	2 (22.2)	0 (0.0)	2 (4.7)
	Less than 5 years	4 (44.5)	17 (50.0)	21 (48.8)
	5–10 years	1 (11.1)	5 (14.7)	6 (14.0)
	More than 10 years	2 (22.2)	12 (35.3)	14 (32.5)
BMI Category	Overweight	42 (38.2)	69 (43.4)	111 (41.3)
	Obese	68 (61.8)	90 (56.6)	158 (58.7)
Obesity based on WC	Obese	69 (62.7)	145 (91.2)	214 (79.6)
	Non –obese	41 (37.3)	14 (8.8)	55 (20.4)

Overweight: 23.0–27.4 kg/m^2, Obese: ≥ 27.5 kg/m^2, WC: Waistt circumference

The mean body weight and height of all participants was 75.7 (± 12.8) kg and 161.5 (± 8.3) cm respectively. The mean BMI of the participants was 29.0 (± 3.7) Kg/m^2 and mean waist and hip circumference was 92.2 (± 9.4) cm and 98.8 (± 10.5) cm respectively. The mean HbA1c of participants was 5.4 (± 0.4). Independent sample t-test shows that male students have significantly higher mean weight, height and HbA1c than the female students (p=0.00) [Table 2]. Males were found to have a higher mean BMI than females, but this finding was not significant.

According to HbA1c categories based on the ADA recommendations; Normal glucose tolerance (<5.7%), pre-diabetes (A1C 5.7-6.4%), and diabetes (≥ 6.5%). According to this classification, 76.6% were in the normal category, 20% were in the pre- diabetes category, and only 3.3% were in the diabetes category. Among diabetes category, two students have been already diagnosed to have diabetes. There is a significant different between sex distribution among the three categories (p=0.00) [Table 3].

In addition, a statistically significant difference was found between participant's gender, BMI category and ethnic groups with their HbA1c categories (p<0.05) [Table 4].

The mean HbA1c was significantly higher in male and obese compared to their counterparts (p<0.05). Further, ANOVA shows a statistically significant difference in mean HbA1c across the ethnicity (F (2,266)=10.09, p=0.00). Bonferroni post-hoc comparisons of the three groups of ethnicity indicate that Muslim ethnicity has a significantly higher mean HbA1c compared to Sri Lankan Tamil ethnicity (M=0.23, 95% CI=0.10-0.36, p=0.00) [Table 5].

Weight, height, BMI, WC and HbA1c distribution were significantly different among the three categories (ANOVA, p<0.05). Across the HbA1c categories, participants tended to be heavier (Weight and BMI) in the pre-diabetes and diabetes categories (p=0.00 and p=0.04). Further, participants belonging to pre-diabetes and diabetes categories showed higher waist circumference compared to normal category (p=0.00). In addition, HbA1c levels were lower in the normal category compared with both the pre- diabetic and diabetes categories (p=0.00) [Table 6].

In addition, a simple linear regression was calculated to predict participant's HbA1c level based on their BMI. A significant regression equation was found (F(1,267)=5.855, p=0.016), r=0.24. Participant's predicted HbA1c level is equal to 4.943+0.017 (BMI) when BMI is measured in Kg/m^2. Participant's average HbA1 level increased 0.017 for each Kg/m^2 of BMI.

Table 2: Mean anthropometric measures based on gender.

Characteristic	Male	Female	Total	p value*
Body weight (± SD) Kg	82.1 (± 12.2)	71.2 (± 11.1)	75.7 (± 12.8)	0.00
Height (± SD) cm	168.0 (± 6.7)	157.0 (± 6.0)	161.5 (± 8.3)	0.00
BMI (± SD) Kg/m^2	29.3 (± 3.9)	28.8 (± 3.5)	29.0 (± 3.7)	0.32
Waist circumference (± SD) cm	98.1 (± 9.5)	91.0 (± 9.4)	92.2 (± 9.4)	0.22
Hip circumference (± SD) cm	98.4 (± 11.5)	99.1(± 9.7)	98.8 (± 10.5)	0.61
HbA1c (± SD) %	5.5 (± 0.4)	5.4 (± 0.4)	5.4 (± 0.4)	0.00

*: Independent sample t- test

Table 3: The prevalence of normal, pre-diabetes, and diabetes according to the HbA1c levels.

Glycemic status based on HbA1c level	Male n (%)	Female n (%)	Total n (%)	p value
Normal (<5.7%)	69 (62.7)	137 (86.2)	206 (76.6)	0.00*
Pre-diabetes (5.7%–6.4 %)	36 (32.8)	18 (11.3)	54 (20.1)	
Diabetes (≥ 6.5%)	5 (4.5)	4 (2.5)	9 (3.3)	

*: Pearson Chi-square test

Table 4: Comparison of factors associated with diabetes in the study population.

