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Original article

Parent and Peer Norms are Unique Correlates of COVID-19 Vaccine Intentions in a Diverse Sample of U.S. Adolescents

Adam A. Rogers, Ph.D. a, *, Rachel E. Cook, Ph.D. b, and Julie A. Button a

a School of Family Life, Brigham Young University, Provo, Utah
b Institute for Child Development and Family Relations, California State University, San Bernardino, California

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ABSTRACT

Purpose: Recent studies have documented worrisome levels of hesitancy and resistance to the COVID-19 vaccine, including within the adolescent population. In this study, we examined attitudinal (perceived severity of COVID-19, vaccine-related concerns) and interpersonal (parent and peer norms) antecedents of adolescents’ intentions to receive the COVID-19 vaccine.

Methods: Participants were 916 adolescents (aged 12–17 years) from across the United States (47.3% male) representing diverse ethnic and socioeconomic backgrounds (26% African-American, 22% Hispanic/Latinx, 35% white, 7% Asian American). They completed a survey on their experiences and attitudes surrounding COVID-19 and the COVID-19 vaccine.

Results: Parent and peer norms were distinct predictors of adolescent willingness to receive the vaccine. These norms were associated with vaccine intentions directly and indirectly through adolescents’ beliefs about the vaccine’s safety, efficacy, and necessity. Parent norms in particular displayed large effect sizes and explained considerable variance in adolescents’ vaccine intentions.

Conclusions: Parents and friends—who figure as adolescents’ most salient interpersonal relationships—are key leveraging points in promoting adolescents’ uptake of the COVID-19 vaccine. Norm interventions and family-based interventions may be successful in this regard.

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IMPLICATIONS AND CONTRIBUTION

Public scrutiny of the COVID-19 vaccines has resulted in many obstacles to its uptake, and vaccine hesitancy is a reality for many adolescents. Parent and peer vaccination norms explain unique and considerable variance in adolescents’ intentions to receive the COVID-19 vaccine. These relationships are leverage points for intervention.

The approval of COVID-19 vaccines for youth aged 12 years and up means that adolescents are now a key, target population in the vaccination effort. Promoting the COVID-19 vaccine among U.S. adolescents is critical to ensure their safety from the virus and slow its overall spread, particularly in the midst of rapidly emerging and highly infectious variants (e.g., Delta) [1]. However, given the heightened public scrutiny of the COVID-19 vaccine, there are considerable attitudinal and social apprehensions, and pediatricians may find vaccine hesitancy to be a challenge to vaccine uptake in this population. Guided by the health belief model (HBM) [2], this study identified the unique attitudinal and interpersonal antecedents of adolescents’ COVID-19 vaccination intentions, including their direct and indirect pathways of association.

Antecedents of COVID-19 Vaccination Intentions

The HBM [2] and supporting literature [3,4] hold that the most proximal determinants of an individual’s uptake of a vaccine include (a) their perceived severity of and susceptibility to the disease, alongside (b) their perceived benefits and/or risks of receiving the vaccine. Adolescents report various perceptions and anxieties regarding the severity of COVID-19 and its impact on their lives, including worries about their health, changes in

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* Address correspondence to: Adam A. Rogers, Ph.D., Brigham Young University, 2089 JFSB, Provo, UT 84602.
E-mail address: adam_rogers@byu.edu (A.A. Rogers).
their peer networks and family dynamics, increased economic difficulties for their parents, and academic difficulties [5]. These perceived impacts might motivate greater vaccine uptake. However, a significant portion of adolescents have also reported hesitancy or resistance to the COVID-19 vaccines [6], expressing worries about their safety, efficacy, and doubts about their necessity. As per the HBM, perceiving more severe impact of, or susceptibility to, COVID-19 would promote more willingness to be vaccinated, whereas harboring concerns about the vaccine's safety or necessity would undermine such motivations.

