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RESEARCH ARTICLE

REVISED Knowledge, attitude, and behaviours on diet, physical activity, and tobacco use among school students: A cross-sectional study in two Indian states [version 2; peer review: 2 approved]

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Abstract

Background: Non-communicable diseases (NCDs) are escalating in India and can be attributed to behavioural risk factors such as unhealthy diet, physical inactivity and tobacco use that began in early years. Understanding adolescents' knowledge, attitudes and behaviours (KAB) related to NCD risk factors would inform the development of school-based health programmes to prevent NCDs.
Methods: Sixth-grade students (n=1026) in 20 schools (10 private, 10 public) from two Indian cities (n=667 from Pune; n=359 from Bengaluru) participated in a KAB survey in 2019. Differences in KAB by gender, school type within cities were investigated.
Results: Knowledge about the harms of tobacco use was higher than knowledge about a healthy diet and importance of physical activity. Only a small proportion of students did not eat breakfast (8.7%) or fruits (11.3%) daily. Only 33.4% of students read nutrition labels before choosing their food. Moderate-to-vigorous physical activity of less than an hour per day was reported by 42.5% of students. Approximately one-third of students had ever tried smoking tobacco (30.1%), smokeless tobacco (30.5%), and e-cigarettes (32.4%). Differences in these behaviours by gender and school type showed that both boys, girls and students of private and public schools are

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vulnerable.

Conclusions: The study findings highlight that knowledge is low for thematic areas like diet and physical activity. While knowledge of tobacco related harms is better but the prevalence of ever tobacco use was found to be high. Socio-demographic factors such as school type and gender had a varying effect on various KAB indicators. There is a need to strengthen health education activities by developing context-specific health intervention materials by engaging school children, their parents, teachers, and communities to promote healthy behaviours among adolescents. Need to augment school health programmes in India with a differential approach based on the issues, specific to school type and city.

Keywords
Non-communicable diseases, risk factors, school, children, lifestyle related behaviours, health promotion

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REVISED **Amendments from Version 1**

All the sections of the manuscript have been further refined to incorporate the suggestions from both the reviewers. The Introduction section has been revised and provided scientific evidence to include 6th graders for our study. Under method section, we also elaborated the selection criteria for schools, using purposive sampling technique. The limitation section of the study is further revised based on the suggestion from both the reviewers (with regard to purposive sampling, non-inclusion of study participants from the rural areas, role of home environment in shaping the individual behavior and not using the food frequency questionnaire). The conclusion section (in abstract and otherwise) has been revised to highlight the findings of the study. The revised discussion section includes information on the implications of the findings, within the context of behaviour change models. The usability of the research findings for the designing and strengthening of the government health programmes has been discussed. The revised discussion also includes minor formatting, grammatical changes and edits to confer to the required word limit.

Any further responses from the reviewers can be found at the end of the article

Introduction

The rising epidemic of non-communicable diseases (NCDs), such as cardiovascular diseases, cancers, diabetes and chronic respiratory diseases is recognised as a leading cause of mortality and morbidity across all age groups in India and globally.[1] NCDs are responsible for more deaths in India each year than all other causes of death combined.[2] In the year 2019, 9.3 million deaths in India were attributed to all-cause mortality, of which 6.1 million (64.9%) were due to NCDs.[3]

Most NCDs are attributable to potentially modifiable behavioural risk factors, including unhealthy diets, physical inactivity, tobacco and alcohol use.[4] Synergistic effects of demographic transition, globalisation, and economic growth have resulted in an environment where more children and adolescents are exposed to and/or engage in these behaviours than ever before.[5] It is a well-known fact that lifestyle-related behaviours are often formed early and persist throughout life.[6,7] Evidence has shown that 70% of premature deaths in adults due to NCDs are associated with risky behaviours that began in childhood.[8] Primordial prevention, including community-based intervention to promote healthier lifestyles, is extremely important for national development and to achieve the Sustainable Development Goals by 2030. Investment at an early age can yield a triple dividend of benefits, i.e., improving health later during adolescence, enhancing health throughout the course of life, and eventually contributing to the health of the next generation of children.[9] By 2030, India is expected to be the first country in the world to become home to more than 1.5 billion people, and its population is on target to reach 1.7 billion by 2050.[10] Thus, protecting and supporting child and adolescent health in this country is paramount not only to India's overall well-being, but also to global health and economy.

Schools have been widely recognised as an important location for promoting healthy behaviours among children and adolescents.[11,12] Incorporating health-based programmes into the school curriculum can substantially influence both health promoting behaviours and educational achievements. The above outcomes can be achieved by providing children and adolescents with adequate knowledge and skills, allowing them to establish healthy attitudes and social norms through such a curriculum.[13] Understanding their current knowledge, attitudes and lifestyle-related behaviours would immensely help both the health and education sectors in developing and implementing effective and efficient school-based health lifestyle programmes and policies.

We have developed Project PaTHWay, a three-year, school-based programme (2018-2021), to promote healthier lifestyle practices among children.[14,15] The overall objective of the programme is to prevent and control the risk factors of NCDs by delivering a school-based health lifestyle programme to students in two cities of India. Specifically, the Project PaTHWay aims to address key behavioural NCD risk factors, such as unhealthy diet, physical inactivity, and tobacco use among school children of grade 6th followed for three years (till grade 8th). Recruitment of sixth graders was done as the World Health Organization defines that adolescent age begins at 10 years. When a child enters adolescence, there is a change in explorative and emotive behaviours due to the shift from parental dependence to independence.[16] Adolescents are vulnerable as they gain more control of what, when, how, and where they eat; moreover, their preferences and personal choices may gain priority over eating habits that are nurtured within the family setting.[17]

The first year of the programme included baseline knowledge, attitude, and behaviour (KAB) assessment and development of a health education programme based on the KAB assessment. Subsequently, school-based health lifestyle programme is being implemented for two years, followed by endline evaluation. Baseline analysis of the KAB of the target population would provide better insight to the 'on-ground' situation and can guide the development of the intervention programme. In this paper, we present the baseline KAB of students relevant to these NCD behavioural risk factors, which have helped us develop the Project PaTHWay school intervention.

Methods

Study design

A cross-sectional study was conducted during January- March 2019 in schools of Pune and Bengaluru to understand the KAB of school students related to diet, physical activity and tobacco use.

Setting

The programme is being carried out in two cities of India, namely Pune (Maharashtra) and Bengaluru (Karnataka). Pune is situated in Western India, while Bengaluru is situated in Southern India. The number of NCD related deaths in both Maharashtra (70.6%) and Karnataka (72.4%) is higher than the national average of all Indian states (64.9%), across all age groups and both sexes.[18] Both Pune and Bengaluru are densely populated and highly urbanised cities. The total population of Pune is 9,429,408, of which there are 4,924,105 males and 4,505,303 females. The average literacy rate is 86.2%.[19] Similarly, Bengaluru is home to 9,621,551 individuals, of which there are 5,022,661 males and 4,598,890 females, and the average literacy rate is 87.6%.[20]

Twenty schools (n = 10 public and n = 10 private) in Pune and Bengaluru were selected to implement Project PaTHWay. These schools were purposely selected from the existing network of collaboration to represent different socioeconomic strata (private schools: middle to higher socioeconomic status; public schools: lower socioeconomic status) within the two cities. The selected schools had common characteristics, such as each school having a division of the sixth grade into not more than one to two sub-sections, availability of playgrounds and equipment for physical activity, and provision of a school meal programme (public schools only).