Parameters	Normal (n=206) n (%)	Pre-diabetes (n=54) n (%)	Diabetes (n=9) n (%)	p value
Gender				0.00*
Male	69 (33.5)	36 (66.7)	5 (55.6)	
Female	137 (66.5)	18 (33.3)	4 (44.4)	
BMI category				
Overweight	97 (47.1)	12 (22.2)	2 (22.2)	0.00*
Obese	109 (52.9)	42 (77.8)	7 (77.8)	
Ethnic Background				
Tamil	147 (71.4)	17 (31.5)	4 (44.4)	0.00#
Muslim	55 (26.7)	37 (68.5)	5 (55.6)	
Burger	4 (1.9)	0 (0.0)	0 (0.0)	
Permanent area of residence				
Urban	137 (66.5)	37 (68.5)	4 (44.4)	0.36*
Rural	69 (33.5)	17 (31.5)	5 (55.6)	
Are you active in sports?				
Yes	50 (24.3)	21 (38.9)	2 (22.2)	0.09*
No	156 (75.7)	33 (61.1)	7 (77.8)	

*: Pearson Chi-square test, #: Likelihood ratio

Table 5: Mean differences between HbA1c and other factors.

Parameters	Mean HbA1c (± SD)	p value	Post-Hoc test (p value)
Gender			
Male	5.5 (± 0.4)	0.00*	
Female	5.4 (± 0.4)		
BMI category			
Overweight	5.4 (± 0.4)	0.00*	
Obese	5.5 (± 0.4)		
Ethnic Background			
Tamil	5.4 (± 0.4)	0.00#	0.00
Muslim	5.6 (± 0.4)		
Burger	5.2 (± 0.1)		
Area of residence			
Urban	5.4 (± 0.4)	0.45*	
Rural	5.5 (± 0.5)		
Are you active in sports?			
Yes	5.5 (± 0.4)	0.07*	
No	5.4 (± 0.5)		

*: Independent sample t-test, #: ANOVA

Table 6: Anthropometric features of the study participants according to HbA1c categories (Means and 95% CI).

	Normal (<5.7%) (n=206)	Pre-Diabetes (5.7%–6.4%) (n=54)	Diabetes (≥ 6.5%) (n=9)	p value*
Weight (Kg)	74.2 (72.4-76.0)	80.6 (77.7-83.5)	80.7 (72.0-89.3)	0.00
BMI (Kg/m^2)	28.7 (28.2-29.2)	29.8 (29.0-30.5)	31.0 (27.6-34.4)	0.04
WC (cm)	91.0 (89.7-92.3)	96.4 (94.4-98.3)	95.8 (87.3-104.0)	0.00
HC (cm)	98.1 (96.6-99.5)	101.8 (99.0-104.6)	98.2 (91.0-105.4)	0.06
HbA1c (%)	5.3 (5.2-5.3)	5.8 (5.8-5.9)	7.0 (6.4-7.6)	0.00

*: ANOVA, WC: Waist circumference, HC: Hip circumference

Discussion

Obesity and overweight in the childhood represent a severe public health problem in adolescent life. According to our knowledge, this is the first survey to determine the HbA1c level of overweight and obese school children in urban schools in Sri Lanka, especially in Batticaloa District. Out of the 1150 students who were screened and 269 (23%) were found to have either obesity or overweight. While this prevalence, is similar to the global trend an alarming proportion of these children (60%) were found to be obese.

HbA1c was used as a tool to diagnose the glycemic status among school children. The American Diabetes Association (ADA) has recommended the use of HbA1c levels for prediabetes screening in both children and adolescents [9]. In the present study, the mean HbA1c of participants was 5.4 % (± 0.44). Similarly, a study on association of HbA1c levels with insulin resistance in obese children has reported that the mean HbA1c values of obesity was 5.46% (SD ± 0.5). [6] Another study on distribution of HbA1c levels among children and young adults in the USA shown that the mean HbA1c level was 4.99% (SD ± 0.50%). [19] Contrast to these findings, a study carried out among obese subjects attending the University of Calabar Teaching Hospital, Calabar, Nigeria had discovered a high mean HbA1c of 6.13 ± 2.76% among obese participants. [20] As such, insulin resistance can be diagnosed among school children, using HbA1c levels. [7] In addition, Glucose homeostasis is maintained by the balance between insulin sensitivity and secretion, decreased insulin sensitivity and impaired pancreatic beta-cell function, which are considered the two main components in the pathogenesis of T2DM. [21] Thus, the assessment of insulin resistance (pre-diabetes and diabetes status) is a key element in evaluating the risk for T2DM among school overweight or obese children. Therefore, information on HbA1c level help to identify the glycemic status of pre-diabetes and diabetes among urban school overweight and obese children in Batticaloa District in order to carry out the preventive strategies.

