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Public attitudes and influencing factors toward COVID-19 vaccination for adolescents/children: a scoping review

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Abstract

Objective: This study aimed to systematically clarify attitudes and influencing factors of the public toward COVID-19 vaccination for children or adolescents.

Methods: This scoping review screened, included, sorted, and analyzed relevant studies on COVID-19 vaccination for children or adolescents before December 31, 2021, in databases, including PubMed, Elsevier, Web of Science, Cochrane Library, and Wiley.

Results: A total of 34 studies were included. The results showed that the public’s acceptance rate toward COVID-19 vaccination for children or adolescents ranged from 4.9% (southeast Nigerian mothers) to 91% (Brazilian parents). Parents’ or adolescents’ age, gender, education level, and cognition and behavior characteristics for the vaccines were the central factors affecting vaccination. The vaccine’s safety, effectiveness, and potential side-effects were the main reasons affecting vaccination.

Conclusions: Realizing current public attitudes of COVID-19 vaccination for adolescents or children can effectively develop intervention measures and control the pandemic as soon as possible through herd immunity.

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Introduction

The COVID-191 is a new strain of coronavirus called as a severe acute respiratory syndrome coronavirus (SARS-CoV-2) or COVID-19. COVID-19 was first discovered and widely spread in Wuhan, China, in December 2019. So far, the global COVID-19 pandemic has been complex.2 COVID-19 adapts to new human hosts and produces mutant individuals with different characteristics from their ancestral strains, such as Alpha (B.1.1.7), Delta (B.1.617.2), etc.3 These mutant individuals continue to cause damage and waves of pandemic around the world. All by August 2021,4 persistent COVID-19 pandemic has generated more than 4,500,000 deaths worldwide. Since the first pandemic spread, experts have always stressed the importance of personal protective measures (e.g. home quarantine, wear masks, and disinfecting).5 However, in essence, these physical protective measures cannot eliminate the virus and restore people’s everyday life. Similarly, it is also impossible for the public to abide by protective measures for many years.

Herd immunity6,7 is an important measure to control the pandemic situation as soon as possible from protecting susceptible individuals through a significant enough immune individual in the group. The COVID-19 vaccines’ development and application may be the effective roads to curb the pandemic spread and then realize herd immunity.6 As we know, the Pfizer-BioNTech COVID-19 vaccine was emergently approved and put into use in the United States on December 11, 2020. After that, a variety of vaccines with reasonable safety and effectiveness (Oxford-AstraZeneca, Moderna’s mRNA-1273, Sinovac’s CoronaVac, etc.) displayed a fantastic speed of research and development. All by January 2022,8 nearly 134 vaccines remain in clinical development. Existing studies reported that the messenger RNA vaccine (specifically reference Pfizer-BioNTech COVID-19) showed excellent reliability to reach the global vaccine demand against COVID-19.9 Even so, we found that adults varied degrees of hesitation about the vaccine, and the acceptance rate ranged from 29.4% to 86% in COVID-19 vaccination studies over the past few months.10 The majority of people hesitated because of COVID-19 vaccines’ safety
and side-effects, which remains a principal problem for children. Today, lots of evidence about the vaccines’ safety and effectiveness among children is provided, and Food and Drug Administration (FDA) urgently approved Pfizer-BioNTech COVID-19 vaccines for application among adolescents on May 10, 2021, and among children aged 5–11 years on October 29, 2021. Experts have repeatedly stressed that child protection remains the key to reducing infection rates. Once a vaccine is available, vaccinating young people and children is necessary. However, there was no high acceptance rate in Pan’s report. Most parents were skeptical and unwilling to receive emergency-approved vaccines. With the continuous fermentation of COVID-19 pandemic, the pace of vaccine development has also increased, appearing the new progress in public willingness to vaccinate children.

