

Vaccination literacy versus the willingness and attitudes to receiving vaccination in high school students of Chennai

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Abstract- Vaccine literacy may heavily influence willingness to vaccinate among high school students who experienced the COVID-19 pandemic and are frequent users of social media, where misinformation can spread easily. This study investigated the association between vaccination literacy, attitudes towards vaccination, and willingness to receive future vaccines among 75 high school students from grades 9 to 12 in Chennai, Tamil Nadu. A questionnaire-based design was used to assess demographics, vaccination status, vaccination literacy, attitudes and willingness to vaccinate, and sources of information. Pearson's correlation and knowledge, attitude, and willingness scores were calculated. Univariable and multivariable linear regression analyses were performed to identify factors associated with willingness to receive future vaccination. Participants who had received all recommended COVID-19 vaccines and booster doses had significantly higher willingness scores than the rest ($\beta=1.52$, $\text{beta} = 1.52$, 95% CI: 0.54–2.49, $P=0.003$, $P=0.003$, $P=0.003$). Higher knowledge scores were independently associated with greater willingness to receive future vaccination ($\beta=0.413$, $\text{beta} = 0.413$, 95% CI: 0.105–0.721, $P=0.009$, $P=0.009$, $P=0.009$). Positive vaccination attitudes showed a significant correlation with willingness but were not independently associated after adjustment. These findings suggest that age-appropriate, reliable vaccination education involving schools, healthcare professionals, and families may help support informed vaccination decisions among adolescents.

Keywords: Vaccine literacy, Vaccine hesitancy, Knowledge score, Vaccination attitudes, Pearson correlation, Univariable and multivariable linear regression, High school students.

I. INTRODUCTION

Vaccines are among the safest and most effective public health tools, preventing 3.5–5 million deaths every year from diseases such as measles, diphtheria, pertussis, and polio (9). Vaccines have been highly

successful and have played a major role in the eradication of smallpox. Most vaccines contain either an attenuated or inactivated form of a pathogen. Some vaccines contain inactivated toxoids or subunit components of pathogens, which stimulate the immune system when they are recognised as non-self-antigens. mRNA vaccines, including the COVID-19 vaccines developed by Pfizer and Moderna, work by instructing cells to produce a harmless piece of viral protein, which then triggers an immune response. Vaccination of large populations can lead to herd immunity, reducing the transmission of infectious diseases and decreasing death rates.

“Vaccination literacy is the ability of people to access, process, and understand basic vaccination knowledge and vaccination services, as well as to assess the potential consequences and risks of their behaviour and make health-related decisions” (2).

Vaccination literacy has been suggested as a promising approach to reducing vaccine hesitancy, which may lead to increased vaccination.

During the pandemic, social media usage increased, making it a major source of vaccine-related misinformation. Misinformation about vaccines on social media increased concerns regarding vaccine safety and efficacy. High school students are a critical population for vaccination-literacy research because, as frequent social media users, they were highly exposed to both medical information and vaccine misinformation during the COVID-19 pandemic. This generation largely developed its vaccination attitudes during the pandemic, unlike adults who had already established many of their beliefs before 2020.

However, few studies have examined how vaccination literacy affects willingness to receive vaccines among high school students in Chennai in post-COVID settings. This research aims to investigate the relationship between vaccination literacy and willingness to receive future vaccines among high school students in the post-COVID era.

Hypothesis: In the post-COVID era, there will be a moderate-to-strong positive correlation between vaccination literacy and willingness to receive future vaccines among high school students.

Research objectives:

- To identify whether there is a correlation between vaccination literacy and willingness to receive vaccines among high school students in Chennai in the post-COVID era.
- To assess the level of vaccination literacy among high school students in Chennai.
- To identify the factors contributing to willingness to vaccinate.
- To evaluate attitudes toward future vaccines.
- To determine current vaccination practices.

