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Original Article

A Student-Led School Wellness Intervention for Improving Human Health Behaviours and Antimicrobial Resistance Awareness

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Abstract - *School health activities often address everyday habits and Antimicrobial Resistance (AMR) separately. This pilot documented a student-led programme that combined hydration, dietary variety, preventive-health discussions and peer communication. Nine Grade 10 volunteers at one urban Indian school took part over 12 weeks. The activities were Hydration Bar 2.0, a weekly Color-5 fruit-and-vegetable challenge, monthly physician-led educational sessions and a student-managed wellness blog. Questionnaires and programme records were examined descriptively. Six students (6/9; 66.7%) reported drinking 1–2 L of water during a typical school day, and five (5/9; 55.6%) identified forgetting to drink as a barrier. Eight students (8/9; 88.9%) felt the flavoured-water activity encouraged greater intake, while seven (7/9; 77.8%) reported becoming much more aware of hydration. Numerical paired results on dietary behaviour, AMR knowledge and other reported outcomes were not available. The programme was delivered within a single school and received favourable hydration-related feedback, but this uncontrolled, small-sample pilot cannot establish effects on behaviour or health. It identifies practical measures for a future, more rigorous evaluation.*

Keywords - *Adolescent Health Education, Antimicrobial Resistance, Dietary Diversity, Hydration, School Health.*

1. Introduction

School is where many adolescents make routine decisions about food, water and personal health. It is also a setting in which information can be put into practice repeatedly rather than encountered in a single lesson. The WHO and UNESCO standards for health-promoting schools emphasise this link between education, school environments and health [13]. A Cochrane review by Langford et al. [8] found benefits for certain health behaviours in school-based programmes, while also identifying variation in methods and the strength of evidence.

Water intake and diet offer straightforward starting points for practical activities. Water is required for ordinary physiological function, and a varied diet contributes to adequate nutrient intake [10]. However, knowing that water and nutritious foods are important does not ensure that they become part of a school-day routine.

Reviews of water-promotion and nutrition interventions have described encouraging results in some settings, but differences in programme design and outcome measurement make comparisons difficult [4, 9, 11]. The school setting is particularly relevant because students may have opportunities to practise a behaviour several times during an ordinary day. At the same time, there is a difference between understanding health advice and acting on it.

A programme that supplies information without considering timetable demands, convenience or student preferences may leave that gap unaddressed. The present project included direct activities as well as health talks; for this reason, whether the activities changed behaviour was a question for assessment, not an assumption.

Antimicrobial Resistance (AMR) also deserves attention before students begin making independent healthcare decisions. Unnecessary antibiotic exposure contributes to selective pressure for resistance, while inadequate infection prevention can facilitate the spread of resistant organisms. Global antibiotic consumption rose substantially between 2000 and 2015 [6].

In New Delhi, Kotwani et al. [7] identified gaps in the way high-school students and teachers understood antibiotics and resistance. Their findings point to a need for clear, age-appropriate teaching without implying that students themselves are responsible for prescribing decisions.


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Much of the school-health literature examines nutrition, hydration, peer education or AMR awareness as distinct subjects. The less explored practical question is how these can be combined in a modest programme organised largely by students, while retaining input from health professionals. This study addresses that question through a 12-week pilot consisting of four linked activities. It does not test a new clinical treatment, nor was it designed to establish that a combined programme is more effective than existing approaches.

The local emphasis was also important. The project was conducted within an urban Indian school and paired routine health topics with AMR, a matter of particular public-health relevance in India. Its value as a pilot lies in an account of delivery, acceptability and measurement limitations in that setting rather than in statistically generalisable claims.

The study aimed to document how the programme was delivered and how its participants responded, particularly to the hydration activity. A further aim was to assess what the existing questionnaire and participation records could—and could not—show about changes in behaviour and health knowledge.

2. Review of Literature

2.1. Schools and Peer-Led Health Education

School-health initiatives differ widely in scale. Some involve classroom lessons alone; others incorporate changes to school routines, services and community participation.

Langford et al. [8] evaluated the broader Health Promoting Schools framework, while WHO guidance sets out ways schools can support health and access to services [14, 13]. These sources provide a basis for combining educational content with activities that students encounter during the school day.

Peer delivery may make health information more familiar and allow students to take responsibility for the way it is communicated. However, its success depends on training, content accuracy and the context in which it is used. The systematic review by Dodd et al. [1] reported considerable diversity across peer-education interventions.

Smith et al. [12] likewise found variation in health-literacy programmes for adolescents. These findings support investigating student participation, but they do not justify assuming that peer-led activities automatically produce stronger health outcomes.

A further lesson from peer-education studies is that knowledge, attitudes and observed behaviour should be evaluated separately. For example, a student may enjoy contributing to a blog without changing an established habit. The current intervention similarly combined participation and education, but did not treat attendance at an activity as proof of learning. This distinction guided the interpretation of the questionnaire findings [1, 12].

2.2. Hydration and Nutrition Education

Hydration interventions have used strategies such as improving water access, changing school environments and making drinking water more appealing. Franse et al. [4] reviewed interventions involving younger children and found that outcomes depended on programme and measurement choices. Their review is relevant to the present activity, although its participants were younger than the Grade 10 students in this pilot. Importantly, a favourable opinion of flavoured water is not equivalent to a measured increase in daily intake or an improvement in hydration status.

Fruit-and-vegetable interventions show similar methodological diversity. Evans et al. [2] examined school programmes for younger children; O'Brien et al. [9] and Samad et al. [11] reviewed broader nutrition-intervention evidence. Flores-Vázquez et al. [3] focused on adolescent programmes informed by behavioural theory. These studies show the value of defining dietary outcomes in advance and collecting comparable measurements. The Color-5 Challenge was designed as a simple prompt to notice variety, not a validated dietary assessment.

