ORIGINAL ARTICLE

# Profile of Selected Lifestyle Disease Risk Factors among Adolescent School Students in an Industrial Area of Vellore District, Tamil Nadu

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**Abstract:**

*Background:* Lifestyle or non-communicable diseases are associated with long-term health consequences and tremendous socioeconomic implications. Early identification of risk factors with lifestyle modification is the most effective measure of prevention and control. Schools offer unique opportunity for comprehensive assessment of risk factors and initiation of healthy behaviours. *Aim and Objectives:* This study was aimed to assess the risk factor profile for lifestyle diseases among adolescent school students in Ranipet, Vellore district, Tamil Nadu and to identify the socio-demographic factors associated with above risk factors among students. *Material and Methods:* A school-based, descriptive, cross-sectional study was conducted among students aged 13 to 17 years, from 3 randomly selected schools (2 Private; 1 Government) in Ranipet, Vellore district, between June and September 2018. A pretested, semi-structured, self-administered questionnaire and standardized instruments were used to assess risk factors. *Results:* A total of 932 students participated. Fruit and vegetable consumption and physical activity practices were sub-optimal compared to recommended guidelines. Males reported better dietary and physical activity practices compared to females ($p<0.05$). 20% of adolescents were overweight and 17.4% had elevated Blood Pressure (BP). A higher proportion of private school students had overweight and elevated BP ($p<0.05$). *Conclusion:* High prevalence of overweight and elevated BP among adolescents signifies need for intense health promotion measures and reorienting school health services towards prevention of lifestyle diseases. Parents, teachers and students should be sensitised to the impact of behavioural and physical risk factors on long-term morbidity and be equipped with knowledge and training to prevent or modify these risk factors.

**Keywords:** Adolescents, School Students, Risk Factors, Lifestyle Diseases, Non-Communicable Diseases, Overweight, Hypertension

## Introduction:

According to World Health Organization (WHO), Non-communicable Diseases (NCD) or lifestyle diseases contributed to 71% of global deaths in 2016 [1]. Eighty percent of these deaths were attributed to the tetrad of cardiovascular diseases, diabetes, cancer and chronic respiratory diseases [1]. In terms of absolute numbers, low and middle-income countries accounted for 78% of these deaths [1]. It has been sufficiently documented that, four harmful, yet modifiable lifestyle behaviours, namely unhealthy diet, physical inactivity, tobacco and harmful alcohol use, accelerate the onset and progression of NCDs and resultant deaths [1-2]. These lifestyle practices manifest in metabolic changes such as raised Blood Pressure (BP), increased blood sugar and lipids and obesity which act as intermediate risk factors, further augmenting the course of NCDs [1-2].

The extended course and expensive treatment of most NCDs and their complications could significantly drain resources in low-income families [1-3]. The resultant poverty impedes health-seeking and further potentiates NCD progression, evoking a vicious cycle. With more than 85% of population with NCDs living in developing countries, implementation of effective interventions to reduce risk factors among population is the most cost-effective and high-priority approach to challenge the growing burden [1-3].

In India, 23% of population are at risk of NCD-related premature deaths [4-5]. Rapid globalization of unhealthy lifestyles exposes children, especially adolescents to as much risk as adults. But they are more vulnerable owing to lack of experience and capacity to reflect on these risks and protect themselves against lifestyle diseases [6]. Hence, preventive interventions attempted among children often have profound advantages over any mitigating measures to reduce risk and restore health in adults.

Schools present a unique opportunity to perform comprehensive assessment of adolescents for presence of lifestyle disease risk factors and encourage them to modify their behaviours for a healthy adulthood. Literature review reveals substantial research among school children focussed on assessment of individual or limited group of risk factors such as obesity and hypertension or cardiovascular risk factors. But there is paucity of studies on complete and comprehensive assessment of these risk factors among adolescents in Tamil Nadu. Hence the present study was conducted to assess the risk factor profile for lifestyle diseases (4 major behavioural risk factors- physical inactivity, unhealthy diet, tobacco and alcohol use; 2 major physical risk factors- obesity and hypertension; family history) among adolescent school students in Ranipet, an industrial area of Vellore district, Tamil Nadu and to identify the sociodemographic factors associated with above risk factors among the study population.

