



**Determinants of COVID-19 vaccine willingness among people incarcerated in Canadian federal prisons: a cross-sectional study**

Journal:	<i>CMAJ Open</i>
Manuscript ID	CMAJOpen-2021-0248
Manuscript Type:	Cross-sectional
Date Submitted by the Author:	21-Sep-2021
Complete List of Authors:	Romanchuk, Kathryn; Research Institute of the McGill University Health Centre Linthwaite, Blake; Research Institute of the McGill University Health Centre Cox, Joseph; Research Institute of the McGill University Health Centre, Medicine Park, Hyejin; Research Institute of the McGill University Health Centre Dussault, Camille; Research Institute of the McGill University Health Centre Basta, Nicole; McGill University Faculty of Medicine and Health Sciences, Epidemiology, Biostatistics, and Occupational Health Varsaneux, Olivia; Correctional Service Canada Worthington, James; Correctional Service Canada Lebouché, Bertrand; Research Institute of the McGill University Health Centre MacDonald, Shannon; University of Alberta, Faculty of Nursing Ismail, Shainoor; Public Health Agency of Canada Kronfli, Nadine; McGill University Health Centre; Research Institute of the McGill University Health Centre
Keywords:	Infectious diseases, Public health
More Detailed Keywords:	Prison, Corrections, COVID-19 vaccine
Abstract:	<p>Background: Maximizing COVID-19 vaccine uptake among people in prison is essential in mitigating future outbreaks. We aimed to determine factors associated with willingness to receive a COVID-19 vaccine in Canadian federal prisons prior to vaccine availability.</p> <p>Methods: Three Canadian federal prisons were chosen based on previously low influenza vaccine uptake. Participants completed a self-administered questionnaire on knowledge, attitude, and beliefs towards vaccines. The primary outcome was "willingness to receive a COVID-19 vaccine", measured using a five-point Likert to the question "If a safe and effective COVID-19 vaccine becomes available in prison, how likely are you to get vaccinated?". The association of independent variables,</p>

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

	<p>identified a priori, with willingness were examined using logistic regression and crude and adjusted odds ratio (aOR) with 95% confidence intervals (CI) were calculated.</p> <p>Results: A total of 229 participants were included (median age: 46; female: 20%, Indigenous: 25%); 189 (83%) were willing to receive a COVID-19 vaccine. Participants who received the 2019-2020 influenza vaccine (aOR 4.24, 95% CI 1.61-12.40; vs. not) and who perceived vaccines to be important (aOR 10.20, 95% CI 4.33-26.00; vs. not) had higher odds of COVID-19 vaccine willingness. Conversely, those in medium security (aOR 0.27, 95% CI 0.07-0.88; vs. minimum security) had lower odds of COVID-19 vaccine willingness.</p> <p>Interpretation: The majority (83%) of participants were willing to receive a COVID-19 vaccine prior to vaccine roll-out. While reasons for vaccine hesitancy are complex, efforts focused on those who do not perceive vaccines as important and those in high-security prisons may improve vaccine willingness.</p>



STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8-9
Bias	9	Describe any efforts to address potential sources of bias	7,9
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	NA
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9
		(b) Describe any methods used to examine subgroups and interactions	NA
		(c) Explain how missing data were addressed	9
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	NA
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10
		(b) Give reasons for non-participation at each stage	10
		(c) Consider use of a flow diagram	25
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10-11 26
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

		(b) Report category boundaries when continuous variables were categorized	NA
		© If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	11-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14-15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	14-15
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

1  
2  
3 **Determinants of COVID-19 vaccine willingness among people incarcerated in Canadian**  
4 **federal prisons: a cross-sectional study**  
5  
6  
7  
8  
9