Although these attitudinal considerations are viewed as proximal determinants of vaccine uptake, scholars have observed that vaccine-related attitudes and beliefs are socially derived phenomena [3] and that the adoption of medical innovations like vaccines must diffuse through social systems [7]. Therefore, adolescents' attitudes toward COVID-19 and vaccination represent shared interpersonal understandings that constitute "localized vaccine cultures [3]", and these shape the transmission of vaccine willingness as a social process. As such, social messaging about the COVID-19 vaccines and interpersonal norms surrounding the vaccines are likely fundamental antecedents of adolescents' COVID-19 vaccination willingness. Specifically, from an HBM standpoint, interpersonal norms might act directly on vaccination intentions and indirectly by giving rise to vaccine-related attitudes (i.e., mediation). Unfortunately, no studies to our knowledge have examined how adolescents' perceived interpersonal norms shape their COVID-19 vaccination intentions, either directly or indirectly. Such social considerations are relevant to the adolescent population because this period of life is characterized by heightened sensitivities to social belonging [8]. Indeed, studies have long documented the role of adolescents’ relationships—including interpersonal norms—in influencing various health-related behaviors [9]. Therefore, we focused on adolescents' perceived vaccination norms from their parents and peers, given that these are among the most influential relationships in adolescence. We examined descriptive norms (what parents and peers are doing or planning to do about the COVID-19 vaccines) and injunctive norms (what parents and peers believe people should do about the vaccines).

This study was guided by three goals. First, we examined variability in adolescents' intentions to receive a COVID-19 vaccine (e.g., yes/already received, maybe, no), as well as their concerns about receiving a vaccine. Second, we examined attitudinal and interpersonal correlates of COVID-19 vaccination intentions. Specifically, we examined whether perceived impact and severity of COVID-19, COVID-19-related anxiety, vaccine-related concerns, and parent and peer norms were unique predictors of vaccination intentions. We also examined if these processes were moderated by age, gender, and ethnic identity. Finally, because social factors give rise to vaccine-related attitudes [3,4], we examined whether vaccine-related concerns mediated the relations between parent and friend vaccination norms and adolescents’ intention to be vaccinated. In all analyses, we controlled for adolescent age, gender identity, household income, parent education, and race/ethnicity.

Method

Participants and procedures

Between 10 June and 24 June 2021, participants were recruited from a third-party research service, Qualtrics, which retains a national database of research participants gathered through various digital advertising channels (e.g., social media, search engines) and address-based sampling methods (e.g., mailing lists). A stratified random sample of adolescents was drawn from this database, using national quotas for adolescent age, gender, parent income, and U.S. geographic region (south, west, midwest, and northeast). We oversampled ethnic minority adolescents to ensure adequate statistical representation of ethnic groups. Participants had to be between 12 and 17 years of age to participate. Just over 1,200 adolescents were contacted through an online survey platform. A description of the study was provided, and adolescents and their parent/caregiver were required to provide assent and consent (respectively). In total, 928 families consented, with 916 adolescents completing the questionnaire (a response rate of 74.9%). The survey asked about their experiences and attitudes surrounding COVID-19 and the COVID-19 vaccine. Surveys took approximately 10 minutes to complete, and adolescents were compensated in points to redeem with their survey provider (approximately $3 USD in value). All procedures were approved by the Brigham Young University Institutional Review Board.

Measures

COVID-19 vaccination intention. Adolescents completed a single item, "Do you plan to get the COVID-19 vaccine?" They responded 1 = no, 2 = maybe, 3 = yes. Adolescents who already were vaccinated were coded as 3 = yes.

COVID-19 impact. Adolescents completed four items capturing the impact of the pandemic on their health and daily lives. Health impact was assessed by lifetime COVID-19 diagnosis (0 = no, 1 = yes), as well as a sum score of underlying health risks for diabetes, heart disease, lung disease, or asthma (possible range 0–4). School format was also assessed to indicate educational impact (0 = all in-person classes; 1 = blended in-person and remote learning; 2 = all remote learning/homeschooling). Finally, adolescents reported whether their families had experienced reduced income during the pandemic (0 = no, 1 = yes). All were analyzed as single items.

COVID-19—related anxiety. Adolescents reported their anxiety surrounding COVID-19 during the past two weeks. Seven items were drawn from a measure of perseverative negative thinking [10]—a key dimension of anxiety—and adapted to reflect repetitive and consuming negative thoughts about COVID-19 (e.g., "I get stuck worrying about COVID-19 and cannot move on"). These were rated on a 5-point scale (1 = never, 5 = almost always) and averaged with higher scores indicating greater anxiety about COVID-19, $\alpha = .89$.