**Material and Methods:**

This was a descriptive, cross-sectional study conducted between June and September 2018, among adolescent school students aged 13 to 17 years and studying in standards 8 to 11, in Ranipet, an industrial area of Vellore district of Tamil Nadu. Applying the prevalence of hypertension among adolescent school students, 21.4% as identified by Tony *et al.* in their study conducted in Thiruvananthapuram, Kerala [7], the sample size was calculated using the formula, $N= [Z\ \alpha^2\ pq]/d^2$, where $Z\ \alpha^2 =4$, p=21.4, q=78.6 and d= 13% relative error. The sample size derived was 869 and assuming a 10% non-response rate, the final sample size estimated was 955.

Ranipet, an industrial town in Vellore district, Tamil Nadu was selected as study area for logistic purposes. A multi-stage random sampling method was used. There are 6 higher secondary schools in Ranipet, 2 Government and 4 private schools. In the first step, 50% of the schools were chosen by simple random sampling method (2 among the private and 1 of the Government schools). In the second step, the number of students to be selected from each school was calculated using Population-Proportionate to size method. In the third step, the number of students to be selected from each school was divided equally among the classes 8 to 11. The

number of students from each class was then chosen by simple random sampling. A semi-structured, self-administered questionnaire was prepared in English based on WHO STEPS Schedule, with focus on risk factors for the following lifestyle diseases: cardiovascular diseases, cancer, diabetes and stroke [8]. It was translated into Tamil and back-translated to English to check for consistency and clarity. The questionnaire consisted of following four sections: sociodemographic characteristics; lifestyle or behavioural risk factors such as dietary practices, physical activity and sedentary practices, smoking and alcohol use among participant and family members; family history of NCDs; physical measurements- height, weight, blood pressure. A pilot study was performed among a similar group of participants, and necessary changes were made. The results of pilot study were not included in the study.

Institutional Ethics Committee approval was obtained. After obtaining necessary permission from school authorities, consent form with an information sheet was distributed to the selected participants and their parents. The purpose of the study was explained and complete confidentiality of responses was assured to students and parents. After obtaining informed written consent, the questionnaire was administered in both English and Tamil to obtain the requisite details. The doubts raised by students were clarified by investigators. Physical measurements were performed using standardized protocols and standardized instruments. All measurements were recorded by the same investigator and same instruments were used throughout the study.

After collection of responses, with necessary assistance from school authorities, health education was given to all students of participant schools on the burden of NCDs and the need to adopt healthy lifestyle practices. The students with elevated Body Mass Index (BMI) and blood pressure were counselled on dietary management and physical activity measures.

The data was entered in Microsoft Office Excel version 2007 and statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 23. Qualitative variables such as dietary practices, physical activity, tobacco and alcohol use and family history of NCDs were categorized and expressed as frequencies and percentages. The statistical analysis of categorical variables was performed using Chi-square test. *P* less than 0.05 was considered significant.

**Operational definitions**

Overweight and Obesity were defined as recommended by Indian Council of Medical Research (ICMR) as BMI $\geq$ + 1 SD to < +3 SD of Median and BMI $\geq$ + 3SD of Median respectively, according to Simplified field charts of 2007 WHO Reference Standards [9].

Elevated Blood pressure: BP level $\geq 95^{th}$ percentile by gender, age and height based on the reference charts developed for Indian children [10]. The term Elevated BP was used in our study, since we could not take 3 separate measurements according to standard recommendations [10].

**Results:**

A total of 932 students participated in the study with the age range of 13 to 17 years. Table 1 presents the baseline characteristics of study participants. Table 2 depicts the distribution of selected lifestyle risk factors namely, dietary practices, physical activity, sleep and sedentary behaviour among participants. None of the study participants reported history of smoking, smokeless tobacco use or alcohol at present or in the past. Smoking and alcohol use among family members was reported by 2.1% and 2.8% students respectively. Exposure to passive smoking was reported by 17.4% of students at home, tuition centres, bus stops and other places and 17 (1.8%) students reported being exposed for more than 10 minutes per day. Table 3 details the distribution of family history of chronic diseases among the participants.

