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Proficiency and implementation associated with noncommunicable diseases among secondary school students in Bangladesh

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ABSTRACT

Background: The burden of non-communicable diseases (NCDs) is growing swiftly in low-resourced countries. In Bangladesh, a high prevalence of unhealthy lifestyles has been observed among its population. This study aimed to measure the knowledge and practices related to NCDs and associated factors among Bangladeshi secondary school-going students.

Methods: A cross-sectional study was conducted among secondary students from all administrative regions. Data were collected through questionnaires in-person, over telephone interviews, and online surveys. Data were analyzed descriptively by frequencies and percentages. The Pearson chi-square test was used to examine the association between the variables. A multiple logistic regression model was introduced to identify the predictors of healthy lifestyle practices.

Results: A total of 1,744 students were included in this study. Several gaps in knowledge and insufficient healthy practices were revealed. In the multiple linear regression analysis, the type of school, place of residence, parent's educational level, and monthly income accounted for variability in the level of knowledge about NCDs. Gender, type of school, and monthly income were independent predictors of healthy lifestyle practices.

Conclusion: Health educational programs on risk factors of NCDs and healthy lifestyles should be incorporated into the core school curriculum of all schools in Bangladesh. The programs should target economically disadvantaged populations and ethnic minorities to address social inequalities.

INTRODUCTION

Non-communicable diseases (NCDs) are a group of chronic diseases that cannot be transmitted from person to person through direct contact (Budreviciute *et al*., 2020). The leading causes of NCDs include hypertension, overweight or obesity, hyperglycemia, and hyperlipidemia (Alamnia *et al*.,2021; WHO, 2021). Besides, smoking, lack of physical activity (PA), misuse of alcohol, and an unhealthy diet increase the risk of NCD development (Budreviciute *et al*., 2020; Ng *et al*., 2020). In 2016, an estimated 40.5 out of 56.9 million deaths globally (71%) were attributed to NCDs. Specifically, 32.2 million deaths occurred due to four main types of NCDs: cardiovascular diseases (CVDs), chronic respiratory diseases (CRDs), cancers, and diabetes mellitus (DM) (NCD Countdown 2030 collaborators, 2018).

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NCDs affect all regions and countries worldwide (Budreviciute *et al*., 2020). In recent years, the highest mortality rates from NCDs have been recorded in low-income and lower-middle-income countries (LMICs), especially in sub-Saharan Africa, Central Asia, and Eastern Europe (Martinez *et al*., 2020; NCD Countdown 2030 collaborators, 2018). In LMICs, urbanization and its links with the nutrition transition have appeared as the drivers of the rising burden of NCDs (Batal *et al*., 2018; Popkin, 2015; Popkin and Ng, 2022). As urbanization accelerates, more people switch to a Western-style diet containing large amounts of animal-based, processed, high-sugar, high-fat, and low-fiber foods, which increase the risk of chronic diseases (Billingsley *et al*., 2018; Goh *et al*.,2020; Nettleton *et al*., 2016; Olatona *et al*., 2018). Several studies in LMICs have found that urbanization is associated with a higher prevalence of type 2 DM, high blood pressure, and dyslipidemia (Bernabé-Ortiz *et al*., 2017; de Groot *et al*., 2019; Gassasse *et al*., 2017; Schutte *et al*., 2021). Evidence shows that adults and children living in urban areas are more likely to be overweight or obese than those in rural areas (Nurwanti *et al*., 2019). Besides, multiple studies reported that lower socioeconomic status contributes to the development of NCDs and their fatal outcomes, especially among the younger populations (Allen *et al*., 2017a, 2017b; Williams *et al*., 2018).

Bangladesh is a highly populated country, and being the LMICs where the burden of NCDs is among the most complex and critical public health challenges (Rawal *et al*., 2019, 2020). According to the World Health Organization, NCDs account for 67%–70% of all deaths in Bangladesh (The Daily Star, 2022; Uddin, 2022). It has been estimated that 35% of the Bangladeshi population consumes tobacco regularly (Burki, 2019). The population-based national survey in 2018 showed that 26.2% of the respondents had three or more NCD risk factors (Riaz *et al*., 2020). The same study revealed that urban dwellers had lower levels of PA, consumed fewer fruits and vegetables, and had a higher prevalence of obesity, hypertension, hyperglycemia, and type 2 DM than those living in the countryside (Riaz *et al*., 2020).

The main barriers to adequate NCDs prevention, service provision, and care-seeking include outdated and inflexible legislative frameworks, limited access to healthcare services, high healthcare expenditure, stigma and cultural disbeliefs related to NCDs, and the patients' fear of breaching confidentiality (Dong *et al*., 2021; Patton *et al*., 2016). Although the government of Bangladesh has developed various strategies and policies to address NCDs and the risk factors, improper planning and monitoring are hindrances that hamper their implementation (Biswas *et al*., 2017). Besides, Bangladesh's low-income communities experience a more significant healthcare expenditure burden (Kankeu *et al*., 2013; Mistry *et al*., 2021; Zhou *et al*., 2021). This is particularly important when considering the high cost of treatment for chronic NCDs. A recent study showed that households with members who had NCDs spent a 59% higher share of their income on care for these diseases than non-NCD households (Datta *et al*., 2018). It has been reported that NCDs have triggered most households to sell assets or borrow money from informal sources to meet the financial needs required for therapeutic interventions (Datta *et al*., 2018; Kabir *et al*., 2019; Onarheim *et al*., 2018). On top of that, the people in Bangladesh are also ignorant of incorporating a healthy lifestyle into their daily routine due to a lack of knowledge, infrastructure, and resources and an inability to recognize its importance (Hasan *et al*., 2020).

