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School Without Walls High School Students and COVID-19 Vaccine Hesitancy

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ABSTRACT

In Washington, D.C., adolescents aged 12 to 17 have a relatively low COVID-19 vaccination rate compared to the overall population of D.C.— about 66 percent of adolescents aged 12 to 15 and 62 percent of teenagers aged 16 to 17 have received at least one shot, compared to 82 percent for the whole of D.C. This number falls even further when socio-demographic data are explored. School Without Walls High School students appear to have received at least one shot of the COVID-19 vaccine at a higher rate than the general adolescent population. Approximately 97% of participants reported having received at least one shot compared to 95% of all Washington, D.C. residents as of April 17th, 2022 (Ivory et al., 2021), as well as 100% of participants aged 12 to 15 compared to 85% of all Washington, D.C. adolescents aged 12 to 15 as of April 17th, 2022 (*Vaccination Data | Coronavirus*, 2021). Two possible reasons for this are that SWWHS students appear to be both better informed than the general population about COVID-19 and the risks of contracting it, and more aware of the risk of infecting others who are more vulnerable.

Introduction

The first human case of coronavirus disease 19 (COVID-19), which is caused by an infection of severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2), was identified in early December of 2019 in Wuhan City, China. The disease spread quickly around the globe: the first U.S. laboratory-confirmed case of COVID-19 in the United States was confirmed by the CDC on January 20, 2020 (*CDC Museum COVID-19 Timeline | David J. Sencer CDC Museum*, 2022). The World Health Organization declared COVID-19 a public health emergency of international concern on January 30, and a pandemic on March 11, 2020. In the United States, the White House "declared COVID-19 a national emergency on March 13, and the majority of states had issued stay-at-home orders by the end of March 2020" (Sol Hart et al., 2020). The first human trials for a vaccine to protect against COVID-19 began in the United States on March 17, 2020, and the Pfizer-BioNTech COVID-19 vaccine for those aged 16 and up was issued an Emergency Use Authorization by the FDA and recommended for use by the CDC Advisory Committee on Immunization Practices (ACIP) in December of 2020 (Wallace et al., 2021).

The coronavirus has caused more than six million deaths worldwide—almost one million deaths in the United States alone—as of May 1, 2022 ("Covid in the US: Latest Maps, Case and Death Counts," 2022). Vaccination against COVID-19 is one of the best ways to prevent these numbers from rising further: Scientists have every reason to believe that COVID-19 vaccines are effective in preventing serious symptoms and contraction of COVID-19 without posing serious safety concerns (*Benefits of Getting a COVID-19 Vaccine*, 2022). However, the circumstances surrounding the COVID-19 pandemic have given rise to a wave of misinformation about vaccines, public health, and science, which in turn have caused increased vaccine hesitancy across the United States. Adolescents aged 12 to 17 represent a significant demographic of the US population that could reduce COVID-19 spread by getting vaccinated, yet there has been very little research on COVID-19 vaccine hesitancy in the age group. This survey will assess the COVID-19 vaccine acceptability of Washington, D.C. high school students in an effort to inform efforts focused on vaccinating adolescents and determine how Washington, D.C. schools can best combat this vaccine hesitancy.

Literature Review

Millions of people across the United States have received at least one dose of a COVID-19 vaccine, including, as of December 3rd, about 15.5 million adolescents aged 12 to 17[1] (*CDC COVID Data Tracker*, 2021). The FDA issued an emergency use authorization for the use of the Pfizer-BioNTech COVID-19 vaccine to prevent the disease in those aged 16 and older on December 11th, 2020; the CDC ACIP issued an interim recommendation for its use on December 12th, 2020; and the FDA fully approved the vaccine for use in individuals aged 16 and over on August 23, 2021. These permissions came later for those aged 12 to 15: the FDA expanded the emergency use authorization for the use of the vaccine to that age group on May 10th, 2021; and the CDC ACIP issued an interim recommendation for its use on May 12th, 2021. It soon became clear that these measures were necessary—adolescents represented a "growing proportion of new COVID-19 cases reported to the CDC" as well as a high proportion of "cases of MIS-C, a severe hyperinflammatory syndrome occurring several weeks after acute SARS-CoV-2 infection" (Wallace et al., 2021), and though cases of COVID-19 are often mild for the age group, they also present the risk of household transmission (Lessler et al., 2021).