10 Kathryn Romanchuk<sup>1</sup>, Blake Linthwaite<sup>1</sup> MScPH, Joseph Cox<sup>1,2,3</sup> MD MSc, Hyejin Park<sup>1</sup>  
11 MScPH, Camille Dussault<sup>1</sup> MScPH, Nicole E. Basta<sup>2</sup> PhD, Olivia Varsaneux<sup>4</sup> MSc, James  
12 Worthington<sup>4</sup> MBChB, Bertrand Lebouché<sup>1,3,5,6</sup> MD PhD, Shannon E. MacDonald<sup>7,8</sup> RN PhD,  
13  
14 Shainoor J. Ismail<sup>9</sup> MD MSc, and Nadine Kronfli<sup>1,2,3</sup> MD MPH  
15  
16  
17  
18  
19  
20

21 <sup>1</sup>Centre for Outcomes Research and Evaluation, Research Institute of the McGill University  
22 Health Centre  
23  
24  
25

26 <sup>2</sup>Department of Epidemiology, Biostatistics and Occupational Health, School of Population and  
27 Global Health, McGill University  
28  
29

30 <sup>3</sup>Department of Medicine, Division of Infectious Diseases and Chronic Viral Illness Service,  
31 McGill University Health Centre  
32  
33  
34

35 <sup>4</sup>Correctional Service Canada (CSC)  
36  
37

38 <sup>5</sup>Canadian Institutes of Health Research Strategy for Patient-Oriented Research Mentorship  
39 Chair in Innovative Clinical Trial in HIV, Research Institute of the McGill University Health  
40 Centre  
41  
42  
43

44 <sup>6</sup>Department of Family Medicine, McGill University  
45  
46

47 <sup>7</sup>Faculty of Nursing, University of Alberta  
48

49 <sup>8</sup>School of Public Health, University of Alberta  
50

51 <sup>9</sup>Division of Immunization Programs and Pandemic Preparedness, Centre for Immunization and  
52 Respiratory Infectious Diseases, Public Health Agency of Canada and Metro City Medical Clinic  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4  
5 **Corresponding author:**  
6

7 Nadine Kronfli  
8

9  
10 1001 Decarie Boulevard, D02.4110  
11

12 Montreal, Quebec H4A 3J1, Canada  
13

14 Telephone: 1-514-934-1934  
15

16 Fax: 1-514-843-2092  
17

18 Email: nadine.kronfli@mcgill.ca  
19  
20  
21  
22

23  
24 **Word count : 2812**  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Confidential

## Abstract

**Background:** Maximizing COVID-19 vaccine uptake among people in prison is essential in mitigating future outbreaks. We aimed to determine factors associated with willingness to receive a COVID-19 vaccine in Canadian federal prisons prior to vaccine availability.

**Methods:** Three Canadian federal prisons were chosen based on previously low influenza vaccine uptake. Participants completed a self-administered questionnaire on knowledge, attitude, and beliefs towards vaccines. The primary outcome was “willingness to receive a COVID-19 vaccine”, measured using a five-point Likert to the question “If a safe and effective COVID-19 vaccine becomes available in prison, how likely are you to get vaccinated?”. The association of independent variables, identified *a priori*, with willingness were examined using logistic regression and crude and adjusted odds ratio (aOR) with 95% confidence intervals (CI) were calculated.

**Results:** A total of 229 participants were included (median age: 46; female: 20%, Indigenous: 25%); 189 (83%) were willing to receive a COVID-19 vaccine. Participants who received the 2019-2020 influenza vaccine (aOR 4.24, 95% CI 1.61-12.40; vs. not) and who perceived vaccines to be important (aOR 10.20, 95% CI 4.33-26.00; vs. not) had higher odds of COVID-19 vaccine willingness. Conversely, those in medium security (aOR 0.27, 95% CI 0.07-0.88; vs. minimum security) had lower odds of COVID-19 vaccine willingness.

**Interpretation:** The majority (83%) of participants were willing to receive a COVID-19 vaccine prior to vaccine roll-out. While reasons for vaccine hesitancy are complex, efforts focused on

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

those who do not perceive vaccines as important and those in high-security prisons may improve vaccine willingness.