COVID-19 vaccine concerns. Adolescents reported their degree of concern about the COVID-19 vaccines on eight items. These items reflected two themes identified in recent work on adults’ [11] and adolescents’ [6] vaccination concerns: worry about safety and efficacy and doubts about its necessity. All items were rated on a 5-point scale (1 = not at all true of me; 5 = very true of me). An exploratory factor analysis was estimated (principal axis factoring) using an oblique rotation (promax) to verify this dimensionality (items and factor loadings in Table S1 in online supplemental material). We used an oblique rotation because we anticipated covariance between these vaccine-related concerns.
COVID-19 vaccination norms. Finally, participants reported their perceived norms of parents’ and friends’ receipt of the COVID-19 vaccines. They completed a single item indicating descriptive friend norms, “How many of your close friends do you think will get a COVID-19 vaccine?” (1 = none of them, 5 = almost all of them), and a single item assessing friend injunctive norms, “How many of your friends believe that other people should get vaccinated for COVID-19?” (1 = none of them, 5 = almost all of them). These items were highly correlated (r = .78, p < .001) and averaged for an overall friend norms score, higher scores indicating greater perceived support for vaccination among one’s friends.

Parents’ descriptive norms were assessed with one item for each parent, e.g., “Does your [mother-/father-] figure a plan on getting vaccinated for COVID-19?” (1 = no, 2 = maybe, 3 = yes/already vaccinated). Injunctive norms were assessed with a single item, “Do your parents generally believe that others should get vaccinated for COVID-19?” (1 = not at all, 5 = yes, very much). These three items were highly correlated (rs ranging from .67 to .83, ps < .001), so they were combined for an overall parental norms score. Higher scores indicated greater perceived support for the COVID-19 vaccine by one’s parents.

Sociodemographics. Participants reported their age, gender identity (male, female, transgender, non-binary), and racial-ethnic identity (African-American, Asian American, Hispanic/Latinx, white, American Indian or Alaska Native, Pacific Islander, other, or mixed/biracial). For analysis, gender identity was dummy coded for female (1 = female, 0 = other) and non-binary identities (1 = non-binary, 0 = other), with male as the reference category. Transgender adolescents were included with the gender category with which they identified. Dummy codes were also created for ethnic identity, with white as the reference category: African-American, Hispanic/Latinx, Asian American, and other (American Indian, Pacific Islander, other, and mixed/biracial) ethnicities. They also reported their primary caregiver’s highest level of formal education (1 = no formal education, 2 = less than high school, 3 = high school/GED, 4 = some college, 5 = 2-year college degree, 6 = 4-year college degree, 7 = master’s degree, 8 = doctoral or professional degree). Parents reported annual household income (1 = less than $20,000; 2 = $20,000 to $34,999; 3 = $35,000 to $49,999; 4 = $50,000 to $74,999; 5 = $75,000 to $99,999; 6 = $100,000 to $149,000; 7 = $150,000 to $199,999; 8 = $200,000 to $499,999; 9 = $500,000 or more).

Analytic plan

Hierarchical regressions. To examine hypotheses regarding the correlates of vaccination intentions, we conducted hierarchical linear regressions in SPSS 26 (Armonk, NY: IBM Corp.). As the dependent variable was ordinal, we considered several regression frameworks for the analysis, including ordinal logistic regression. However, findings did not differ between this approach and a multiple linear regression model, and so multiple linear regression was favored for its practicality and straightforward interpretations. Missing data were minimal (<1% across all cases), so the default for listwise deletion was used. In step 1 of the model, we included sociodemographic variables, including age, gender identity, parent income, mother’s education, and racial-ethnic identity. In step 2, we added COVID-19 impact, including COVID-19 diagnosis, underlying health risks, school format, and income reduction. In step 3, we added COVID-19-related anxiety as an index of internalized threat of COVID-19. In step 4, we added vaccine-related concerns, including concerns about the safety and efficacy of the COVID-19 vaccine and doubts about its necessity. Finally, in step 5, we included parent and friend vaccination norms. We then examined whether the effects of parent and peer norms were moderated by age, gender, or ethnic identity.

Mediation analysis. To examine whether vaccine-related concerns mediated the association between interpersonal norms and vaccine intentions, we estimated a path model in Mplus 8.0 [12] in which interpersonal norms predicted vaccine concerns, which, in turn, predicted vaccine intentions. Bias-corrected bootstrapping with 1,000 draws was used to estimate confidence intervals for indirect effects.