Participants

Students from these 20 schools, enrolled in the sixth grade (n = 1238; Pune: n = 806; Bengaluru: n = 432) were eligible and invited to participate in the baseline KAB questionnaire administered in 2019.

Instrument and measures

A self-administered, baseline questionnaire was implemented, to assess the students' KAB related to NCD behavioural risk factors (unhealthy diet, physical inactivity, and tobacco use). The questionnaire included a section on socio-demographic profile of the student on aspects such as age, gender as well as education and occupation of their parents and sections on KAB. Diet related knowledge was measured with six questions, each related to elements of a balanced diet (e.g., *How many times per week should one eat breakfast?*). Knowledge about physical activity was measured with five questions (e.g., *How many minutes of physical activity should people of your age have daily?*); and tobacco use knowledge was assessed with 16 questions (e.g., *Does using chewing tobacco cause oral cancer?*).

Attitudes towards diet (e.g., *It is important for me to eat breakfast daily*), physical activity (e.g., *Taking part in physical activities can help me get better marks at school*) and tobacco use (e.g., *Using tobacco makes a person appear to be braver and more grown-up*) were measured using a 5-point Likert scale - strongly agree, agree, not sure, disagree and strongly disagree. Cronbach alpha was calculated for this construct as the mean score was calculated and presented for attitude towards diet, physical activity, and tobacco use. A higher diet and physical activity score denotes a positive attitude towards healthy diet and physical activity, indicating lower risk of indulging in risky behaviours. A higher attitude score for tobacco indicates that the adolescents have a less favourable attitude towards tobacco use, indicating a lower risk of tobacco consumption.

The questionnaire also included behaviours specific to diet (e.g. *In a week, on how many days do you eat breakfast?*), physical activity (e.g., *How many hours do you spend doing moderate to vigorous physical activities?*), and tobacco use (e.g., *Have you ever tried a cigarette/beedi/hookah - even once or twice?*). Susceptibility to tobacco use, for both smoking tobacco and smokeless tobacco was assessed using eight items (e.g. *Do you think you will smoke any type of tobacco when you enter college*?).

This questionnaire was developed based on the socio-ecological model[21] and by adapting measures from reliable instruments that have been validated with adolescents in India. Surveys that we referred included, Global Youth Tobacco Survey (GYTS-2010),[22] Global Adult Tobacco Survey (GATS-2016-17),[23] Project EAT,[24] SPAN survey[25] and surveys used by the author of this study in previous studies conducted in India.[26–28] An English version of the questionnaire was administered in private schools, and Kannada and Marathi versions were administered in public schools in Bengaluru and Pune, respectively. The questionnaire was pre-tested to assess its validity (face and content) and reliability (internal reliability of attitude construct).

For content validity, feedback was obtained from experts (n = 5) from multi-disciplinary field. These national and international experts have more than two decades of experience in psychology, epidemiology, public health and nutrition.

Based on their feedback, the sequence of the questions was modified, more relevant questions were incorporated and language edits were made to simplify the questionnaire for students for better comprehension. To assess face validity, focus group discussions were conducted with students (n = 80) of grade six from both cities. These 80 students were selected from two schools in each city (one public and one private). To assess reliability, the questionnaire was administered with another 177 students from both cities. The schools and students who were involved in face validity and internal reliability were not part of the main study. Based on students' feedback and internal reliability findings, language of the questionnaire was simplified, repeated and offending questions were deleted, options for questions were changed and added, detailed marking instructions were added to the questionnaire. Revised questionnaire was administered by a trained research team of the project. The questionnaire was administered during school hours, using a standardised protocol. Students were given unique identification codes to ensure confidentiality. Copies of the questionnaire in all three languages (English, Marathi, and Kannada) are available in *Extended data.*[65]

Ethics statement

Permissions for implementation of the study were obtained from the Maharashtra State Board of Secondary and Higher Education and Karnataka Secondary Education Examination Board. We also received permission from authorities at schools, written active informed parental consent, and student assent, indicated by a signature on the consent form. Information sheets were sent from the schools to the parents of all eligible students, wherein details of the study and questionnaire were outlined. The consent stated the permission for data collection, scientific publications, dissemination of study findings in conferences by maintaining the confidentiality of the study participants and anonymity of the collected data. Ethical approval for this study was obtained from the Institutional Ethics Committee of both PHFI (TRC-IEC-373/18) and NIMHANS [NIMHANS/EC (BEH.SC.DIV.)].

Statistical analysis

Statistical analyses were performed using STATA Version.13.1 software.[29] The descriptive data were expressed as mean with standard deviation (SD) or proportions (%). A chi-square test was performed to examine differences in the categorical variables by socio-demographic factors (gender, school type). The summary scores for all attitude scales by gender and school type within each city were compared using the *t*-test. All statistics were analysed through a two-sided test; p-value less than or equal to 0.05 was considered statistically significant. Participants with missing information, parent refusal, student refusal or absenteeism on the day of questionnaire administration were excluded.

Results

82.8% of the recruited sample participated in the baseline questionnaire (n = 1026 out of 1238). The reasons for non-participation included absenteeism (n = 112; boys: 67, girls: 45) and parent refusal (n = 100, boys: 54, girls: 46). The final sample size was 1026 (Private: 518 and Public: 508) consisting of 61.1% boys and 55.1% of the sample was from private schools. The mean age of the students recruited for the study was 12.5 ± 0.75 years. The full, de-identified dataset of student responses is available in *Underlying data.*[64]

Knowledge
Diet

Overall, students' knowledge about healthy dietary practices was low (Table 1). Many students (67.5%) knew that breakfast was the most important meal of the day. Only a few students (6.8%) knew they should eat at least five servings of fruits and/or vegetables a day. Knowledge about healthy dietary practices was generally higher among girls and private school students. In Pune, more girls (68%) knew breakfast was the most important meal of the day compared to boys (59.4%) (p = 0.02). Similarly, more girls (15.1%) were able to identify iron rich foods than boys (7.7%) (p = 0.03). In Bengaluru, more girls (42.2%) knew about the importance of a balanced diet than boys (22.2%) (p = 0.000). Knowledge on the importance of a balanced diet was more prevalent among private school students than public school students in both cities (p < 0.01). In Bengaluru, more private school students (49.2%) knew salty foods could lead to hypertension, compared to public school students (32.9%) (p = 0.002) (Table 1).

Physical activity

Compared to knowledge about healthy dietary practices, students' understanding of the benefits of physical activity was higher (Table 1). Around 66%-69% of students were aware of the positive impact physical activity can have on reducing the risk of NCDs such as diabetes, heart disease and obesity. Difference in knowledge level of boys and girls was seen in both Pune and Bengaluru but a significant difference was seen only in Bengaluru for variables linking physical activity with low risk of diabetes (boys: 84.8% vs girls: 73.9%, p = 0.01) and obesity (boys: 79.3% vs girls: 86.9%, p = 0.05). However, less than one-fifth of the students (18.9%, overall) knew that the level of recommended daily physical activity is 60 minutes or more. More students (59.2%, overall) knew screen time should be limited to two hours or less per day.

