



Older adolescents and young adults willingness to receive the COVID-19 vaccine: Implications for informing public health strategies



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ABSTRACT

Importance: The success in ending the COVID-19 pandemic rests partly on the mass uptake of the COVID-19 vaccine. Little work has been done to understand vaccine willingness among older adolescents and young adults. This is important since this age group may be less likely to adhere to public health guidelines.

Objective: To understand willingness of getting a vaccine and reasons for vaccine hesitancy among a sample of older adolescents and young adults.

Design: Data were from the Well-Being and Experiences study (The WE Study), a longitudinal community-based sample of older adolescents and young adults collected from Winnipeg, Manitoba, Canada from 2017 to 2020 (n = 664).

Setting: The study setting was a community-based observational longitudinal study.

Participants: Participants for the study were aged 14 to 17 years old at baseline in 2016–17 (n = 1000). Data were also collected on one parent/caregiver. Waves 2 (n = 747) and 3 (n = 664) were collected in 2019 and 2020, respectively.

Exposures: The main exposures were sociodemographic factors, health conditions, COVID-19 knowledge, and adversity history.

Main Outcomes: The main outcomes were COVID-19 vaccine willingness, hesitancy, and reasons for hesitancy.

Results: Willingness to get a COVID-19 vaccine was 65.4%. Willingness did not differ by age, sex, or mental health conditions, but did differ for other sociodemographic characteristics, physical health conditions, COVID-19 knowledge, practicing social/physical distancing, and adversity history. The most common reasons for not wanting a vaccine were related to safety, knowledge, and effectiveness. Sex differences were noted.

Conclusions and Relevance: Increasing uptake of the COVID-19 vaccine among older adolescents and young adults may rely on targeting individuals from households with lower income, financial burden, and adversity history, and generating public health messaging specifically aimed at vaccine safety, how it works to protect against illness, and why it is important to protect oneself against a COVID-19 infection.

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1. Introduction

During 2020, the COVID-19 pandemic had a significant impact on health and well-being worldwide, which continues to persist well into 2021. COVID-19 vaccines were rapidly developed [1,2] with some already approved and available to individuals ages

16 years and older [3]. The success of ending the COVID-19 pandemic rests in large part on mass uptake of vaccines. Historically, some individuals have been unwilling to receive vaccines [4] and vaccine hesitancy has been noted as a threat to global public health [5]. Vaccine hesitancy captures a spectrum for why people may delay acceptance, accept some, or refuse all vaccines, [6] with commonly identified reasons being complacency, inconvenience, and lack of confidence [5]. In Canada, vaccine hesitancy has been identified as an important issue to address with respect to parental acceptance of childhood immunizations, [7–9] uptake of HPV vaccines, [10,11] and concerns related to the COVID-19 vaccine among adults [12]. It is not yet clear to what degree hesitancy towards COVID-19 vaccines may be similar to vaccine hesitancy in general, making this an important research gap.

Several studies using adult samples age 18 years or older have found that approximately 24% to 42.4% would not receive the COVID-19 vaccine or were unsure [13–17]. In a study of caregivers, 33% did not plan to provide the COVID-19 vaccine to their children when available [18]. In a study from Manitoba, Canada, 26% of adults aged 18 years and older were hesitant about the COVID-19 vaccine [17]. Understanding why one is hesitant about getting immunized is important for informing public health efforts; particularly when dealing with Public Health Emergencies of International Concern (PHEIC) [19]. A systematic review of studies examining the confidence and receptivity for COVID-19 vaccines noted several important findings related to lower acceptance of the vaccine including: fear of side effects, safety, effectiveness, belief that it is unnecessary, inadequate information, unknown duration of immunity, and general anti-vaccination belief [20]. Differences in willingness to get COVID-19 vaccines were noted for age, sex, education, and income with some inconsistencies found across studies [20].

A current knowledge gap is whether other factors such as having a health condition or a childhood adversity history might be related to COVID-19 vaccine willingness. Previous studies indicate that less contact with health care systems and not having a pre-existing medical condition is related to lower uptake of influenza vaccines [21]. Likewise, a large literature indicates that adverse childhood experiences (ACEs) are related to an increased likelihood of poor health outcomes and emergency department visits [22–26]. However, despite this, several studies have indicated that an ACEs or child abuse history is related to being more likely to cancel or not show up to medical appointments, [25,27] and to have not had a physician checkup in the past year [28]. Research has also shown a relationship between an ACEs history and challenges to accessing healthcare [29]. It is possible that vaccine uptake or vaccine hesitancy may also be more likely among individuals who have experienced ACEs. We also know social inequities are associated with vulnerability to COVID-19 [30,31]. Certain communities and individuals with a history of adversity may have limited access to health care and may be disproportionately affected by the virus. Importantly, how ACEs may be related to vaccine hesitancy has not been previously studied. Extending knowledge in this area may have important implications for informing public health efforts.