Furthermore, the long-term effects of COVID-19 in adolescents have become increasingly obvious as the pandemic has progressed. Long COVID, or "post-acute sequelae of SARS CoV-2 infection" has become more common in adolescents as cases have risen, with experts estimating it represents anywhere from 2% to 50% of all pediatric cases (Weiner, 2021). This condition is marked by "new, returning, or ongoing symptoms such as brain fog and chronic fatigue" for weeks or months after initial infection, which can result in serious complications in rare cases (Katella, 2021). Even after most United States schools have returned to in-person learning, symptoms such as these combined with high rates of student quarantines have contributed to educational disruption across the country—disruption that disproportionately affects students of color and students in low-income schools (Dworkin et al., 2022). All of these issues could be enduring: Experts have suggested that the idea of "herd immunity" is not applicable to COVID-19 due to "the harsh reality of new variants, waning immunity, and the rejection of vaccines by some Americans" (Johnson, 2022). Instead, they argue, the United States should be working towards "herd resistance", which occurs when enough of a population has protection against COVID-19 to prevent infection spikes and reduce the severity of the virus. This makes it even more crucial that the adolescent population is vaccinated to protect the vulnerable from potential future infection and prevent these consequences in the adolescents themselves.

Despite the risks mentioned above, many adolescents in the United States remain hesitant about receiving a COVID-19 vaccine. In one United States study conducted by the CDC in April 2021, only "52% of unvaccinated adolescents aged 13–17 years reported intent for adolescent COVID-19 vaccination" (Scherer et al., 2021). This number is significantly lower than similar age groups in other countries—a July 2021 study in China found that 75.6% of adolescents surveyed from November 2020 to March reported acceptance of a potential future vaccine (Cai et al., 2021); and a July 2021 study in Great Britain found that of adolescents surveyed from May to June of 2021, "86% of those aged 16 to 17 years reported positive sentiment towards a COVID-19 vaccine" (Vizard, 2021). The United States study reported that the main reasons for this hesitation among adolescents in the United States were a lack of "information about adolescent COVID-19 vaccine safety and vaccine efficacy" (Scherer et al., 2021); a December 2021 study also included concerns about contracting COVID-19 from the vaccine and a fear of needles (Middleman et al., 2021). These reasons are understandable when the majority of COVID-19 public health messaging targeting adolescents has provided little information "on the effectiveness of [COVID-19 safety] measures to keep other at-risk individuals connected to the [adolescents] safe from infection" and instead highlighted the lack of severity of the disease for adolescents (Abbott et al., 2021).

Another reason for this vaccine hesitancy in the United States is the rise of Americans accessing COVID-19 vaccine misinformation on digital social networks, including the news, websites, and social media. A study conducted

[1] About 17.4 million adolescents aged 12 to 17, as of April 17th, 2022 (*CDC COVID Data Tracker*, 2021)

by the Pew Research Center in 2020 found that "55% of Americans with access to the internet sought health or medical information online, with some reporting that the information they obtained influenced their health behaviors", a concerning trend considering "researchers found that 43% of websites propagated during a web search for "vaccination" and "immunization" comprised of anti-vaccination websites" (Garett & Young, 2021). Additionally, a report by the Centre for Countering Digital Hate determined that globally, between 2019 and 2020, "social media accounts held by so-called anti-vaxxers [had] increased their following by at least 7·8 million people", resulting in a total of "31 million people follow[ing] anti-vaccine groups on Facebook, with 17 million people subscribing to similar accounts on YouTube" (Burki, 2020). An analysis of anti-vaccination websites discovered that "arguments around the themes of safety and effectiveness, alternative medicine, civil liberties, conspiracy theories, and morality were found on the majority of websites analyzed", as well as misinformation (Kata, 2010). These anti-vaccine views are having a measurable effect on COVID-19 vaccine hesitancy: a 2021 study found that "relative to factual information, recent misinformation induced a decline in [COVID-19 vaccine intent] of…6.4 percentage points (95th percentile interval 4.0 to 8.8) in the USA" (Loomba et al., 2021). This presents alarming public health implications, as research has shown that adolescents "may have only average knowledge around COVID-19" (Mathews et al., 2021) and tend to be more vulnerable to online misinformation (Shrestha & Spezzano, 2021). Indeed, one study found that 57% of teens agreed that information that they had "read on social media concerned [had] concerned [them] about the safety of some vaccines" (Middleman et al., 2021).