II. MATERIALS AND METHODS

2.1. Study design and setting

The results for this study were generated through a questionnaire-based design to investigate the relationship between vaccination literacy, attitudes towards vaccination and willingness to receive future vaccines.

The study was conducted among 75 high school students from grade 9 to 12 in Chennai, Tamil Nadu – majority being from CPSGS Anna Nagar, Chennai, Tamil Nadu.

2.2 Participants

Participants were recruited from the researcher's school and from outside-school networks such as LinkedIn. Participants were eligible if they belonged to the age group 13-18 and were currently studying in grades 9-12. Those who did not provide consent were excluded from this questionnaire.

2.3 Sampling

A convenience sampling method was used. The questionnaire was circulated among interested students who had given consent to participate in the study with conditions on the responses from being anonymous.

2.4 Data- collection questionnaire

Data were collected using a structured questionnaire consisted of 6 sections with a total of 38 questions.

The sections included:

- Demographics
- Vaccination status
- Vaccination literacy / knowledge
- Attitudes towards vaccines
- Willingness to vaccinate
- Information sources and behaviour

Vaccination knowledge questions were answered using "True, False, Don't know" options. Attitudes and willingness were answered using linear scale.

2.5 Data collection procedure

The questionnaire was administered during the month of June and July 2026 using Google forms. Participation was voluntary, and students were informed about the purpose of the study before completing the questionnaire. Names of students remained anonymous throughout the process.

Statistical analysis

Statistical analysis was performed using R. Categorical variables were summarized as frequencies and percentages, while continuous variables were presented as mean and standard deviation (SD) or median and range, as appropriate. The knowledge score was calculated as the sum of correctly answered knowledge items (range: 0–10), attitude score was calculated by summing the responses to the nine attitude items after reverse coding negatively worded statements (range: 9–45), and willingness score was calculated by summing the three willingness items (range: 3–15), with higher scores indicating greater willingness to receive future vaccination.

Pearson's correlation coefficient was used to examine the relationship between knowledge score, attitude

score, and willingness score. Univariable linear regression analyses with robust standard errors were performed to assess the association between willingness score and demographic characteristics, COVID-19-related variables, vaccination-related variables, knowledge score, and attitude score. Subsequently, multivariable linear regression models with robust standard errors were done to identify

independent predictors of willingness to receive future vaccination.

Multicollinearity among predictor variables was assessed using the variance inflation factor (VIF). All statistical tests were two-sided, and a P value <0.05 was considered statistically significant.

III. RESULTS

Variables	N = 75
Age	
14–15 years	27 (36.0%)
16–17 years	46 (61.3%)
18+ years	2 (2.7%)
Gender	
Female	42 (56.0%)
Male	31 (41.3%)
Non-binary / Third gender	2 (2.7%)
Have you personally been infected with COVID-19?	
No, I never had it	41 (54.7%)
Not sure / Don't remember	7 (9.3%)
Yes, I tested positive	27 (36.0%)
What class/grade are you in?	
9th standard	13 (17.3%)
10th standard	15 (20.0%)
11th standard	15 (20.0%)
12th standard	32 (42.7%)
Have you chosen biology as one of your main subject choices?	
No	37 (49.3%)

Yes	38 (50.7%)
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A total of 75 participants were included in the study. The majority of participants were aged 16–17 years (46, 61.3%), followed by 14–15 years (27, 36.0%), while only two participants (2.7%) were aged 18 years or older. More than half of the participants were female (42, 56.0%), with 31 (41.3%) identifying as male and 2 (2.7%) as non-binary/third gender. Overall, 27 participants (36.0%) reported having previously tested positive for COVID-19, whereas 41 (54.7%) had never been infected and 7 (9.3%) were unsure or did not remember. Students from the 12th standard comprised the largest proportion of the study population (32, 42.7%), followed by those from the 10th and 11th standards (15, 20.0% each) and the 9th standard (13, 17.3%). Biology had been chosen as a

main subject by 38 participants (50.7%), while 37 (49.3%) had not selected biology.