Results

Participants were 916 adolescents from across the United States, ranging in age from 12 to 17 years (M_age = 14.69, standard deviation = 1.69) and representing diverse racial/ethnic, socioeconomic, and geographic backgrounds (see Table 1 for sample characteristics; see Table S2 of online supplemental material for vaccination intentions by sample characteristics).

Descriptive statistics

Table 2 displays response proportions of vaccination intentions and means on the eight vaccine concern items. At the time of data collection, approximately half the sample was either vaccine-hesitant (responded “maybe”; 26.4%) or vaccine-resistant (responded “no”; 23.1%). The most common concerns were regarding the vaccine’s perceived safety. Table 3 displays the means and standard deviations for all continuous study variables. Adolescents reported moderate average levels of perceived friend and parent support for the vaccines (vaccination norms). They also reported moderate levels of concern regarding the vaccines’ safety and efficacy, low concern about their necessity, and low COVID-related anxiety. Table 4 presents zero-order correlations. Vaccination intentions were related to all continuous study variables. We then conducted sensitivity analysis comparing adolescents who intended versus did not intend to get the COVID-19 vaccine (independent samples t-tests; see Table 3). Those who intended to receive a COVID-19 vaccine (or who already received one) reported higher annual household income, higher parent education, and more COVID-related anxiety than those who did not intend to receive the vaccine, all with moderate effect sizes. They also reported fewer concerns about the vaccines, with large effect sizes. Finally, they reported higher vaccination norms among friends and parents, again with a large effect size.
Hierarchical regressions

Table 5 displays results of the regression analysis. In step 1, age was positively associated with vaccination intentions, indicating that older adolescents had a slightly greater intention to be vaccinated than younger adolescents. Gender identity dummy codes were unassociated with vaccination intentions, indicating similar levels of vaccine willingness among boys, girls, and non-binary adolescents. Parent education and household income were also positively associated with vaccination intention. Adolescents whose primary caregivers had more education and who earned higher income had greater intentions to be vaccinated. The dummy codes for Asian American and Latinx adolescents were significant and positive. Compared with their white counterparts, Asian American and Latinx youth expressed greater willingness to be vaccinated. The dummy codes for African-American and “other” (e.g., American Indian, Pacific Islander, biracial/mixed) were not significant, indicating similar levels of vaccine intentions as white adolescents. Altogether, sociodemographic variables accounted for approximately 10% of the variance in vaccination intention, \( F(8, 868) = 10.13, p < .001 \).

The inclusion of COVID-19 impact variables did not explain unique variance in vaccination intentions beyond the sociodemographic variables in the prior step, \( F(4, 864) = .41, p = .824 \). Having been diagnosed with COVID-19, having underlying health risks, experiencing reduced family income, and continued receipt of schooling through remote formats did not indicate more or less intention to get vaccinated. However, the addition of COVID-19–related anxiety in step 3 was positively and significantly associated with vaccination intention. Adolescents with more COVID-19–related anxiety indicated more willingness to be vaccinated, an effect that explained an additional 4.6% of the variance, \( F(1, 863) = 43.19, p < .001 \).

In step 4, there were significant and negative associations between vaccine-related concerns and vaccination intentions. Adolescents who expressed more concerns about the safety and efficacy of the vaccine were less likely to express an intention to get vaccinated, as were those who expressed more doubt about its necessity (e.g., COVID is mild). The addition of these concerns explained an additional \( 27.0\% \) of the variance in vaccine intentions, \( F(2, 861) = 187.48, p < .001 \).

In step 5, parent and peer vaccination norms were unique predictors of greater vaccination intention. Adolescents who perceived more support and uptake of the vaccine by the parents and friends reported more willingness to be vaccinated. These variables explained an additional 23.4% of the variance, beyond all prior variables in the model, \( F(2, 859) = 270.94, p < .001 \).

We then tested whether relations between parent and friend norms and vaccine intentions were moderated by age, gender identity, and ethnic identity. We included all two-way interactions (e.g., parent norms–by-age, parent norms–by-gender, parent norms–by-ethnicity dummy codes; friend norms–by-age, friend norms–by-gender, friend norms–by-ethnicity dummy codes). None of these were statistically significant (\( p \) values \( \leq .05 \)).
ranged from .135 to .993), and so for brevity, they are not displayed.

