ARTICLE

Covid-19 hesitancy among adolescents: a systematic review

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OBJECTIVE: Vaccine hesitancy has been a public health issue for some time now, but gained more attention during COVID-19 pandemic. This systematic review aimed to estimate the prevalence of COVID-19 vaccination hesitancy and identify factors affecting it among adolescents.

MATERIALS AND METHODS: The preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P 2020) was used. A search was performed in PubMed/ MEDLINE, EMBASE, Google Scholar, Herdin, and Cochrane databases on September 2023 using the key words: (COVID-19 OR SARS-COV OR corona virus) AND (Vaccination OR immunization) AND (adolescence OR teenagers OR youth) AND (hesitancy OR acceptance). Observational studies which determined the prevalence or risk factors for COVID-19 vaccine hesitancy among adolescents aged 10-19 years old were included.

RESULTS: There were 5 good quality cross-sectional studies included. The prevalence of adolescents who did not want to be vaccinated ranged between 8.4% and 61.0%; while the prevalence of being unsure if they want to be vaccinated was between 31.6% and 88.0%. Factors associated with vaccine hesitancy included being economically disadvantaged, not having influenza vaccination, worrying about its effectiveness and safety, and low perceived necessity.

CONCLUSION: There is good quality evidence that COVID-19 vaccine hesitancy exists among adolescents. It is recommended that health workers should conduct information and education campaigns to iterate the effectiveness, safety, and misconceptions about of COVID-19 vaccination. Vaccination programs should also reach out to economically disadvantaged adolescents, and tapping parents and social media may be an effective strategy to improve vaccination acceptance among adolescents.

KEYWORDS: *COVID-19, SARS-COV, Corona virus, Vaccination, Immunization, Adolescence, Teenagers, Youth, Hesitance, Acceptance.*

INTRODUCTION

The severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) has caused a devastating global disease impact, with over 760 million confirmed cases and 6.9 million fatalities by the end of July 2023.[1,2] In the Philippines, around 4.1 million confirmed cases and 66,000 deaths were reported.[3] Around 72% of people worldwide received at least one dose of the COVID-19 vaccine, but only 67% are fully immunized.[4] Vaccine hesitancy, a reluctance to receive vaccination, is a serious public health concern that inhibits herd immunity.[5-7] Age was identified as one of the reliable predictors of vaccine hesitancy.[8-11] Given that between 9 and 10% of Filipinos are between the ages of 10 and 19,[12] it is crucial to vaccinate this age group in order to increase population immunity. This study's findings could guide decisions on COVID-19 vaccinations, particularly in adolescents, and serve as a foundation for future research and emergency preparedness. Also, this study may serve as a basis of knowledge for future research and emergency preparedness.

Vaccination is the most important mitigation plan, cost-efficient and effective in preventing spread of COVID-19. As vaccines become more available, widespread immunization of adolescents is needed to reduce the illness burden and the likelihood of novel variant creation.[13,14] Vaccine hesitancy is a significant obstacle to vaccine uptake, influenced by factors such as complacency, convenience, and confidence.[5,15] Adolescents are more likely to be overconfident and relaxed, leading them to underestimate the dangers of the disease.[16-18] They may also experience psychological distress due to the outbreak, which could lead to less confidence in the safety and effectiveness of the vaccine.[19,20] Statistics show that only 52% of unvaccinated adolescents aged 13 to 17 years would definitely or probably receive a COVID-19 vaccine.[21] Reasons for hesitation include concerns about effectiveness, safety, side effects, lack of trust in medical professionals, conspiracies, and the perception that natural immunity is a better option. To develop specialized approaches for promoting immunization among adolescents and lowering vaccine hesitancy, these factors should be considered.[13]

The general objective of this study is to determine the prevalence of COVID-19 vaccine hesitancy and identify factors affecting it among adolescents by synthesizing available published evidence. Specific objectives are to determine the prevalence of COVID-19 vaccine hesitancy among adolescents globally and in Asian countries and to determine if demographic factors, clinical factors, parental factors, or socio-cultural influence COVID-19 vaccine hesitancy among adolescents.

METHODOLOGY

The preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P 2020) declaration was used to create this study.