Overall COVID-19 vaccination rates in Washington, D.C. have remained among the highest in the country—at 82 percent of the population having received at least one shot, the District is well above the national average of 70 percent, as of November 30th, 2021[2] (Ivory et al., 2021). This trend has remained generally consistent among older age groups, who, as the most vulnerable, were often the main focus of information campaigns about the dangers of the virus and the benefits of vaccination. However, it begins to falter among teenagers aged 12 to 17. In Washington, D.C., 66 percent of adolescents aged 12 to 15 and 62 percent of teenagers aged 16 to 17 have received at least one shot[3] (*Vaccination Data | Coronavirus*, 2021). This number falls even further when socio-demographic data are explored. Among Black residents of Washington, D.C., 42 percent of adolescents aged 12 to 15 and 43 percent of adolescents aged 16 to 17 reported that they had received at least one COVID-19 vaccine dose[4], compared to 71 percent of adolescents aged 12 to 15 and 61 percent of adolescents aged 16 to 17 among White residents[5], as of November 29th, 2021. Adolescents aged 12 to 17 were much less likely to be vaccinated against COVID-29 in Wards 7 and 8 (two districts of D.C.), in which 28 percent and 25 percent, respectively, of adolescents have reported being fully vaccinated[6] (*Vaccination Data | Coronavirus*, 2021). DC Council members have partially attributed this disparity to late and underdeveloped "efforts to distribute the vaccine equitably", which prioritized mass-vaccination sites in downtown areas and depended on a "hard-to-access registration system" (Fadulu & Brice-Saddler, 2021).

Though there have been many surveys on adolescent COVID-19 vaccine acceptability internationally (Afifi et al., 2021; Ainslie et al., 2021; Cai et al., 2021; Verger et al., 2021), it has yet to be fully studied in the United States. The COVID-19 vaccine acceptability of adult Americans has been well researched (Malik et al., 2020; Reiter et al., 2020; Shekhar et al., 2021), but current applicable research I have found on adolescents is limited to two nationwide studies (Middleman et al., 2021; Scherer et al., 2021). One other study discussing youth opinions on COVID-19

[2] About 95% of D.C. residents compared to 77% of all Americans, as of April 17th, 2022 (Ivory et al., 2021)
[3] About 85% of adolescents aged 12-15 and 83% of adolescents aged 16-17, as of April 17th, 2022 (*Vaccination Data | Coronavirus*, 2021)
[4] About 62% of Black adolescents aged 12 to 15, data of adolescents aged 16 to 17 not available, as of April 17th, 2022 (*Vaccination Data | Coronavirus*, 2021)
[5] About 104% of White adolescents aged 12 to 15, data of adolescents aged 16 to 17 not available, as of April 17th, 2022 (*Vaccination Data | Coronavirus*, 2021)
[6] Data of adolescents fully vaccinated per ward not available, as of April 17th, 2022 (*Vaccination Data | Coronavirus*, 2021)

vaccines was found (Brandt et al., 2021), but as this study did not disaggregate response data into adolescents and young adults it is not relevant to this paper. Both Dr. Scherer and Dr. Middleman's studies should be contextualized by survey timing. Dr. Scherer's study collected data before the FDA expanded the emergency use authorization for use of the vaccine in adolescents aged 12 to 15; and both studies collected data before the FDA fully approved the COVID-19 vaccine for use in those aged 16 and up, before the Delta and Omicron variants of COVID-19 became dominant in the US, and before most high school students had returned to in-person schooling. My research will focus on public high schools in Washington, D.C. in an attempt to determine how many students have received at least one shot of a COVID-19 vaccine and the main reasons for this uptake. I expect to be able to differentiate between different genders, wards, ages, and races to determine where opinions about COVID-19 vaccines differ in an effort to inform attempts to expand adolescent COVID-19 vaccine coverage in Washington, D.C. I predict that vaccine uptake will mimic that of the city: I believe White students will have a higher rate of COVID-19 vaccine acceptability than their Black counterparts and there will be differences among the different ages and wards, but that there will be little significant difference between genders.