Table 1. Knowledge related to diet and physical activity by gender and school type.

Variable	Overall (N = 1026) N (%)	Pune (N = 667)			Bengaluru (N = 359)			Pune (N = 667)			Bengaluru (N = 359)		
		Boys N (%)	Girls N (%)	p-value	Boys N (%)	Girls N (%)	p-value	Public School N (%)	Private School N (%)	p-value	Public School N (%)	Private School N (%)	p-value
Diet													
Knowledge about balanced diet	262 (25.5)	93 (21.6)	57 (23.9)	0.5	44 (22.2)	68 (42.2)	0.000**	33 (11.9)	117 (30)	0.000**	60 (25.9)	52 (40.6)	0.004**
Should have five servings of fruits and vegetables daily	70 (6.8)	27 (6.3)	12 (5)	0.5	17 (8.6)	14 (8.7)	0.97	11 (4)	28 (7.1)	0.08	19 (8.2)	12 (9.4)	0.710
Eating breakfast daily is important	693 (67.5)	255 (59.4)	162 (68.0)	0.02*	143 (72.2)	133 (82.6)	0.02*	178 (64.3)	239 (61.3)	0.434	172 (74.4)	104 (81.2)	0.144
Fat is a calorie dense nutrient	186 (18.1)	81 (18.8)	45 (18.9)	0.99	33 (16.6)	27 (16.7)	0.979	20 (7.2)	106 (27.1)	0.000**	49 (21.2)	11 (8.5)	0.002**
Excessive intake of salty foods can lead to hypertension	335 (32.6)	123 (28.7)	73 (30.7)	0.58	78 (39.4)	61 (37.8)	0.771	77 (27.8)	119 (30.5)	0.448	76 (32.9)	63 (49.2)	0.002**
Sources of iron rich food	101 (9.8)	33 (7.7)	36 (15.1)	0.003*	21 (10.6)	11 (6.8)	0.212	17 (6.1)	52 (13.3)	0.003**	15 (6.5)	17 (13.3)	0.03*
Physical activity													
Physical activity decreases the risk of diabetes	681 (66.3)	255 (59.4)	139 (58.4)	0.794	168 (84.8)	119 (73.9)	0.01*	151 (54.5)	243 (62.3)	0.04*	196 (84.8)	91 (71.0)	0.002*
Physical activity decreases the risk of heart diseases	680 (66.2)	264 (61.5)	158 (66.4)	0.213	138 (69.7)	120 (74.5)	0.311	170 (61.3)	252 (64.6)	0.39	173 (74.9)	85 (66.4)	0.08
Physical activity decreases the risk of obesity	714 (69.5)	257 (55.9)	160 (67.2)	0.06	157 (79.3)	140 (86.9)	0.05*	167 (60.3)	250 (64.1)	0.31	197 (85.3)	100 (78.1)	0.08
60 minutes of physical activity is recommended	194 (18.9)	70 (16.3)	43 (18.0)	0.564	46 (23.2)	35 (21.7)	0.73	47 (16.9)	66 (16.9)	0.988	47 (20.3)	34 (26.5)	0.177
Screen time should be less than 2 hours a day	608 (59.2)	250 (58.2)	154 (64.7)	0.104	102 (51.5)	102 (63.3)	0.02*	158 (57.0)	246 (63.0)	0.116	124 (53.6)	80 (62.5)	0.106

*P < 0.05.
**p < 0.01.

Tobacco use

Few differences in tobacco use knowledge by gender were seen in Pune and Bengaluru. Where present, there was higher comprehension among boys in Pune for items like tobacco use is harmful to health (boys: 83.2% vs girls:76%, p = 0.025) and about the legal age for buying or selling tobacco (boys: 61% vs girls: 52.1%, p = 0.025). In Bengaluru, girls had higher knowledge of smoking and its association with heart attack (boys: 84.3% vs girls: 95%, p = 0.001) and cancer (boys: 88.8% , girls: 95%, p = 0.03). In Bengaluru, significantly more public school students were knowledgeable about tobacco use related harms and policies in India than private school students (p < 0.01) (Table 2).

Attitudes

Diet

The maximum score a participant could achieve for attitude towards diet was 40. The mean score of students was 28.4 $\pm$ 6.5, which is 70% of the maximum score. Within the two cities, students' attitude about healthy dietary practices was similar for boys and girls (p > 0.05) and was similar in both school types (p > 0.05) (Table 3).

Physical activity

The highest score a student could achieve for attitude towards physical activity was 45. The students' mean score was 29.5 $\pm$7.5, which is 65% of the maximum score. No significant differences were observed between boys and girls in both cities, highlighting that both have a positive attitude towards physical activity (p > 0.05). In Bengaluru, public school students had a more positive attitude towards physical activity in comparison to private school students (p = 0.001), whereas the opposite was observed in Pune (Table 3).

Tobacco use

The maximum score a student could achieve in this construct was 45. The students' mean score was 31.3 $\pm$ 12.7, which is 68% of the maximum score. In Pune, mean scores were significantly higher among girls than boys (29.7 $\pm$ 13.3 in girls vs 26.8 $\pm$ 14.1 in boys; p = 0.01) and among public school (28.3 $\pm$ 12.5) students than private schools' students (27.6 $\pm$ 4.8) (p = 0.01), suggesting girls and public school students had less favourable attitudes towards initiating a tobacco habit. In Bengaluru, no significant differences between gender were observed but a significant difference in scores by school type was observed (public school: 38.5 $\pm$ 5.8 vs private school: 36.4 $\pm$ 6.6, p = 0.002) (Table 3).

Behaviours

Diet

Overall, the vast majority of students (94.7%) were eating "outside food" (i.e. takeaway/street food) daily. Few students (8.7%) skipped breakfast daily. In Pune, fewer girls (8.8%) than boys (18.9%) reported that they had never eaten fruits (p = 0.001) or pulses (p = 0.004). In Bengaluru, fewer girls than boys reported that they had never eaten pulses (4.3% girls and 14.1% boys; p = 0.002) or salads (1.2% girls and 11.1% boys; p = 0.000) and more boys (51.8%) than girls (39.4%) reported that they had never read nutrition labels (p = 0.020). In Bengaluru, more girls (46.3%) than boys (35.2%) reported watching television while eating meals (p < 0.01), while the reverse was observed in Pune (boys: 20.2% vs girls 17.2%) (p < 0.01).

With respect to school type, in Pune skipping breakfast and never reading nutrition labels were more common among students in public schools (15.2%) compared to private school (9.7%) (p < 0.05). Nearly one-third of public school students (30%) and 22.7% of private school students never read a food label before buying food items (p < 0.005). Never reading nutrition labels was also very common among public school students in Bengaluru (64.8%) (Table 4).

Physical activity

Overall, very few students (3.3%) watched screens (television, computer, video games etc.) for more than two hours a day. No significant differences were seen between girls and boys for screen time either in Pune or Bengaluru (p > 0.05). However, significantly more public-school students compared to private school students reported at least two hours of screen time a day in both Pune (4.3% in public school and 1.0% in private schools; p = 0.006) and Bengaluru (6.9% in public schools and 1.6% in private schools; p = 0.026).

Table 2. Tobacco related knowledge by gender and school type.