Although several studies on COVID-19 vaccine willingness and hesitancy have been conducted, these studies have mainly focused on adult samples aged 18 years and older [20]. Understanding willingness to receive the COVID-19 vaccine, especially among older adolescents and young adults, remains an important public health priority. While some COVID-19 vaccines are approved for ages 16 years and older, [3] many vaccines to date have been developed and tested only on adult samples aged 18 years and older [2]. Limited global vaccine supply and priorities to inoculate other individuals such as front-line health care workers and the elderly, also means that this young age group has been understudied because

it may be several months before they are offered vaccines. However, older adolescents and young adults remain an important group requiring further examination for three main reasons. First, adolescents/young adults often misjudge exposure to hazards by believing they are less susceptible to harm or adverse outcomes compared to others; a concept known as optimistic bias [32,33]. Second, widespread availability of vaccines for individuals age 16 years and older will soon be available and a proactive and targeted public health strategy for these individuals may improve vaccine uptake. Third, older adolescents and young adults may have greater potential to spread COVID-19 due to increased likelihood of socialization and reduced adherence to public health guidelines [34,35]. Reducing COVID-19 infections with increased uptake of effective vaccines among older adolescents and young adults may be one strategy to reduce and prevent the spread of COVID-19. To do this, it is important to understand the willingness to receive a COVID-19 vaccine and reasons for hesitancy specifically among older adolescents and young adults.

The objectives of the current study of older adolescents and young adults (16 to 21 years) are: 1) to determine the willingness of getting a COVID-19 vaccine; 2) to determine if differences exist in willingness to get a COVID-19 vaccine based on age, sex, parental education, household income, financial burden during COVID-19, self-reported knowledge of COVID-19, practicing social/physical distancing, having a mental or physical health condition, or having an ACE history; and 3) to understand the most common reasons for COVID-19 vaccine hesitancy and if differences exist based on sex and age.

2. Methods

2.1. Data and sample

The sample was drawn from the Well-Being and Experiences (WE) Study, a three-wave longitudinal and intergenerational community survey conducted in Winnipeg and surrounding rural areas in Manitoba, Canada. Data were collected from 2017 to 18, 2019, and 2020 for Wave 1 (baseline $n = 1002$), Wave 2 ($n = 748$), and Wave 3 ($n = 664$), respectively. Data for the present study were mainly from Wave 3 when respondents were 16 to 21 years old. The overall retention rate at Wave 3 was 66.4% (75% at Wave 2 and 88.8% retained from Waves 2 to 3). The sampling design used three recruitment methods: random digit dialing (21%), referrals (40.6%), and community advertisements (38.4%). Few differences were found based on sampling methods and with no differences noted for age, grade, ethnicity, and several adverse childhood experiences [36]. Forward Sortation Area from postal codes, sex, income, and ethnicity were observed to confirm the baseline sample was closely representative of the population from which it was drawn [37]. Data were collected using computer-based questionnaires. Wave 3 data were collected between November and December 2020. All respondents provided informed consent. The Health Research Ethics Board at the University of Manitoba provided ethics approval.

3. Measures

3.1. Covid-19

Willingness to get a COVID-19 vaccine was assessed by asking “If a COVID-19 vaccine was available would you get it?” Those who responded “no”, “maybe” or “I don’t know” were subsequently asked “Why would you NOT get a COVID-19 vaccine if it was available?” Refer to Table 3 for fixed response options. An “other” open-ended response option was also provided.

Financial burden during the pandemic was assessed with the question: “Have you or your family experienced financial difficulties because of the COVID-19 pandemic?” COVID-19 knowledge was assessed with the question: “How much do you know about COVID-19?” Respondents were also asked if they practiced social/physical distancing or self-isolation because of the COVID-19 pandemic. Refer to Table 1 for the fixed response options for these constructs.