Further, it was observed that nearly one fifth of study participants had pre-diabetes status. Similarly, in a cohort study conducted among Emirati overweight/obese children and adolescents, the prevalence of pre-diabetes was found in a higher proportion of children (21.9 %). [22] In addition, another study carried out among a multiethnic cohort of 1,156 obese children and adolescents in New Haven, Connecticut found the similar findings (21%) of pre-diabetes category. [23] But contrast to these findings, a study of 254 overweight or obese children, aged 10–17 years shown that nearly 39% of participants had pre-diabetes. [24] Another study on the role of HbA1c in screening obese children and adolescents for glucose intolerance and T2DM conducted in Portugal found that according to HbA1c, only 12% obese children had pre-diabetes. [25] In addition, the prevalence of pre-diabetes among overweight and obese Costa Rican school children was 6.5%. [26] Pre-diabetes precedes an earlier onset of T2DM in adolescent. Increased insulin resistance in peripheral tissues has been shown to be an early manifestation in the development of T2DM, followed by compensatory hyperinsulinemia. [27] The early onset of T2DM in children and adolescents increases the risk of microvascular complications, which are known to be directly related to the duration of diabetes and hyperglycemia. [21] The progression of obesity-related insulin resistance among children and adolescents, could lead to hypertension, abnormal serum lipid profile, premature cardiovascular disease, and emotional and behavioral disorders, such as depression and eating upsets. [28] Therefore, lifestyle modifications such as healthy eating, physically active lifestyle and stress control are urgent to prevent the development of T2DM during the childhood. Sex distribution was significantly different among the three glycemic categories (p=0.00) and it should be noted that there was a trend toward a greater number of male participants in the higher categories of HbA1c.The tendency for males to have higher rates of pre-diabetic and diabetic states needs attention. Programmes focusing on physical activities to school boys have to be arranged at the school and community level.

A statistically significant difference was observed between glycemic status (normal, pre-diabetes and diabetes) and ethnic background of the study participants. Similarly, the ADA has highlighted the fact that the Hispanic ethnic group has a twofold greater risk of developing T2DM than other populations. [29] Further, Nowicka et al. concluded from their study that ethnic differences among the HbA1c categories are significant. [23] But in contrast, Lee et al. stated that there was no statistically significant difference between glycemic status and ethnic groups in a study conducted among overweight or obese children in Southeast Michigan area. [24] Even though, an ethnic group has higher HbA1c level, it could be influenced with several confounders including socioeconomic conditions. In addition, different ethnic group may have difference lifestyle patterns such as eating habits, physical activities and type of occupation. Further, other factors influencing glycemia, such as adiposity, fasting, post-glucose load glucose levels, b-cell function, and insulin resistance [23] have not been studied among different ethnic groups in the present study which influences in HbA1c level.

Obesity-related metabolic disorders have not been adequately addressed due to failures to distinguish the importance of general obesity in relation to developing T2DM risk. [20] Waist circumference and BMI has been used as measures of central and general obesity respectively [30]. In the present study, the mean BMI and waist circumference were 28.98 (± 3.68) Kg/m^2 and 92.23 (± 9.45) cm respectively. It indicates that mean BMI and Waist circumference are more than expected cut off point. In addition, since males having higher BMI, height and weight than females at all ages is a physiological phenomenon, the above findings are to be expected. Further, in the present study, the assessment of correlations between BMI and HbA1c level was studied and BMI showed a weak positive correlation with HbA1c. It indicates that HbA1c level tends to be slightly higher in the higher BMI. Similarly, a study conducted among overweight and obese children and adolescents found a positive correlation between BMI and glucose level. [31] In another study, a statistically significant positive correlation was found between HbA1c and BMI. [32] It could be described that obesity has been associated with decreased glucose tolerance, alterations in glucose-insulin homeostasis, reduced metabolic clearance of insulin, and decreased insulin-stimulated glucose disposal. [33] Thus, lifestyle modifications such as healthy eating and physical activity need to be emphasized among these school children in order to maintain a normal body weight as weight gain in children is an important health concern which can continue into adulthood increasing the risk of cardiovascular diseases and metabolic disorders. [34]

Limitation of the study was that pre-diabetes status was estimated using the gold standard method of HbA1c test which is too expensive and not easily affordable to use as a screening tool. Diet and body compositions were not evaluated.

Conclusions

The present study demonstrates a higher proportion of (20.1%) HbA1c level of 5.7%-6.4 % and 3.3% with HbA1c ≥ 6.5%. There was a statistically significant difference between glycemic status of school children (normal, pre- diabetes and diabetes) and their gender, BMI category and ethnic background. Further, BMI showed a weak positive correlation with HbA1c level. Lifestyle interventions focusing on weight management and increasing physical activity should be carried out targeting overweight and obese school children, and should be promoted in several social environments, such as the family, school, and community in order to prevent premature development of T2DM in the future.

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Availability of data and materials

All data related to this study are included in the manuscript. If needed, can get the information from corresponding author.

Ethics approval and consent to participate

The ethical clearance for the study was obtained from the Ethic Review Committee, Faculty of Health-Care Sciences, Eastern University of Sri Lanka. Written permission was obtained from Zonal Director of Manmunai North, and Eavur, Baticaloa and from all school principal prior to the commencement of the study. A written informed consent was obtained from individual participants. For those under 18 years of age, assent was obtained from the study participants and written consent was taken from their caretakers. Confidentiality and anonymity of the participants were ensured by coding the interviews. Study participants were informed clearly about their freedom to opt-out of the study at any point of time without justifying for doing so.

Competing Interests

Authors have no competing interest associated with this paper.

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