Tobacco	Overall (N = 1026) N (%)	Pune (N = 667) Boys N (%)	Girls N (%)	p-value	Bengaluru (N = 359) Boys N (%)	Girls N (%)	p-value	Pune (N = 667) Public School N (%)	Private School N (%)	p-value	Bengaluru (N = 359) Public School N (%)	Private School N (%)	p-value
All kinds of tobacco use are harmful to health	871 (84.9)	357 (83.2)	181 (76.0)	0.025*	186 (93.9)	147 (91.3)	0.338	229 (82.6)	309 (79.2)	0.268	220 (95.2)	113 (88.2)	0.01*
Tobacco use by a young person harms his/her health immediately	679 (66.2)	254 (59.2)	133 (55.8)	0.405	155 (78.3)	137 (85.1)	0.100	149 (53.7)	238 (61.0)	0.062	202 (87.4)	90 (70.3)	0.000**
Safe to use tobacco products for one or two years	724 (70.5)	272 (63.4)	145 (60.9)	0.526	164 (82.8)	143 (88.8)	0.109	173 (62.4)	244 (62.5)	0.977	212 (91.7)	95 (74.2)	0.000**
Smoking tobacco (e.g., cigarettes, bidis) causes heart attack	811 (79.0)	321 (74.8)	170 (71.4)	0.340	167 (84.3)	153 (95.0)	0.001**	207 (74.7)	284 (72.8)	0.582	211 (91.3)	109 (85.1)	0.07
Chewing tobacco (guthka, khaini etc.) causes heart attack	790 (77)	301 (70.1)	181 (76.0)	0.104	170 (85.8)	138 (85.7)	0.969	207 (74.7)	275 (70.5)	0.231	209 (90.4)	99 (77.3)	0.001**
Smoking tobacco (e.g., cigarettes, bidis) causes stroke	776 (75.6)	308 (71.7)	160 (67.2)	0.217	169 (85.3)	139 (86.3)	0.791	195 (70.4)	273 (70.0)	0.912	212 (91.7)	96 (75.0)	0.000**
Chewing tobacco (guthka, khaini etc.) causes stroke	765 (74.5)	305 (71.1)	163 (68.4)	0.481	164 (82.8)	133 (82.6)	0.956	189 (68.2)	279 (71.5)	0.358	200 (86.5)	97 (75.7)	0.01*
Smoking tobacco (e.g., cigarettes, bidis) causes lung cancer	820 (79.9)	314 (73.1)	177 (74.3)	0.741	176 (88.8)	153 (95.0)	0.036*	203 (73.2)	288 (73.8)	0.871	216 (93.5)	113 (88.2)	0.087
Chewing tobacco (guthka, khaini etc.) causes oral cancer	792 (77.1)	302 (70.4)	163 (68.4)	0.607	176 (88.8)	151 (93.7)	0.105	191 (68.9)	274 (70.2)	0.718	218 (94.3)	109 (85.1)	0.003**
It's harmful to your health if you are near a person who is smoking	788 (76.8)	291 (67.8)	165 (69.3)	0.691	181 (91.4)	151 (93.7)	0.396	189 (68.2)	267 (68.4)	0.950	225 (97.4)	107 (83.5)	0.000**
Quitting tobacco improves a person's health	707 (68.9)	254 (59.2)	137 (57.5)	0.680	177 (89.3)	139 (86.3)	0.375	175 (63.1)	216 (55.3)	0.04*	218 (94.3)	98 (76.5)	0.000**

Table 2. *Continued*

Tobacco	Overall (N = 1026) N (%)	Pune (N = 667)			Bengaluru (N = 359)			Pune (N = 667)			Bengaluru (N = 359)		
		Boys N (%)	Girls N (%)	p-value	Boys N (%)	Girls N (%)	p-value	Public School N (%)	Private School N (%)	p-value	Public School N (%)	Private School N (%)	p-value
Is there a law which bans sale of tobacco products to and by minors (under 18 years of age)	680 (66.2)	262 (61.0)	124 (52.1)	0.025*	159 (80.3)	135 (83.8)	0.385	162 (58.4)	224 (57.4)	0.787	203 (87.8)	91 (71.0)	0.000**
Is there a law which mandates display of a "Tobacco Free School" or "Tobacco Free Institution" sign at a prominent place on the boundary wall outside the main entrance of your school	594 (57.9)	207 (48.2)	117 (49.1)	0.822	140 (70.7)	130 (80.7)	0.028*	135 (48.7)	189 (48.4)	0.944	209 (90.4)	61 (47.6)	0.000**
Is there a law which mandates display of a "No smoking area - smoking here is an offence" sign inside your school"?	654 (63.7)	248 (57.8)	128 (53.7)	0.315	160 (80.8)	118 (73.3)	0.090	158 (57.0)	218 (55.9)	0.769	195 (84.4)	83 (64.8)	0.000**
Is there a law which bans tobacco advertising on television channels and print media?	674 (65.6)	237 (55.2)	120 (50.4)	0.231	176 (88.9)	141 (87.5)	0.701	128 (46.2)	229 (58.7)	0.001**	216 (93.5)	101 (78.9)	0.000**
Is there a law which stops people from smoking in public places (like within the premises of your school)?	726 (70.7)	260 (60.6)	150 (63.0)	0.539	172 (86.8)	144 (89.4)	0.455	158 (57.0)	252 (64.6)	0.048*	216 (93.5)	100 (78.1)	0.000**

*P < 0.05.
**p < 0.01.

Table 3. Attitude related to diet, physical activity and tobacco by gender and school type.

Variable	Cronbach Alpha	Overall (N = 1026) Mean ± SD (95% CI)	Pune (N = 667) Boys Mean ± SD (95% CI)	Girls Mean ± SD (95% CI)	p-value	Bengaluru (N = 359) Boys Mean ± SD (95% CI)	Girls Mean ± SD (95% CI)	p-value	Pune (N = 667) Public School Mean ± SD (95% CI)	Private School Mean ± SD (95% CI)	p-value	Bengaluru (N = 359) Public School Mean ± SD (95% CI)	Private School Mean ± SD (95% CI)	p-value
Diet	0.68	28.4±6.5 (28.0-28.8)	27.0 ±7.3 (26.3-27.7)	27.8 ±7.3 (26.9-28.8)	0.153	30.2 ± 3.8 (29.7-30.7)	30.7±3.8 (30.1-31.3)	0.256	26.7 ±7 (25.9-27.5)	27.7 ± 7.5 (27-28.5)	0.073	30.2 ± 3.9 (29.7-30.7)	30.8± 3.5 (30.2-31.4)	0.135
Physical activity	0.71	29.5 ±7.5 (29.1-30.0)	27.4± 8.5 (26.6-28.2)	28.3 ± 7.5 (27.4-29.3)	0.152	32.6 ±4.5 (31.9-33.2)	33.2 ±4.3 (32.5-33.9)	0.186	26.7 ± 8.3 (25.7-27.7)	28.5 ± 7.9 (27.7-29.3)	0.005*	33.6 ±4.5 (33-34.2)	31.5 ± 4.0 (30.8-32.2)	0.001**
Tobacco use	0.89	31.3 ± 12.7 (30.6-32.1)	26.8 ± 14.1 (25.5-28.2)	29.7 ± 13.3 (28.0-31.4)	0.011*	37.5 ± 6.5 (36.6-38.4)	38.1±5.7 (37.2-39.0)	0.356	28.3±12.5 (26.8-29.8)	27.6 ±14.8 (26.1-29.0)	0.493	38.5 ± 5.8 (37.8-39.3)	36.4 ± 6.6 (35.2-37.6)	0.002*

*P < 0.05.
**p < 0.01.
SD: Standard deviation, Higher the score better is the attitude towards diet and physical activity and less favourable to tobacco use.