A. Eligibility criteria:

Observational studies (Cohort, cross-sectional, case-control, previous systematic reviews) which determined the prevalence or risk factors for COVID-19 vaccine hesitancy among adolescents aged 10 -19 years old. case series, case reports, posters, and conference abstracts will be excluded. Only studies written in the English language were used. Studies with no clearly reported outcomes were excluded as well.

The study population included adolescents (10-19 years old). To be excluded were patients with a history of allergy or adverse reaction to any type of COVID-19 vaccination. Outcome of interest is vaccine hesitancy defined as delay in acceptance, or refusal, of vaccines despite the availability of vaccine services

B. Information sources and search strategy

A search was performed in PubMed/ MEDLINE, EMBASE, Google Scholar, Herdin, and Cochrane databases in September 2023. Hand-searching of printed journals was not conducted.

The search terms used included: (COVID -19 OR SARS-COV OR corona virus) AND (Vaccination OR immunization) AND (adolescence OR teenagers OR youth) AND (hesitancy OR acceptance). Duplicate articles were removed and additional relevant articles were identified by scanning the reference lists of articles found from the original search.

C. Definition of procedures

Full-text articles for potential inclusion were saved in a Google drive. Extracted data were managed using Microsoft Word. Investigator independently scanned the titles and abstracts found using the search approach described above. Papers by the same author were compared to reduce data duplication caused by duplicate reporting. The full-text articles were obtained for reports that were considered to be eligible based on the title or abstract. Full-text copies of potentially relevant papers selected were retrieved and reviewed. Articles that met the inclusion requirements were evaluated. Following the PRISMA 2020 criteria, a flow diagram for the search and selection process was created (Figure 1).

Study name (along with first author's name and year of publication), country where the study was conducted, source from which patients or study participants were selected, study design, outcomes, study strengths, and limitations were all extracted using a standardized extraction form. To ensure the correctness and consistency of the extracted data, the data extraction forms were cross-checked.

D. Data Synthesis/Analysis

Information from the studies were consolidated through a narrative review by detailing individual study characteristics and conclusions, as well as analyzing possible hypotheses to explain the factors affecting vaccine hesitancy among adolescents.

RESULT

A total of 506 articles were identified during the database search. Non- duplicate titles and abstracts were screened, and 7 articles were identified for potential inclusion. After full-text selection, 2 were further excluded because they were conducted among parents of adolescents. A total of 5 studies were finally included in this meta-analysis.