**Table 1: Distribution of Baseline Characteristics of Students**

| Variable | Frequency (N=932) | Percentage |
|---|---|---|
| **Type of school** | | |
| Government (Karai welfare) | 128 | 13.7 |
| Private (Gangadhara) | 511 | 54.8 |
| Private (CSI) | 293 | 31.4 |
| **Age in years** | | |
| 13 | 200 | 21.4 |
| 14 | 296 | 31.8 |
| 15 | 244 | 26.2 |
| 16 | 152 | 16.3 |
| 17 | 40 | 4.3 |
| **Gender of students** | | |
| Male | 667 | 71.6 |
| Female | 265 | 28.4 |
| **Class** | | |
| 8$^{th}$ standard | 265 | 28.4 |
| 9$^{th}$ standard | 319 | 34.2 |
| 10$^{th}$ standard | 180 | 19.3 |
| 11$^{th}$ standard | 168 | 18.1 |

*Continued...*

| Variable | Frequency (N=932) | Percentage |
|---|---|---|
| **Type of family** | | |
| Nuclear | 705 | 75.6 |
| Joint | 227 | 24.4 |
| **Mother's education** | | |
| Primary | 120 | 12.9 |
| Middle | 185 | 19.8 |
| High | 376 | 40.3 |
| Higher secondary | 180 | 19.3 |
| Diploma/ Degree | 71 | 7.6 |
| **Father's education** | | |
| Primary | 106 | 11.4 |
| Middle | 116 | 12.4 |
| High | 398 | 42.7 |
| Higher secondary | 203 | 21.8 |
| Diploma/ Degree | 109 | 11.7 |
| **Mother's occupation** | | |
| Home-maker | 671 | 72 |
| Daily wages/Non-fixed pay | 64 | 6.9 |
| Clerical or technical job with monthly pay | 167 | 17.9 |
| Semi-professional- Teacher/ nurse | 30 | 3.2 |
| **Father's occupation** | | |
| Daily wages/ Non-fixed pay | 173 | 18.6 |
| Monthly pay- Clerical/Technical- unskilled | 350 | 37.6 |
| Monthly pay- Clerical/Technical- semi-skilled | 56 | 6 |
| Self-employed or Business owner | 334 | 35.8 |
| Professional | 19 | 2 |

**Table 2: Distribution of Frequency of Selected Dietary Practices, Physical Activity, Sleep and Sedentary Behaviour among Study Population (N=932)**

| Variable | Frequency (N=932) | Percentage |
|---|---|---|
| **Dietary practices** | | |
| **Frequency of intake of common dietary components** | | |
| Fruit intake ≤ 3 days | 658 | 70.6 |
| Fruit servings per day ≤ 2 servings | 489 | 52.5 |
| Vegetable intake ≤ 5 days | 375 | 40.2 |
| Vegetable servings per day ≤ 2 servings | 540 | 57.9 |
| Frequency of consumption of outside food ≥ 2 days | 313 | 33.6 |
| Reported High Salt intake pattern | 43 | 4.6 |
| **Frequency of intake of selected food items** | | |
| Sugar intake per day > 6 teaspoons | 49 | 5.2 |
| Fried local foods ≥ once per week | 314 | 33.7 |
| Red meat ≥ once per week | 286 | 30.7 |
| Chicken ≥ once per week | 384 | 41.2 |
| Aerated drinks ≥ once per week | 259 | 27.8 |
| Bakery products ≥ once per week | 285 | 30.6 |
| Pickle products ≥ once per week | 263 | 28.2 |
| Dried fish ≥ once per week | 147 | 15.8 |
| Noodles / Pasta ≥ once per week | 207 | 22.2 |
| Packaged foods ≥ once per week | 408 | 43.8 |
| Fish < once per week | 699 | 75 |
| Egg intake 3 or more/week | 252 | 27 |
| **Physical activity, Sleep and Sedentary behaviour** | | |
| Moderate to vigorous physical activity ≤ 3 days/ week | 501 | 53.8 |
| Duration of physical activity ≤ 120 minutes per week | 503 | 54 |
| Sleep duration per day < 8 hours | 328 | 35.2 |
| Sedentary duration > 2 hours | 831 | 89.2 |

**Table 3: Distribution of Family History of Chronic Diseases among Participants (N= 932)**

| Disease | Family history: Frequency (Percentage) [N= 932] | |
|---|---|---|
| | One parent | Both parents |
| **Diabetes mellitus** | 114 (12.2) | 17 (1.8) |
| **Hypertension** | 151 (16.2) | 10 (1.1) |
| **Coronary Heart disease** | 27 (2.9) | 1 (0.1) |
| **Stroke** | 10 (1.1) | |
| **Cancer** | 5 (0.5) | |

The distribution of nutritional status and blood pressure status of the participants is presented in figs. 1 and 2 respectively.