Table 4. Dietary, physical activity and tobacco use behaviour of students by gender and school type

Behaviours	Overall (N = 1026) N (%)	Pune (N = 667)			Bengaluru (N = 359)			Pune (N = 667)			Bengaluru (N = 359)		
		Boys N (%)	Girls N (%)	p-value	Boys N (%)	Girls N (%)	p-value	Public School N (%)	Private School N (%)	p-value	Public School N (%)	Private School N (%)	p-value
Diet													
Skipping breakfast (daily)	90 (8.7)	56 (13.1)	24 (10.1)	0.258	8 (4.0)	2 (1.2)	0.109	42 (15.2)	38 (9.7)	0.034*	5 (2.2)	5 (3.9)	0.337
Eat whole fruits in a week (never)	116 (11.3)	81 (18.9)	21 (8.8)	0.001**	10 (5.1)	4 (2.5)	0.212	39 (14.1)	63 (16.2)	0.463	8 (3.5)	6 (4.7)	0.566
Eat pulses and lentils in a week (never)	167 (16.2)	99 (23.1)	33 (13.9)	0.004**	28 (14.1)	7 (4.3)	0.002**	60 (21.7)	72 (18.5)	0.307	23 (10.0)	12 (9.4)	0.859
Eat salads in a week (never)	187 (18.2)	114 (26.6)	49 (20.6)	0.085	22 (11.1)	2 (1.2)	0.000**	76 (27.4)	87 (22.3)	0.129	16 (6.9)	8 (6.3)	0.806
Eat food/snack while watching TV (always)	261 (26.7)	79 (20.2)	39 (17.2)	0.364	69 (35.2)	74 (46.3)	0.034*	45 (17.6)	73 (20.1)	0.430	119 (52.2)	24 (18.8)	0.000**
Read the food labels to choose if the food is healthy or not (never)	311 (33.4)	99 (27.7)	49 (22.4)	0.159	100 (51.8)	63 (39.4)	0.020*	71 (30.7)	77 (22.3)	0.022*	147 (64.8)	16 (12.7)	0.000**
Eat food from outside (daily)	895 (94.7)	334 (92)	218 (95.6)	0.08	189 (97.4)	154 (96.2)	0.527	227 (96.6)	325 (91.3)	0.01*	220 (96.9)	123 (96.8)	0.973
Physical activity													
Screen time (> 2 hours per day)	34 (3.3)	11 (2.6)	5 (2.1)	0.708	13 (6.6)	5 (3.1)	0.135	12 (4.3)	4 (1.0)	0.006**	16 (6.9)	2 (1.6)	0.026*
Moderate to vigorous activity less than 60 minutes per day	437 (42.5)	216 (50.3)	124 (52.1)	0.665	52 (26.3)	45 (28.0)	0.720	140 (50.5)	200 (51.3)	0.850	69 (29.9)	28 (21.9)	0.102
Tobacco													
Ever tried smoked tobacco (cigarette/beedi/hookah etc.)	289 (30.1)	174 (45.7)	111 (50.2)	0.160	3 (1.5)	1 (0.6)	0.391	174 (65.4)	111 (33.0)	0.001**	2 (0.9)	2 (1.6)	0.446
Ever tried smokeless tobacco (gutkha, khaini, etc.)	293 (30.5)	179 (46.6)	107 (48.6)	0.347	6 (3.0)	1 (0.6)	0.100	173 (64.8)	113 (33.5)	0.001**	6 (2.6)	1 (0.8)	0.223
Ever tried electronic vapor product	310 (32.4)	187 (49.3)	118 (53.8)	0.285	3 (1.5)	2 (1.2)	0.827	182 (69.2)	123 (36.7)	0.001**	2 (0.86)	3 (2.4)	0.243

*P < 0.05.
**p < 0.01.

No significant differences in moderate-to-vigorous physical activity were seen by gender or school type in both cities (p > 0.05). However, fewer students in Bengaluru (21.9%-29.9%) reported that they had less than adequate moderate-to-vigorous physical activity per day compared to students in Pune (50.3%-52.1%) (Table 4).

Tobacco

Overall more students in Pune (50.7%) than Bengaluru (2.8%) reported having ever used tobacco. In both cities, no significant differences by gender were observed. However, the prevalence of ever smoking (65.4% vs. 33.0%, p = 0.001), ever use of smokeless tobacco (64.8% vs. 33.5%, p = 0.001), and ever e-cigarette use (69.2% vs. 36.7%, p = 0.001) was significantly higher among public school students in Pune than private school students (Table 4).

The boys from the participating schools of Pune were found to be more susceptible to tobacco use (23.3% smoking and 25.9% smokeless tobacco) in comparison to the girls (15.5% both smoking and smokeless tobacco use) (p < 0.05) (Table 5).

Discussion

This is one of the few studies on NCD risk factors that has comprehensively assessed KAB of school going children from two major metropolitan areas of India. During recruitment, it was ensured that the schools included in the study had similar characteristics, as differences in school characteristics could have influenced the results. Given the wide geographic variability in NCDs in this country,[18,30,31] it is important to assess students' KAB in a myriad of contexts before designing an intervention for them.

The findings of our study revealed low dietary knowledge among students. Knowledge was better among girls and private school students. Similar differences were reported in school going students of Haryana (North India).[32] The students' knowledge of physical activity was better than their knowledge of diet and 66%-69% of students were aware of association between NCDs and physical inactivity. In contrast to our study findings, a better knowledge about physical activity (88%) was reported in students of Gujarat,[33] and Delhi-India.[34] Similarly, adolescents from the eighth and ninth grade in other low-and-middle-income countries (LMICs) such as Nepal, knew that physical activity is imperative for disease prevention and for staying healthy.[35]

In our study, students' knowledge about the harms of tobacco use was much higher in comparison to their knowledge about diet and physical activity. This increase in knowledge could be attributed to the Government of India's efforts to combat rising burden of tobacco use and its associate health impact, including comprehensive national tobacco control law i.e., COTPA-2003,[36] National Tobacco Control Programme[37] as well as tobacco-free educational institutional guidelines.[38]

With regard to behaviours, only 8.7% of students were missing their breakfast daily. This is similar to the findings of a study conducted among Indian school students[39] and Kenya.[40] In our study, more students from public schools reported missing their daily breakfast than students in private schools. This could be attributed to a low level of knowledge and the presence of students from lower middle-income families in these schools. Students from lower income families are more likely to experience scarcity of good quality food, meaning they may lack a wholesome breakfast as well as other meals of the day.[41] An additional factor could be the availability of a mid-day meal scheme (i.e., school meal) in public schools,[42] which may preclude the importance of their first meal at home (i.e., breakfast).