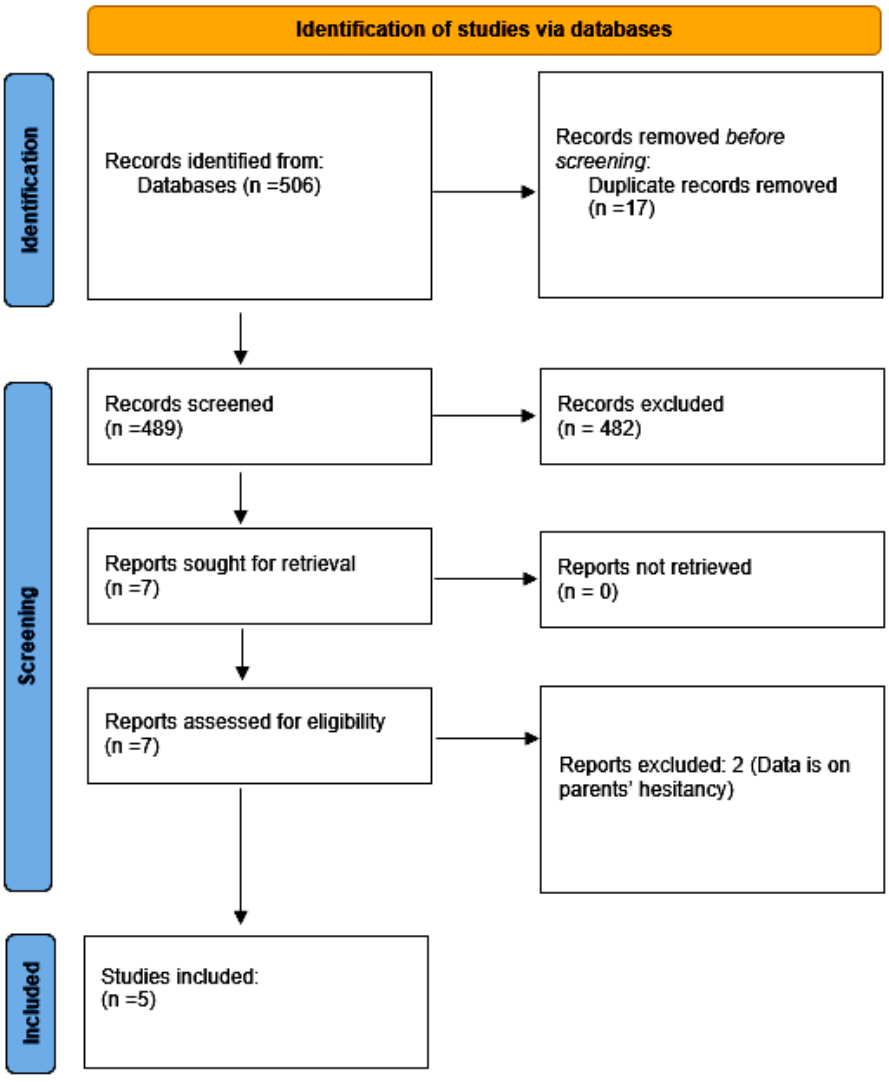

Figure 1. PRISMA Flow Diagram of the Research Study

Table 1. Characteristics of studies included in the study

Author, year	Country	Study Design	Sample size	Sex ratio and age range	Prevalence of vaccine hesitancy	Factors associated with hesitancy
Fazel, 2021[22]	United Kingdom	Cross-sectional	27,910	M:F=43:52, 10 to 18 years	37% were undecided while 13% did not want to get vaccinated	Factors related to hesitancy: Economically disadvantaged Smokers Spends more time on social media
Rehati, 2022[23]	China	Cross-sectional	9153	M:F=50:50, 12 to 17.5 years	765 (8.4%) were not willing to get vaccinated while 2891 (31.6%) were not sure about the vaccination	Factors related to hesitancy: Female sex Concerns on price No prior influenza vaccine Factors that promote willingness: Fear of transmission Perceived effectiveness Perceived convenience
Wang, 2022[24]	Africa	Cross-sectional	2662	M:F=47:53, 10 to 19 years	Vaccine hesitancy was 14% in rural Kersa, 23% in rural Ibadan, 31% in rural Nouna, 32% in urban Ouagadougou, 37% in urban Addis Ababa, 48% in rural Kintampo, 65% in urban Lagos, 76% in urban Dar es Salaam, and 88% in rural	Factors related to hesitancy: Perceived low necessity Concerns on safety Concerns on effectiveness Factors that promote willingness: Health workers, parents, teachers' recommendation

Wong, 2022[25]	Hong Kong	Cross-sectional	2609	M:F=55:45, 12 to 18 years	61.4% do not plan to receive vaccination	Factors related to hesitancy: Concerns on safety Concerns on effectiveness Factors that promote willingness: Having at least one parent vaccinated Knowing somebody diagnosed with COVID-19 Receiving the influenza vaccine Fear of transmission
Zhang, 2022[26]	China	Cross-sectional	1009	M:F=40:60, 17 to 19 years	Vaccine hesitancy is as much as 16.5%	Factors related to hesitancy: History of physical disease Maladaptive health behavior Concerns on safety Perceived low risk for transmission Factors that promote willingness: Perceived effectiveness Perceived safety

As seen in Table 1, three studies were from Asia and one each from UK and Africa. All studies were cross-sectional surveys with large sample size. The age range was 10-19 years old. Table 2 shows that all studies were of good quality with minimal risk for bias.