Frequency of consumption of vegetables and outside food was found to be significantly associated with gender. A higher proportion of females (64.5%) reported inadequate vegetable intake (< 2 servings per day) compared to 55.3% of males (P<0.05). Frequency of consumption of outside food (for 2 or more days per week) was higher among males (37.9%) as against 22.6% in females (P<0.05).

Males also reported frequent consumption (once or more per week) of fried local foods (37.3%), red meat (36.6%), chicken (34.5%) and aerated drinks (29.8%) compared to females and the difference was statistically significant (P<0.05). Twice the proportion of males (31.6%) consumed at least 3 or more eggs per week compared to 16.2% of females (P<0.05).

Frequency of consumption of vegetables and selected food items such as fried local foods, red meat, chicken, aerated drinks, dried fish, noodles, packaged foods, fish and egg was higher among Government school students compared to private school students (P<0.05).

Despite the overall sub-optimal physical activity observed among students, females reported markedly reduced frequency and duration of physical activity compared to males; 64.2% of females reported less than 3 days of moderate-to-vigorous physical activity per week and 64.9% of them were engaged for 120 minutes or less per week. In comparison, 49.6% of males reported reduced frequency and duration of weekly physical activity. The difference was statistically significant (P<0.05). Similar trend was also observed in sedentary behaviour, 92.8% of females reported being sedentary for more than 2 hours per day compared to 87.7% of males (P<0.05).

Reported frequency and duration of physical activity per week was higher among Government school students compared to private school students (P<0.05). A higher proportion of private school students (90.8%) spent more than 2 hours

per day in sedentary behaviour compared to 78.9% of Government school students (P<0.05). Among Government school students, 62.5% were overweight and 12.5% were obese compared to 64.3% and 20.6% respectively among private school students and the relationship was statistically significant (P<0.05). Similar trend was identified in elevated BP; 19% of private school students had elevated BP in contrast to a prevalence of 7% among Government school students (P<0.05).