Other protective dietary factors include fruit consumption, and only 11.3% of students did not eat fruits daily. The Comprehensive National Nutrition Survey (2019) showed that among adolescents (10-14 years), 59% in Maharashtra and 74% in Karnataka ate whole fruits only once a week.[30] Though fruits are "price elastic" (connection between price and the demand of a product),[43,44] no difference in consumption was seen by school type. Results from other LMICs were poorer, with only 9% of adolescents (8-11 years) consuming fruits four to seven times a week.[40] On other hand, in a cross-country comparison among 49 LMICs, India had highest percentage (29.5%) of adolescents (13-17 years old) who met WHO's recommendation for fruit and vegetable consumption.[45]

Another worrisome behaviour observed among students was the habit of eating "outside food" (i.e., takeout) every day (95%). Contributing factors to its popularity could be ease of access, taste, parent's occupation, and fast-food companies marketing strategies.[46] Fast food consumption data from 153,496 young adolescents (12-15 years) from 54 LMICs showed that 55.2% (51.3–59.1%) of the adolescents consumed fast food at least once per week, and 10.3% (8.3–12.4%) consumed fast food between four to seven days per week. The prevalence of fast-food consumption for four to seven days per week was lowest in the Americas (8.3%; 95% CI: 6.7–9.9) and highest in Southeast Asia

Table 5. Tobacco use susceptibility of students by gender and school type.

Tobacco	Overall (N = 1026)	Pune (N = 667)			Bengaluru (N = 359)			Pune (N = 667)			Bengaluru (N = 359)		
	N (%)	Boys N (%)	Girls N (%)	p-value	Boys N (%)	Girls N (%)	p-value	Public School N (%)	Private School N (%)	p-value	Public School N (%)	Private School N (%)	p-value
Susceptibility to smokeless tobacco	168 (16.4)	111 (25.9)	37 (15.5)	0.002**	13 (6.6)	7 (4.3)	0.368	58 (20.9)	90 (23.1)	0.513	11 (4.8)	9 (7.0)	0.369
Susceptibility to smoke tobacco	157 (15.3)	100 (23.3)	37 (15.5)	0.017**	11 (5.6)	9 (5.6)	0.989	58 (20.9)	79 (20.3)	0.830	15 (6.5)	5 (3.9)	0.306

*P < 0.05.
**p < 0.01.

(17.7%; 95% CI: 2.3–33.2%).[47] Our study found that only 33% students not reading nutritional labels while making food choices. Students in public schools were practicing this behaviour more often than students in private schools. In contrast to this trend, 88% of students in Kolkata reported reading nutritional labels, and this was most common among girls.[48]

Lack of physical activity among adolescents is a major NCD risk factor. More than half of the students (57.5%) in this study reported engaging in moderate-to-vigorous physical activity for at least 60 minutes, daily, with no significant differences by gender or school type. One recent publication showed that 73.9% of adolescents in India are insufficiently physically active.[49] However, a global study of 49 LMICs with 164,771 adolescents found that India had the highest percentage (29.5%) of adolescents who met WHO's recommendations for physical activity.[45] On an encouraging note, in the same study, few adolescents (3%) reported screen time of more than two hours a day. This is in contrast to 52.5% of school going adolescents in Tamil Nadu (Southmost part of India) who had an average daily screen time of more than two hours a day.[50]

One third of adolescents had ever tried tobacco (smoke, smokeless and e-cigarette). Evidence from 68 LMICs showed that mean prevalence of tobacco use among adolescents (12-15 years) was 13.6%, ranging from 2·8% in Tajikistan to 44·7% in Samoa and in most countries prevalence among boys was higher compared to girls.[51] However, no difference among boys and girls was observed in this study, indicating a narrowing of gender gap for tobacco use which is much wider among adults in India.[52] In Pune, public school students used more tobacco (all forms) in comparison to private schools. Whereas in Bengaluru, smokeless tobacco was more commonly used among public school students in comparison to smoke forms. Tobacco use (all forms) was found to be more prevalent in public school boys (13.4%) in comparison to private school boys (11.7%).[53] This could be due to the students' lack of compliance with provisions of Indian tobacco control law as well as the availability and ease of access to tobacco products outside of their schools.[54] Surprisingly, 32.4% of the students also reported that they have tried e-cigarettes in the past. To the best of our knowledge, no other study in India has yet reported the prevalence of e-cigarette use among school going children. The prevalence found in our study was much higher than that found in a study from Mexico.[55]

As the 2030 deadline for Sustainable Development Goals is only a decade away, the low levels of knowledge, particularly about unhealthy diet and physical inactivity, are a matter of concern.[56] Aiming to reduce the NCD burden and the budding role of education in primary prevention was emphasised at the 2011 United Nations' Meeting on the Prevention and Control of NCDs.[57] Lack of healthy behaviours among adolescents has been linked with lack of sufficient knowledge, and research has also indicated a positive relationship between information level and overt behaviour.[58] Sufficiently designed health promotion programmes[59] may provide the much needed knowledge that will help to reduce risk behaviours such as unhealthy diet, physical inactivity, and tobacco use, hence providing a pathway for behaviour change.

In India, various education programmes have been designed for school going adolescents but there are only few comprehensive education programs addressing diet, physical activity and tobacco.[60] In 2018, the Government of India launched the National School Health Programme under Ayushman Bharat or Healthy India. The programme comprehensively addresses the above risk factors, and is delivered by health ambassadors (two teachers per school) only in government and government aided schools across country.[61] The study highlighted the need to co-design an intervention, using participatory action approach, that involves target audience (adolescents in our study) in development and implementation of the intervention. The advantage of involving adolescents is that experiences, barriers, and facilitators faced by them in adopting healthy behaviours can be considered while development of intervention. This also gives the programme a sense of ownership, which boosts the target audience's interest in the programme. The programme development should also consider engagement of parents and teachers who plays a crucial role in the nurturing the adolescent's behaviours. Considering these, a two-year intervention programme has been developed for students in the sixth to eighth grades, their parents, and community members. The programme is based on social cognitive theory, explains that learning and acquiring health behaviours occurs within a social context, through an interaction of external and internal factors.[62] The agents of intervention implementation are trained teachers and peer leaders, as facilitators. This model of delivery has proven successful in India and elsewhere globally for tobacco[63] and nutrition[12] education.

The sampling of schools was one of the limitations of this study. The schools were not randomly selected from the population but were representative of the socio-economic spectrum in these two cities. Furthermore, the sample did not include schools from rural areas, hence limiting the generalizability of the findings. The statistical tests used in the study are indicative only, as the sample selection was purposive. The self-reported method utilised (i.e., survey) also may have led to skewed estimates of dietary intake, physical activity and tobacco use patterns among the students due to the fact that adolescents would have wanted to report positive health behaviours (social desirability - reporting bias). Behaviours

related to diet, physical activity and tobacco of all students were assessed without understanding the home environment as it plays a vital role in shaping students' behaviours. The behaviour for all type of tobacco use was evaluated without further investigating the number of times the tobacco was used by the students. Given budgetary constraints, no anthropometric or biochemical (e.g., salivary cotinine) or food frequency questionnaire were used, which may be a drawback of this study.

Conclusion

The results from this study provide insights in to the KAB of school going children with respect to the risk factors of non-communicable diseases. In the two states of India, a higher proportion of school students know the harm of tobacco use than the benefits of a healthy diet and physical activity. Both gender and school type influenced specific KABs but both the magnitude and direction of such influence were variable. There is a need to strengthen the health education activities by developing context-specific health intervention materials by engaging school children, teachers, parents and communities to promote healthy behaviours among adolescents. This study highlights the need to augment school health programmes in India with a differential approach based on the issues which are specific to each school type (public and private) and city (Pune and Bengaluru).