Table 2. Study Quality

Author, Year	Selection	Sample size	Validity of survey tool	Outcome	Overall
Fazel, 2021[22]	Truly repre-sentative	Large (≥400)	Validated tool	Self report, multi-variate analysis	4/5 (Good)
Rehati, 2022[23]	Truly repre-sentative	Large (≥400)	Large (≥400)	Self report, multi-variate analysis	4/5 (Good)
Wang, 2022[24]	Truly repre-sentative	Large (≥400)	Large (≥400)	Self report, multi-variate analysis	4/5 (Good)
Wong, 2022[25]	Truly repre-sentative	Large (≥400)	Large (≥400)	Self report, multi-variate analysis	4/5 (Good)
Zhang, 2022[26]	Truly repre-sentative	Large (≥400)	Large (≥400)	Self report, multi-variate analysis	4/5 (Good)

Prevalence of hesitancy

There were 5 cross-sectional surveys, 4 published in 2022 and 1 published in 2021, included in this systematic review. A school-based survey was done across the 4 counties of England from 14 May to 21 July 2021 to determine the willingness to receive the COVID-19 immunization in the study of Fazel et al. (2021).[22] The survey was self-reported by 27,910 students (ranging in age from 9 to 18) from 180 different schools. According to the results, 13984 (50.1%) students would choose to receive a vaccination, 10322 (37.0%) were unsure, and 3604 (12.9%) would choose not to. [22]

In the study by Rehati et al. (2022),[23] 9153 students (mean age 14.2 years) in four Chinese cities responded to a survey from 8 to 30 December 2020 to provide information regarding their concerns about receiving the COVID-19 vaccination. The findings revealed that 765 (8.4%) people were opposed to vaccination while 2891 (31.6%) were hesitant.[23]

Wang et al. (2022)[24] conducted a survey using computer-assisted telephone interviewing among adolescents in five sub-Saharan African nations (Burkina Faso, Ethiopia, Ghana, Nigeria, and Tanzania), wherein a rural area and an urban area were included in each country (except Ghana, which only had a rural area) with roughly 300 adolescents (age 10-19 years) in each area and 2662 in total, between July and December 2021. The percentage of vaccine hesitancy against COVID-19 was in rural Kersa, it was 14%; in rural Ibadan, 23%; in rural Nouna, 31%; in urban Ouagadougou, 32%; in urban Addis Abeba, 37%; in rural Kintampo, 48%; in urban Lagos, 65%; in urban Dar es Salaam, 76%; and in rural Dodoma, 88%. [24]

The attitudes of adolescents in Hong Kong concerning the COVID-19 immunization are examined in survey study conducted by Wong et al. (2022).[25] Online surveys on vaccination intentions and reasons were completed by 2609 adolescents (aged 12–18 years) from all throughout Hong Kong before 31 June 2021. A total of 61% (n=1602) of adolescents did not plan to get the COVID-19 immunization.[25]

Likewise, Zhang et al. (2022)[26] conducted an online survey between 14 March 14 and 15 April 2021 among older adolescents (16–17 years old) and young adults (18–21 years old), for a total of 2,414 respondents. The findings revealed that older adolescents had greater prevalence rates of COVID-19 vaccine hesitancy than young adults (16.5 vs. 7.9%, p<0.001). [26]

Factors associated with vaccine hesitancy

In the study of Fazel et al. (2021), students who were 'opt-out' or 'undecided' were more likely to originate from disadvantaged socioeconomic situations with higher percentages of house renting than home ownership (opt-out: OR=1.84, 95% CI 1.61-2.11, p<0.001; undecided: OR=1.53, 95%CI 1.39-1.69, p<0.001), and their school locations were more likely to be in areas of greater deprivation (opt-out: OR=2.06, 95% CI 1.77-2.4, p=<0.001; undecided: OR=1.60, 95%CI 1.44-1.77, p<0.001). They also reported lower levels of anxiety and depression (opt=out: OR=0.81, 95% CI 0.74-0.88, p<0.001; undecided: OR=0.85, 95% CI 0.8-0.9, p<0.001), were more likely to smoke or vape (opt-out: OR=1.71, 95% CI 1.34-2.17, p<0.001; undecided: OR=1.56, 95%CI 1.3-1.87, p<0.001), spend more time on social media (opt=out: OR=1.51, 95% CI 1.33-1.72, p<0.001; undecided: OR=1.49, 95% CI 1.36-1.63, p<0.001), and feel like outsiders in their educational environment (opt-out: OR=1.16, 95%CI 1.11-1.2, p<0.001; undecided: OR=1.10, 95% 1.07-1.14, p<0.001).[22]