Evidence from Asia offers an additional point of comparison. A systematic review and meta-analysis of school nutrition interventions in Asian countries examined nutritional outcomes across multi-component programmes [15]. That review addressed outcomes that were not measured by the Color-5 Challenge; it is therefore used as context rather than a benchmark for direct numerical comparison. Reviews of intervention intensity and individual nutrition components also suggest that duration, delivery and follow-up matter when judging whether a change persists [16, 17]. The 12-week duration alone does not establish an intervention dose or lasting benefit.

2.3. Antibiotic Knowledge and Antimicrobial Resistance

Klein et al. [6] documented the growth of antibiotic consumption globally. In India, the qualitative work of Kotwani et al. [7] showed that misconceptions about appropriate use are present within school communities.

A later systematic review by Grailey et al. [5] examined education on antimicrobial resistance among children and adolescents. Together, this literature suggests that school-based AMR education has a clear rationale, but that exposure to information and demonstrated learning are different outcomes. Evidence of learning requires questions that are administered and scored consistently over time.

Communication and education are also among the public-health responses to AMR described in the discussion

of the WHO global action plan [18]. In a school setting, an educational session can cover the distinction between bacterial and viral illness, the need to follow professional treatment advice, and the public-health consequences of unnecessary antibiotic use. These were themes of the reported physician sessions, but the available records did not document a validated test of students' understanding before and after each session.

2.4. Rationale and Intended Contribution

The distinct feature of this pilot is the combination of ordinary wellness activities with AMR teaching and student-written health communication within a single 12-week school project. The account adds detail about participants' preferences and practical barriers to drinking water. It is not a head-to-head comparison with earlier programmes: the sample size, design and measures do not permit claims of better outcomes.

The project thus addresses an implementation question: whether hydration reminders, a simple food-variety activity, clinician input and student-produced communication can be organised together during one school term. The information collected can describe the participants' experiences and the practical barriers they identified. It cannot determine the relative contribution of any component or compare the programme's effectiveness with an intervention that used a different population, design or outcome measure.

3. Materials and Methods

3.1. Study Design and Setting

The study was conducted at one urban Indian school over 12 weeks. It was an uncontrolled pilot, described in the project record as using questionnaires before and after the programme. Students organised the activities with input from healthcare professionals. There was no random assignment or comparison group. No medicines were administered, no biological samples were collected, and the programme was educational rather than clinical.

The programme was organised as a school wellness activity rather than as a clinical trial. It did not include physiological testing, a prescribed diet, an assigned water-intake target or antibiotic treatment. The emphasis was on making everyday preventive-health themes more visible in the school environment and providing structured opportunities to discuss responsible antibiotic use. The evaluation was observational and descriptive.

3.2. Participants and Recruitment

Nine students in Grade 10 volunteered to participate. The original account states that the school approved the activity and that participants provided informed consent. It does not describe the recruitment criteria, the process for parental or guardian permission, or an independent ethics review. Those procedures, therefore, cannot be reported as having occurred. The questionnaire percentages supplied in the account are consistent with nine respondents for most items, although the exact response files are no longer available.

The sample size was nine, meaning that one response represents 11.1% of the group. This is important when interpreting statements such as "88.9% agreed": the proportion corresponds to eight students. Demographic characteristics beyond grade level, including age distribution or gender, were not supplied. No eligibility screening criteria, sample-size justification or response-rate denominator for a wider invitation pool could be reconstructed from the manuscript. The participants should therefore be understood as one group of volunteers rather than a representative sample of the school.

3.3. Intervention Protocol and Schedule

The programme had three strands. The Holistic Health Corner housed the Hydration Bar 2.0 and Color-5 Challenge. Physician-led sessions addressed antibiotic use and wider preventive health topics. A student-run blog gave participants another way to share information. The project account describes weekly Color-5 goals and blog articles, monthly physician sessions and periodic flavoured-water offerings. The exact dates, number of completed sessions and attendance at each activity were not included in the available records (Table 1).

Within the Holistic Health Corner, Hydration Bar 2.0 offered water infused with ingredients that included tulsi, mint, fennel and lemon. The description also recorded preferences for lemon and ginger, mint, tulsi and jeera combinations. The activity was intended to offer choice and draw attention to regular drinking, not to treat any medical condition. Because the frequency and quantities of water served were not recorded consistently, the amount consumed from the station cannot be estimated. The Color-5 Challenge asked participants to aim for fruits and vegetables of five different colours during a week. It was an educational prompt about food variety rather than a measurement of nutrient intake. The available report mentions tracking sheets but does not present a scored food-frequency instrument, weighed intake, or complete weekly records.

Physician-led sessions were described as monthly and addressed appropriate antibiotic use, antibiotic resistance, hygiene, vaccination, nutrition, infection prevention and other preventive-health topics. The blog was described as student-managed, with weekly posts sharing basic wellness information, student reflections and myth-versus-fact explanations about antibiotics. The number of completed posts, view counts and minutes of engagement were not retained in the supplied account. These details matter because the intended timetable cannot be assumed to equal documented exposure for every participant.

Table 1. Programme components and documented frequency

Programme component	Activity	Reported schedule	Details not in source
Hydration Bar 2.0	Flavoured water using combinations of tulsi, mint, fennel and lemon; reported preferences also mentioned ginger and jeera.	Offered periodically during the programme.	Frequency, servings, water volumes, recipes and dates.
Color-5 Challenge	Encouraged inclusion of fruits and vegetables representing five colours in a week.	Weekly target during the 12-week period.	Weekly completed records and scoring rules.
Physician sessions	Discussed antibiotic use, AMR, infection prevention, hygiene, vaccination and nutrition.	Described as monthly.	Number, dates, duration, attendance, and teaching materials.
Wellness blog	Student-written health information, myth-versus-fact posts and reflections.	Described as weekly.	Post count, reach and engagement analytics.
Questionnaires	Baseline form and endline Google Forms survey.	Before the programme and after 12 weeks.	Original forms, timestamps, identifiers, and paired response file.

Note. Frequency is taken from the programme description; session-level attendance and delivery dates were not available.

3.4. Questionnaire Development and Measurement

The initial questionnaire covered water consumption, dietary habits, stress and knowledge of antimicrobial resistance. A Google Forms survey after the programme asked about hydration habits, flavoured-water preferences, perceived benefits, dietary variety and awareness of antibiotics and infection prevention.