Data availability

Underlying data

Figshare: Knowledge, Attitude and Behaviours (KAB) on diet, physical activity, and tobacco use among school students: Survey Dataset. https://doi.org/10.6084/m9.figshare.14760147.v4.[64]

This project contains the following underlying data:

- KAB Survey Dataset.xlsx (student knowledge, attitude and behaviour responses regarding their diet, physical activity and tobacco consumption).

Extended data

Figshare: Knowledge, Attitude and Behaviours (KAB) on diet, physical activity, and tobacco use among school students: Survey Tool. https://doi.org/10.6084/m9.figshare.14760480.v2.[65]

This project contains the following extended data:

- KAB Questionnaire_English.pdf

- KAB Questionnaire_Marathi.pdf

- KAB Questionnaire_Kannada.pdf

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

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Open Peer Review

Current Peer Review Status: ✔ ✔

Version 2

Reviewer Report 22 October 2021

✔ **Subhash Pokhrel**

Health Economics Research Group, Division of Global Public Health, Department of Health Sciences, Brunel University London, Uxbridge, UK

The manuscript now addresses my previous concerns.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public health, behaviour change, health economics

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 23 August 2021

✔ **Nishibha Thapliyal**

Department of Sports Science, Punjabi University Patiala, Patiala, Punjab, India

The paper **"**Knowledge, attitude and behaviours on diet, physical activity and tobacco use among school students: A cross-sectional study in two Indian states by Shalini Bassi *et.al*. looks at measuring the knowledge, attitudes and behaviours (KAB) of school children (grade 6) in relation

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to NCD behavioural risk factors, primarily unhealthy dietary intake, physical inactivity and tobacco use. This information gathered is the baseline evaluation of Project PaTHway (a 3-year school-based healthy lifestyle programme).

Overall, an interesting and impressive read. The strength of the paper lies in its massive contribution (KAB findings) towards limited literature of school-going children about NCDs awareness and also in providing emphasis to support the development of school-based health education programmes (policy) in India. However, since the subject population from rural areas (villages) could not be captured, it is suggested to be added as a limitation.

Abstract: It is an extremely well structured abstract with reasonable focus on the key areas.

Introduction: The introduction is sound and clearly demarcates the problem that will be addressed in the paper. The area of focus and the aims are easily identified. However, a little more on the prospective role of KAB as a tool to develop any kind of intervention programme can be added. A little on the current behavioural habits of school children can also be mentioned, including the reason for the selection of school children (specifically 6th grade) as the study population.

Methods: It is a well planned and thoroughly designed methodology, keeping in mind all permissions, clearance and consents requirement of a good study design. The credibility and validity of the tools have also been established. However, certain factors that could not be controlled (home environment) should be mentioned as a limitation. Also, the use of an additional supportive tool (like a food frequency or anthropometric) to decrease the reporting bias of a 'self-reporting survey' (also highlighted by the author) should be mentioned as a suggestive approach for future researches.

Results & Discussion: The results are extensive and logically sequenced with a simple and easy to understand presentation. All areas of interest (KAP of dietary intake, tobacco use and physical inactivity) have been clearly depicted. However, there are certain findings (results of fruit intake, screen time and consumption of outside food) that challenge the traditional findings/beliefs of people's behaviours that vary due to socioeconomic inequality. This could be due to the bias (subjects giving out socially approved answers) in self-reporting surveys (also listed as a limitation by the author) and can be added as a limitation in the study.

Conclusion: The findings of this project correctly identify the need for school-based lifestyle intervention programmes in terms of national policy planning for the prevention of NCD's. The conclusion is precise and clear.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public health nutrition, physical activity, NCD, obesity

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 23 Sep 2021
Shalini Bassi, Public Health Foundation of India, Gurgaon, India

Overall, an interesting and impressive read. The strength of the paper lies in its massive contribution (KAB findings) towards limited literature of school-going children about NCDs awareness and also in providing emphasis to support the development of school-based health education programmes (policy) in India. However, since the subject population from rural areas (villages) could not be captured, it is suggested to be added as a limitation.
- **Response:** Suggestion accepted. Added a line in the limitation section.

Abstract: It is an extremely well structured abstract with reasonable focus on the key areas.

Introduction: The introduction is sound and clearly demarcates the problem that will be addressed in the paper. The area of focus and the aims are easily identified. However, a little more on the prospective role of KAB as a tool to develop any kind of intervention programme can be added. A little on the current behavioural habits of school children can also be mentioned, including the reason for the selection of school children (specifically 6th grade) as the study population.
- **Response**: Suggestion accepted, we have incorporated a justification for assessing a KAB at baseline. "*The baseline analysis of the KAB of the target population would provide better insight on the 'on-ground' situation and can guide the development of the intervention programme*".

- We have included a justification of recruiting class 6th students under the Introduction section: "*Recruitment of sixth graders was done as the World Health Organization defines that adolescent age begins at 10 years. When a child enters adolescence, there is a change in explorative and emotive behaviors due to the shift from parental dependence to independence. Adolescents are vulnerable as they gain more control of what, when, how, and where they eat; moreover, their preferences and personal choices may gain priority over eating habits that are nurtured within the family setting*".

Methods: It is a well-planned and thoroughly designed methodology, keeping in mind all

permissions, clearance and consents requirement of a good study design. The credibility and validity of the tools have also been established. However, certain factors that could not be controlled (home environment) should be mentioned as a limitation. Also, the use of an additional supportive tool (like a food frequency or anthropometric) to decrease the reporting bias of a 'self-reporting survey' (also highlighted by the author) should be mentioned as a suggestive approach for future researches.

- ○ **Response:** With context to the role of home environment in shaping the individual behavior has been added in the limitation section. We have also added the use of a food frequency questionnaire in the limitation section.

Results & Discussion: The results are extensive and logically sequenced with a simple and easy to understand presentation. All areas of interest (KAP of dietary intake, tobacco use and physical inactivity) have been clearly depicted. However, there are certain findings (results of fruit intake, screen time and consumption of outside food) that challenge the traditional findings/beliefs of people's behaviours that vary due to socioeconomic inequality. This could be due to the bias (subjects giving out socially approved answers) in self-reporting surveys (also listed as a limitation by the author) and can be added as a limitation in the study.

- ○ **Response:** This information already exists in the limitation section: "The self-reported method utilised (i.e., survey) also may have led to skewed estimates of dietary intake, physical activity and tobacco use patterns among the students due to the fact that adolescents would have wanted to report positive health behaviours (social desirability - reporting bias).".

Conclusion: The findings of this project correctly identify the need for school-based lifestyle intervention programmes in terms of national policy planning for the prevention of NCD's. The conclusion is precise and clear.

- ○ **Response:** Thanks.

Competing Interests: No competing interests

Reviewer Report 17 August 2021

? **Subhash Pokhrel**
Health Economics Research Group, Division of Global Public Health, Department of Health Sciences, Brunel University London, Uxbridge, UK

This is a well-written paper that provides data on the knowledge, attitude and behaviours of school students in two Indian states. Such data will provide a baseline against which the impact of any behaviour change intervention can be measured in the future. As such, this is a timely and

valuable paper.