In the study by Rehati et al. (2022), the following were associated to vaccine resistance and vaccine hesitancy: not having received an influenza vaccination before (OR=1.33, 95% CI 1.14-1.55; OR=1.57, 95% CI 1.25-1.98), no perceived susceptibility (OR=1.72, 95% CI 1.50-1.97; OR=3.57, 95% CI 2.86-4.46), and perceived no cues to action (OR=3.24, 95% CI 2.56–4.11; OR=27.68, 95% CI 21.81–35.13). Girls (OR= 1.21, 95% CI 1.09-1.36) had higher risk, while students who boarded at school (OR=0.79, 95% CI 0.68-0.92), had easy access to vaccines (OR=0.84, 95% CI 0.73-0.96), and had doctors' recommendations (OR=0.86, 95% CI 0.76-0.98) had lower risk of vaccine hesitancy. The study's findings concluded that a lack of health literacy and a lack of risk awareness were associate with students' hesitation to be immunized in China.[23]

Wang et al. (2022) reported that the three main causes of hesitation were perceived low necessity (46.70%),

safety worries (45.00%), and vaccine effectiveness worries (11.20%). The three groups with the highest effects on vaccine acceptance were healthcare professionals, parents or other family members, and instructors. Greater vaccine reluctance was associated with perceived lack of safety (aPR: 3.52; 95% CI: 3.00, 4.13) and lack of effectiveness (aPR: 3.46; 95% CI: 2.97, 4.03).[24]

In the study by Wong et al. (2022), having at least one immunized parent (OR=5.02. 95%CI 4.2–5.99) knowing someone who had the disease (OR=2.098, 95% CI 1.20–3.66), and getting the flu shot (OR=1.64, 95% CI 1.36–1.99) were all significant ($p<0.001$) factors in their decision to receive vaccination. The safety (79%) and effectiveness (52%) of the vaccine or the risk of infection were the main worries of adolescents.[25]

Likewise, Zhang et al. (2022) revealed that a history of physical disorders (OR=2.58, 95%CI 1.30-5.15, p=0.007) and atypical sickness behavior (OR=1.17, 95% CI 1.07-1.28, p=0.001) were risk factors for hesitancy in older adolescents. The most common justifications for vaccine hesitancy were worries about the side effects of the COVID-19 vaccine (67.1%) and the notion that one is immune to infection risk (41.9%). The best arguments for vaccination promotion included evidence that the vaccine reduces the risk of contracting COVID-19 (67.5%), assurances of vaccine safety (56.7%), and the low likelihood of adverse reactions (52.7%).

Discussion

The COVID-19 vaccination is an essential strategy to continuously reduce the spread of the disease and the cost it places on society. It also serves to lessen the possibility of the formation of new variants that may cause another health scare to people. However, vaccine hesitancy has gained more global attention because of COVID-19 vaccination and has put the COVID-19 vaccination efforts under pressure. The WHO has identified vaccine hesitancy as one of the top 10 concerns for 2019.[6,27] During adolescence, boys and girls start to make important decisions regarding their health wherein they also form attitudes and behaviors that they will carry into adulthood. To design specialized interventions to encourage immunization against COVID-19, it is important to thoroughly understand and take into account their issues and concerns with regard to vaccination against COVID-19.

Only one study[23] showed that the female sex was more associated with higher vaccine hesitancy, which was consistent with earlier studies.[28-30] This may be partially attributed to the false information spreading on social media regarding the COVID-19 vaccine impairing fertility, but more research is required to validate this. This may also be related females having a lower willingness to

to take risks than boys do (viewing getting the COVID-19 vaccine as a risky behavior).[31]