3.2. Sociodemographic characteristics

Respondent age was stratified into older adolescents (ages 16–17 years) and young adults (ages 18–21 years). Sex (male, female) was collected at Wave 1 from the adolescent respondent. Household income and parent education were previously collected from the parent/caregiver at Wave 1. Household income was coded into three categories (\$49,999 or less, \$50,000 to \$99,999, \$100,000 or more) and parent education was dichotomized (trade school, community college or less compared to university undergraduate or graduate degree) for the present study.

3.3. Mental and physical health

Current self-reported mental and physical health conditions were assessed with the multiple fixed response question “Do you currently have a long-term health condition that is expected to last or has lasted 6 months or more and has been diagnosed by a medical doctor or other health care professional?”. Mental health conditions included depression, bipolar disorder, anxiety disorder, obsessive-compulsive disorder, posttraumatic stress disorder, attention-deficit/hyperactivity disorder, eating disorder, alcohol

problems, drug problems, oppositional defiant disorder, and conduct disorder. Physical health conditions included asthma, allergies, migraines, diabetes, thyroid disease, epilepsy, seizures, cerebral palsy, kidney condition/disease, Crohn’s disease, colitis, irritable bowel syndrome, celiac disease, stomach/intestinal ulcers, eczema, psoriasis, acne, hypertension, cancer, and HIV/AIDS. These two variables were each dichotomized (yes/no) if they reported having any of the listed conditions.

3.4. Adverse childhood experiences

ACEs were assessed at Waves 1 to 3 and included child maltreatment, household challenges, and peer victimization [38]. Some child maltreatment types were assessed differently among adolescents and young adults due to reporting laws for minors. Among adults (18 years and older at Waves 2 or 3 depending on age), physical abuse, sexual abuse, emotional abuse, physical neglect, and emotional neglect were assessed with the Childhood Trauma Questionnaire (CTQ) referring to experiences before the age of 16 years [39]. Each ACE was coded with binary (yes/no) classifications informed by CTQ guidelines. Exposure to physical intimate partner violence (IPV) was defined as seeing or hearing parents, step-parents or guardians hit each other or another adult in your home 3–5 times or more. Among adolescents (16 to 17 years), physical abuse, sexual abuse, and physical neglect were not measured. Emotional abuse was defined as having a parent or guardian say hurtful or mean things once a month or more. Emotional neglect was assessed using the CTQ and coded the same as for adults. Exposure to verbal IPV was defined as having seen or heard adults say hurtful or mean things to another adult in your home monthly or more. Spanking, assessed at Wave 1 among all

Table 1
Willingness to get a Covid-19 Vaccine.

	Total Sample %	Willingness to get a COVID-19 Vaccine			X ² (df)
		Yes %	No %	Maybe/I don't know%	
Age					
16 and 17 years	39.5	64.9	7.0	28.2	1.87 (2)
18 to 21 years	60.5	65.8	9.4	24.7	
Sex					
Male	45.3	67.4	7.2	25.4	1.48 (2)
Female	54.7	63.6	9.5	26.9	
Parental education					
Trade school, community college or less	46.1	58.0	12.3	29.7	17.15 (2) ***
University undergraduate or graduate degree	53.9	71.7	5.1	23.1	
Household income					
\$49,999 or less	15.8	52.1	9.4	38.5	20.93 (4) ***
\$50,000 to \$99,999	38.0	60.8	9.3	30.0	
\$100,000 or more	46.2	74.5	6.2	19.3	
Financial burden during COVID-19					
Quite a bit/A lot	10.6	51.5	23.5	25.0	38.20 (8) ***
Some	13.8	58.0	11.4	30.7	
A little	25.0	69.3	5.5	25.2	
Not at all	45.4	71.5	4.8	23.7	
I don't know	5.2	45.5	15.2	39.4	
Self-reported COVID-19 knowledge					
Nothing / A little	6.4	50.0	9.5	40.5	15.01 (4) **
Some	43.5	63.6	6.0	30.4	
A lot	50.1	69.4	10.2	20.4	
Social/Physical distancing					
Not at all/ a little/some	11.2	50.0	12.9	37.1	13.19 (4) **
Quite a bit	35.4	62.2	8.7	29.1	
A lot	53.5	70.9	7.2	21.9	
Self-reported mental health condition (current)					
Yes	35.1	66.5	8.5	25.0	0.16 (2)
No	64.9	65.0	8.6	26.4	
Self-reported physical health condition (current)					
Yes	38.7	67.8	4.7	27.5	7.63 (2) *
No	61.3	64.1	11.1	24.9	

* p < .05; ** p < .01; *** p < .001

respondents, was defined as responding “2–3 times a year” or more often to the question “In a typical year, when you were 10 years or younger, about how often do you remember an adult spanking you with their hand on your bottom (bum)?”.