Young people need to have an awareness of NCDs and their risk factors. Recent research revealed a high prevalence of smoking and alcohol consumption among high school students (Kim and Sohn, 2014; Lee *et al*., 2021; Lim *et al*., 2017). Worldwide, it has been estimated that 21% of school-going teenagers smoke tobacco (Ahammed *et al*., 2021; Desai *et al*., 2019). A significant association between cigarette smoking and alcohol use with low PA and low intake of fruits and vegetables among adolescents has been reported in 89 countries around the globe (Uddin *et al*., 2020). In Bangladesh, previous research revealed that more than a quarter of secondary school and university students were regular tobacco smokers (Islam *et al*., 2016; Kamruzzaman *et al*., 2022).

Moreover, schools do not prioritize PA due to a general lack of understanding of its importance. Also, since physical education does not contribute to grades, many parents prefer screen-based activities to PA for their children (Hasan *et al*., 2020). Suboptimal adherence of children and adolescents to health recommendations exposes them to a higher risk of developing NCDs during adulthood (Akseer *et al*., 2020; Hardy *et al*., 2017). Several studies advocated installing healthy lifestyle changes early on to reduce the NCDs burden (Afshin *et al*., 2017; Bruins *et al*., 2019; Olatona *et al*., 2018).

Studies in India and Sri Lanka have found insufficient knowledge about healthy lifestyles and NCDs among high school students (Bassi *et al*., 2021; Gamage and Jayawardana, 2017). There is limited research on this topic in Bangladesh. A recent study found that 43% of adolescents aged 13–19 had poor knowledge of NCDs (Islam *et al*., 2019). However, the generalizability of these results is uncertain, given the limited number of purposefully selected students from two public schools in the capital city. Besides, no local studies cover the relationship between sociodemographic factors and NCDs-related knowledge and practices among school-going children. Therefore, the objectives of this study were 1) to measure the level of knowledge about NCDs and healthy lifestyle practices and 2) to identify and appraise the independent predictors and their relationship with sociodemographic factors, in addition to the NCDs-related knowledge, practices, and healthy lifestyle practices among secondary school students in Bangladesh. The findings of this study will inform public health authorities concerning the prioritization of NCD prevention interventions in school settings in Bangladesh.

METHODS

Study setting and sampling

This study was a nationally representative survey conducted across Bangladesh. It was carried out among adolescents attending secondary schools with Bangla, English, and Arabic (Islam-centred madrasahs) mediums of instruction. The sample size calculated was 2,029, having considered a pooled difference in proportions of students with good knowledge and practices by sociodemographic variable as 0.07

(Gamage and Jayawardana, 2017), a ratio between students with good and poor knowledge and practices set at 2, and the addition of a nonresponse rate of 15% (Lwanga and Lemeshow, 1991). To ensure equal representation of participants from different geographical areas and sociodemographic backgrounds, the study encompassed school-going students from all eight regional divisions of Bangladesh (Dhaka, Chattogram, Sylhet, Khulna, Rajshahi, Mymensingh, Barisal, and Rangpur). A stratified, household-based cluster sampling technique was used. Out of 64 administrative districts, 21 were purposely selected to allow geographical comparisons. The probability of selection was proportional to population size. The geographical distribution and size of the cluster determined whether schools were selected through systematic random or classic proximity sampling. The study included respondents from remote rural districts, such as Bandarban, Tangail, Jamalpur, and Bhola, and tribal and indigenous children from the hill tracts of Chattogram.

Participants and data collection

Grade 6–10 students were selected for this study. The necessary written permission to conduct the study was obtained from the school authorities. The respondents were recruited after informed assent and consent were obtained from them and their guardians. The **inclusion criteria** were those between 10 and 18 years old. Children with any acute health conditions and those for whom informed consent was not obtained were excluded from the study. The data were collected between June 2020 and December 2020 via in-person interviews and telephone surveys. Additionally, an online survey method of data collection was used where it was not easy to conduct in-person or telephone surveys (Arafa *et al*., 2019; Marcano *et al*., 2015; McIlven *et al*., 2021). In total, 37 dedicated, well-trained individuals from life science and medical backgrounds collected the data.

Study instrument

A structured questionnaire, both in Bangla and English, was developed for use in this study and pretested by a group of eight experienced epidemiologists, endocrinologists, social science researchers, and pediatricians on a sample of 20 students from multiple geographical regions. The questionnaire consisted of three parts, including the questions regarding (1) sociodemographic data, such as sex, medium of instruction, educational level of parents, monthly household income, and type of residence; (2) knowledge about NCDs (eight questions); (3) healthy lifestyle practices (nine questions). The questionnaire was pretested for validation. Reliability analysis revealed that most of the segments of the survey instrument exhibited accepted values, with a range between 0.672 and 0.882, which indicates good internal consistency and reliability. The evidence of convergent validity was demonstrated by the significant correlations between the items of each section and the overall mean in each section (r_s = 0.332–0.718; $p < 0.05$) (Barman *et al*., 2012; Bhagat *et al*., 2016; Haque *et al*., 2016).

Scoring and measurement

The response options for seven items on knowledge were coded as "yes" and "no," where the "yes" answers were given one point. One additional question was added where the participants needed to indicate which of the nine listed diseases (high blood pressure, diabetes, cancer, obesity, Alzheimer's disease, stroke, heart attack, osteoarthritis, and osteoporosis) can spread from one person to the other. All the disorders were NCDs, so the scoring was grouped and reversed, as shown in Table 1. The minimum and maximum possible total knowledge scores are 0 and 11, respectively, so the scores of 0 to 3, 4 to 7, and 8 to 11 were categorized as poor, moderate, and good knowledge, respectively. Sleep pattern was recorded based on sleep foundation (Suni, 2022).

Three practice-related questions on specific food consumption, namely, fruits, vegetables, and soft drinks, had Likert scale options including "every day," "more than once a week," "once a week," "once a month," and "never," which were coded from four (every day) to zero (never). For soft drinks, the coding was reversed. Questions were also asked on how frequently the participants took junk or fast food per month and how many hours of sleep the participants got on an average school night. The answers were grouped and scored, as shown in Table 1.