Until now, COVID-19 vaccination remains essential for achieving herd immunization to reduce the pandemic burden. Vaccination hesitancy has been identified as a significant public health crisis. Whereas, we conducted a rapidly scoping review for the latest studies in recent months to clarify the public (including adults, parents, and adolescents themselves) attitudes and influencing factors toward COVID-19 vaccination for adolescents or children and provide information or advice for public institutions to better implement immunization plans. Considering the vaccines’ rapid development and application, we mainly included studies after Pfizer-BioNTech COVID-19 vaccine first emergency approval among adults to present the latest views.

Methods

Protocol and registration

We conducted a scoping review according to PRISMA Extension for Scoping Reviews (PRISMA-ScR) [supplementary documents]. Furthermore, we preregistered on OSF Registries (osf.io/qw985). The study’s questions are as follows:

1. What are the public attitudes toward COVID-19 vaccination approval among adults? Is there any difference between before and after approval COVID-19 vaccination for adolescents?
2. What are the influencing factors about COVID-19 vaccination for adolescents or children?

Information sources

We searched databases including PubMed, Wiley, Web of Science, Elsevier, and Cochrane Library to obtain relevant literature about the public attitudes toward COVID-19 vaccines for adolescents or children before December 31, 2021. Moreover, we searched the reference list of the included literature to find missed literature. The search strategy of Web of Science is as follows:

TS=((Corona OR “SARS-CoV-2” OR “COVID 19” OR 2019 nCoV) AND (vaccine OR vaccination) AND (children OR kid OR teen OR juvenile OR teenagers OR adolescent OR youth) AND (hesitancy OR accept OR demand OR willingness OR antivaccine OR anti-vaccine OR reject OR rejection OR resistance OR refuse OR refusal))

Study selection

We imported retrieved literature into Endnote 9.1 and removed the duplicate; two researchers screened the title and abstract according to the principle of PICOs (P: participants; I: intervention; C: control; O: outcome; s: study design) and cross-checked. After initial screening, we downloaded full texts. Two researchers read full texts for rescreening, and the third researcher decided on conflicts.

Eligibility criteria

Included studies were produced since 2021, only in English. The study population consisted of adults aged >18 years, adolescents, children, and parents (grandparents and other guardians were defined as parents in this study). Articles with incomplete or incorrect content, repeated data studies, commentary studies, and letters to editors without data were excluded to improve the included literature’s quality.

Data charting process

We extracted relevant data through Excel (Microsoft Corporation), including the study’s first author, study setting, study time, country, recruitment, study population, sample size, children or adolescents’ age, COVID-19 vaccination acceptance rate, and subjective reasons or related factors associated with vaccination.

Collate, summarize of results

According to the extracted content, study characteristics and influencing factors toward COVID-19 vaccines were presented in tables to clarify this scoping review’s subject. In addition, the figures described influencing factors of high frequency.

Results

Selection of sources of evidence

According to the literature screening flowchart shown in Fig 1, 34 studies were finally included. After removing the dropout and loss of follow-up caused by various reasons, 85,608 subjects (54,703 parents and adults, 30,905 adolescents) were left.

Study characteristics

All included studies described survey methods and outcome indicators in detail. Table 1 shows the primary characteristics. There were 33 cross-sectional surveys and one cross-sectional survey combined with semistructured interviews. Most studies were online surveys; only seven studies completed questionnaires by face-to-face or paper. All study populations were from one country; 15 of these studies were based on data from Asia, one from Africa, seven from North America, one from South America, seven from Europe, two from Oceania, and one from the Eurasian continent.

In terms of study time, 20 studies were collected after commencing the national childhood COVID-19 vaccination program, and the data of adolescents came from these. The recruitment methods are briefly described as follows: five studies used convenient sampling, two studies included data from representative regions, two studies used purposive sampling, two studies used non-probability quota-based sampling, three studies used snowball sampling, four studies used random sampling, one study was cluster...
sampling, populations of five studies \cite{21,34,40,43,50} were from participant pool or other registered research centers/database, seven studies \cite{24,26,30,33,41,42} were recruited through online platforms (via Facebook, WhatsApp, mail, Wen-Juan-Xin, etc.) or visits, and three studies \cite{46,48,49} did not mention specific recruitment methods.