A history of peer victimization was assessed at both Waves 1 and 2 with the same seven items referring to the past 12 months and required a response of “once a month” or more often to at least one item at either wave. At Wave 1 these experiences referred to “a friend, peer, kid at school, or other young person (not an adult or sibling)” and at Wave 2 referred to “a friend, peer or current or former classmate (not sibling)”. The seven items assessed physical, verbal, social, cyber, and three discriminatory forms of peer victimization (e.g., “said something bad about your race, culture, or religion”).

The remaining ACEs, categorized as household challenges ACEs, used the same measurements among all respondents referring to experiences before the age of 16 years. Household substance abuse was defined as responding “yes” to either one or both of the questions “Did a parent or other adult living in your home ever have problems with alcohol or spend a lot of time drinking or being hung over?” and “Did a parent or other adult living in your home ever have problems with drugs?”. Household mental illness was defined as an responding yes to the question “Did a parent or other adults living in your home ever have mental health problems like depression or anxiety?”. Parental separation or divorce was defined as responding “yes” to the question “Were your biological parents ever separated or divorced?”. Parental trouble with the police was defined as responding “yes” to the question “Did a parent or other adult living in your home ever have problems with the police?”. Parental gambling was defined as responding “yes” to the question “Did a parent or other adult living in your home ever have problems with gambling?”. Foster care or child protective organization (CPO) contact was defined as responding “yes” to “Did you ever see or talk to anyone from a child protective organization (like social services, child welfare, children’s aid, or the Ministry) due to difficulties at home?” and/or “Have you ever been placed in a foster home or group home by Child and Family Services?”. The household running out of money and unsafe neighbourhood ACEs were assessed at Wave 1. Household running out of money was defined based on responding “sometimes” or more often to either or both of the questions “How often does your family run out of money or find it hard to pay for... rent or mortgage on your house?” and “... basic necessities like food or clothing?”. Unsafe neighbourhood was defined as responding either “disagree” or “strongly disagree” to the statement “I feel safe in my community”. Individual ACEs were examined as well as any child maltreatment and/or peer victimization ACE, any household challenge ACE, and any ACE [38].

3.5. Data analysis

Descriptive characteristics of the entire sample and by vaccine willingness were computed with chi-square tests of independence. Next, multinomial logistic regression was used to examine the association between each ACE and vaccine willingness after adjusting for adolescent sex, adolescent age, and household income. Interaction between ACEs with age group and sex were tested. Last, reasons for COVID-19 vaccine hesitancy were summarized overall and by sex and age group. Sex and age differences were examined with binary logistic regression models. Statistical significance was determined with $p < .05$.

4. Results

Characteristics for the entire sample and by willingness to get a COVID-19 vaccine are shown in Table 1. Overall, 65.4% of respon-

dents indicated they would get a COVID-19 vaccine if available, 8.5% indicated they would not, and 26.1% were unsure. Willingness to get a COVID-19 vaccine did not differ by sex, age group, or having a mental health condition, but differed by parent education, household income, financial burden due to the pandemic, self-reported knowledge of COVID-19, practicing social/physical distancing, and having a physical health condition.

Table 2 displays respondents’ willingness to get a COVID-19 vaccine by ACE history after adjusting for adolescent sex, adolescent age, and household income. The correlation between household income and household running out of money was conducted to assess multicollinearity in the models. The biserial correlation was -0.47 (standard error = 0.042), which is low enough to include both variables in the model [40]. Respondents with a history of spanking, peer victimization, household substance abuse, foster care/CPO contact, household running out of money, and any household challenges ACEs compared to those without such histories had a significantly lower likelihood of being willing to get a COVID-19 vaccine (relative risk ratio [RRR] range = 0.33 to 0.49). Respondents with a history of spanking, foster care/CPO contact, household running out of money, and parental gambling also had a significantly lower likelihood of responding “maybe/I don’t know” (RRR range = 0.15 to 0.38) compared to responding “no”. The ACE and age group and ACE and sex interaction terms were non-significant indicating no sex or age differences between ACE history and vaccine willingness.