The project account mentions hydration logs, Color-5 tracking sheets and attendance records, but their numerical entries were not preserved in the supplied manuscript.

The questionnaire included both routine-behaviour questions and questions about the acceptability of the hydration station. The reported categories included typical water volume during the school day, how often participants felt thirsty, whether they carried bottles, barriers to drinking, prior experience of infused water and preferences for flavour combinations.

Other items asked students whether the activity encouraged intake and how they perceived their awareness and sensations afterwards. The available document does not contain the exact wording or answer options for every question, and it is not possible to establish whether all items were administered on both occasions.

The questionnaire appears to have been developed for this school project. No item-by-item instrument, scoring rubric, pilot-test report or formal evidence of validity and reliability was provided. It should therefore not be described as validated.

Several items asked for perceptions—such as whether flavoured water made students more inclined to drink—rather than directly measured changes. Questions allowing more than one choice were treated as multiple-response items.

Questionnaire development is therefore described transparently as a project-specific instrument. Its content resembles the objectives of the activities, but no independent expert review, cognitive interviewing, test-retest study or validation against objective intake measures was documented.

As a result, constructs such as hydration knowledge and dietary change should not be given numerical scale scores or treated as validated outcomes. A later investigation should retain a dated copy of every question, document content review, pilot comprehension with students and specify scoring rules in advance.

Table 2. Study outcomes, instruments and evidence status

Domain	Intended measure	Data available in the source	Interpretation
Hydration practices	Self-reported intake, barriers and carrying water	Aggregated response percentages; survey timing not established for every item	Cross-sectional descriptions only
Hydration acceptability	Agreement and perceived sensations after infused water	Post-programme aggregate percentages	Subjective feedback, not objective intake
Dietary diversity	Weekly colour challenge tracking	Narrative account only	No numerical change estimable
AMR knowledge	Questions before/after education	No question-level scores or paired results	No measured learning gain is estimable
Stress and absence	Self-report and attendance	No counts, days or scoring method	Exploratory statements cannot be quantified
Blog engagement	Published posts and engagement	No counts available	Implementation described, reach not measurable

Note. "Available" refers to results retained in the supplied manuscript, rather than every measure originally planned.

3.5. Analysis

Analysis was limited to descriptive counts and percentages. With nine respondents, 11.1 percentage points corresponds to approximately one student. Counts were reconstructed only where a reported percentage clearly matched a whole number out of nine; they were checked against reported totals when categories were mutually exclusive. Multiple-response questions were not required to total 100%. Although the programme was described as having questionnaires before and after the intervention, the available record did not contain paired responses or scored outcomes for both time points. Tests of change and estimates of intervention effect would therefore be inappropriate. Exact binomial confidence intervals were calculated for two selected post-programme proportions to illustrate sampling uncertainty; these intervals do not measure changes caused by the programme.

The denominator for the descriptive percentages was nine unless otherwise specified. The presence of responses to a multiple-choice question did not establish that its categories were mutually exclusive; for such questions, the sum could exceed nine. A missing response category was marked as unavailable rather than assigned a presumed value. No paired significance test, effect size for a before-and-after difference, or claim of causation was calculated. The confidence intervals reported for selected positive responses are intended only to show the imprecision of small-sample proportions, not to confer representativeness on the voluntary sample.

3.6 Ethical and Reporting Considerations

The supplied manuscript describes participation as voluntary and responses as anonymised. It reports consent from participants and school approval, but provides no further documentation about parental permission, data retention or ethics oversight. Results are presented in aggregate to avoid identifying respondents. No clinical conclusions were drawn from students' reported water intake, sensations, stress or absences.

4. Results

4.1 Participation and Available Observations

Nine Grade 10 volunteers took part in the 12-week programme. Numerical results retained in the source document relate mainly to hydration. Ten figures were reported, with percentages generally corresponding to increments of one respondent out of nine. Where the original survey did not specify an item's timing or every response category, those uncertainties are retained in the reporting below. The results below distinguish current or retrospectively reported habits from actual measured change. Although the initial description names a pre-intervention questionnaire, the retained percentages are not accompanied by a record specifying the time point for every graph. Consequently, the categories shown in Figures 1–7 cannot all be presented as baseline outcomes without confirmation. Figures 8–10 concern students' post-activity perceptions and are described accordingly.

4.2. Water Consumption, Thirst and Barriers

Six students (6/9; 66.7%) reported drinking 1–2 L of water during a typical school day; two (2/9; 22.2%) reported 2–3 L, and one (1/9; 11.1%) reported less than 1 L (Figure 1). All nine reported drinking plain water at school (Figure 2). Thirst was experienced very often by three (3/9; 33.3%), sometimes by five (5/9; 55.6%) and rarely by one (1/9; 11.1%) (Figure 3). These categories reflect self-report rather than a measured assessment of hydration.

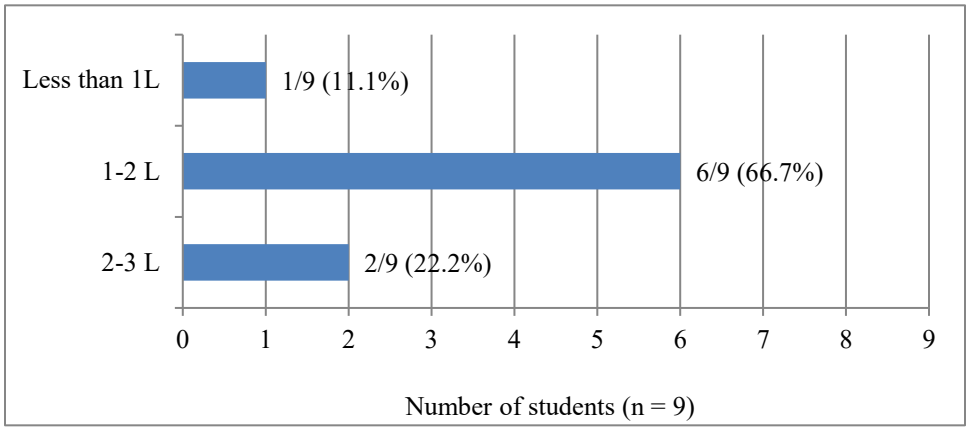


Fig. 1 Reported water consumption during a typical school day

Note. Water volumes were self-reported; the survey timepoint was not identified in the manuscript.