Methods

In order to research the question effectively, I administered a survey to assess the acceptability of adolescent COVID-19 vaccination from February 2nd to 20th, 2022 to adolescents aged 12 to 17. This approach was a modified version of methods from a previously published study (Scherer et al., 2021) and was reviewed and approved by the School Without Walls Institutional Review Board. The format and many of the questions used in this study were drawn directly from the previous study with Dr. Scherer's permission. A total of 27 schools were contacted for research permissions—D.C. Public Schools that served grades 9 through 12 were identified through the District of Columbia Public Schools (DCPS) School Profiles, and Public Charter Schools across Washington, D.C. that served grades 9 through 12 were identified through the D.C. Charter School Alliance School Directory. The school administrators of each were contacted by email with a request for their school to participate in this research study. One D.C. Public School granted approval for research: School Without Walls High School (SWWHS). School administrators were given an online parental consent form to send out to their school communities in a schoolwide email. Parents were given a week from the outgoing school email to return the form. The number of parental consent form responses necessitated an online survey due to time constraints. A survey link was emailed to the students whose parents returned the form, using the student email that the parent provided. Participants were given an online Child Assent Form before they entered the survey, which informed them of their right to withdraw at any point, as well as the risks and benefits of their participation.

Survey questions were separated into five main sections. The first section asked respondents about their experiences regarding COVID-19, including whether they or a household member had ever contracted the virus and if they had received at least one dose of the COVID-19 vaccine. The second section asked about acceptability of the COVID-19 vaccine, including questions about the factors that contributed to vaccine acceptability and Health Belief Model questions to determine respondents' beliefs about the threat of COVID-19. The third section asked about locations respondents felt comfortable receiving the COVID-19 vaccine and trusted sources of COVID-19 information. The fourth section asked about parental vaccine intentions for the respondents and community vaccination levels in order to determine the amount of influence the surrounding community has on adolescent vaccine intent. The fifth and final section asked about respondents' demographics (e.g. race, grade, gender, ward, ethnicity) to identify significant relationships and trends between responses and demographic groups. Two questions about age and high school were asked at the beginning of the survey to ensure respondent eligibility, and the remaining demographic questions were placed at the end of the survey to maximize responses (*Writing Survey Questions*). All of the questions were either multiple-choice or multiple-select to ensure that survey data would be easy to analyze. Participants were given a week to complete the survey after the window to return the parental consent form had closed.

Results

Using data collected by an internet survey of the School Without Walls High School community, the factors contributing to adolescent vaccination intent were assessed among teenagers aged 14 to 17 years old. Among the 600 students attending the high school, 46 students participated in the study, about 8% of the school. Eight of these students were excluded because they indicated that they were 18 years of age or older. The final sample was comprised of 37 students.

Table 1. Respondent characteristic versus COVID-19 health belief model

Respondent Group/Characteristic	No.	% of Sample	Concern about contracting COVID-19*	Concern about infecting others with COVID-19**
Adolescents aged 13-17 yrs				
Total	**37**	**100**	**3.6**	**4.2**
Respondent grade level				
9	9	29.0	3.3	4.0
10	7	22.6	3.1	4.4
11	6	19.4	4.0	4.5
12	9	29.0	3.9	4.0
p-value	—	—	<0.1†	0.7
Respondent gender				
Male	5	16.1	2.5	4.0
Female	23	74.2	3.6	4.3
Non-binary/third gender	2	6.5	4.5	4.0
D.C. ward				
Ward 1	5	16.1	3.6	4.0
Ward 2	1	3.2	3.0	5.0
Ward 3	8	25.8	3.8	4.3
Ward 4	6	19.4	3.3	4.5
Ward 5	2	6.5	5.0	4.0

Ward 6	8	25.8	3.3	4.0
Ward 7	0	—	—	—
Ward 8	0	—	—	—
Ethnicity				
Hispanic/Latinx	2	6.7	4.0	4.0
non-Hispanic/Latinx	28	93.3	3.5	4.2
Race				
American Indian/Alaskan Native	1	2.9	5.0	5.0
Asian	3	8.8	2.7	5.0
Black/African-American	3	8.8	3.7	3.7
Native Hawaiian/Pacific Islander	0	—	—	—
White	26	76.5	3.6	4.4

* Mean value of responses to the statement “I am concerned about the possibility of getting COVID-19”, on a scale of 1 (strongly disagree) to 5 (strongly agree).
**Mean value of responses to the statement “I could spread COVID-19 to someone else and make them sick”, on a scale of 1 (strongly disagree) to 5 (strongly agree).
†Indicates a significant group difference based on chi-squared analysis with $p<0.1$