Another practice question asked with "yes" and "no" answers were whether the participants did monthly health check at least once a month or followed any specific eating habits to avoid the risk of contracting NCDs. "Yes" answers were given one point. On top of that, the participants need to explain how many hours per day they spent doing exercise/walking/running or playing outdoors (cricket/football/others), where the answers were on the Likert scale of "more than 3," "2–3," "1–2 hours," "less than 30 minutes," and "not at all." The answer choices were scored from 4 (more than 3 hours) to 0 (not at all). The minimum and maximum possible total scores of practice are 0 and 27, respectively, so the scores of 0 to 9, 10 to

Table 1. The grouping and scoring of specific knowledge and practice items.

Variable	Grouping	Scoring
Diseases that can spread from	0–1 answer	4
Person to person:	2–3 answers	3
(all listed are	4–5 answers	2
NCDs)	6–7 answers	1
	8–9 answers	0
Frequency of taking junk or fast food:	0–6 times	4
(per month)	7–13 times	3
	14–20 times	2
	21–27 times	1
	≥ 28 times	0
Sleep: (hours per day)		
10–13 years old (school-age)	9–11 hours*	1
14–17 years old (teen)	8–10 hours*	1
18 years old (young adult)	7–9 hours*	1
	More or less than the above	0

Notes: *Sleep Foundation, 2022.

18, and 19 to 27 were categorized as poor, moderate, and good practice, respectively.

Statistical analyses

The statistical analyses involved utilizing SPSS software (version 22) for descriptive statistics and STATA-15 (Version 15) software for inferential statistics, and the figure was prepared with GraphPad Prism 8.3.2. Customarily distributed numerical or quantitative variables were described using mean and SD measures, while qualitative or categorical variables in this study were presented as frequencies and percentages. A multinomial logistic regression model was employed to examine the factors associated with knowledge of NCD and healthy lifestyle practices. Assumptions for the regression analyses were assessed before interpreting the results. All variables were treated as independent, and a significance level of $\alpha = 0.05$ was established.

RESULTS

Sociodemographic distribution of participants

Table 2 provides a comprehensive overview of the study participants' characteristics. A total of 1,744 participants were analyzed, with age distribution showing that 31.9% were in the 10–13 years old category, 65.5% were in the 14–17 years old category, and only 2.5% were 18 years old. Gender distribution was nearly equal, with 48.3% being male and 51.7% female. The majority of participants (72.6%) attended schools with Bangla as the medium of instruction, while a smaller percentage attended schools with English (9.3%) or Arabic (18.1%) as the medium. In terms of residence, approximately half of the participants lived in rural areas (49.2%), while 38.6% were from urban areas and 12.2% from suburban regions. Regarding parental education, a notable proportion of fathers (34.5%) and mothers (38.5%) had either no education or completed only primary education. Household income varied, with 25.0% of students coming from households earning less than 10,000 Bangladeshi Taka (BDT) (118 USD) per month, and the remaining participants were distributed across different income ranges.

The distribution of the participants' knowledge scores into poor and good knowledge is shown in Figure 1. In contrast, their answers to questions on NCDs-related knowledge are shown in Table 3. More than two-thirds (71.9%) of the participants did not know that NCDs cannot be spread from person to person. Almost half believed that NCDs do not increase the risk of other diseases (49.8%) and that teenagers are not susceptible to NCDs (48.7%). Most students were aware of the role of smoking as a risk factor for NCDs (77.3%) and aware of diabetes (78.0%) and high blood pressure (63.9%), and 78. Perhaps 2% agreed that junk or fast food could be an essential factor in contributing to ill health. When given some examples of NCDs, most participants were aware that those diseases could not spread from person to person, with 91.9% wrongly listing only 0 or 1 of those diseases as infectious.

The distribution of the participants' healthy life practice scores into poor and good practice is illustrated in Figure 2, while their detailed responses are shown in Table 4. Only about one-third (32.5%) of the participants reported

Table 2. Sociodemographic distribution of the participants (n = 1,744).

Variables	Categories	Frequency (n)	Percentage (%)
Age (in years)	10–13 years old (school-age)	557	31.9
	14–17 years old (teen)	1,143	65.5
	18 years old (young adult)	44	2.5
Gender	Male	843	48.3
	Female	901	51.7
Type of school	Bangla medium of instruction	1,266	72.6
	English medium of instruction	163	9.3
	Arabic medium (madrasah)	315	18.1
Place of residence	Rural	858	49.2
	Sub-urban	213	12.2
	Urban	673	38.6
Father's educational level	None	141	8.1
	Primary	460	26.4
	Secondary	377	21.6
	Higher secondary	291	16.7
	Undergraduate	209	12.0
	Post-graduate	266	15.3
Mother's educational level	None	150	8.6
	Primary	521	29.9
	Secondary	443	25.4
	Higher secondary	263	15.1
	Undergraduate	194	11.1
	Post-graduate	173	9.9
Monthly household income	<10,000 BDT (<118 USD)	436	25.0
	10,000–20,000 BDT (118–236 USD)	375	21.5
	20,000–30,000 BDT (236–354 USD)	411	23.6
	30,000–40,000 BDT (354–472 USD)	167	9.6
	40,000–50,000 BDT (472–590 USD)	129	7.4
	>50,000 BDT (>590 USD)	226	13.00