Table 2. Vaccination status of the participants	
Variables	N = 75
Have you received any COVID-19 vaccine doses?	
No, I haven't received any	44 (58.7%)
Yes, all recommended doses (booster included)	16 (21.3%)
Yes, but not all doses	15 (20.0%)
Are you up-to-date with ALL recommended childhood vaccines (measles, polio, D	
Not sure	9 (12.0%)
Partially vaccinated	19 (25.3%)
Yes, completely vaccinated	47 (62.7%)
Who usually makes vaccination decisions for you?	
Doctor recommends, I agree	10 (13.3%)
I decide for myself	1 (1.3%)
Parents and I decide together	4 (5.3%)
Parents/guardians decide	59 (78.7%)
Social media influences me	1 (1.3%)
Has anyone influenced you to not get vaccinated?	
No	62 (82.7%)

Yes, doctors	2 (2.7%)
Yes, friends	2 (2.7%)
Yes, other family members	2 (2.7%)
Yes, parents	5 (6.7%)
Yes, social media	2 (2.7%)

Table 3. Knowledge questionnaire responses of the participants	
Variables	N = 75
Vaccines work by training the immune system to recognise and fight viruses/b	
Don't know	4 (5.3%)
False	5 (6.7%)
True	66 (88.0%)
Herd immunity occurs when enough people are vaccinated, protecting those who	
Don't know	31 (41.3%)
False	13 (17.3%)
True	31 (41.3%)
Vaccines cause your body to produce antibodies.	
Don't know	7 (9.3%)
False	5 (6.7%)
True	63 (84.0%)
Vaccines can cause the disease they're meant to prevent.	
Don't know	17 (22.7%)
False	32 (42.7%)
True	26 (34.7%)
Side effects like mild fever or sore arm after vaccination are normal and us	
Don't know	5 (6.7%)
False	1 (1.3%)
True	69 (92.0%)
Vaccines undergo safety testing before being approved for public use.	
Don't know	4 (5.3%)
True	71 (94.7%)

People with weakened immune systems (e.g., cancer patients) benefit from com	
Don't know	27 (36.0%)
False	9 (12.0%)
True	39 (52.0%)
Vaccine side effects are more common than side effects from the actual disea	
Don't know	36 (48.0%)
False	16 (21.3%)
True	23 (30.7%)
mRNA vaccines teach your cells to make a harmless piece of protein that trig	
Don't know	52 (69.3%)
False	2 (2.7%)
True	21 (28.0%)
mRNA vaccines change or alter your DNA.	
Don't know	42 (56.0%)
False	23 (30.7%)
True	10 (13.3%)

Table 4. Attitude towards vaccination of the participants	
Variables	N = 75
Vaccines are safe for most people.	
Strongly disagree	1 (1.3%)
Disagree	4 (5.3%)
Neutral	13 (17.3%)
Agree	28 (37.3%)
Strongly agree	29 (38.7%)
I believe vaccines are important for protecting my family.	
Strongly disagree	2 (2.7%)
Disagree	0 (0.0%)
Neutral	14 (18.7%)

Agree	21 (28.0%)
Strongly agree	38 (50.7%)

I'm worried about vaccine side effects.	
Strongly disagree	8 (10.7%)
Disagree	29 (38.7%)
Neutral	22 (29.3%)
Agree	11 (14.7%)
Strongly agree	5 (6.7%)
I am worried about the safety of vaccines that were developed quickly.	
Strongly disagree	3 (4.0%)
Disagree	8 (10.7%)
Neutral	34 (45.3%)
Agree	20 (26.7%)
Strongly agree	10 (13.3%)
Natural remedies are better than vaccines.	
Strongly disagree	23 (30.7%)
Disagree	16 (21.3%)
Neutral	24 (32.0%)
Agree	3 (4.0%)
Strongly agree	9 (12.0%)
I trust my doctor's vaccine recommendations.	
Strongly disagree	2 (2.7%)
Disagree	1 (1.3%)
Neutral	18 (24.0%)
Agree	30 (40.0%)
Strongly agree	24 (32.0%)
I believe vaccines can be harmful to the body.	
Strongly disagree	16 (21.3%)
Disagree	29 (38.7%)
Neutral	21 (28.0%)
Agree	5 (6.7%)
Strongly agree	4 (5.3%)
I believe vaccinations should be mandatory during public health emergencies.	
Strongly disagree	1 (1.3%)