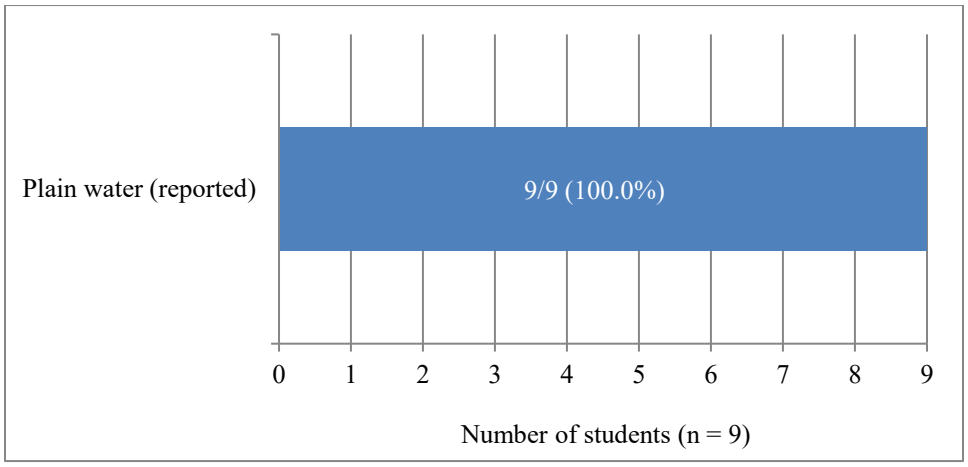


Fig. 2 Plain-water consumption during school hours

Note. Nine participants reported drinking plain water. Responses about other drinks were not supplied.

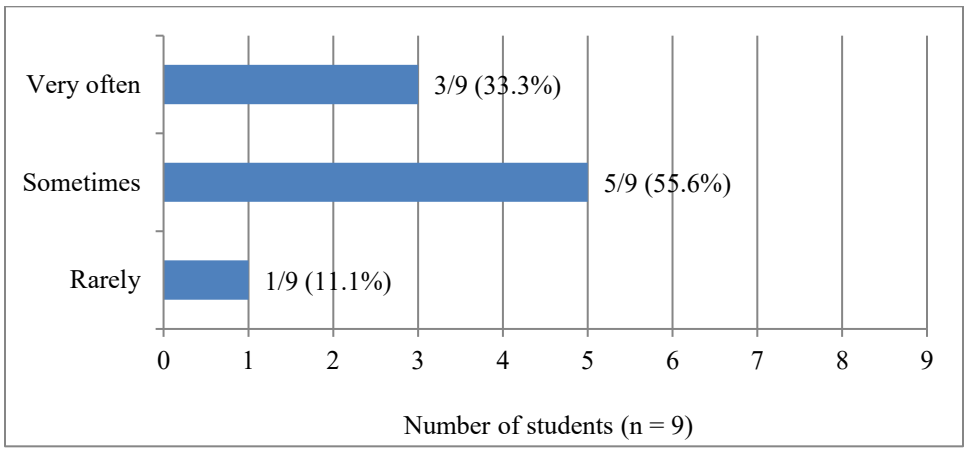


Fig. 3 Reported frequency of thirst at school

Note. Thirst frequency was self-reported; it was not a clinical assessment.

The most common reason for not drinking regularly was forgetting (5/9; 55.6%). A busy class schedule was mentioned by four students (44.4%), limited water access by three (33.3%), and dislike of plain water by one (11.1%); one student reported no barrier (Figure 4). As respondents could select more than one reason, the counts overlap. Seven students (77.8%) said they always brought a water bottle, one (11.1%) usually did, and one (11.1%) did not bring one regularly (Figure 5).

A notable contrast in the descriptive results is that most students said they brought a water bottle, yet barriers to drinking were still reported. The information does not show which individual participants selected each answer, so a cross-tabulation of bottle carrying against forgetting could not be constructed. The observations identify possible targets for the next evaluation, especially reminders and timetable-related barriers, but they do not show how much water any respondent actually consumed because of the programme.

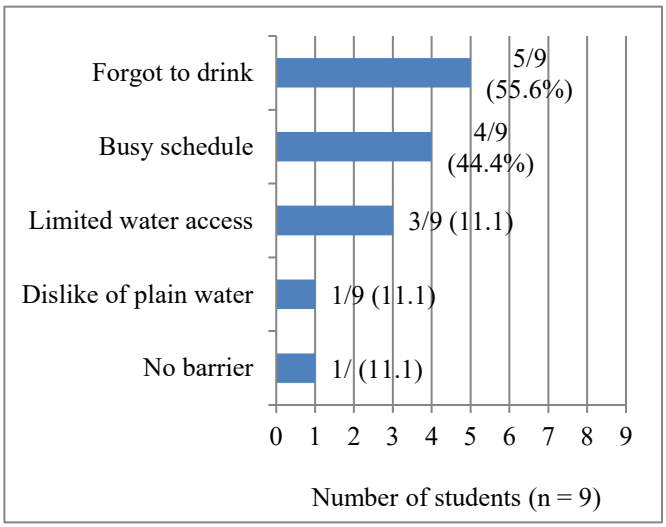


Fig. 4 Barriers to water consumption
Note. This question allowed multiple selections, so counts exceed nine.