**Mediation analysis**

Finally, we examined evidence that vaccine-related concerns might mediate the association between interpersonal norms and vaccination intentions. A path model was estimated in which parent and friend norms predicted vaccine concerns for safety and efficacy, as well as necessity, which, in turn, predicted vaccination intentions. In the final models, parent norms were associated with vaccination intentions directly, \( \beta = .58; 95\% \) confidence interval [CI] [.53, .63], and indirectly through safety and efficacy concerns, \( \beta = .04; 95\% \) CI [.02, .05], as well as doubts about the vaccine’s necessity, \( \beta = .04; 95\% \) CI [.02, .06]. Peer norms were also associated with vaccination intentions directly, \( \beta = .16; 95\% \) CI [.15, .20], and indirectly through doubts about the vaccine’s necessity, \( \beta = .03; 95\% \) CI [.02, .05], but not through concerns about safety and efficacy, \( \beta = .01; 95\% \) CI [.00, .03].

**Discussion**

Adolescents are now a focus in the COVID-19 vaccination effort, but little is known about the antecedents of their intentions to be vaccinated. We examined attitudinal and interpersonal antecedents of adolescents’ intentions to receive a COVID-19 vaccine, including the direct and indirect pathways characterizing these associations. Specifically, we examined the impact and perceived threat of the pandemic, concerns about the vaccine’s safety and necessity, and parent and peer norms surrounding the vaccine.

We were somewhat surprised that adolescents who were more adversely impacted by COVID-19, such as those who were continuing to attend online classes or whose families saw reduced income, were not more willing to receive the vaccine than their less-impacted counterparts. Although one may reasonably surmise that more impacted youth might favor vaccination, our data indicated that the more important factor was their subjective and internalized degree of anxiety about COVID-19. Despite low mean levels of COVID-19 anxiety, it remained a unique predictor of adolescents’ vaccine willingness. These findings might suggest that efforts to promote vaccination are unlikely to prove successful if they primarily emphasize a return to normalcy (e.g., more in-person socialization).

More effective, as per our results, is to find ways to address adolescents’ concerns about the COVID-19 vaccine, which may be accomplished through leveraging their interpersonal and social relationships (e.g., norm interventions). Vaccine-related concerns and interpersonal vaccination norms all explained unique variance in adolescents’ vaccination intentions. Furthermore, the effects of parent and friend norms operated in part through adolescents’ concerns about the vaccine. Consistent with the HBM emphasis on socially embedded health beliefs [3], adolescents might derive their concerns about vaccine safety and efficacy, as well doubts about the vaccine’s necessity, within their closest interpersonal circles. This supposition should be tested and verified in future studies using longitudinal data.

Even after considering indirect effects through vaccine-related concerns, parent and peer norms still explained substantial variance as a direct effect of their own. Many adolescent health behaviors are shaped by similar social processes [9], and so the perceived behavior of others surrounding the COVID-19 vaccine represents a key mechanism through which COVID-19 vaccine adoption might diffuse through adolescent networks. Importantly, we found that these processes were not moderated by adolescents’ age, gender, or ethnic identity. The pandemic has

### Table 3
Descriptive statistics among continuous study variables and sensitivity analyses comparing means by vaccine status

|                      | Full sample (n = 916) | Comparison by vaccine intention status |
|----------------------|-----------------------|----------------------------------------|
|                      | M (SD)    | Min | Max | M (SD)    | Min | Max | p  | Cohen’s d |
| Age                  | 14.69 (1.69) | 12  | 17  | 14.86 (1.67) | 14.62 (1.73) | .09 | .14 |
| Income               | 3.65 (2.04) | 1   | 9   | 4.16 (2.06) | 3.08 (1.87) | <.001 | .54 |
| Parent education     | 4.66 (1.72) | 1   | 10  | 4.95 (1.80) | 4.28 (1.58) | <.001 | .41 |
| COVID anxiety        | 2.16 (2.58) | 1   | 5   | 2.32 (2.91) | 2.32 (2.90) | <.001 | .58 |
| Concern—safety/efficacy | 2.84 (1.08) | 1   | 5   | 2.35 (2.99) | 3.54 (1.00) | <.001 | -1.19 |
| Concern—necessity   | 2.26 (1.14) | 1   | 5   | 1.76 (.94) | 3.17 (1.14) | <.001 | -1.41 |
| Friend norms         | 2.90 (1.21) | 1   | 5   | 3.61 (1.11) | 1.92 (.13) | <.001 | 1.67 |
| Parent norms         | 3.29 (1.26) | 1   | 5   | 4.17 (.66) | 1.80 (.85) | <.001 | 3.26 |

SD = standard deviation.