Public attitudes toward COVID-19 vaccination for adolescents or children

All studies reported the acceptance rate of vaccination for children in the study population. One study \cite{44} reported parents’ and adolescents’ acceptance rates (we separately analyzed the data), and one study \cite{31} reported three child age levels’ acceptance rates (we selected the median of the three for analysis). The acceptance rate ranged from 4.9% (southeast Nigerian mothers) to 91.0% (Brazilian parents), and the median acceptance rate was 53.70% (47.60%, 70.40%). As a reference, the median acceptance rate of 28 studies reported adults’ or parents’ attitudes was 60.20% (46.78%, 70.03%) and seven studies reported by adolescents was 50.40% (49.60%, 72.10%). At the same time, we analyzed the data before and after the commencement of the national adolescent’s COVID-19 vaccination program. The median before the approval was 49.43% (43.55%, 60.78%), and the median after the approval was 64.20% (48.95%, 80.20%). Even if the data have high heterogeneity, it can provide a reference in this study.

Influencing factors toward COVID-19 vaccination for adolescents or children

According to the studies reported, we summarized and charted the influencing factors of acceptance and hesitation for COVID-19 vaccine among the study population, divided into related factors (single factors or multifactor statistical analysis; Table 2) and related reasons (qualitative data; Table 2). Meanwhile, we summarized high-frequency factors and reasons as shown in Figs. 2 and 3.

Sociodemographic or personal characteristics

Twenty-four studies depicted sociodemographic or personal characteristics in vaccination attitudes for adolescents or children (Table 2). Female, \cite{27,28,33,43,49} low household income, \cite{28,32,34,39,43,45,49} parents with lower educational level, \cite{21,28,32,34} and non-native \cite{27,39,40} were more likely to hesitate, whereas older parents \cite{17,30,38} and children \cite{25,30,36,38} were associated with vaccination acceptance. Similarly, parents who worked for health care were associated with vaccination for children, \cite{25,30,36,38} and freelance \cite{34} or part-time jobs \cite{20} parents were more hesitant about vaccination; Asian parents \cite{28} and adolescents \cite{47} were more likely to vaccination. In addition, other factors such as the number of children, \cite{32,36,37} children who attended in-person school or daycare, \cite{22} and rural residence \cite{46} were related factors affecting children’s vaccination. Adolescents with remote, poor schools,
| First author | Study setting | Recruitment | Study time | Country | Study population | Sample size | Age of the child (year) | Acceptance rate |
|--------------|---------------|-------------|------------|---------|------------------|-------------|------------------------|----------------|
| Bader A. Altulaihi | A cross-sectional, paper questionnaire | Convenience sampling | After adult approval | Saudi Arabia | Parents | 333 | ≤18 | 53.70% |
| Awoere T. Chinawa | A cross-sectional, face-to-face survey | Simple random sampling in hospital | After adult approval | Southeast Nigeria | Mothers | 577 | Baby | 4.90% |
| Kristine M. Ruggiero | A cross-sectional, online survey | Snowball sampling | November 2020 to January 2021 | The United States | Parents | 427 | ≤18 | 49.45% |
| Robin M. Humble | A cross-sectional, online survey | Representatively sampling survey | December 10 to 24 2020 | Canada | Parents | 1702 | 0–17 | 63.10% |
| Marco Montalti | A cross-sectional, online survey | Personnel of the local public health service | December 2020 to January 2021 | Italy | Parents | 4993 | ≤18 | 60.40% |
| Xiao Wan | A cross-sectional, paper questionnaire | Two-stage stratified random sampling | December 2020 to February 2021 | Korea | Parents | 468 | 3–6 | 86.75% |
| Haifa Aldakhil | A cross-sectional, face-to-face survey | Non-probability purposive sampling | January to February 2021 | Saudi Arabia | Mothers | 270 | ≤7 | 43.77% |
| S. Evans | A cross-sectional, online survey, and open interview | Via paid and unpaid social media advertisements | January to February 2021 | Australia | Parents | 1094 | ≤18 | 48.30% |
| Meltem Yılmaz | A cross-sectional, online survey | Via Facebook, WhatsApp, and mail groups | February 2021 | Turkey | Parents | 1035 | ≤17 | 36.30% |
| Nuno Fernandes | A cross-sectional, online survey | Institutional email and online social networks (e.g. Facebook) | January to March 2021 | Portugal | Adults and parents | 649 | – | 60.00% |
| Chloe A. Teasdale | A cross-sectional, online survey | Non-probability quota-based sampling | March to April 2021 | The United States | Parents | 1119 | 4.7 (2.0, 8.5) | 61.90% |
| Takeshi Yoda | A cross-sectional, online survey | Non-probability quota-based sampling | March to April 2021 | The United States | Parents | 2074 | ≤12 | 49.40% |
| Mateusz Babicki | A cross-sectional, online survey | Purposive sampling | April 2021 | Japan | Parents | 1100 | 0–15 | 42.90% |
| Pierre Verger | A cross-sectional, online survey | Via Facebook.com social network, promoting and disseminating in groups | May 2021 | Poland | Parents | 4432 | ≤18 | 44.10% |
| Leonardo Evangelista Bagatellii | A cross-sectional, face-to-face survey | Convenient sampling in hospital | May to June 2021 | Brazil | Parents | 501 | ≤17 | 62.70% for adolescents; 48.30% for school children; 30.90% for preschoolers |
| Mei-Xian Zhang | A cross-sectional, online survey | Wen-Juan-Xing platform without random | June 2021 | China | Parents | 1788 | 13.7 ± 3.2 | 46.50% |
| Stefano Zona | A cross-sectional, online survey | The Crowd Signal platform | July to August 2021 | Italy | Parents | 1799 | 12–17 | 26.50% |
| Jian Wu | A cross-sectional, online survey | Snowball sampling | August 2021 | China | Parents or grandparents | 16,133 | 3–18 | 82.61% |
| Yunyun Xu | A cross-sectional, online survey | Cluster sampling | July to August 2021 | China | Parents | 917 | – | 68.90% |
| Mohammed Samannodi | A cross-sectional, online survey | Convenience sampling | June to July 2021 | Saudi Arabia | Parents | 581 | 0–17 | 63.90% |
| Mohamad-Hani Temsah | A cross-sectional, online survey | Snowball sampling | After adolescent approval | Saudi Arabia | Parents | 3167 | ≤18 | 47.60% |
| Britt McKinnon | A cross-sectional, online survey | Representative sampling survey | May to June 2021 | Canada | Parents | 809 | 2–17 | 87.60% |
| Sarah Musa | A cross-sectional, online survey | A database of adolescents | May to June 2021 | Qatar | Parents | 4023 | 13.4 ± 1.1 | 82.10% |
smoking, and time in media or television were associated with vaccine hesitation.