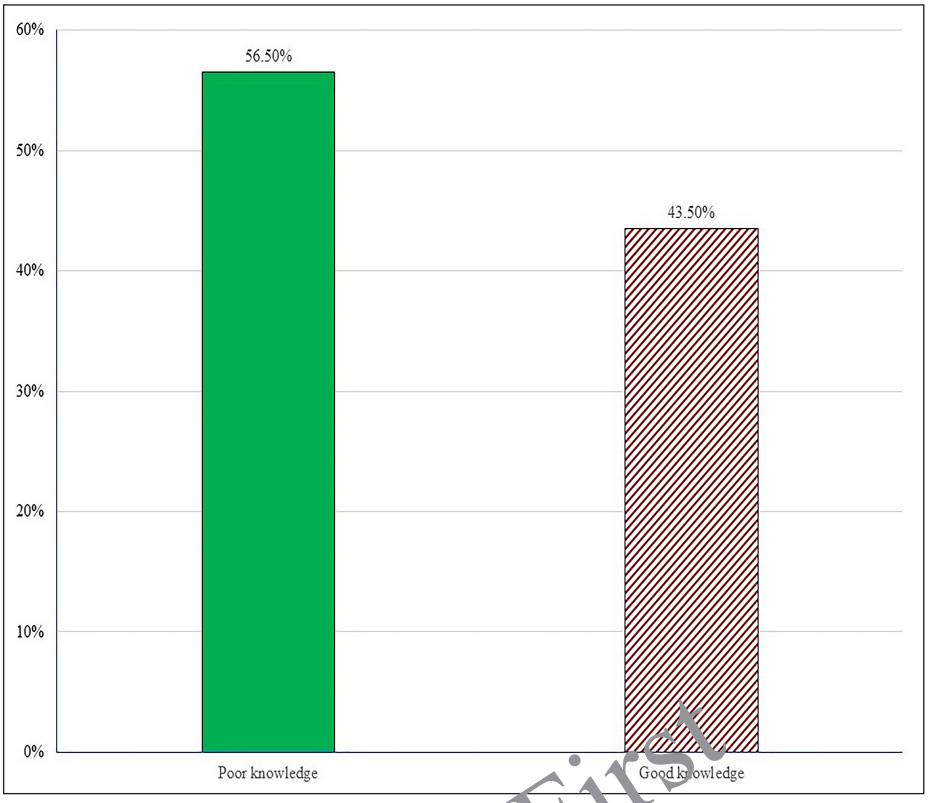

Figure 1. The distribution of the knowledge scores into poor and good knowledge.

Table 3. Knowledge of NCDs among secondary school students (n = 1,744).

Knowledge	Yes		No	
	Frequency	Percentage	Frequency	Percentage
Is it correct that NCDs cannot be spread between people?	490	28.1	1,254	71.9
Does NCDs increase the risk of other ailments?	876	50.2	868	49.8
Can teenagers have NCDs?	894	51.3	850	48.7
Do you think smoking can cause any NCDs?[a]	1,328	77.3	389	22.7
Have you ever heard of diabetes?	1,361	78.0	383	22.0
Have you ever heard of high blood pressure?	1,115	63.9	629	36.1
Do you think junk or fast food can harm your health?	1,364	78.2	380	21.8
Diseases that can spread from person to person[a]	**Answers given**		**Frequency**	**Percentage**
(Choices of answers:	0–1 answer		1,577	91.9
high blood pressure; diabetes;	2–3 answers		118	6.9
cancer; obesity; heart attack;	4–5 answers		14	0.8
Alzheimer's disease, stroke;	6–7 answers		5	0.3
osteoarthritis; osteoporosis)	8–9 answers		2	0.1

Notes: [a]With some missing values.

daily consumption of fruits, while most were eating vegetables daily (62.4%). A relatively small proportion (13.4%) reported having soft drinks daily. Notably, almost three-quarters of the participants ate junk or fast food less than seven times per month (72.4%) and slept well on an average school night (71.7%). Undergoing regular medical check-ups was reported by 15.5%, and about one-third (32.7%) of respondents were following specific healthy eating habits for NCDs prevention. Only 12.1% never exercised daily, and 27.3% never played outdoor games.

The association between sociodemographic characteristics and knowledge of NCDs among secondary school students

The findings from the multinomial regression model indicate several significant associations between different factors and the participants' knowledge of NCD: Participants with overweight had poorer knowledge of NCD compared to those with normal BMI, with an odds ratio (OR) of 0.69 [95% confidence interval (CI) = 0.48, 0.99, $p = 0.049$]. Participants studying in English medium schools exhibited poorer NCD knowledge (OR = 0.43, 95% CI = 0.32, 0.59, $p < 0.001$) than those in Bangla medium schools. Urban participants demonstrated better NCD knowledge (OR = 1.92; 95% CI = 1.45, 2.53; $p < 0.001$) than their rural counterparts. When considering the educational level of fathers, those with secondary school certificates (SSC) and postgraduate education had higher levels of good NCD knowledge, being 1.52 and 1.56 times more likely, respectively, than illiterate fathers. Regarding maternal education, children whose mothers had a postgraduate degree displayed a 1.90 times greater likelihood of having good knowledge of NCD compared to those with illiterate mothers. Among different household income groups, individuals with an income range of 20,000–40,000 BDT had a 1.38 times higher likelihood (95% CI = 1.31, 1.75; $p = 0.032$) of possessing good NCD knowledge than those with an income below 20,000 BDT (Table 5 and Fig. 3).

The association between sociodemographic characteristics and healthy lifestyle practices among secondary school students

Female participants exhibited higher healthy lifestyle scores, with a 1.25 times greater likelihood (95% CI = 1.25, 1.51; $p = 0.028$), than male participants. Additionally, children studying in English medium schools had poorer scores, with a 0.77 times lower likelihood, than children in Bangla medium schools. Notably, when the household income level exceeded 40,000 takas, individuals displayed better knowledge of healthy lifestyles, with an OR of 1.39 (95% CI = 1.09, 1.99; $p = 0.039$), than those from households with a lower-income level of less than 20,000 BDT. These associations are summarized in Table 5.