A few areas where the authors may want to improve on:

Abstract
1. Conclusions: The last few sentences are policy speculations, not study conclusions, so they may be better placed in the Discussion section instead (of course with some backup references there).

Methods
1. Setting: Purposive sampling technique - explain a bit further to explain how exactly the 20 schools were selected. What was the sampling frame (total number of schools) and how exactly did you balance various characteristics mentioned here.

2. Participants: The number given for the final sample size (n=1238) does not match the number given in the Results section. Need to rephrase this sentence.

3. Statistical analysis: A commentary needs to be added in the limitation section later saying that statistical tests are indicative only, as the sampling design was purposive (not random). Also, need justification for a t-test in the light of Likert-scale data.

Results
1. The presentation looks fine as this is largely descriptive data. However, I wonder whether additional analysis examining if the reported KAB differed by parental education and occupation may provide more helpful insights. In other words, would observed gender differences in KAB disappear (or the other way around) once you have controlled for parental education and/or parental occupation? Note that in the Discussion section (p.13, para 6), you hypothesise the habit of eating outside food may have been influenced by parental occupation, among other things. Why not test these when you have collected your own data?

Discussion
1. Most space in the Discussion section has been devoted to compare and contrast study findings with wider literature, which is important but doing so has limited the ability for the study to provide valuable insights for policymakers in relation to answering "what next". So, you may choose to summarise the comparison of your findings with the study results in addition to providing a succinct discussion as to how Indian (and wider South Asian) policymakers can go from here. For example, for the sake of the argument, if we followed COM-B model of behaviour change to design and implement interventions for this age group, how can the study results help us identify where capabilities, opportunities and motivations lie and how can adolescents be supported in their lacking space to change their behaviour. I think the rich discussion in this area makes this paper more useful.

2. A confusion/error, p.13, para 5: Seems to be a confusion between "price elasticity" and "income elasticity". Please revise the sentence.

3. Limitations: Acknowledge that statistical tests are indicative only as the whole sample was purposive.

Conclusion
1. Strongly recommend revising the conclusion section. The sentences here must be backed up by the study findings and leave any speculative policies to the Discussion section

above. An example conclusion may be: "In the two states of India, a higher proportion of school students know the harm of tobacco use than the benefits of a healthy diet and physical activity. Both gender of the student and which type of the school that the student went to influenced specific KABs but both the magnitude and direction of such influence were variable. The data suggests that there is an urgent need for designing and implementing interventions that can improve school students' capability and motivation as well as create opportunities to change their unhealthy behaviours.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Partly

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public health, behaviour change, health economics

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 23 Sep 2021

Shalini Bassi, Public Health Foundation of India, Gurgaon, India

Abstract
1. Conclusions: The last few sentences are policy speculations, not study conclusions, so they may be better placed in the Discussion section instead (of course with some backup references there).

   ○ **Response:** This has been revised as suggested. The conclusion highlighted the key study findings.
Methods
1. Setting: Purposive sampling technique - explain a bit further to explain how exactly

the 20 schools were selected. What was the sampling frame (total number of schools) and how exactly did you balance various characteristics mentioned here.

- ○ **Response**: Schools and colleges were selected based on the existing network of collaboration to represent different socio-economic statuses. This information has been incorporated under the setting section to make information comprehendible.

2. Participants: The number given for the final sample size (n=1238) does not match the number given in the Results section. Need to rephrase this sentence.

- ○ **Response**: The line "Total sample of 1238 students (Pune: n = 806; Bengaluru: n = 432) were included in the present study" has been deleted. The existing lines under this section emphasized that 1238 students were eligible and invited to participate in the study. Out of 1238 eligible students, 1026 students participated, which is already highlighted in the result section.

3. Statistical analysis: A commentary needs to be added in the limitation section later saying that statistical tests are indicative only, as the sampling design was purposive (not random). Also, need justification for a t-test in the light of Likert-scale data.

- ○ **Response**: Suggested accepted, added a line in the limitation section regarding purposive sampling. Each attitude statement was given a score and a mean score was calculated for this construct. This has been explained under the instrument and measure section. Thus, a t-test was used for this construct to do gender and school type comparisons within each city.

Results

1. The presentation looks fine as this is largely descriptive data. However, I wonder whether additional analysis examining if the reported KAB differed by parental education and occupation may provide more helpful insights. In other words, would observed gender differences in KAB disappear (or the other way around) once you have controlled for parental education and/or parental occupation? Note that in the Discussion section (p.13, para 6), you hypothesise the habit of eating outside food may have been influenced by parental occupation, among other things. Why not test these when you have collected your own data?

- ○ **Response:** We anticipated doing this analysis, however, many of the students did not attempt the questions (missing response) related to their parental education and occupation.

Discussion

1. Most space in the Discussion section has been devoted to compare and contrast study findings with wider literature, which is important but doing so has limited the ability for the study to provide valuable insights for policymakers in relation to answering "what next". So, you may choose to summarise the comparison of your findings with the study results in addition to providing a succinct discussion as to how Indian (and wider South Asian) policymakers can go from here. For example, for the sake of the argument, if we followed COM-B model of behaviour change to design

and implement interventions for this age group, how can the study results help us identify where capabilities, opportunities and motivations lie and how can adolescents be supported in their lacking space to change their behaviour. I think the rich discussion in this area makes this paper more useful.

- **Response:** Some information on the applicability of the research findings exist in the discussion and is linked to the implications for Sustainable Development Goals and School Health Programmes by the Government of India. Further information has been added on the underlying theory of change models and linked with recommendations for the Government. Few comparative literatures has also been deleted.

2. A confusion/error, p.13, para 5: Seems to be a confusion between "price elasticity" and "income elasticity". Please revise the sentence.

- **Response:** As suggested, revised.

3. Limitations: Acknowledge that statistical tests are indicative only as the whole sample was purposive.

- **Response:** Suggestion accepted and this has been incorporated in the limitation section.

Conclusion

1. Strongly recommend revising the conclusion section. The sentences here must be backed up by the study findings and leave any speculative policies to the Discussion section above. An example conclusion may be: "In the two states of India, a higher proportion of school students know the harm of tobacco use than the benefits of a healthy diet and physical activity. Both gender of the student and which type of the school that the student went to influenced specific KABs but both the magnitude and direction of such influence were variable. The data suggests that there is an urgent need for designing and implementing interventions that can improve school students' capability and motivation as well as create opportunities to change their unhealthy behaviours.

- **Response:** Suggestion accepted and the conclusion has been revised.

Competing Interests: No

Comments on this article

Version 2

Reader Comment 18 Oct 2021

Alireza Azizi, Assistant Professor in Clinical Psychology, Social Determinants of Health Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, Iran, Babol, Iran

Abstract:
Conclusion: Some sentences in this section are not considered as a consequence of this study and it is necessary to remove these sentences.

Method:
In the sampling section, 20 schools with different economic and social statuses were selected. Exactly by what criteria is this difference measured? Has China Statistics Center been used?

Result:
In the discussion section, you made hypotheses that you could test with the available information. Has the occupation of the parents made adolescents accustomed to eating outside? If you have missing data, why not test this hypothesis with the remaining data? You have an appropriate sample size.

Competing Interests: No competing interests were disclosed.

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