Disagree	6 (8.0%)
Neutral	13 (17.3%)
Agree	19 (25.3%)
Strongly agree	36 (48.0%)
I would take booster shots if required.	
Strongly disagree	1 (1.3%)
Disagree	6 (8.0%)
Neutral	18 (24.0%)
Agree	19 (25.3%)
Strongly agree	31 (41.3%)

Table 5. Responses regarding Willingness towards vaccination of the participants	
Variables	N = 75
How willing are you to get a vaccine for a future pandemic disease?	
Strongly disagree	3 (4.0%)
Disagree	3 (4.0%)
Neutral	12 (16.0%)
Agree	18 (24.0%)
Strongly agree	39 (52.0%)
How willing are you to take newly developed vaccines that are available?	
Strongly disagree	4 (5.3%)
Disagree	14 (18.7%)
Neutral	29 (38.7%)
Agree	26 (34.7%)
Strongly agree	2 (2.7%)
How willing are you to get a booster shot if recommended?	
Strongly disagree	1 (1.3%)
Disagree	7 (9.3%)
Neutral	16 (21.3%)
Agree	33 (44.0%)
Strongly agree	18 (24.0%)

Table 6. Sources of information and recommendation regarding vaccination of the participants	
Variables	N = 75
Who do you rely on mostly for vaccination information? (Select up to 2)	
Doctors/hospitals	66 (88.0%)
Parents/family	50 (66.7%)
School/teachers	4 (5.3%)
Social media	7 (9.3%)
Friends	4 (5.3%)
Others	7 (9.3%)
Do you cross-check the information given to you by other individuals with a credible source?	
All the time	15 (20.0%)
Most of the time	31 (41.3%)
Never	5 (6.7%)
Rarely	10 (13.3%)
Sometimes	14 (18.7%)
Do you trust social media with vaccine information?	
No	48 (64.0%)
Sometimes	26 (34.7%)
Yes	1 (1.3%)
Would you advise other people to get vaccinated?	
All the time	11 (14.7%)
Most of the time	27 (36.0%)
Never	6 (8.0%)
Rarely	11 (14.7%)
Sometimes	20 (26.7%)
What's your BIGGEST concern about vaccines? (Select one)	
Cost/availability	3 (4.0%)
No concern	13 (17.3%)
Not effective	10 (13.3%)
Other	3 (4.0%)
Religious/cultural beliefs	2 (2.7%)
Side effects/safety	29 (38.7%)

Trust in government/manufacturers

15 (20.0%)

Univariable linear regression analysis of factors associated with willingness to receive future vaccination among school students

Variable	β (Coefficient)	Robust SE	P value	95% CI
Age				
16–17 years (vs 14–15 years)	-0.63	0.528	0.237	-1.683 to 0.423
Gender				
Male (vs Female)	-0.271	0.576	0.639	-1.421 to 0.878
Previous COVID-19 infection				
Yes (vs No)	0.045	0.561	0.936	-1.073 to 1.164
Class				
10th standard (vs 9th standard)	0.183	0.787	0.817	-1.387 to 1.754
11th standard (vs 9th standard)	-0.631	0.914	0.492	-2.454 to 1.192
12th standard (vs 9th standard)	-0.481	0.808	0.554	-2.094 to 1.132
Biology as a main subject				
Yes (vs No)	0.855	0.546	0.122	-0.235 to 1.944
COVID-19 vaccination status				
Yes, all recommended doses (booster included) (vs No)	1.797	0.439	<0.001	0.921 to 2.672
Yes, but not all doses (vs No)	-1.261	0.847	0.141	-2.950 to 0.428
Childhood vaccination status				
Partially vaccinated (vs No)	0.528	1.083	0.628	-1.632 to 2.688
Completely vaccinated (vs No)	1.163	1.009	0.253	-0.850 to 3.176
Influenced not to vaccinate				
Yes (vs No)	-0.65	0.871	0.458	-2.387 to 1.087
Knowledge score	0.645	0.127	<0.001	0.392 to 0.898
Attitude score	0.19	0.054	0.001	0.082 to 0.298