**Table 4**
Correlations among continuous study variables

| 1.     | 2.     | 3.     | 4.     | 5.     | 6.     | 7.     | 8.     | 9.     |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 1.     | -.17   | -.49   | -.35   | -.72   | -.52   | -.52   | -.06   | -.35   |
| 2.     |        | -.69   | -.47   | -.47   | -.47   | -.47   | -.47   | -.47   |
| 3.     | .59    |        | -.23   | -.23   | -.23   | -.23   | -.23   | -.23   |
| 4.     | -.47   |        | -.49   | -.49   | -.49   | -.49   | -.49   | -.49   |
| 5.     | -.47   | .47    |        | -.38   | -.38   | -.38   | -.38   | -.38   |
| 6.     | .11    | -.09   | .14    |        | -.03   | -.03   | -.03   | -.03   |
| 7.     | .18    | .25    | -.23   | -.18   |        | -.09   | -.09   | -.09   |
| 8.     | .24    | .25    | .27    | -.21   | -.21   |        | -.09   | -.09   |
| 9.     | .07    | -.05   | .10    | -.13   | -.13   | -.13   |        | -.04   |

**.13** *p < .001, **p < .01, *p < .05.
Table 5
Hierarchical multiple linear regression results predicting vaccine intentions among adolescents (n = 916)

| Step       | Model 1 |          | Model 2 |          | Model 3 |          | Model 4 |          | Model 5 |          |
|------------|---------|----------|---------|----------|---------|----------|---------|----------|---------|----------|
|            | β       | 95% CI   | p       | β        | 95% CI   | p       | β        | 95% CI   | p       | β        | 95% CI   | p       |
| 1. Demographics |         |          |         |         |         |         |         |         |         |         |         |         |
| Age        | .05     | [.02, .08] | .004    | .05     | [.02, .08] | .003    | .05     | [.01, .08] | .003    | .02     | [-.01, .05] | .096    | .01     | [-.01, .03] | .391    |
| Parent Ed. | .05     | [.02, .09] | .005    | .05     | [.01, .09] | .009    | .05     | [.01, .09] | .009    | .02     | [-.01, .05] | .116    | .01     | [-.04, .01] | .338    |
| Income     | .06     | [.03, .09] | .000    | .06     | [.03, .09] | .000    | .06     | [.03, .09] | .000    | .04     | [.01, .06] | .003    | .01     | [.00, .05] | .353    |
| Female     | -.18    | [-.54, .18] | .320    | -.17    | [-.54, .18] | .336    | -.18    | [.54, .18] | .336    | -.07    | [.36, .22] | .633    | .11     | [.12, .34] | .340    |
| Non-binary | -.15    | [-.51, .21] | .419    | -.14    | [.50, .22] | .449    | -.14    | [.50, .22] | .449    | -.01    | [.30, .28] | .928    | .13     | [.09, .36] | .247    |
| African-American | -.06    | [-.21, .07] | .375    | -.07    | [.21, .08] | .384    | -.07    | [.20, .08] | .429    | .09     | [.12, .12] | .947    | .00     | [.08, .15] | .933    |
| Hispanic/Latinx | .20     | [.05, .35] | .008    | .21     | [.05, .36] | .008    | .21     | [.03, .33] | .019    | .19     | [.06, .31] | .003    | .07     | [.03, .17] | .148    |
| Asian American | -.46    | [-.24, .08] | .000    | .45     | [.23, .67] | .000    | .45     | [.21, .64] | .000    | .30     | [.12, .48] | .001    | .02     | [.12, .159] | .798    |
| Other ethnicity | -.07    | [-.27, .14] | .535    | -.06    | [-.26, .15] | .599    | -.06    | [-.25, .11] | .533    | -.04    | [.21, .13] | .644    | -.02    | [-.15, .11] | .774    |
|            | R² = .101; ΔR² = .101*** |          |         |         |         |         |         |         |         |         |         |         |
| 2. COVID impact |         |          |         |         |         |         |         |         |         |         |         |         |
| COVID Diag. |         |         |         | -.05    | [-.23, .13] | .602    | -.07    | [-.25, .11] | .452    | .05     | [-.10, .20] | .487    | .06     | [-.06, .17] | .247    |
| Health risk |         |         |         | .01     | [-.09, .10] | .928    | -.05    | [-.14, .05] | .344    | -.02    | [.10, .06] | .678    | -.06    | [.12, .02] | .042    |
| Reduced income | -.07    | [-.18, .05] | .245    | -.12    | [-.23, .01] | .059    | -.02    | [.11, .08] | .730    | .02     | [.05, .10] | .511    | .02     | [.05, .10] | .511    |
| School format | .01     | [-.06, .08] | .875    | -.03    | [-.09, .04] | .462    | -.02    | [-.08, .04] | .444    | -.03    | [.08, .01] | .176    |         |         |         |
|            | R² = .102; ΔR² = .002 |          |         |         |         |         |         |         |         |         |         |         |
| 3. COVID threat |         |          |         |         |         |         |         |         |         |         |         |         |
| COVID anxiety | .20     | [.14, .26] | .000    | .19     | [.14, .24] | .000    | .06     | [.02, .10] | .003    |         |         |         |         |
|            | R² = .148; ΔR² = .045*** |          |         |         |         |         |         |         |         |         |         |         |
| 4. Vaccine concern |         |          |         |         |         |         |         |         |         |         |         |         |
| Safety/efficacy | -.24    | [-.29, -.19] | .000    | -.06    | [.10, -.01] | .010    |         |         |         |         |         |         |         |
| Necessity   | -.21    | [-.26, -.17] | .000    | -.08    | [.12, -.04] | .000    |         |         |         |         |         |         |         |
|            | R² = .148; ΔR² = .270*** |          |         |         |         |         |         |         |         |         |         |         |
| 5. Vaccine norms |         |          |         |         |         |         |         |         |         |         |         |         |
| Friend norms | .13     | [.09, .16] | .000    |         |         |         |         |         |         |         |         |         |
| Parent norms | .36     | [.32, .40] | .000    |         |         |         |         |         |         |         |         |         |
|            | R² = .552; ΔR² = .234*** |          |         |         |         |         |         |         |         |         |         |         |