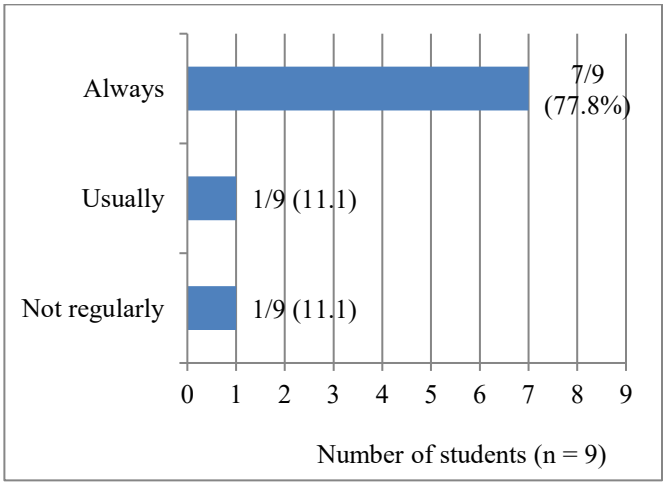


Fig. 5 Frequency of bringing a water bottle
Note. Categories follow the original manuscript.

4.3. Experience and Acceptability of Flavoured Water

Before taking part, six students (66.7%) had tried infused water, and three (33.3%) had not (Figure 6). Preferences recorded in the manuscript were lemon and ginger (4/9; 44.4%), mint (3/9; 33.3%), tulsi (1/9; 11.1%) and jeera (1/9; 11.1%) (Figure 7). The exact wording of the preference item was not retained, so these categories are reproduced as reported.

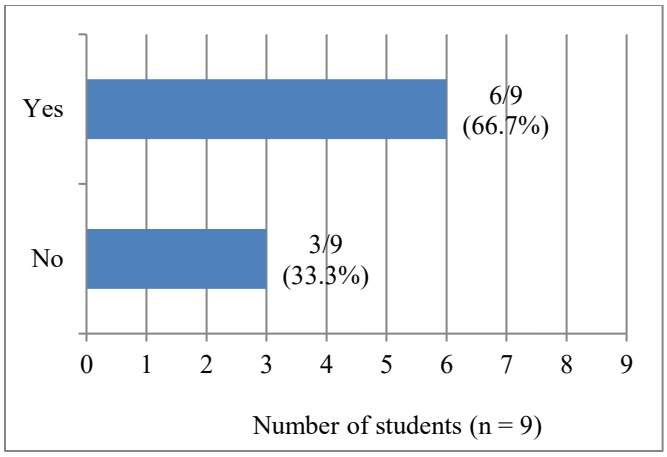


Fig. 6 Previous experience with infused water
Note. Students were asked about their experience before the programme.

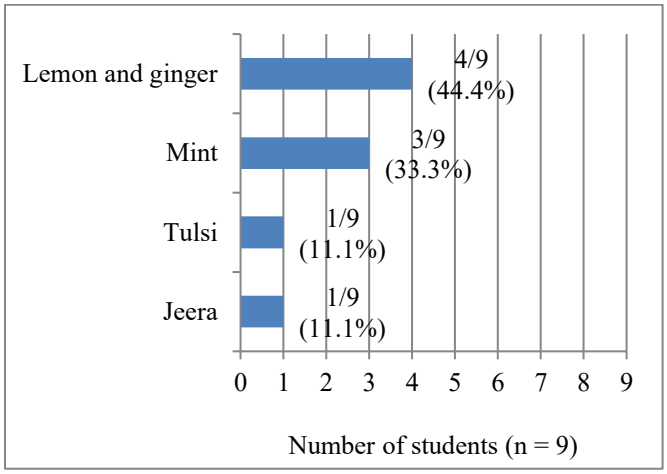


Fig. 7 Preferences for water flavouring
Note. Preferences are reproduced as reported; the precise response instructions were not available.

Seven students (77.8%) agreed, and one (11.1%) strongly agreed that flavoured water encouraged them to drink more than usual (Figure 8). The response category chosen by the ninth student was not recorded in the manuscript. After drinking infused water, eight students (88.9%) reported feeling refreshed, six (66.7%) reported being more energetic, four (44.4%) reported better digestion, and three (33.3%) described improved concentration (Figure 9). These overlapping responses describe subjective experiences; they do not demonstrate the physiological effects of the ingredients.

These answers were favourable toward the activity, but encouragement was self-reported. A participant who agreed with the statement was not necessarily drinking a larger volume than before. Similarly, the questions about energy, digestion, concentration and feeling refreshed gathered perceptions rather than blinded, objective measurements. No specific health effect should therefore be attributed to tulsi, lemon, ginger or other added ingredients.

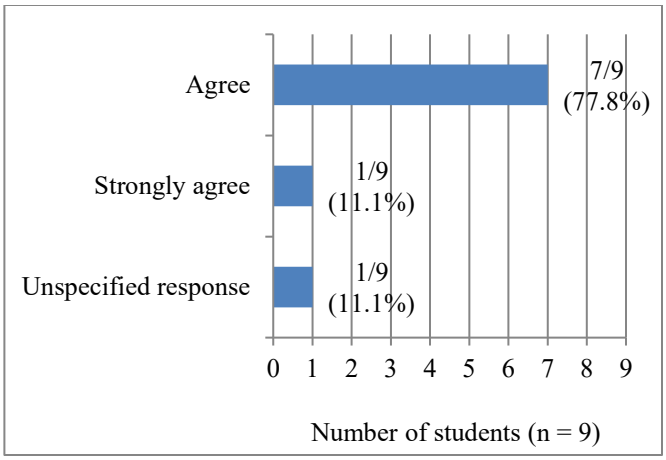


Fig. 8. Perceived encouragement to drink more water

Note. The ninth response category was not reported and has not been assigned a value.

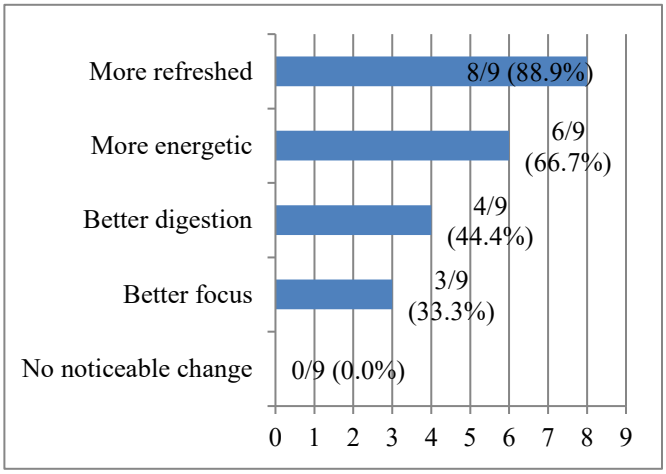


Fig. 9. Perceived sensations after flavoured water

Note. Responses were subjective and could overlap; no physiological effects were tested.