DISCUSSION

NCDs, such as CVDs, cancers, respiratory diseases, and diabetes, cause 71% of all deaths globally and over 85% in LMICs (WHO, 2018).The mean age of the study student was 14.4 ± 1.72 years. Most of the students, 65.5%, were between 14 and 17 years old, mostly girls, and 72.6% were from Bangla medium instruction. A similar study in Nepal reported that their range was almost similar, 15.61 ± 0.99 years; nevertheless, the majority (51.1%) were male (Sitaula *et al*., 2022). Over 60% of our study participants were from rural and suburban areas, and most were from families with low- or middle-income backgrounds. Nonetheless, the Nepalese study found that most of the research participants were urban (Sitaula *et al*., 2022), and one more Malaysian study found similar respondents were principally from rural (Ithnin *et al*., 2020). Also, most of the students' parents in this study did not complete education beyond the higher secondary level. One Tanzanian study reported that parents' educational level, child sex, family earnings levels, and the number of children remain important determinant factors for children's and adolescents' attendance at secondary

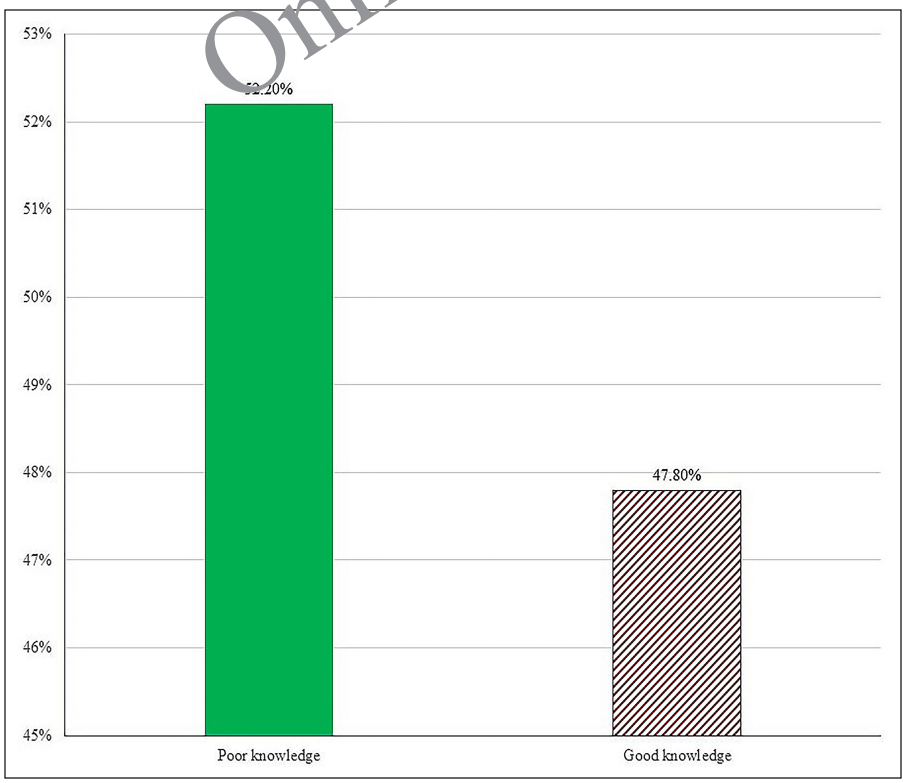

Figure 2. The distribution of the healthy life scores into poor and good practices.

Table 4. Healthy lifestyle practices among secondary school students (n = 1,744).

Practice	Frequency	Percentage
How often do you eat fruit?		
Everyday	566	32.5
More than once a week	546	31.3
Once a week	375	21.5
Once a month	228	13.1
Never	29	1.7
How often do you eat vegetables?		
Everyday	1,089	62.4
More than once a week	478	27.4
Once a week	119	6.8
Once a month	35	2.0
Never	23	1.3
How often do you take a soft drink?		
Everyday	233	13.4
More than once a week	228	13.1
Once a week	595	34.1
Once a month	509	29.2
Never	179	10.3
How frequently do you eat junk or fast food per month?		
0–6 times	1,263	72.4
7–13 times	225	12.9
14–20 times	138	7.9
21–27 times	29	1.7
≥ 28 times	89	5.1
How many hours of sleep do you get on an average school night?		
Good sleep[a]	1,251	71.7
Less or more sleep	493	28.3
Do you get your health checked at least once a month?[b]		
Yes	266	15.5
No	1,451	84.5
Do you follow any specific eating habits to avoid certain diseases?[b]		
Yes	562	32.7
No	1,155	67.3
How many hours per day do you spend doing exercise/walking/running?		
More than 3 hours	143	8.2
2–3 hours	304	17.4
1–2 hours	526	30.2
Less than 30 minutes	560	32.1
Not at all	211	12.1
How many hours per day do you play outdoors (cricket/football/others)?		
More than 3 hours	105	6.0
2–3 hours	299	17.1
1–2 hours	486	27.9
Less than 30 minutes	378	21.7
Not at all	476	27.3

Notes: [a]10–13 years old: 9–11 hours; 14–17 years old: 8–10 hours; 18 years old: 7–9 hours. [b]With some missing values.

Table 5. OR of healthy lifestyle practice score (poor knowledge compared to good knowledge) in the socio-demographic factors among the studied participants.