CI = confidence interval.

***p < .001, **p < .01, *p < .05.
disproportionately affected youth from various demographics (particularly youth of color) [13], so although some pathways to vaccination will likely differ for youth from diverse backgrounds, our findings indicate that the effectiveness of interpersonal norms cuts across the adolescent population with relative uniformity. This makes sense as needs for relatedness and social belonging are universal [14]. As such, this finding underscores the practicality and potential efficacy of norm-based interventions on adolescent vaccine uptake. Although there are existing interventions to increase adolescents’ adoption of other vaccines (e.g., HPV, influenza, MenACWY), the unique scrutiny around the COVID-19 vaccines likely warrants unique intervention strategies.

Finally, we note that the effect size of parent norms was large. Although peers are often seen as a predominant influence in adolescence [15], most adolescents still trust parents more than any other source when it comes to large and significant life decisions [16]. Furthermore, age of consent for vaccines varies from state to state, and so parents are sometimes the final say in their child’s vaccination. Implanted is the success of adolescent vaccination efforts will hinge largely on the attitudes and behaviors of parents, a pattern that bears out in studies on various other vaccines (e.g., STI, influenza, HPV) [17–19]. Efforts to promote vaccination among youth must consider this family context and find ways to address parental concerns and persuade parents themselves to be vaccinated.

Limitations and future directions

The data were cross-sectional. Although results mapped onto theory and extant literature in the expected ways [3], longitudinal data are needed to verify hypothesized directions, particularly in the mediation models. Furthermore, the situation with COVID-19 has proven to evolve rapidly. Although our findings might be useful for pediatricians and other practitioners, research should continue tracking these processes as they unfold over the coming months. For example, full approval of the COVID-19 vaccines by the U.S. Food and Drug Administration might change safety and efficacy perceptions, and norms may shift in response.

The COVID-19 vaccines are vital for protecting adolescents from the virus and may require regular and repeated administration (e.g., booster shots) in the coming months and years. Our study shows that parents’ and friends’ COVID-19 vaccination norms are likely to be uniquely influential over adolescents’ willingness to get vaccinated themselves. Adolescents’ perceived social norms may also operate in part by generating specific concerns about the vaccine. Norm-based interventions may prove successful in promoting higher vaccination rates in this population.

Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jadohealth.2021.09.012.

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