At the end of the programme, seven students (77.8%) described themselves as "much more aware" of the importance of hydration, one (11.1%) as "somewhat more aware", and one (11.1%) was unsure (Figure 10). The item asked students to judge their own awareness rather than complete a matched knowledge test.

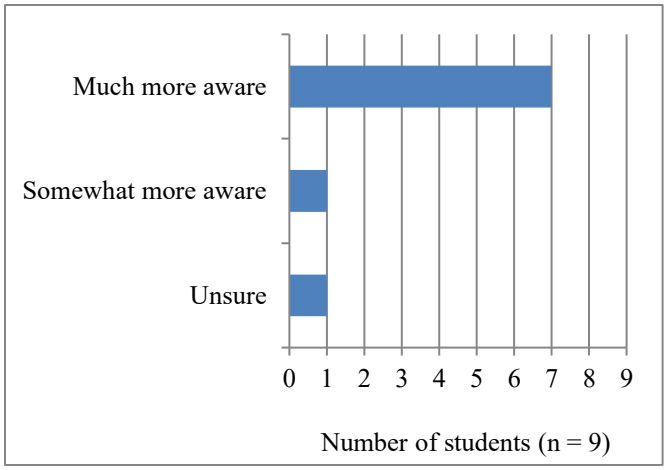


Fig. 10. Retrospective self-reported hydration awareness

Note. Ratings describe perceived awareness, not a scored pre–post assessment.

A total of eight of nine students (88.9%) responded positively to the question about flavoured water encouraging drinking. The exact 95% binomial confidence interval for this proportion is approximately 51.8%–99.7%. For the seven of nine students (77.8%) who reported being much more aware of hydration, the corresponding interval is approximately 40.0%–97.2%. The wide intervals reflect the considerable uncertainty associated with only nine responses, even before accounting for volunteer recruitment or response bias.

The presence of a wide interval is not a defect in the calculation; it follows from observing only nine responses. For that reason, the descriptive counts are more informative for this pilot than an isolated percentage. Even a proportion near 90% would be insufficient to establish an effect without a comparison, repeated measurements and clearer sampling procedures.

Table 3. Selected questionnaire results on drinking behaviour and hydration experiences (n = 9)

Item	Response	n/N	%
Typical water consumed at school	Less than 1 L	1/9	11.1
Typical water consumed at school	1–2 L	6/9	66.7
Typical water consumed at school	2–3 L	2/9	22.2
Frequency of thirst	Very often	3/9	33.3
Frequency of thirst	Sometimes	5/9	55.6
Frequency of thirst	Rarely	1/9	11.1
Carrying a water bottle	Always	7/9	77.8
Carrying a water bottle	Usually	1/9	11.1
Carrying a water bottle	Not regularly	1/9	11.1
Had previously tried infused water	Yes	6/9	66.7
Had previously tried infused water	No	3/9	33.3

Note. The timing of several questionnaire items was not identified in the supplied study summary; no baseline assignment has been assumed.

Table 4. Reported barriers and perceived outcomes (n = 9)

Measure/response	Count	Percent
Barrier: forgetting to drink	5/9	55.6%
Barrier: busy class schedule	4/9	44.4%
Barrier: limited water access	3/9	33.3%
Barrier: dislike of plain water taste	1/9	11.1%
Barrier: no barrier	1/9	11.1%
Infused water encouraged drinking: agree	7/9	77.8%
Infused water encouraged drinking: strongly agree	1/9	11.1%
Agreement item: remaining category not specified	1/9	11.1%
Perceived feeling: refreshed	8/9	88.9%
Perceived feeling: more energetic	6/9	66.7%
Perceived feeling: better digestion	4/9	44.4%
Perceived feeling: more focused	3/9	33.3%
Hydration awareness: much more aware	7/9	77.8%
Hydration awareness: somewhat more aware	1/9	11.1%
Hydration awareness: unsure	1/9	11.1%

Note. Students could select more than one barrier or sensation. The unreported category for the ninth response in the agreement item has not been invented.

4.4. Dietary-Diversity Activity

The Color-5 Challenge encouraged students to include fruits and vegetables of five different colours over the course of a week. The manuscript records that the activity was carried out and that participants appeared interested in food variety. However, it does not provide completed weekly tallies or comparable results from before and after the challenge. A change in dietary diversity cannot be calculated.

The weekly goal may have made dietary variety easier to discuss by using an observable feature of food, namely colour. Colour, however, is not a validated substitute for dietary quality, nutrient density or actual fruit-and-vegetable servings. The source material did not give a weekly compliance denominator or a baseline count of colour groups. Therefore, no trend line, dietary improvement percentage or inferential statistic was produced for this activity.

4.5. Antimicrobial-Resistance Education

Monthly discussions led by healthcare professionals addressed antibiotic use, resistance, hygiene, vaccination, infection prevention and nutrition. The original account describes greater awareness following the sessions, but neither baseline nor endline AMR knowledge scores were reported. The sessions can therefore be documented as educational activities, not as a quantitatively demonstrated improvement in antibiotic knowledge.

The reported educational topics were relevant to the programme's stated aim of preventive health and antibiotic stewardship. Nonetheless, an account of topics taught is evidence of content delivered, not evidence that specific misconceptions were corrected. Without the same scored items at both timepoints, the size, direction and persistence of any change in AMR knowledge remain unknown.

The discussion, therefore, considers the sessions as a plausible and feasible educational component, rather than a demonstrated knowledge intervention.