Confidential



## Introduction

Canadian correctional settings have witnessed several large SARS-CoV-2 outbreaks since the start of the pandemic.<sup>1-3</sup> Many of the risk factors that predispose correctional settings to SARS-CoV-2 outbreaks – close living conditions,<sup>4-6</sup> challenges in accessing and implementing effective infection prevention and control measures,<sup>5,7</sup> an aging and comorbid population,<sup>4-6</sup> and limited autonomy impacting access to health care<sup>6</sup> – are non-modifiable, underscoring the importance of COVID-19 vaccination. The Canadian National Advisory Committee on Immunization prioritized “resident and staff of congregate settings” such as correctional settings for early COVID-19 vaccination in December 2020.<sup>8</sup> However, vaccine uptake rates have remained historically low in Canadian prisons despite the routine availability and promotion of vaccination since the 1990s.<sup>9</sup> Given the disproportionate incarceration of people experiencing social and health inequities,<sup>10-14</sup> maximizing vaccine acceptance is essential in preventing morbidity and mortality due to vaccine-preventable diseases among the 30,000 adults currently incarcerated in Canadian federal and provincial/territorial prison each day.<sup>11</sup>

Very few studies have thus far sought to understand predictors of COVID-19 vaccine acceptance among people incarcerated in prison. The few that have, have found that race/ethnicity,<sup>15,16</sup> age,<sup>16</sup> correctional facility type and security level,<sup>15,16</sup> presence of chronic health conditions,<sup>15</sup> and a history of COVID-19<sup>15</sup> were associated with vaccine willingness or acceptance. Drawing from studies conducted in the general population, in addition to these factors,<sup>17-19</sup> higher socioeconomic status and level of education,<sup>20</sup> previous influenza vaccination,<sup>21,22</sup> and acceptance of other routine vaccines<sup>23</sup> were predictors of COVID-19 vaccine acceptance. Understanding determinants of COVID-19 vaccine acceptance is crucial in preventing severe cases, hospitalizations, and deaths, and mitigating future outbreaks and the

1  
2  
3 consequent harms in correctional settings. Additional studies are needed to understand who  
4 remains at risk of COVID-19 vaccine hesitancy such that targeted interventions can be designed  
5  
6 to improve vaccination uptake. Cognizant of the knowledge gaps that exist in correctional  
7  
8 settings, we aimed to determine factors associated with COVID-19 vaccine willingness in  
9  
10 Canadian federal prisons.  
11  
12  
13  
14  
15  
16

## 17 **Methods**

### 18 *Study design and setting*

19  
20 We conducted an observational cross-sectional study in three Canadian federal prisons.  
21  
22 Correctional Service Canada (CSC) oversees federal corrections, where adult individuals serve  
23 sentences of two years or more.<sup>11</sup> Three Canadian federal correctional facilities, representing the  
24 sites with historically low influenza vaccine uptake (and thus hypothesized to have lower  
25 willingness towards COVID-19 vaccination), served as the study sites: Matsqui Institution (MI) in  
26 British Columbia, Grand Valley Institution for Women (GVIW) in Ontario, and Federal Training  
27 Centre (FTC) in Quebec. MI is a minimum and medium-security prison that houses 313 men.  
28  
29 Over one-third (112; 36%) of incarcerated people in this facility are Indigenous and one-fifth  
30 (65; 20%) are from other ethnic minority groups (Asian, Black, Hispanic, and other). GVIW is a  
31 multi-security level prison with minimum, medium, and maximum levels, housing 169  
32 incarcerated women. Approximately one-third (53; 31%) of incarcerated people in this facility  
33 are Indigenous and one-quarter (42; 25%) are from other minority groups. FTC is a minimum  
34 and medium-security prison housing 420 incarcerated men; less than one-fifth of incarcerated  
35 people in this facility are Indigenous (70; 17%) or from other minority groups (57; 14%). Both  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 GVIW and FTC were sites of prior COVID-19 outbreaks; eight and 163 individuals tested  
4  
5 positive, respectively.<sup>24</sup>  
6

7  
8 We included individuals aged 18 years or older who were able and willing to consent to  
9  
10 study participation in either English or French. We excluded individuals who had been  
11  
12 previously vaccinated with a COVID-19 vaccine (older, medically-vulnerable federal inmates  
13  
14 were offered COVID-19 vaccination in January 2021<sup>25</sup>), those whose sentences would end  
15  
16 within 14 days, and/or those who posed a security risk to the research team as determined by  
17  
18 facility staff. Participants did not receive compensation for their participation as per CSC  
19  
20 regulations.  
21  
22