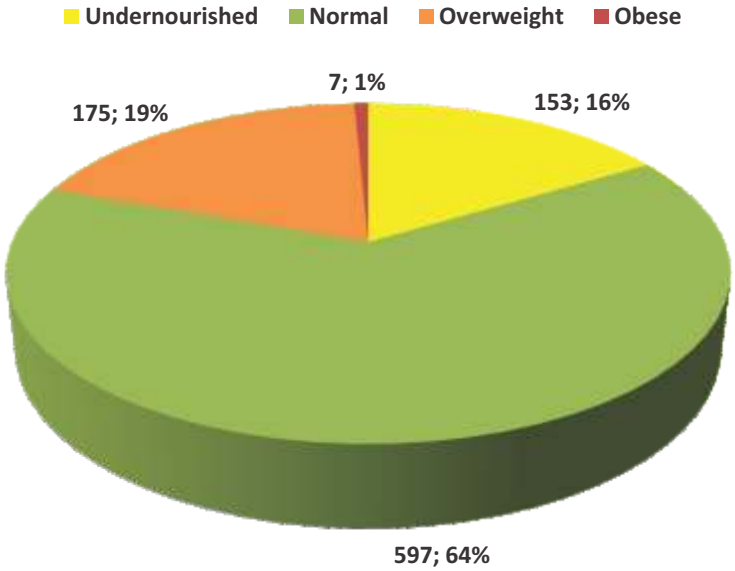


**Fig. 1: Distribution of Nutritional Status of Study Population (N=932)**

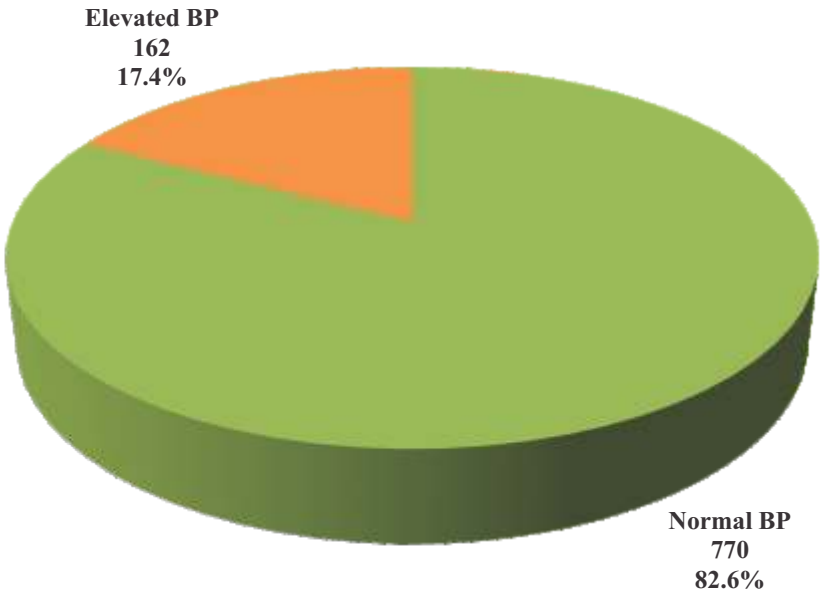


**Fig. 2: Distribution of Blood Pressure Status among Study Population (N=932)**

**Discussion:**

A total of 932 students, chosen from 2 private schools and one government school in Ranipet participated in the study. The students from the respective classes were proportionately chosen using simple random sampling contributing to a sample of 804 students from two private schools and 128 students from government school. The predominance of private schools could be attributed to the industrial nature of the study setting. Boys constituted 71.6% of study population. Three-fourth (75.6%) participants were from nuclear families.

**Dietary Practices**

WHO recommends a minimum of 400 grams of vegetables and fruits per day split into servings of approximately 80 grams [11]. But the reported weekly intake among our participants was inadequate with 70.6% of the students reporting fruit intake for less than 2 days per week and 40.2% of students reporting vegetable intake for less than 5 days per week. About one-third of students reported outside food consumption for more than 2 days per week. Yari *et al.* also reported lower consumption of fruits and vegetables among secondary school students in Iran [12].

Children today are increasingly exposed to various forms of unhealthy diet practices such as fast foods, junk foods, instant foods and street foods [13]. Intensive and innovative marketing, increased pace of lifestyle with insufficient time for preparation of healthy foods at home and easy availability have contributed to these foods invading the dietary schedule of children. High in sugar, saturated fat, salt and calories, these foods have contributed considerably to the burgeoning problem of childhood obesity and resultant complications of adult life [13]. Consumption of selected food items such as fried local foods, red meat and packaged foods was substantially high among our participants. Our findings are also supported by a similar research by Kumarasamy *et al.* among students from Imphal [14].

A statistically significant difference was observed among males and females in certain dietary practices. Vegetable consumption was lower among females and consumption of outside food was higher among males. The consumption of obesogenic food items such as fried local foods, red meat, chicken, aerated drinks and egg was significantly higher among boys. Kumarasamy *et al.* and Tassitano *et al*. have also reported significant difference in junk food and fruit consumption between girls and boys [14-15]. On comparison of dietary practices, Government school students reported lower vegetable consumption and higher consumption of obesogenic foods.

**Physical Activity, Sleep and Sedentary Behaviour**

More than 50% of students reported less than recommended physical activity and 89.2% students spent more than 2 hours per day in sedentary activity. Reported physical inactivity and sedentary behaviour was found to be higher among girls compared to boys and the difference was statistically significant.

Bergmann *et al.* has reported a comparable predominance of physical inactivity among students in Brazil (68%) and it was more pronounced among girls [16]. Mondal *et al.* also

reported high physical inactivity (22.4%) among girls in an industrial town of West Bengal [17]. Kumarasamy *et al*. and Tassitano *et al*. have reported significant difference in physical inactivity between girls and boys [14-15].

The marked predominance of physical inactivity and sedentary behaviour among adolescent students in all the above studies, points to an alarming trend, considering the increasing burden of NCDs worldwide and calls for immediate action.

**Substance Use**

None of our study participants reported smoking or alcohol use which was a positive trend. In contrast, Kumarasamy *et al*. and Mahmood *et al*. have reported substantial tobacco, betel-nut and alcohol use among students in Imphal and Bareilly respectively [14, 18]. Despite Second Hand Smoke (SHS) being a recognised risk factor in cancer, chronic respiratory diseases and hypertension, very few studies have focused on assessment of SHS exposure. Regular SHS exposure was reported by 17.4% of our participants at homes, tuition centres, bus-stops and other places. Kumarasamy *et al*. have reported a relatively higher exposure (26.4%) [14].