The primary measures used in this survey were self-reported concern about contracting COVID-19 and concern about infecting others with COVID-19. Chi-squared analyses were conducted on the results to test for differences between groups using Qualtrics Data Analysis, and then means were taken of each population. When asked to rate agreement with the statement, “I am worried about the possibility of getting COVID-19”, on a scale of 1 (strongly disagree) to 5 (strongly agree), the mean response was 3.6 with no significant difference among different genders or wards. There was, however, a significant relationship between grade and reported concern: 10th-grade students reported the lowest levels of concern (mean value of 3.1), followed by 9th-grade students (mean value of 3.3) and 12th-grade students (mean value of 3.9), while 11th-grade students reported the highest levels of concern (mean value of 4.0). When asked to rate agreement with the statement, “I could spread COVID-19 to someone else and make them sick”, on a scale of 1 (strongly disagree) to 5 (strongly agree), the mean response was 4.2 with no significant difference among different genders, wards, or grades (Table). I was not able to use Chi-squared analyses to test for differences among students of different races or from different wards due to the limited number of responses.

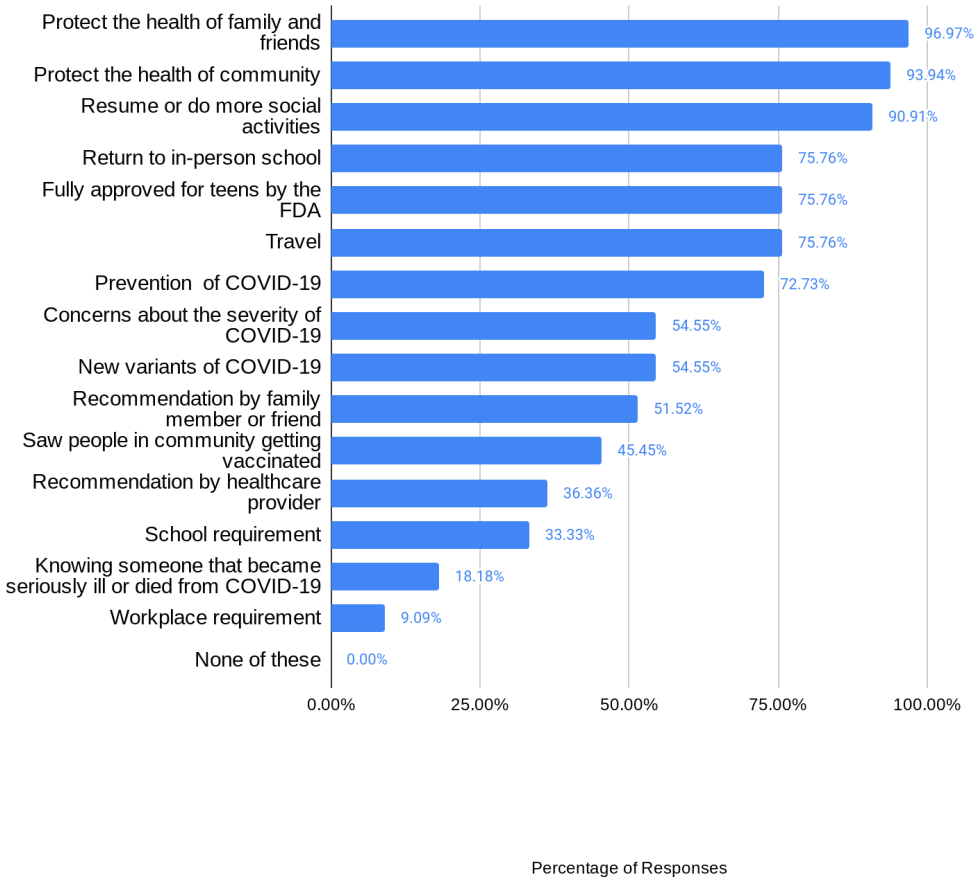

Figure 1. Self-reported factors that contributed to adolescent COVID-19 intent according to D.C. vaccinated adolescents aged 14-17 years