In the univariable linear regression analysis, participants who had received all recommended COVID-19 vaccine doses, including booster doses, had significantly higher willingness scores than unvaccinated participants ($\beta = 1.80$, 95% CI: 0.92–2.67, $P < 0.001$). Higher knowledge score ($\beta = 0.65$,

95% CI: 0.39–0.90, $P < 0.001$) and attitude score ($\beta = 0.19$, 95% CI: 0.08–0.30, $P = 0.001$) were also significantly associated with greater willingness to receive future vaccination. No significant associations were observed for age, gender, previous COVID-19 infection, class, biology subject, childhood

vaccination status, or influence against vaccination (P > 0.05)

Multivariable linear regression analysis of factors independently associated with willingness to receive future vaccination among school students:

Variable	β (Coefficient)	SE	P value	95% CI
Age				
16–17 years (vs reference)	-0.578	0.758	0.448	-2.095 to 0.939
Gender				
Male (vs female)	0.229	0.564	0.687	-0.900 to 1.357
Previous COVID-19 infection				
Yes (vs No)	-0.258	0.434	0.554	-1.126 to 0.610
Class				
10th standard (vs 9th)	-0.597	0.681	0.384	-1.961 to 0.767
11th standard (vs 9th)	-0.159	0.663	0.812	-1.486 to 1.169
Biology as a main subject				
Yes (vs No)	0.733	0.504	0.151	-0.276 to 1.742
COVID-19 vaccination status				
Yes, all recommended doses (booster included) (vs No)	1.516	0.486	0.003	0.544 to 2.488
Yes, but not all doses (vs No)	-0.967	0.895	0.285	-2.759 to 0.825
Childhood vaccination status				
Partially vaccinated (vs No)	0.305	0.882	0.73	-1.460 to 2.071
Completely vaccinated (vs No)	0.453	0.792	0.57	-1.133 to 2.039
Influenced not to vaccinate				
Yes (vs No)	-0.543	0.658	0.413	-1.860 to 0.775
Knowledge score	0.413	0.154	0.009	0.105 to 0.721
Attitude score	0.09	0.056	0.111	-0.021 to 0.202

SE- standard error, CI – confidence interval; bolded were statistically significant; reference group were inside the brackets

In the multivariable linear regression analysis, participants who had received all recommended

COVID-19 vaccine doses, including booster doses, had significantly higher willingness scores than unvaccinated participants ($\beta = 1.52$, 95% CI: 0.54–2.49, $P = 0.003$). In addition, knowledge score was independently associated with willingness to receive future vaccination, with each one-point increase in

knowledge score associated with a 0.41-point increase in willingness score ($\beta = 0.41$, 95% CI:

significantly associated with willingness after adjustment Knowledge, attitude and willingness score:

0.10–0.72, $P = 0.009$). Attitude score showed a positive but non-significant association with willingness ($\beta = 0.09$, 95% CI: -0.02 to 0.20 , $P = 0.111$). Age, gender, previous COVID-19 infection, class, biology subject, childhood vaccination status, and influence against vaccination were not