Table 3 summarized the reasons for vaccine hesitancy. Overall, the most prevalent reasons among those who responded no, maybe, or I don’t know to receiving a COVID-19 vaccine were thinking the vaccine is not safe (64.5%), not knowing enough about the vaccine (60.6%), and thinking the vaccine would not work (23.4%). Sex differences were noted. Males were more likely to indicate not being concerned about getting COVID-19 and females were more likely to indicate not knowing enough about the COVID-19 vaccine. A summary of the open-ended responses for reasons for not wanting a COVID-19 vaccine included: concerns for vaccine safety because participants perceived that COVID-19 vaccine development was rushed and protocols were skipped, media reports of people getting sick from the vaccine, not enough research on the vaccine, side effects cannot be known in the short term, and fear of needles.

5. Discussion

The novel findings from this study are as follows. First, sex, age, and having a mental health conditions were not related to willingness to get a COVID-19 vaccine. Second, parent/caregiver educational attainment, household income, financial burden due to the pandemic, self-reported COVID-19 knowledge, practising social/physical distancing, and having a physical health condition were related to significant differences in willingness to get a COVID-19 vaccine. Third, spanking, household substance abuse, foster care/CPO contact, household running out of money, and any household challenges ACE were associated with decreased willingness of getting a COVID-19 vaccine. Fourth, the most common reasons for not getting a COVID-19 vaccine were related to safety concerns, knowledge, and effectiveness. Finally, sex differences were found for two reasons for not getting a COVID-19 vaccine. These findings are useful for informing public health strategies for improving willingness and uptake of the COVID-19 vaccine among older adolescents and young adults. To date, little focus has been placed on this group, which is a significant gap in knowledge that might have an impact on efforts to reduce and prevent COVID-19 transmission. Having a public health strategy in place before wide-spread availability of the vaccine for this age group may increase willingness to receive the vaccine.

Table 2
Willingness to get a COVID-19 Vaccine by Adverse Childhood Experiences History.

Adverse Childhood Experience (ACE)	Yes %	No %	Maybe/I don't know %	Yes vs No ARRR (95% CI)	Maybe/I don't know vs No ARRR (95% CI)
Physical abuse ^a	9.5	14.3	10.6	0.80 (0.25–2.57)	0.90 (0.25–3.22)
Sexual abuse ^a	18.4	17.1	19.2	1.16 (0.43–3.14)	1.06 (0.36–3.10)
Emotional abuse ^b	24.1	22.6	32.0	1.08 (0.52–2.25)	1.45 (0.67–3.13)
Physical neglect ^a	16.9	16.7	19.6	1.02 (0.39–2.70)	1.03 (0.36–2.95)
Emotional neglect	12.3	20.8	15.8	0.58 (0.27–1.24)	0.65 (0.28–1.49)
Exposure to IPV ^b	14.0	14.6	17.7	1.04 (0.40–2.71)	1.09 (0.40–2.99)
Spanking ^c	25.8	54.0	30.6	0.33 (0.17–0.62) **	0.38 (0.19–0.76) **
Peer victimization ^{c,d}	36.8	50.0	40.3	0.49 (0.25–0.96) *	0.50 (0.24–1.04)
Any Child Maltreatment and/or Peer Victimization ACE	68.1	79.6	75.9	0.48 (0.22–1.07)	0.66 (0.28–1.56)
Household substance abuse	13.7	29.4	20.3	0.41 (0.20–0.83) *	0.58 (0.27–1.23)
Household mental illness	41.4	38.3	41.9	1.38 (0.69–2.76)	1.22 (0.58–2.57)
Parental separation/divorce	21.7	34.0	27.2	0.62 (0.30–1.27)	0.58 (0.27–1.26)
Parental trouble with police	5.3	6.0	11.5	0.93 (0.26–3.32)	1.76 (0.49–6.38)
Parental gambling	4.2	6.3	1.2	0.67 (0.18–2.47)	0.15 (0.02–0.98) *
Foster care/CPO contact	10.0	24.1	12.7	0.34 (0.16–0.72) **	0.33 (0.14–0.75) **
Household running out of money ^c	15.1	34.7	18.1	0.45 (0.21–0.97) *	0.36 (0.16–0.84) *
Unsafe neighbourhood ^c	3.8	7.4	3.5	0.71 (0.19–2.60)	0.53 (0.12–2.24)
Any Household Challenges ACE	61.1	78.4	72.1	0.45 (0.20–0.99) *	0.54 (0.23–1.28)
Any ACE	84.3	92.3	91.4	0.43 (0.13–1.43)	0.64 (0.17–2.35)

Abbreviations: ARRR = Adjusted relative risk ratio; CI = confidence interval; IPV = intimate partner violence; CPO = child protective organization.