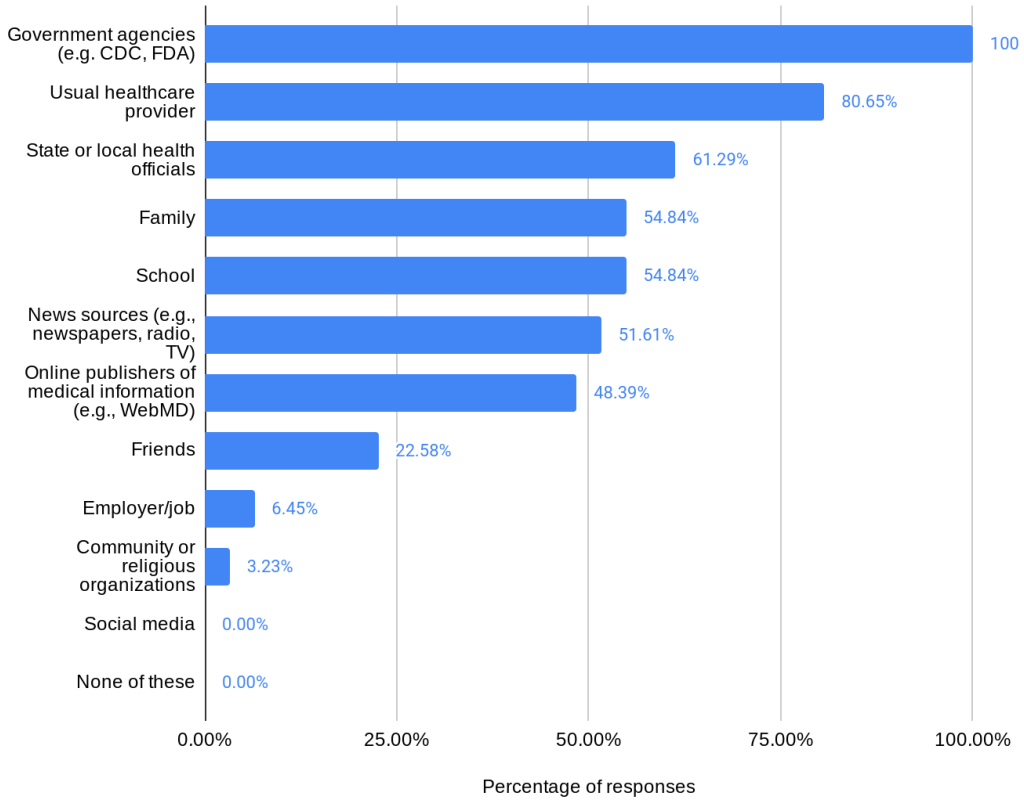

Figure 2. Trusted COVID-19 information sources according to D.C. adolescents aged 14-17 years

Secondary measures were factors that contributed to adolescent COVID-19 vaccine intent and trusted sources of vaccines and COVID-19 information. Approximately 97% of respondents reported having received at least one dose of the COVID-19 vaccine. Among participants who reported having received at least one dose of the COVID-19 vaccine, protecting the health of family and friends (97.0% of respondents), protecting the health of the community (93.9%), and resuming or doing more social activities (90.9%) were the most common factors that contributed to adolescent COVID-19 vaccine intent. Surprisingly, preventing COVID-19 in themselves (72.7%) and concerns about the severity of COVID-19 (54.6%) were not among the top five factors (Figure 1). Respondents reported feeling most comfortable receiving the COVID-19 vaccine at their doctor's or clinic (93.3% of respondents), a local pharmacy (86.7%), or a temporary indoor clinic (86.7%). The most trusted sources of COVID-19 information were government agencies such as the CDC and the FDA (100% of respondents), their usual health care provider (80.7%), and state or local health officials (61.3%). No respondents selected social media as a trusted source of COVID-19 information (Figure 2).