One study[22] indicated that adolescents who were hesitant to receive COVID-19 vaccination were more likely to engage in unhealthy behaviors, such as more smoking and vaping, and spend more time on social media, and they were also less socially connected and less inclined to identify with their school. Also, those who had disadvantaged socioeconomic status were associated with higher hesitancy. With 1.2 billion adolescents aged 10 to 19 in the world today, adolescents represent a significant demographic group.[32] The majority of adolescents live in environments with less access to resources. Given the distribution and acceptance of vaccination in contexts with limited resources, addressing teenage COVID -19 immunization must take into account resource implications as well as questions of equity, justice, and prioritization of certain demographic groups.[33] Furthermore, given how much time adolescents spend on social media, this platform appears essential for attempting to raise vaccine awareness and understanding.[22]

Adolescents having a parent who had received an influenza vaccination were more receptive to receiving the COVID-19 vaccine, as seen in 2 studies.[23,25] Knowing the advantages of getting vaccinated against influenza will help one understand how COVID-19 and other respiratory viral illnesses can be prevented.[34] Prior influenza vaccination experience is related to increased COVID-19 vaccine uptake.[10] The promotion of the influenza vaccine may improve the likelihood that adolescents will take the COVID-19 vaccination,[35] implying that influenza vaccine initiatives may also increase adolescent's willingness to receive the COVID-19 vaccination.

Another favorable predictor of future immunization is the self-perception of a high risk of contracting a serious COVID-19 infection.[36] Adolescents who do not perceive necessity to get the vaccine because of its nonsignificant connection to their health were more likely to exhibit vaccine resistance or hesitancy.[23,24,26] The main causes of vaccine hesitancy were a lack of information and awareness of vaccination as well as a lack of understanding of its relevance, according to a WHO/UNICEF joint report utilizing 2015-2017 data.[37] Additionally, compared to those who are eager to obtain a vaccine, vaccine-resistant individuals have been exposed to much less information about COVID-19 from the public media.[38] According to Health Belief Model, signals that can affect behavior and aid in the prevention of COVID-19 through a rise in vaccination uptake include early content education, addressing previous symptoms or concerns, and obtaining accurate information from the media.[23]

On the other hand, one study[26] showed that history of physical illnesses and atypical sickness behavior were associated with higher

vaccination hesitancy. When patients with a history of physical illnesses consider getting the COVID-19 vaccine, one of their main worries is whether the vaccine may make their pre-existing illnesses worse or cause them to repeat. On the other hand, people who exhibit abnormal disease behaviors show improper reactions in their capacity to assess and respond to their symptoms. When seeking professional assistance, these people frequently display excessive physical worry and hypochondriacal beliefs, which could hinder the development of a trusting connection.[38-40]

Greater vaccination hesitation is highly predicted with perceived inefficacy and lack of safety. These results are consistent with earlier research among adults in high- and low- and middle-income contexts.[41-43] Therefore, to increase the number of adolescents who receive the COVID-19 vaccine, public health campaigns should emphasize that the shots are both safe for adolescents and offer protection from COVID -19 infections.[44]

No single strategy can fully address the problem of vaccine hesitancy due to the diversity of causes causing COVID-19 vaccination resistance.[45-47] The significance of having reliable sources deliver this information in a widely accepted and approachable style is emphasized. It is worthwhile to increase knowledge of the value, safety, and effectiveness of COVID-19 vaccinations among adolescents. Additionally, schools should think about include the function, evolution, and impacts of vaccinations as a subject to be covered in both primary and secondary school curricula.[15] Health professionals were identified as the most reliable providers of information regarding the COVID-19 vaccine,[16,17] which is consistent with previous global surveys of the general public.[50] Wang et al. (2022) also identified parents, instructors as important people who can influence vaccine acceptance or hesitancy among adolescents.[24] Therefore, efforts are required to promote vaccine acceptance among healthcare personnel and adult community members. Increased social support from family, friends, professionals in the medical field, and public health authorities would also help to reduce vaccine reluctance and encourage vaccine acceptance[46,47]. Healthcare workers, parents, schoolteachers, and peers should be used as advocates for COVID-19 vaccines.

There is good quality evidence that COVID-19 vaccine hesitancy exists among adolescents. Health workers should conduct information and education campaigns to iterate the effectiveness and safety of vaccination against COVID-19 and correct misconceptions that it is not necessary. Vaccination programs should also reach out to economically disadvantaged adolescents to ensure their participation. Tapping parents and social media may also be a strategy to improve vaccination acceptance among adolescents.

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