**Cognition and behavior characteristics for the vaccines**

Twenty-five studies depicted the cognition and behavior characteristics for the vaccines in vaccination attitudes for adolescents or children (Table 2). Parents’ willingness to get themselves vaccinated, positive or negative attitudes, impact of social vaccination programs, and high risk for their children to COVID-19 were related factors affecting children's vaccination. Next, accessing information about COVID-19 vaccines from community workers or the World Health Organization were associated with vaccine acceptance and from web/social media or unofficial media were associated with vaccine hesitation. The attention to COVID-19 vaccine-related information was also a related factor. In addition, compulsory vaccination policy, general favorability to vaccination, trusting doctors, and COVID-19's tested or infected histories affected willingness to vaccinate children.

**Reasons associated with vaccination**

Twenty-one articles reported reasons associated with COVID-19 vaccination for children, see Table 2 for details; the main reasons for acceptance or hesitancy are shown in Fig. 3.

We found that most of them were associated with the vaccine characteristics among relevant reasons. Most people accepted the vaccine because of its protective effects or they believed in the vaccines' safety and effectiveness. They were afraid that their children would be infected in the future and they would spread the virus to people around them. Nevertheless, 17 articles pointed out that parents and adolescents were reluctant to vaccinate as they were worried about the vaccine's safety, effectiveness, and potential side-effects. Meanwhile, some people believed that children were at a low risk and COVID-19 vaccine lacked sufficient information and evidence.