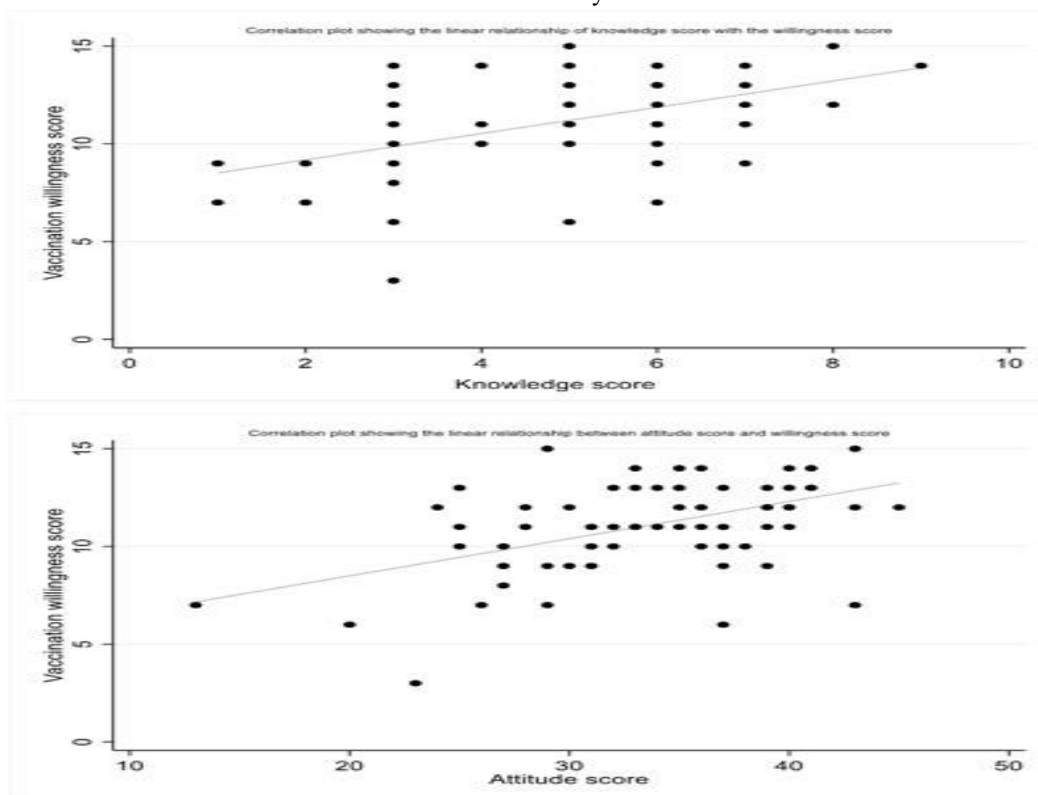
	Mean (SD)	Min – Max	Median	Pearson correlation* (r)	P value
Knowledge score	4.8 (1.75)	1 – 9	5	0.506	<0.001
Attitude score	33.5 (6.09)	13 – 45	34	0.499	<0.001
Willingness score	11.07 (2.32)	3 – 15	11	-	-

*correlated with the willingness score

Knowledge score demonstrated a moderate positive correlation with willingness to receive future vaccination ($r = 0.506$, $P < 0.001$). Similarly, attitude score was moderately positively correlated with

willingness score ($r = 0.499$, $P < 0.001$), indicating that participants with higher knowledge and more positive attitudes towards vaccination were more willing to receive future vaccines.

Correlation analysis:



IV. DISCUSSION:

Main findings:

This study examined the relationship between vaccination literacy, attitudes towards vaccination, and willingness to receive future vaccines among high school students. The main findings showed that students with higher vaccination-related knowledge were more willing to receive future vaccines. Similarly, students with more positive attitudes towards vaccination demonstrated greater willingness to receive future vaccines. Students who had received COVID-19 vaccines, including booster doses, also reported higher willingness to receive future vaccines compared with those who had not received any doses. No significant associations were observed between willingness to receive future vaccination and age, gender, previous COVID-19 infection, class, biology as a main subject, childhood vaccination status, or influence against vaccination. Knowledge score was positively correlated with willingness score, while attitude score showed a positive but non-significant association with willingness. Doctors and family members were the main sources of vaccination-related information, while most participants reported that they did not trust social media for vaccine-related information.