Variables	OR(95% CI)	*p*-value
Age (in years)		
<15 years	1	
>15 years	1.08(0.89, 1.32)	0.438
Gender:		
Boys[a]	1	
Girls	1.25(1.02, 1.51)	0.028
BMI		
Normal	1	
Underweight	1.08(0.89, 1.34)	0.417
Overweight	1.15(0.81, 1.63)	0.437
Type of school:		
Bangla medium of instruction	1	
English medium of instruction	0.77(0.57, 99.0)	0.049
Arabic medium (madrasah)	1.03(0.69, 1.54)	0.873
Place of residence:		
Rural	1	
Sub-urban	1.14(0.83, 1.57)	0.433
Urban	1.15(0.89, 1.51)	0.292
Father's educational level:		
Illiterate	1	
Primary	0.98(0.63, 1.54)	0.939
SSC	0.89(0.54, 1.43)	0.618
HSC	0.84(0.48, 1.43)	0.509
Graduation	1.07(0.57, 1.99)	0.833
Post-graduation	1.11(0.58, 2.12)	0.772
Mother's educational level:		
Illiterate	1	
Primary	0.87(0.63, 1.54)	0.515
SSC	1.03(0.64, 1.67)	0.895
HSC	0.82(0.47, 1.42)	0.469
Graduation	0.95(0.51, 1.79)	0.873
Post-graduation	1.13(0.57, 2.25)	0.732
Monthly household income:		
<20,000 BDT (<236 USD)[a]	1	
20,000 – 40,000 BDT (236 – 472 USD)	1.14(0.90, 1.43)	0.301
>40,000 BDT (>472 USD)	1.57(1.09, 1.99)	0.039

The multinomial regression model was used to estimate the *p*-value. **Notes**: [a]Reference group; # CI = Confidence Interval.

school (Pezzulo *et al*., 2022). Over half of the students had poor knowledge of NCDs and healthy life practices. Sri Lankan school students (17–19 years old) were found to possess poor knowledge regarding NCDs and healthy lifestyles (Gamage and Jayawardana, 2017). About one-third of students had the misconception that NCDs could be spread from one person

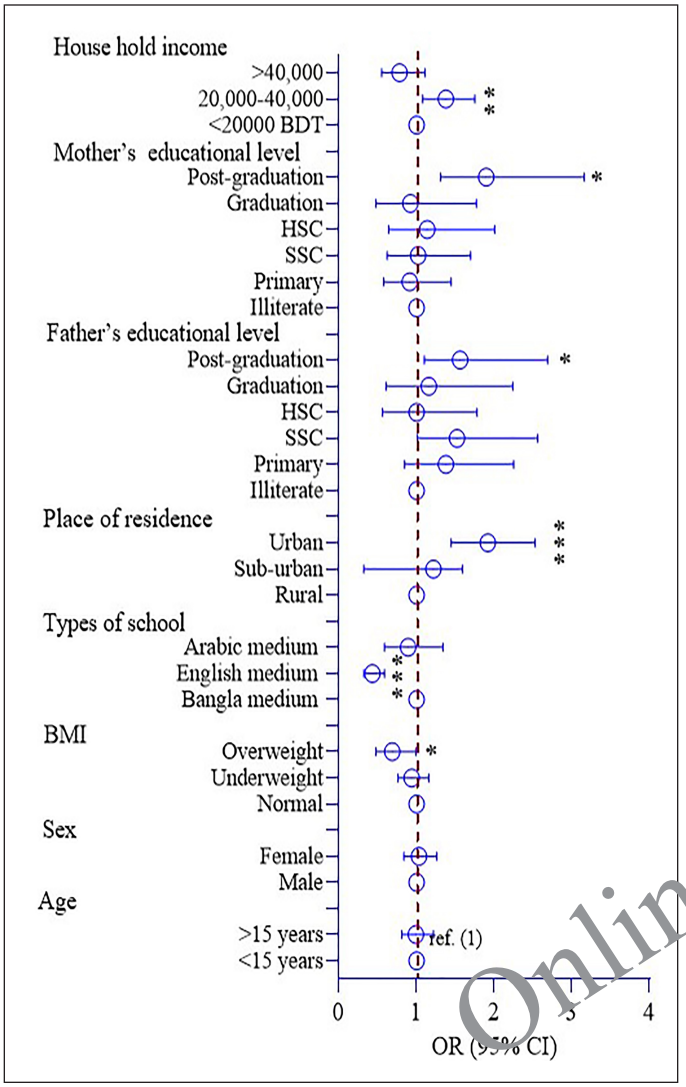

Figure 3. OR of good NCDs knowledge in the sociodemographic factors among the studied participants. The multinomial regression model was used to estimate the *p* value. ***$p < 0.001$, **$p < 0.01$, and *$p < 0.05$. **Notes**: *Reference group; #CI = Confidence Interval.