Discussion/Conclusion

School Without Walls High School students appear to have received at least one shot of the COVID-19 vaccine at a higher rate than the general adolescent population. Approximately 97% of participants reported having received at least one shot compared to 95% of all Washington, D.C. residents as of April 17th, 2022 (Ivory et al., 2021), as well as 100% of participants aged 12 to 15 compared to 85% of all Washington, D.C. adolescents aged 12 to 15 as of April 17th, 2022 (*Vaccination Data | Coronavirus*, 2021). A likely reason for this is that SWWHS students are better

informed than the general population about COVID-19 and the risks of contracting it. Participants rated reliable sources of COVID-19 information (e.g. government agencies such as the CDC and the FDA, usual health care providers, and state or local health officials) as trusted sources of COVID-19 information at a much higher rate than participants in Dr. Aaron Scherer's nationwide study. Furthermore, participants were much less likely to select less reliable sources of COVID-19 information, such as social media, as trusted sources of COVID-19 information than participants in Dr. Scherer's study. This media literacy likely makes SWWHS less susceptible to COVID-19 vaccine misinformation, which could therefore result in a higher COVID-19 vaccine acceptability rate.

This level of COVID-19 vaccine awareness is also a potential reason that SWWHS students were more conscious of the risk of infecting others with COVID-19. As one article reported, one reason that adolescents have been less likely to follow proper COVID-19 safety measures, such as getting a COVID-19 vaccine, is failures in "COVID-19 communication efforts targeting adolescents and young adults" that have mainly focused on "highlight[ing] an individual's perceived susceptibility to and their perceived severity of [COVID-19]", a strategy that is less successful in improving adolescent vaccine acceptability because adolescents are "unlikely to experience severe effects" (Abbott et al., 2021). This awareness of milder symptoms in adolescents compared to adults is evident in participants' responses—the mean of responses on a Likert scale to the statement "I am worried about the possibility of getting COVID-19" was 3.6, between the "Neutral" and "Agree" answer choices (Table), and when asked to rate the factors that contributed to their COVID-19 vaccine uptake, neither preventing COVID-19 in themselves (72.7% of respondents) nor concerns about the severity of COVID-19 (54.6% of respondents) were among the top five factors (Figure 1). Instead, the high level of vaccine acceptability in SWWHS students is more likely due to an awareness of the risk of infecting others who are more vulnerable. That same article recommended that communication efforts targeting adolescents and young adults "focus messaging on severity from the perspective of individuals with meaningful connections to [adolescents and young adults] such as older family members and those with pre-existing health conditions" in order to increase adolescent and young adult participation in COVID-19 safety measures (Abbott et al., 2021). Respondents appear to have internalized this message if they were exposed to it: the mean of responses on a Likert scale to the statement "I could spread COVID-19 to someone else and make them sick" was 4.2 (Table), slightly above the "Agree" answer choice, and protecting the health of family and friends and protecting the health of the community were the top two factors respondents identified when asked why respondents had received a COVID-19 vaccine (Figure 1).

This form of COVID-19 communication could be used to increase the vaccine acceptability of D.C. adolescents. Approximately 15 percent of D.C. adolescents aged 12 to 15 and 17 percent of D.C. adolescents aged 16 to 17 remain unvaccinated as of April 11th, 2022 (*Vaccination Data | Coronavirus*, 2021). This population is larger when examining Black residents in Washington, D.C. , and residents who live in Wards 7 and 8. Focusing COVID-19 communication efforts that target adolescents on the risk of infecting others close to them who may experience more severe effects would likely help increase COVID-19 vaccination coverage among D.C. adolescents.

Limitations

The results of this paper are subject to at least three limitations: Firstly, this research was restricted to a case study. As a DCPS high school student, I had to contact schools individually for permission to conduct research. This was made especially difficult because school administrators have been extremely busy coordinating students' return to in-person learning and were wary about taking on additional work. This limits the potential for generalizability, as School Without Walls students might be different from DCPS students overall. Secondly, this survey was only available online and in English, which could yield an underrepresentation of students and families who have limited English proficiency or internet access. Thirdly, the time constraint created by the AP Research project timeline restricted the amount of time I was able to allow schools to respond to emails asking for their permission to conduct this survey, the amount of time allowed to parents to return the parental consent forms, and the amount of time allowed to School Without Walls students to submit their survey responses. This made the Chi-squared analyses I conducted more

volatile due to the smaller sample size. Both the second and the third limitations likely contributed to a response bias—the respondents were overwhelmingly White (75.8% of respondents) and female (76.7% of respondents), which is not representative of School Without Walls High School as a whole, DCPS, or all D.C. adolescents. Additionally, no respondents said that they lived in Wards 7 or 8, which is representative of School Without Walls High School but is not representative of DCPS or all D.C. adolescents. These limitations could be addressed in future research with a larger sample size, and a more D.C.-representative pool of respondents.

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