Moreover, a small number of people preferred to vaccinate as they followed medical advice or mandatory policies, and from web/social media or unofficial media. They were afraid that the vaccines were provided free of charge, insufficient supply, and they could contribute to national epidemic prevention and control. Equally, a small number of people were reluctant to vaccinate because of their personal beliefs or they had no time to vaccinate their children.

**Discussion**

This scoping review updates 34 recent studies on the public attitudes toward COVID-19 vaccination for adolescents or children. We found that the public’s willingness to vaccinate children was not high, and the median acceptance rate was 53.70%. This rate is lower than the 61.40% vaccination rate for parents. Snehota's systematic review mentioned that percentage of people's intention to vaccinate themselves was 75%, which is also much higher than this study's results. Meanwhile, the results showed that the vaccination willingness of different study populations remained different. The median vaccination rate for children among adults and parents was 60.20%, whereas the median acceptance rate among adolescents was 50.40% (in particular, these studies' time was after children's COVID-19 vaccination program). This may be because adolescents do not fully understand COVID-19 vaccine and did not experience adequate vaccination plans' publicity like parents. In addition, the results showed that the acceptance rate after approval for children's COVID-19 vaccination was higher than...
| First author                  | Related factors                                                                 | Related reasons                                                                 | Acceptance/hesitancy |
|------------------------------|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------|----------------------|
| Bader A. Altulaihi<sup>17</sup> | 1. Parents aged between 31 and 40 years; 2. Children age group was 4–12; 3. Had a history of taking the seasonal influenza vaccine; 4. The scores of negative attitude scale. The scores of positive attitude scale | 1. Highly effective in protecting their children from COVID-19; 2. Contributed to the control of COVID-19; 3. Adequate supply of COVID-19 vaccination. | Acceptance            |
| Awoere T. Chinawa<sup>18</sup>  | 1. Believed they could be infected with the COVID-19; 2. Aware of someone that died from COVID-19. | 1. Lack of information and evidence; 2. Severe side-effects; 3. The protection of COVID-19 vaccines will only last for a short time; 4. Child was afraid of vaccination; 5. Lack of time. | Hesitancy             |
| Kristine M. Ruggiero<sup>19</sup> | Already or planned to vaccinate their child against influenza this season | Vaccine side-effects and safety | Hesitancy |
| Robin M. Humble<sup>20</sup> | 1. Parents employed part-time; 2. Parents who spoke English; 3. Children did not receive the influenza vaccine pre-pandemic; 4. Parents had low intention to vaccinate themselves; 5. Lacked confidence in the safety of COVID-19 vaccines; 6. If vaccines had not yet been tested in children. | 1. Rely on medical advice; 2. Mandatory vaccination policies. | Acceptance |
| Marco Montalti<sup>21</sup> | 1. Children aged 6–10 years old; 2. Parents aged 20–29 years, with low educational level; 3. Rely on information found in the Web/social media; 4. Dislike mandatory vaccination policies. | | Acceptance |
| Xiao Wan<sup>22</sup> | 1. Female parents; 2. High risk for their children to COVID-19; 3. Often pay attention to the COVID-19 vaccine—related information; 4. Believed in the safety of the COVID-19 vaccine; 5. Thought the COVID-19 vaccine could prevent COVID-19. | 1. Vaccine side-effects, safety, and effectiveness; 2. Had contraindication to vaccination. | Hesitancy |
| Haifa Aldakhil<sup>23</sup> | 1. Not know where to get vaccination; 2. Not know where to access good/reliable information; 3. Not think vaccine was effective and necessary; 4. Not think the vaccine was safe or concerned about side-effects; 5. Someone else told their child had a bad reaction and was not safe; 6. Heard or read negative media associated with vaccine hesitancy toward childhood immunizations. | | Hesitancy |
| S. Evans<sup>24</sup> | — | To parent is to protect, for children have health issues 1. Vaccine risks were higher and benefits are lower; 2. To parent is to protect, for child’s ill health would be further compromised; 3. Unclear advice. | Acceptance/Hesitancy |
| Meltem Yilmaz<sup>25</sup> | 1. Parents are healthcare workers; 2. Parents’ willingness to receive the vaccine and positive attitudes (participate in the COVID-19 vaccine trial, participate in the COVID-19 vaccine trial, etc.). | 1. Need for COVID-19 control; 2. The benefits of the COVID-19 vaccine outweighing its potential harm; 3. To protect their own families and others. | Acceptance |
| Nuno Fernandes<sup>26</sup> | Positive beliefs and attitudes toward the vaccine | 1. Lack of sufficient scientific studies; 2. Concerned about safety and side-effects; 3. Potential inefficacy of the vaccine due to mutations. | Hesitancy |
| Chloe A. Teasdale<sup>27</sup> | Children attend in-person school or daycare | — | Acceptance/Hesitancy |
| Chloe A. Teasdale<sup>28</sup> | Asian parents | — | Acceptance/Hesitancy |
1. Female parents;  
2. Lower education;  
3. Household income $25,000.