ARRRR adjusted for adolescent sex, adolescent age, and household income.

* $p < .05$; ** $p < .01$; *** $p < .001$.

^a measured among adults only.

^b measured differently for adults and adolescents.

^c collected at Wave 1.

^d collected at Wave 2.

Table 3
Reasons for COVID-19 Vaccine Hesitancy by Sex and Age.

Reason for not getting a COVID-19 vaccine	Overall %	Males%	Females %	OR (95% CI) ^a	Older Adolescents 16–17 years %	Young Adults 18–21 years %	OR (95% CI) ^b
Worried that vaccine is not safe	64.5	59.2	68.4	1.49 (0.87–2.57)	62.4	65.9	1.17 (0.68–2.02)
Do not know enough about the COVID-19 vaccine	60.6	49.0	69.2	2.34 (1.36–4.01) **	60.2	60.9	1.03 (0.60–1.76)
Do not think it will work	23.4	21.4	24.8	1.21 (0.65–2.26)	22.6	23.9	1.08(0.58–2.01)
It might cost me money to get it	16.0	15.3	16.5	1.10 (0.54–2.24)	19.4	13.8	0.67(0.33–1.35)
Not concerned about getting COVID-19	15.2	23.5	9.0	0.32 (0.15–0.69) **	14.0	15.9	1.17(0.56–2.45)
I do not get any vaccines	6.1	8.2	4.5	0.53 (0.18–1.58)	7.5	5.1	0.66 (0.22–1.94)
Other health conditions that prevent me from getting vaccines	4.3	5.1	3.8	0.73 (0.20–2.58)	NR	NR	6.42 (0.80–51.54)
I don't know how to get it	4.3	5.1	3.8	0.73 (0.20–2.58)	4.3	4.4	1.01(0.28–3.69)
Do not have time	3.0	NR	NR	0.98 (0.21–4.49)	NR	NR	4.18(0.50–35.32)
Had COVID-19	2.6	NR	NR	–	NR	NR	0.67(0.13–3.38)
Religious reasons	2.2	NR	NR	1.11 (0.18–6.76)	NR	NR	0.44 (0.07–2.69)
Other	12.6	10.2	14.3	1.47 (0.65–3.31)	11.8	13.0	1.12(0.50–2.49)
No response	7.4	12.2	3.8	0.28 (0.10–0.82) *	8.6	6.5	0.74(0.28–2.00)

Abbreviations: OR = odds ratio; CI = confidence interval; NR = not releasable.

* $p < .05$; ** $p < .01$; *** $p < .00$.

^a Males are the reference group.

^b Older adolescents are the reference group.

In the current sample, 65.4% indicated willingness to get the COVID-19 vaccine, which is similar other studies using data from several countries from around the world (57.6% to 76%) using adult respondents aged 18 years and older [13–17]. Consistent with some previous studies, education and income were related to willingness to get a COVID-19 vaccine [20]. However, not consistent with other studies, age and sex were not related to overall vaccine willingness [20]. This is likely due to the current sample having a more narrow age range (16–21 years) compared to the others studies (18 years and older). The current study extends knowledge with the findings that unwillingness to get a COVID-19 vaccine is related to parent/caregiver education, lower household income, and financial burden due to the pandemic. Collectively, these factors provide targets for public health messaging. As well, increased self-reported COVID-19 knowledge and practicing social/physical distance were related to willingness of getting a vaccine, providing further support for public health education.

A history of having specific ACEs (i.e., spanking, household substance abuse, foster care/CPO contact and household running out of money) were related to a decreased likelihood of willingness to get a COVID-19 vaccine. To date there is no literature on ACEs and vaccine uptake. What is known is that an ACEs history is related to self-reported barriers to health care, cancelled and no-show medical appointments, and decreased likelihood of seeing a physician in the past year [25,27–29]. It is possible that the associations between some ACEs and vaccine hesitancy may be similar to these other medical health care utilization challenges. These data indicate that individuals with certain ACEs histories may be less willing to be inoculated and may highlight an important target for public health strategies aimed at improving access to health care by addressing vaccine uptake and increasing knowledge of vaccine safety and efficacy. More work in this area is warranted.