to another. Most research respondents had an appropriate conception of the differences between NCDs and infectious diseases. NCDs became a burden for developed and developing nations (Boutayeb, 2006; Boutayeb and Boutayeb, 2005; Islam *et al*., 2014; Ndubuisi, 2021). The burden of infectious disease was so high that it accounted for the substantial disease load nationally and internationally (Luna and Luyckx, 2020). NCD diseases have been comparatively neglected in international health policy and planning (Luna and Luyckx, 2020). It has been reported that NCDs are socially and environmentally behave like communicable diseases (Luna and Luyckx, 2020; Marmot and Bell, 2019). Additionally, an unhealthy way of life is escalated through household members, especially among financially marginalized neighborhoods (Azul *et al*., 2021; Hilmers *et al*., 2012; Luna and Luyckx, 2020). The principally identified factors of NCDs were genetic, physiological, environmental, and behavioral factors, low PA, overweight/obesity, consuming fast food and ready eat a meal, tobacco, and alcohol (Bandoh *et al*., 2020; Pécout *et al*., 2021). Half of the secondary school students had no idea that NCDs could increase the risk of other ailments and that teenagers can develop NCDs. Earlier Bangladeshi studies reported that urban school-going teenagers had a mixed level of perception regarding NCDs risk factors; in certain aspects, it was good, and in others, it was inadequate or poor. It has been further reported that often NCDs management was not adequate or poor, such as renal diseases were neglected or did not receive any treatment that resulted in the development of hypertension (Luna and Luyckx, 2020; Luyckx *et al*., 2021). A similar situation happens with other NCDs, such as DM, rheumatic heart disease, and many more NCDs. If they remain neglected or not timely intervened, these NCDs sequel in developing other grave complications (Nulu, 2017). Multiple studies revealed that secondary school adolescents have a high possibility of developing NCDs because risk factors equally exist among them as the adult population (Shayo, 2019; Tandon *et al*., 2022; Uddin *et al*., 2020). In these issues, our research respondent awareness and perception were inadequate. Approximately one-quarter of students had no idea that smoking and junk or fast food are the risk factors for NCDs. One similar Saudi Arabian study revealed that more than one-third of the study population (youngsters) eat ready meals more than eleven times per week (Rahamathulla and Mohemmed, 2020). These youngsters have additional risk factors such as low PA and desk-bound life (Rahamathulla and Mohemmed, 2020). Tobacco is one of the top hazardous components for CVDs, CRDs, cancers, and diabetes. It is considered that tobacco consumption among communities is preventable and to minimize NCDs (Bhatt and Goel, 2018; Perez-Warnisher *et al*., 2018; Roy *et al*., 2017). After that, most respondents were aware of the hazard of fast food and smoking. Among the studied students, 22% and 36% had never heard about diabetes and high blood pressure, respectively. Bangladesh has 12.88 million people suffering from DM and is considered the 8th highest diabetic population (Hossain *et al*., 2022; Talukder and Hossain, 2020). One study reported that the pervasiveness of high blood pressure cases was 1.10%–75%. The comprehensive weighted pooled prevalence of hypertension was 20% (Chowdhury *et al*., 2020). One more recent Bangladeshi study reported that the rate of hypertension among Bangladeshi individuals was 27.4%. Among hypertensive Bangladeshi individuals, around 42.4% were conscious of their ailment. This study also revealed that among high blood pressure cases, only 33.8% had controlled hypertension with antihypertensive medication (Al-Kibria *et al*., 2021). Thereby, both DM and hypertension are quite common NCDs in Bangladesh. Nevertheless, many of our research respondents did not know these major NCDs. Around 67.5% and 37.6% of students reported not eating regular fruit and vegetables, respectively. The American Heart Association recommends a daily intake of 4–5 servings of fruits and vegetables (Dayal *et al*., 2017). Besides, more than half of students reported having soft drinks more than once a week. Regularly consuming sugary beverages is associated with an increased risk of NCDs and even premature death (Haque *et al*., 2020; Restrepo *et al*., 2020). Evidence suggests that soft drink advertising significantly improves children's intake (Lichtenstein *et al*., 2021). A study

in Australia reported that adolescents frequently consumed soft drinks because they were convenient to buy and highly available at home and on school canteen menus (Bere *et al*., 2008). More worryingly, 12.1% and 27.3% of students never spend time on exercise or walking or running, and playing, respectively. Low-level PA has been considered a high-risk factor and often ends with developing CVDs and DM. Nevertheless, this risk factor has been appraised as a modifiable risk issue (Bere *et al*., 2008; Saqib *et al*., 2020; Sheikholeslami *et al*., 2018). Thereby, a good proportion of our study respondents' carter high-risk issues and the development of NCDs.

We found a slightly higher percentage of girls than boys students with good knowledge of NCDs. However, the difference was not statistically significant. A recent cross-sectional survey conducted in Bangladesh showed that males had more comorbidities and risk factors for NCDs than females who were less engaged in unhealthy practices, such as smoking and consuming fast food (Biswas *et al*., 2019; Shah *et al*., 2010). Also, females had a higher rate of good practices regarding NCDs than males. However, men suffer from more NCDs than women (Syed *et al*., 2019).

Nonetheless, it has been reported that males enjoy better health than women (Liu *et al*., 2017; Oksuzyan *et al*., 2008). Furthermore, males have shorter life spans than females. Females have much more physiological illnesses, whereas males have deadly diseases. However, females have the more debilitating long-standing illness. Thereby, both sex has health issues, to some degree, which may be non-identical. After that particular sex can be identified as having superior and robust health. This research deduced that health deviation among both sexes depends on time, environment, and topographical area (Crimmins *et al*., 2019). The study found a strong association between the type of school students attended with knowledge and practices related to NCDs among secondary school students. Multiple studies revealed that knowledge, attitude, and practice regarding NCDs primarily depended on privileged communities (Aung *et al*., 2012; Gamage and Jayawardana, 2017; Lorga *et al*., 2013; Thammatacharee *et al*., 2012). English medium-going students demonstrated the lowest level of NCDs-related knowledge and practices. One earlier Bangladeshi study's findings were not similar to our research findings. However, this study was conducted in rural areas (Rahman *et al*., 2022). Nevertheless, this finding is challenging to explain. English was adopted as the instructional language in Sri Lanka in 2001 in both secondary and tertiary education (Navaz, 2021; Wijayatunga, 2018). One Sri Lankan study revealed that secondary school students' knowledge regarding NCDs and healthy lifestyle were substandard (Gamage and Jayawardana, 2017). This study also observed that urban students' knowledge level was higher than rural adolescents. Our results follow a survey among selected urban school students in Bangladesh in 2019 (Desai *et al*., 2019). Our study depicted that students from lower-income backgrounds had poorer knowledge and practices toward NCDs than students from upper socioeconomic backgrounds. Students from wealthier families have more exposure to resources that can educate them regarding NCDs, including a higher possibility of being sent to private English medium schools (Desai *et al*., 2019). Besides, underprivileged communities are disproportionately affected by unhealthy lifestyles, malnutrition, and unhygienic living conditions. A recent study on NCDs and lifestyle-associated risk factors in South Africa revealed high inequality in the geographical distribution of the prevalence of stroke, hypertension, ischemic heart disease, and dyslipidemia. Specifically, the most increased adjusted risks of NCDs were observed in low-income households with limited access to healthcare facilities providing services for chronic diseases (Habib *et al*., 2020).