Parents’ willingness to get themselves vaccinated

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Vaccine side-effects, vaccine safety, and effectiveness

Acceptance

Hesitancy

Mateusz Babicki

1. Female parents;  
2. Older parents;  
3. Parents are healthcare workers;  
4. Parents vaccinated themselves against COVID-19;  
5. Mandatory vaccinations;  
6. History of vaccinations in child;  
7. COVID-19 vaccination campaign for children;

1. Concerned about complications that may arise in the future;  
2. The effectiveness of the preparation used.

Acceptance

Hesitancy

Takeshi Yoda

1. Potential safety and effectiveness;  
2. Children are at low risk;  
3. Religious or medical reasons.

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Acceptance

Hesitancy

Pierre Verger

1. Trust in institutions, sensitivity to social pressure, and general favorability to vaccination (for adolescents);  
2. Low perception of the risks of COVID-19 vaccines, general favorability to vaccination, and sensitivity to social pressure (for school children);

1. Concerned about complications that may arise in the future;  
2. The effectiveness of the preparation used.

Acceptance

Serious side-effects and safety of the vaccines

Hesitancy

Leonardo Evangelista Bagatelli

1. Parents’ young age;  
2. ≥2 children in the house;  
3. Lower educational level;  
4. Low household income.

—

Acceptance

Hesitancy

Stefano Zona

1. Parents aged ≤40 years;  
2. Parents with a secondary school or three-year degree;  
3. Parents are freelancers;  
4. Family income <€28,000;  
5. An erroneous perception of the risk of COVID-19 as the disease.

1. Prevention of COVID-19;  
2. Vaccines free of charge.

Acceptance

Jian Wu

1. Married;  
2. Total family income last year between 9 and 14 ten thousand;  
3. Rejected to Category 1 vaccines;  
4. Accessed information about the COVID-19 vaccines from community workers;  
5. Low COVID-19 vaccine conspiracy;  
6. Guardian’s vaccination behavior;  
7. The importance of vaccinating teenagers.

1. Teenagers’ young age;  
2. Worried about the safety of vaccines;  
3. Believed that the risk of infection was low.

Acceptance

Hesitancy

Yunyun Xu

In Shandong: 1. Female parents; 2. ≥2 children raised.

In Zhejiang: 1. Rural residence; 2. ≥2 children raised.

In Shandong: 1. Yearly household incomes ≥120,000RMB; 2. Parents were medical workers; 3. General attitudes of Parental Attitudes toward Childhood Vaccines (PACV).

In Zhejiang: 1. Behavior; 2. Safety and efficacy; 3. General attitudes of PACV.