**Nutritional Status**

Nineteen percent of our participants were overweight and 1% was obese. Our findings were consistent with those of Selvaraj *et al*. (16.9%) from a semi-urban area of Tamil Nadu and Yari *et al*. (15.2%) from Iran [12, 19]. Our study also identified 16% students who were underweight for age. Trivedi *et al*. in their study among adolescents in rural Gujarat and Mahmood *et al*. from Uttar Pradesh found a contrastingly higher prevalence of thinness and under nutrition and very low prevalence of overweight which could be explained by the varied nature of study settings [18, 20]. Prashanth *et al*. reported a comparatively lower prevalence of overweight (10.1%) among adolescents in Karnataka [21].

Comparing the estimates of overweight among government and private schools, an increased prevalence was identified among private school students and the difference was statistically significant. ORANGE study carried out among 18955 children in Chennai schools by Madras Diabetes Research Foundation and Dr Mohan's Diabetes Specialities Centre identified a comparable trend [22]. Prashanth *et al*. reported a contrasting trend with higher prevalence of overweight among Government school students, in both rural and urban areas [21].

**Elevated Blood Pressure**

Apart from being a major risk factor for myocardial infarction, stroke and cardiovascular mortality in adulthood, elevated blood pressure in children and adolescents is also associated with increased risk of adverse outcomes such as hypertensive encephalopathy, seizures, cerebro-vascular accidents and congestive heart failure [23]. Elevated blood pressure was identified among 17.4% students in our study. The prevalence was more among girls than boys though the difference was not statistically significant. This was higher than the prevalence reported by Mahmood *et al*. from Uttar Pradesh (12%) and Narayanappa *et al.* among rural and urban students from Mysore (4 to 5.5%) [18, 24]. Prasad *et al*. (24.2%) and Tony *et al*. (pre-hypertension: 21.3% and hypertension: 21.4%)

have described a higher burden among students of Lucknow and Thiruvananthapuram respectively [7, 25].

A higher proportion of private school students were found to have elevated blood pressure and the difference was statistically significant. Our finding was consistent with that of Prasad *et al.* from Thiruvananthapuram [25]. However Kavitha *et al*. from Puducherry, found that hypertensive status could be independent of type of school [26].

The positive association identified between overweight and elevated BP in our population is supported by ORANGE study, conducted among school children from Chennai [22]. Consistent findings were also reported by Mondal *et al.*, Nag *et al.* and Prasad *et al.* among adolescents in West Bengal and Lucknow respectively [17, 25, 27]. Despite varying estimates of prevalence, positive association between overweight and hypertension have also been reported by Bohra *et al*. from Northeast India, Buch et al from Surat city, Western India and Kavitha *et al*. from Puducherry, South India [26, 28-29]. Katta *et al*. reported significant association between obesity and mean systolic and diastolic blood pressure among adolescents [30].

Our study identifies a perturbing trend of unhealthy dietary practices and physical inactivity among adolescents. The similarity of estimates between government and private school students could be an indirect indicator of the extent to which changing lifestyle patterns have permeated the entire spectrum of society. Assessment of elevated BP or hypertension among children and adolescents remains a challenge in our country. The recommended guidelines practised in developed countries may not be applicable to a developing country like India. The studies reviewed have used various classifications which might have contributed to the wide range in prevalence of hypertension. However, results of contemporary studies offer substantial insight into the emerging problem of hypertension among adolescents and its strong association with overweight and obesity. There is a need to develop nomogram for our Indian adolescents which takes into account the diversity of our population.

**Conclusion:**

In our study, a considerable proportion of students had lifestyle risk factors in the form of unhealthy dietary practices and sub-optimal physical activity. An approximate one-fifth of adolescents were overweight and a similar proportion had elevated blood pressure. Adolescence is probably the last chance to effectively modify these risk factors and prevent the resultant NCDs. Parents, teachers and students should be sensitised to the impact of behavioural and physical risk factors on long term morbidity and quality of life and be equipped with knowledge and training to prevent or modify these risk factors. The study reinforces the need for orienting school health services to tackle the increasing burden of lifestyle diseases.

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