Knowledge score demonstrated a moderate positive correlation with willingness to receive future vaccination ($r = 0.506$, $P < 0.001$). This finding indicates that participants with higher vaccination-related knowledge reported greater willingness to receive future vaccines. This may be because greater knowledge about vaccination can allow individuals to better understand the safety, benefits, risks, mechanisms, and potential side effects of vaccines, enabling them to make more informed decisions regarding vaccination. However, despite the positive association between knowledge and willingness, several gaps in vaccination-related knowledge were observed among participants, particularly regarding herd immunity, vaccine side effects, and the mechanism of mRNA vaccines. There is a specific knowledge gap among the participants regarding mRNA vaccines and the side effects of vaccination which show that there is anxiety about safety and misapprehensions are the major factors for hesitancy.

Similar literacy challenges were shown in Chinese college students who displayed a weak judgement when evaluating health information which were complex. (7)

Prior health behaviour was one of the strongest predictors of future action as students who accepted past vaccines and boosters had increased willingness to take future vaccines as they have already overcome initial hesitation and have a better understanding of the working and safety of vaccines. This reinforces a broader survey data that indicates that willingness to vaccinate is strongly tied to past engagement, family support and positive health attitudes (1,7)..

A substantial proportion of students exhibited uncertainty regarding modern vaccine platforms, with 69.3% reporting that they did not know how mRNA vaccines function and 56.0% uncertain whether mRNA vaccines alter human DNA. Fundamental epidemiological and clinical concepts also demonstrated notable knowledge gaps; 41.3% of participants were unsure of the definition of herd immunity, and 48.0% were uncertain whether vaccine side effects occur less frequently than disease-related complications. Hence this knowledge gap can prominently affect willingness to vaccinate.

Participants demonstrated a distinct reliance on authoritative clinical and familiar figures over digital media channels. The vast majority relied primarily on healthcare professionals (88.0%) and parents or family members (66.7%) for vaccine guidance, whereas 64.0% explicitly reported a lack of trust in social media platforms. Despite students' reliance on professional advice and emerging health literacy, decision-making authority remained heavily centralized within the household, with parents or guardians determining vaccination status for 78.7% of respondents. This data reflects a pattern seen in the European school study where household support directly influences the youth attitudes and decisions regarding vaccination.

V. CONCLUSION:

This study examined the relationship between vaccination literacy, attitudes toward vaccination, and

willingness to receive future vaccines among high school students. The findings showed that higher vaccination-related knowledge was associated with greater willingness to receive future vaccines. Vaccination attitudes were also positively correlated with willingness; however, attitude score was not independently significant after adjustment for other variables. Students who had received all recommended COVID-19 vaccine doses, including booster doses, showed greater willingness to receive future vaccines than students who had not received any doses.

Although participants generally demonstrated positive attitudes toward vaccination and considered vaccines important for protecting their families, knowledge gaps remained regarding herd immunity, mRNA vaccines, vaccine side effects, and vaccination for people with weakened immune systems. Safety and side effects were the most common concerns reported by participants. Doctors, hospitals, and family members were the main sources of vaccination information, and most participants did not trust social media for vaccine-related information.

These findings suggest that improving vaccination literacy through clear, age-appropriate, and reliable health education in schools may support willingness to receive future vaccines among students. Schools, healthcare professionals, and parents may play an important role in providing trustworthy information about vaccine safety, benefits, side effects, and newer vaccine technologies. However, because this study used a small convenience sample recruited from the researcher's school and outside-school networks, the findings may not be generalisable to all high school students in Chennai. Further research involving larger and more diverse student populations is needed to confirm these findings.

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