≥5 children raised

1. Adequate information about vaccines;  
2. Compulsory vaccination.

Acceptance

Hesitancy

Mohammed Samannodi

(continued on next page)
| First author          | Related factors                                                                 | Related reasons                                                                 | Acceptance/hesitancy |
|----------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------|
| Mohamad-Hani Temsah  | 1. Parents received the COVID-19 vaccine themselves; 2. Kids were aged 12–18 years; 3. Older parents; 4. Had an educational level of high school or less; 5. Native; 6. Rely on the Saudi MOH website information. | 2. Vaccine approval process was fast, so the safety of the vaccine was not assessed adequately; 3. Heard that blood clots were a common side-effect of the vaccine. | Acceptance           |
| Britt McKinnon       | 1. Annual household income <$100,000; 2. Non-nationals; 3. Racialized parents.       | 1. Inadequate safety information; 2. Worried about side-effects.                 | Hesitancy            |
| Sarah Musa           | 1. Younger children; 2. Non-nationals; 3. Previously COVID-19 infected.             |                                                                                 | Hesitancy            |
| Yulia Gendler        | 1. COVID-19 vaccination status of the participants; 2. Higher mean levels of vaccine literacy; 3. More positive perception of the vaccine; 4. Lower perceived vaccine hesitancy. |                                                                                 | Acceptance           |
| Konstadina Griva     | 1. Male parents; 2. Individuals with lower risk perception of COVID-19; 3. Lower perceived benefits of the vaccines; 4. Higher vaccination concerns and perceptions of higher personal necessity for the COVID-19 vaccine. |                                                                                 | Hesitancy            |
| Sayaka Horiuchi      | 1. Trusted in sources of COVID-19 related information other than government/public organization or public news media; 2. Female gender either of parent or child; 3. Parents aged <34 years; 4. Lower household income; 5. Parents are unemployed; 6. Lower perceived risk of infection; 7. Younger children; 8. Mothers with lower satisfaction to social relationships. | COVID-19 vaccines adverse reaction and safety | Hesitancy            |
| Soo-Han Choi         | 1. High confidence of COVID-19 vaccines safety; 2. Parents’ willingness to vaccinate themselves; 3. Awareness of the need for children’s COVID-19 vaccination. |                                                                                 | Acceptance           |
| Mina Fazel           | 1. From deprived socio-economic contexts; 2. Higher rates of home rental vs. homeownership; 3. School locations were more likely to be in areas of greater deprivation; 4. Smoke or vape; 5. Spent longer on social media; 6. Felt that they did not belong in their school community; 7. Lower levels of anxiety and depression. |                                                                                 | Hesitancy            |
| Don E. Willis        | Spent more hours of TV watched during school days                                  |                                                                                 | Hesitancy            |
| Adam A. Rogers       | 1. Older adolescents; 2. More education; 3. Higher income; 4. Asian American and Latinx youth; 5. More COVID–19-related anxiety; 6. High vaccine-related concerns; 7. Parent and peer vaccination norms. |                                                                                 | Acceptance           |
Concerned about the safety and efficacy of the vaccine

**Vaccine's perceived safety**

- Age of adolescent
- Parental education level
- Social media use
- Higher distress over the effects of the vaccine
- Not knowing enough about the harms that a vaccine has in the long run
- Not trusting drug companies that the vaccine will be safe
- Believing the virus is not dangerous
- Doubt about the safety of the vaccine in the short term

**Hesitancy**

- Older adolescents
- Lack of both parents vaccinated
- Social media use

**Acceptance**

- Parents or guardians with no college education

Anna Zychlinsky Scharff

- Older adolescents
- Parents or guardians without college education

Elke Humel

- Migration background
- Female adolescents

Ateret Gewirtz-Meydan

- Older adolescents
- Had both parents vaccinated
- Social media use

Higher distress over the effects of the vaccine

- Not knowing enough about the harms that a vaccine has in the long run
- Not trusting drug companies that the vaccine will be safe
- Believing the virus is not dangerous
- Doubt about the safety of the vaccine in the short term

**Influencing factors for adolescent population**

- Age of adolescent
- Parental education level
- Social media use
- Higher distress over the effects of the vaccine
- Not knowing enough about the harms that a vaccine has in the long run
- Not trusting drug companies that the vaccine will be safe
- Believing the virus is not dangerous
- Doubt about the safety of the vaccine in the short term