Furthermore, previous studies have identified that household income is associated with health check-up rates among different populations (Scully *et al*., 2017; van Ansem *et al*., 2014). Studies have reported that people from LMICs spend more of their budget on medical expenses than on food, hygiene, clothing, and energy (Kim *et al*., 2018; Onah and Govender, 2014; Shin *et al*., 2018). Apart from spending available monetary resources, people often have to sell their assets or borrow money to meet their healthcare needs (Akazili *et al*., 2017; Cunningham, 2009; Khan *et al*., 2017; Onah and Govender, 2014). Previous research in Bangladesh found an association between expenditure for medical care and financial distress and poverty aggravation (Msambichaka *et al*., 2018). Another study in Bangladesh showed that a share of medical expenses was more significant for NCD-afflicted households than households with no reported NCDs (Sloan *et al*., 2021). In the present study, there was a significant disparity in knowledge and practices regarding NCDs between Aboriginal and non-Aboriginal populations. This is consistent with a previous study carried out among high school students in rural Thailand, where most students from ethnic minorities displayed poor knowledge concerning NCDs and associated lifestyle risk factors (Chang *et al*., 2015). Thus, our study highlighted discrepancies in health-related learning between minority and nonminority students.

It was observed that the student's knowledge of NCDs was significantly associated with their parent's education level. Several studies revealed that adolescents whose parents had higher education (Dhungana *et al*., 2019; Roy *et al*., 2020). Additionally, highly educated parents are likely to be more conscientious and knowledgeable about choosing a healthy and unhealthy lifestyle, which could translate to developing healthy lifestyle behaviors in their children (McNiven *et al*., 2021). A study carried out among adolescents in Taiwan found that parents with lower levels of education were less likely to browse health information online. Subsequently, their children had less proficiency in Internet usage concerning health education and lower eHealth literacy and related skills (Alexander *et al*., 2003).

The participants in our sample reported several health issues frequently experienced by them. The most common health issue was body aches, such as back and limb pain. Similarly, a recent African study revealed a high prevalence (36%) of back pain among adolescents (Amarasekara *et al*., 2016). In addition, about a quarter of the participants reported suffering from a sleep disorder in the present study. A cross-sectional survey among 67 countries showed a strong association between difficulty in sleeping and sedentary lifestyle behavior (Golestani *et al*., 2021). A Hong Kong survey of children and adolescents reported that 19.1% of their participants faced

sleeping difficulties, and the prevalence was higher in 16–19 years old students (Lustig, 2020).

Similarly, 40% of adolescents in South China experienced sleep disorders associated with Internet use and depression (Vancampfort *et al*., 2019). The least common health issue experienced by the students in our study was asthma. According to the International Study of Asthma and Allergies in Childhood 2017, the prevalence of asthma among children of Bangladesh and Pakistan was 3.8% and 4.3%, respectively (Lustig, 2020), which is consistent with the present study. Some studies stressed the independent association of a sedentary lifestyle of inactivity and lack of sufficient health resources with NCDs (GBD Chronic Respiratory Disease Collaborators, 2020; Morris *et al*., 2018; Rosenstock *et al*., 1988). Alterations in the circadian rhythm and adaptation of Western lifestyles may have contributed to lifestyle diseases and health issues in children, such as frequent headaches and body pain (Freisling *et al*., 2020; Hootman *et al*., 2003).

In our study, the multinomial regression model revealed that research respondents who are obese and overweight had insufficient knowledge regarding NCDs than the normal individual. One Nigerian study reported that although obesity is low among secondary school students; nonetheless, inadequate knowledge, dismissive attitude, and fatalistic awareness were observed about hazardous issues of overweight and obesity (Oyewande *et al*., 2019). The model also revealed that urban secondary school students possess good knowledge than rural participants regarding NCDs. One Nepalese study reported that research respondents of secondary schools better understand NCDs in metropolitan cities than in smaller municipalities or rural areas (Situla *et al*., 2022). Similarly, one Malaysian study reported that rural adolescents had poor knowledge regarding NCDs than their urban counterparts (Ithnin *et al*., 2020). Our study revealed that research respondents' parent education level of an SSC and higher had good knowledge about NCDs than functionally analphabetic. One earlier recent Bangladeshi study reported similarly (Islam *et al*., 2019). It has been further reported that low educational levels and disparities are associated with higher NCDs (Kim and Nam, 2017; Oshio and Kan, 2019). Our study also found that postgraduate mothers' secondary school children possess higher knowledge levels than those of unschooled mothers. This finding also corresponds with one earlier study (Islam *et al*., 2019). Higher-income households were associated with better knowledge regarding NCDs among secondary school adolescents. An earlier study conducted in Bangladesh similarly reported (Islam *et al*., 2019).

CONCLUSION

NCDs account for more than half of the total deaths in Bangladesh. Knowledge disparity and inequalities in health practices among secondary school students from various sociodemographic backgrounds are evident from the present study's findings. Public health programs designed to educate adolescents and their parents concerning healthy lifestyle practices should target multiple communities to address social inequalities, especially within economically disadvantaged populations and ethnic minorities living in remote areas.

The findings of this study support the idea that health literacy, including basic knowledge about NCDs and their risk factors, should be incorporated into the core curriculum of all types of schools at the earliest stages of education. Various resources, such as newspapers, billboards, and electronic media, are encouraged to disseminate knowledge among students and their parents.

DISCLOSURE

The authors declare that they do not have any financial involvement or affiliations with any organization, association, or entity directly or indirectly with the subject matter or materials presented in this article. This includes honoraria, expert testimony, employment, ownership of stocks or options, patents or grants received or pending, or royalties.

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AUTHORSHIP CONTRIBUTION

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; the took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published, have agreed on the journal to which the article has been submitted, and have decided to be accountable for all aspects of the work.

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All authors reviewed and approved the final version and have agreed to be accountable for all aspects of the work, including any accuracy or integrity issues.

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DATA AVAILABILITY

The data is available only for research from the principal author.

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