4.6. Stress, Absence and Student Blog

The initial manuscript also mentions small decreases in student-reported stress and absence related to minor illness. No scale, number of absent days or comparison figures accompanied these statements. They have therefore not been treated as measured programme outcomes.

The student-run blog provided additional information about nutrition, hydration and antibiotic misconceptions, but post totals and readership data were unavailable.

The account of stress and illness-related absences likewise lacks a baseline measure, consistent follow-up period and numerical totals. The study did not set these outcomes as clinically assessed endpoints. They remain observations noted by the original project and cannot be linked causally to hydration, the dietary challenge or the educational sessions.

For the blog, the existence of written posts and peer communication is documented, while measures of reach, reading frequency and comprehension are absent.

4.7. Quantitative Evidence Available for Change Analysis

Table 5. Availability of pre and post–data and appropriate analyses

Outcome	Baseline numerical data	Post numerical data	Analysis now justified
Water intake (same question/scale)	Not identifiable as baseline	Categorical current intake reported	Descriptive item proportions only
Water drinking is encouraged by infused water	No matched starting volume	Agreement: 8 of 9 positive	Descriptive perceived influence only
Hydration knowledge score	Not available	Retrospective awareness rating	No score difference estimable
Color-5 variety score	Not available	Not available	No pre–post comparison
AMR test score	Not available	Not available	No pre–post comparison
Stress score	Not available	Not available	No pre–post comparison
Days absent due to minor illness	Not available	Not available	No pre–post comparison

Note. Without matched numerical records, a pre–post comparison or significance test cannot be performed reliably.

5. Discussion

5.1. Interpretation of Hydration Findings

One practical issue was particularly clear: carrying a bottle did not remove every reported obstacle to drinking at school. Seven students said they always brought water, yet forgetting was still the most common barrier across the group. The survey does not establish whether the same students reported both experiences, but it suggests a useful question for future work: Does making drinking water more convenient and noticeable matter as much as making it available?

The results also demonstrate how choice might help make a simple activity engaging. Four students preferred lemon and ginger, three mint and one each tulsi and jeera. This preference distribution should not be treated as a ranking for the wider student population; it may reflect the small group, the recipes offered or the wording of the question. Even so, allowing participants to express preferences is a practical feature worth retaining when the activity is evaluated more systematically.

Most participants responded favourably to the flavoured-water activity. This is a useful observation for designing a school activity, but its meaning should remain limited to acceptability. In contrast, the interventions reviewed by Franse et al. [4] assessed water consumption using a range of outcome measures and were conducted mainly with younger children. The present study recorded perceived encouragement to drink, not the amount consumed before and after the activity. It is also unknown whether students would continue choosing infused water after the programme ended.

5.2. Comparison with Dietary Intervention Research

The weekly Color-5 Challenge translated the broad idea of dietary variety into a task students could follow. Earlier reviews examined interventions with specified nutrition measures and, in some cases, direct changes to school food environments [2, 9, 11]. Flores-Vázquez et al. [3] considered the role of behavioural theory in adolescent nutrition education. Unlike those studies, the available Color-5 record contains no defined dietary score or complete response series. Its contribution here is to the description of the activity rather than evidence that students changed their diets.

Comparison with the Asian nutrition literature is especially limited because interventions in the review by Pongutta et al. included interventions with specified nutritional measures [15]. The present initiative did not examine body composition, nutritional status or food intake with a validated instrument. Likewise, Racey et al. considered the influence of intervention characteristics and follow-up across school diet studies [16], whereas the current pilot lacked follow-up data. The comparison highlights evaluation requirements rather than claims that Color-5 outperformed conventional approaches.

5.3. Comparison with AMR and Peer-Education Research

Education about antibiotics was included because the programme sought to connect ordinary preventive health practices with a wider public-health challenge. The misconceptions documented among school students and teachers in New Delhi by Kotwani et al. [7] show the relevance of the topic. Grailey et al. [5] reviewed educational initiatives aimed at children and adolescents and discussed the evidence base for AMR learning. The present pilot cannot be compared with those programmes by knowledge gain, since the necessary pre- and post-session test scores were not retained.

The blog allowed students to contribute to the information presented to their peers. Reviews of peer education, including Dodd et al. [1], indicate that results vary according to delivery and context. Here, the blog was one part of a wider programme rather than a separately evaluated intervention. It would be misleading to credit the blog with

changes in knowledge or claim that it performed better than clinician-led teaching.

A meaningful next step would be to separate the outcomes of the professional sessions from those of the blog. The former could be assessed using a small set of consistently administered knowledge questions; the latter might be evaluated through readership records and short comprehension checks. These are proposed methods for future work, not measures that were collected in the present study.

5.4. What is Distinctive about the Pilot

This project brought together hydration prompts, a food-variety challenge, medical discussions and student-written messages during one school term. That combination is the study's practical contribution. The activities were not developed as a new clinical protocol, and they cannot yet be presented as a model proven to work in other schools. Nevertheless, the participant feedback identifies questions worth pursuing, including barriers to regular drinking and the role of choice in student participation.

The integration is potentially useful as a way to link personal wellness with shared public-health responsibilities. Hydration and food variety are topics that students encounter frequently; clinician-led AMR discussions introduce the more complex idea that antibiotic use can affect the wider community. Student participation in writing about these themes may make the programme easier to maintain. However, because all components were introduced within the same short period, their separate contribution could not be isolated.

Table 6. Contextual comparison with the cited literature

Prior work	What the prior research evaluated	What this pilot adds / cannot establish
Franse et al. (2020)	Water-promotion interventions in children aged 2–12 years.	Student perceptions of flavoured water among Grade 10 students; no measured intake difference.
O'Brien et al. (2021); Samad et al. (2024)	Systematic review evidence on structured school nutrition interventions.	Low-resource Color-5 implementation idea; no validated dietary-change outcome.
Kotwani et al. (2016); Grailey et al. (2026)	Antibiotic knowledge and school-age AMR education.	AMR education included alongside wellness; no paired knowledge scores.
Dodd et al. (2022)	Peer-led school health interventions across settings.	Student-written blog incorporated in one school pilot; no causal test of peer effects.