**Influencing factors for adult population**

- Parents without college education
- Social media use
- Higher distress over the effects of the vaccine
- Not knowing enough about the harms that a vaccine has in the long run
- Not trusting drug companies that the vaccine will be safe
- Believing the virus is not dangerous
- Doubt about the safety of the vaccine in the short term

Parents' willingness to get themselves vaccinated was the most common factor affecting acceptance and hesitancy for the vaccine's cognition and behavior characteristics. People with negative attitudes or low confidence in vaccines also caused vaccine hesitancy. Healthcare centers should improve the cognition, behavior, and attitudes of vaccinated people and carry out regular public education activities to effectively improve the acceptance rate of vaccines. In addition, taking the influenza vaccines' histories was relevant in accepting the vaccine. Parents who have previously vaccinated adolescents with influenza had a higher acceptance of the vaccine, providing us with relevant experience. We also could identify and implement multilevel strategies about COVID-19 relying on influenza's experience to maximize COVID-19 vaccination rates. Second, among the reasons for qualitative data, parents or adolescents accepted vaccines because they relied on medical advice and considered that it could contribute to control of COVID-19. However, there are many ways to get medical advice. Especially in the age of information explosion, it is difficult for people to distinguish obtained information's accuracy and timeliness. Therefore, the official departments and media should strengthen the publicity to ensure that adolescents and parents get correct and adequate information about COVID-19 vaccination. Another result was people's cognition and understanding of childhood vaccination. Some refused vaccination because they deemed children were at low risk, and others accepted for fear of infection among their children. According to current studies, the advantages of COVID-19 vaccine outweighed the disadvantages. Therefore, improving parents' knowledge and cognitive ability is also necessary to enhance vaccination rate. Next, the pandemic risk rate in the study area was also the basis for parents' choice, which we should consider in promoting vaccines. Different vaccination rates should be planned for different strategies and strive for full coverage. Moreover, some people refused vaccination because of their personal beliefs, whereas relevant departments can seek help from religious or ethnic institutions to reduce the conspiracy
theories spread and implement the immunization plans as far as possible on-premise of respecting beliefs.59

Vaccine characteristics were essential factors affecting parents' or adolescents' attitudes among the vaccination reasons. One of the characteristics that people were concerned about the most was COVID-19 vaccines' safety and efficacy. There has been sufficient evidence about the vaccines' development and application in the population. Nevertheless, most hesitant people mentioned the lack of evidence. In addition to the inconvenience of personal communication, healthcare departments should increase publicity and follow-up of COVID-19 vaccine knowledge to ensure that parents and adolescents have adequate and correct access to information, including advertisements on "we media" and streaming media.54 Similarly, although some people were encouraged to receive COVID-19 vaccine through compulsory and free policies, most people hesitated to get the vaccine because of side-effects. However, most reported adverse events in children were mild and transient, and <1% of children needed medical care.60 Hence, it is imperative to make adolescents and parents trust healthcare centers and increase their vaccines' recognition to improve the vaccination rate.61

**Limitations**

Based on this, we summarized and sorted out published studies. Although our results reported the global data, there may be insufficient inclusion and loss of data as languages are all in English. Second, almost all studies included were cross-sectional surveys, which cannot track and update the public opinions and lead to limitations in our inference. Moreover, some studies did not detail specific situations for children of different ages. Still, they contained infants' and young children's data, which may impact results. Future research could focus more on COVID-19 vaccines'
development and application in special crowds to improve produced vaccines' utilization rate.

Conclusions
The above stated the acceptance rate and influencing factors toward COVID-19 vaccination for children or adolescents among adults, parents, and adolescents. The survey data showed that people's willingness to vaccinate children was weak. At the same time, the vaccine's cognition, behavior, and vaccine characteristics were the central influencing factors. Thus, the government should base on scientific data and fully consider individual experiences during the vaccine promotion. The specific situations shall be analyzed and improved according to local and individual conditions. In the future, we can mobilize multiple sectors (healthcare centers, communities, schools, etc.) to improve vaccination rates by providing multilevel interventions for children and parents, controlling COVID-19 pandemic's development as soon as possible, and returning to everyday life.

Author statements

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