Importantly, 26.1% of the current sample were unsure (maybe or I don't know) about receiving a COVID-19 vaccine. It is possible

that understanding and using these reasons for vaccine hesitancy to inform public health efforts could help to increase inoculation by a significant proportion. The top three reasons for not wanting a COVID-19 vaccine were worries about vaccine safety (64.5%), not knowing enough about COVID-19 vaccines (60.6%), and thinking the vaccine will not work (23.4%). These reasons are similar to those found in other studies using adult samples [20,41]. More self-reported knowledge of COVID-19 and practicing more social/physical distancing was related to willingness to get a vaccine. Providing evidence about the COVID-19 vaccine and how it works to protect against infection using simple explanations may contribute to increased willingness to be inoculated. These findings identify important targets for public health strategies aimed at increased vaccine uptake among older adolescents and young adults.

Age differences were not noted indicating different public health strategies for older adolescents and young adults are not warranted. Although no sex differences were found for overall willingness of getting the COVID-19 vaccine, sex differences were noted related to some reasons for COVID-19 vaccine hesitancy among those who were unsure about getting inoculated. Data from another adult sample (18 years and older) from Manitoba also found that males compared to females were more hesitant to receive the COVID-19 vaccine [17]. Sex differences in response to vaccines have been noted in vaccine trials with researchers calling for the sex-specific vaccine design and vaccine strategies [42]. Based on the findings from the current study, this could be extended to sex-specific strategies to address reasons for COVID-19 hesitancy among males and females. These findings could be used for targeting messages specifically to males (i.e., not being concerned about getting COVID-19) and females (i.e., not having enough information about the vaccine).

The limitations of this work should be considered while interpreting the findings. First, the sample was a community sample from Manitoba, Canada. Although, our sample was comparable to the population from which it was drawn on several important indicators (i.e., postal code, sex, household income, and ethnicity), it may not be representative of all individuals age 16 to 21 years. However, these findings could nonetheless help to inform public health strategies and messaging for this age group aimed at increasing uptake of COVID-19 vaccines. Second, our sample was relatively small requiring some variables to be coded into fewer categories. Third, although child abuse was assessed using a validated tool, other adversity in childhood was measured using single items. Although, this still remains the convention in the ACEs literature, it has been indicated that the assessment of ACEs is simplistic and this limitation should be acknowledged when using these indicators in research [43]. Fourth, questions about COVID-19 vaccines assumed those approved by Health Canada, but it was not explicitly stated. Finally, Health Canada approvals for Pfizer (December 9th, 2020) and Moderna (December 23rd, 2020) vaccines occurred towards the end of Wave 3 data collection.

The findings from this study have important public health implications. Overall, the findings indicate that our ability to increase uptake of available COVID-19 vaccines among older adolescents and young adults may rely on appropriately communicating information specifically about the safety of the vaccine, how it works to protect against infection, and why it is important to protect oneself and others against a COVID-19 infection. This is particularly important over time, as there may likely be several COVID-19 vaccines approved for use by the time they are made available to this population. It will be important for this age group to understand differences in reported effectiveness between COVID-19 vaccines. Communication messaging that speaks specifically to known safety and effectiveness data relevant to this age group and to severity of COVID-19 in younger populations may help offset

optimistic bias where some younger people may perceive the risk of the vaccine to be greater than disease risks. Public health messaging specifically for older adolescents and younger adults may include using social media, as well as through schools and universities. Findings from this work indicate that messaging should be tailored not only to address the most common reasons for vaccine hesitancy, but also to families with lower parental education, lower household income, more financial burden due to the pandemic, less COVID-19 knowledge, and individuals with certain ACEs histories. Given ACEs histories, it will be important for public health strategies to engage front-line service organizations that this age group may be more comfortable dealing with as possible communication channels for trusted information. Public health strategies that specifically target older adolescents and young adults using these recommendations may be successful in increasing inoculation uptake. It is important to implement strategies to limit the spread of COVID-19 in this age group since they may have greater potential to spread COVID-19 due to increased likelihood of socialization and reduced adherence to public health guidelines [34,35,44].

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data Sharing

Due to confidentiality and privacy agreements, it is not possible to make these data publicly available.

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