Note. Previous research and this pilot used different designs and measures; outcome superiority cannot be inferred.

5.5. Strengths and Limitations

The pilot had several strengths: the activities were feasible to organise at one school, the intervention lasted a defined 12-week period, health professionals contributed to teaching, and the questionnaire retained specific feedback about hydration. Expressing proportions as both percentages and counts also makes the small sample size visible to readers.

Its limitations are substantial. Only nine students volunteered, all from one school; participants may have been more interested in wellness activities than their peers. Responses were self-reported, with possible recall and social desirability bias. There was no control group, no objectively recorded water-intake change and no matched knowledge scores.

The questionnaire's development and validation were not documented, and the exact dose of each programme component could not be verified. Reports of better dietary habits, lower stress or fewer illness-related absences lacked supporting numerical records. Finally, there was no later assessment to determine whether attitudes or routines persisted.

There is also a reporting limitation: the questionnaire data available for this revision consist of summary percentages and narrative observations rather than a de-identified respondent-level dataset. Counts calculated from exact ninths are useful, but they cannot recreate correlations among questions, paired change scores or any unreported category. The current report is therefore deliberately conservative. It avoids inventing time-series values or treating the participants' retrospective statements as objective evidence of improved health.

5.6. Implications for Future Evaluation

A larger follow-up could keep the same practical activities while improving the evaluation. Identical baseline and endline questions, linked through anonymous codes, would allow changes in knowledge and behaviour to be calculated. A short daily water log, weekly diet records, dated session registers and blog metrics would provide outcomes beyond retrospective impressions. The questionnaire should be reviewed for clear wording and tested before use. If the sample and data quality permit, paired analyses and an appropriate comparison group could then help distinguish programme-related change from other influences.

A future protocol should identify a primary outcome in advance, distinguish baseline from endline survey versions and establish a feasible schedule for recording water intake and challenge participation. A comparison group, if appropriate and ethically feasible, would help evaluate whether observed changes exceeded usual variation during a school term. The feasibility of completing repeated measures and the acceptability of the activities should be evaluated separately from health outcomes.

6. Conclusion

Nine Grade 10 volunteers participated in a 12-week school programme that combined a flavoured-water activity, a fruit-and-vegetable variety challenge, physician-led discussions and a student-managed health blog. The hydration feedback was generally favourable: eight students felt infused water encouraged drinking, and eight reported some increase in their awareness of hydration. These are students' perceptions, not direct measurements of improved water intake or health. With no control group and no completely paired outcomes, the pilot does not establish effectiveness. Its main value is in describing a practical school initiative and showing what should be measured more carefully in future work.

These findings may inform the design of a future integrated school programme. The immediate evidence is that the activities were organised and that the participants reported generally favourable attitudes toward the hydration component. The study does not provide sufficient data to conclude that water intake increased, dietary quality improved, antibiotic misconceptions declined, or minor illness decreased.

7. Future Perspectives

Future evaluations should include a broader group of students and a clear recruitment process. Attendance and activity frequency should be logged as the programme runs. An identical set of validated or carefully piloted questions should be used before and after the intervention, with results reported as counts as well as percentages.

Water and food diaries, school attendance records and scored AMR knowledge questions could supplement feedback. Follow-up beyond 12 weeks, together with a suitable comparison group, would be needed before drawing conclusions about lasting changes or the programme's wider applicability.

A future report should also include the final questionnaire as an appendix, retain dated intervention records and explain any deviations from its planned timetable. Descriptive data should always be shown as both counts and percentages, and numerical pre–post comparisons should be restricted to measures collected using comparable methods. This would allow reviewers to judge reproducibility, measurement quality and the practical significance of any findings without relying solely on perceived improvement.

Conflicts of Interest

Author confirmation is required before submission.

Funding Statement

Funding information was not supplied in the source manuscript; author confirmation is required.

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Appendix 1. Editable data for Figures 1–10

The following values are transcribed from the study manuscript. The charts throughout this paper are embedded with their captions; the figures can be recreated or revised from these editable Word table cells. No original respondent-level data have been inferred. The denominator is nine for the percentages displayed.

Original reported category	Number of students	Percentage
Less than 1 L	1	11.1%
1–2 L	6	66.7%
2–3 L	2	22.2%

Fig. 1 Reported water consumption during a typical school day

Original reported category	Number of students	Percentage
Reported drinking plain water	9	100.0%

Fig. 2 Plain water consumption during school hours

Original reported category	Number of students	Percentage
Very often	3	33.3%
Sometimes	5	55.6%
Rarely	1	11.1%

Fig. 3 Reported frequency of thirst at school

Original reported category	Number of students	Percentage
Forgot to drink	5	55.6%
Busy schedule	4	44.4%
Limited water access	3	33.3%
Dislike of plain water	1	11.1%
No barrier	1	11.1%

Fig. 4 Barriers to water consumption

Original reported category	Number of students	Percentage
Always	7	77.8%
Usually	1	11.1%
Not regularly	1	11.1%

Fig. 5 Frequency of bringing a water bottle

Original reported category	Number of students	Percentage
Yes	6	66.7%
No	3	33.3%

Fig. 6 Previous experience with infused water

Original reported category	Number of students	Percentage
Lemon and ginger	4	44.4%
Mint	3	33.3%
Tulsi	1	11.1%
Jeera	1	11.1%

Fig. 7 Preferences for water flavouring

Original reported category	Number of students	Percentage
Agree	7	77.8%
Strongly agree	1	11.1%
Remaining response not specified	1	11.1%

Fig. 8 Perceived encouragement to drink more water

Original reported category	Number of students	Percentage
More refreshed	8	88.9%
More energetic	6	66.7%
Better digestion	4	44.4%
Better focus	3	33.3%
No noticeable change	0	0.0%

Fig. 9 Perceived sensations after flavoured water

Original reported category	Number of students	Percentage
Much more aware	7	77.8%
Somewhat more aware	1	11.1%
Unsure	1	11.1%

Fig. 10 Retrospective self-reported hydration awareness