### 23 24 25 26 *Data collection*

27  
28 Convenience sampling of individuals meeting the eligibility criteria was undertaken. Potential  
29  
30 participants in every second cell were approached sequentially by site-level CSC nurses. Given  
31  
32 COVID-19 visitation restrictions, CSC nurses were trained by the research team to describe the  
33  
34 study to prospective participants, review the information and consent forms, and obtain verbal  
35  
36 consent. To reduce response bias, participants who agreed to participate were given self-  
37  
38 administered questionnaires to complete in their cells focused on knowledge, attitude, and beliefs  
39  
40 towards vaccines in general, and more specifically, the COVID-19 vaccine. Individuals requiring  
41  
42 assistance with reading and writing could request nursing support to complete their  
43  
44 questionnaires. Individuals were recruited across the three sites between March 31 and April 19,  
45  
46 2021 until 240 were consented – a sample size chosen for an alternative primary endpoint  
47  
48 (change in willingness to receive a COVID-19 vaccine post-educational intervention). The  
49  
50 number of participants recruited from each site was proportional to the study site population.  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## Outcome

The primary outcome measure was “willingness to receive a COVID-19 vaccine”. Willingness was measured by participant response to the question “If a safe and effective COVID-19 vaccine becomes available in prison, how likely are you to get vaccinated?”, choosing among a five-point Likert scale (very willing, somewhat willing, uncertain, somewhat unwilling, very unwilling). Self-reported willingness to be vaccinated served as a proxy for vaccine acceptance as mass vaccination (i.e. following older, medically-vulnerable federal inmates) across CSC sites began post-recruitment. For our primary outcome, we dichotomized responses into “willing” (very and somewhat willing) and “not willing” (all other responses). Independent variables were determined *a priori* using published literature on vaccine hesitancy among incarcerated individuals and the general population. These included: 1. Demographic characteristics: age,<sup>16,17</sup> biologic sex,<sup>16</sup> ethnicity,<sup>15,16,18,19</sup> and highest level of education completed;<sup>20</sup> 2. Clinical characteristics: chronic health conditions related to COVID-19 severity (asthma, cancer, chronic blood disorder, congestive heart disease, chronic kidney disease, chronic lung disease, chronic neurological disorders, diabetes, HIV, hypertension, other immunocompromised condition, and liver disease),<sup>15</sup> smoking history,<sup>21-26</sup> and self-reported prior COVID-19;<sup>15</sup> and 3. Vaccine-related characteristics: self-reported receipt of the 2019-2020 seasonal influenza vaccine,<sup>22,22</sup> perceived vaccine importance (measured by participant response to the question “Vaccines are important for me” from the World Health Organization (WHO) Strategic Advisory Group of Experts on Immunization (SAGE) vaccine hesitancy tool),<sup>21</sup> and facility security level (minimum vs. medium vs. maximum).<sup>15,16</sup> For perceived vaccine importance, responses were reported using a five-point Likert scale (strongly agree, mostly agree, uncertain, mostly disagree, strongly

1  
2  
3 disagree) and dichotomized into “yes” (strongly and mostly agree) and “no” (uncertain, mostly,  
4 and strongly disagree). While factors related to socioeconomic status (housing security, high  
5 gross yearly income, and stable income source) have been found to be associated with vaccine  
6 acceptance,<sup>20</sup> they were excluded from the analysis as they do not apply to our study population  
7 due to long incarceration periods (median incarceration of study participants = 4.1 years).  
8  
9  
10  
11  
12  
13

### 14 15 16 17 *Statistical analysis*

18  
19 Summary statistics, medians, and interquartile ranges (IQR) for continuous variables and counts  
20 and proportions for categorical variables were calculated to describe the study sample.  
21

22  
23 Participants who reported multiple ethnicities (n=14), one of which was Indigenous, were  
24 classified as Indigenous. Those who selected “prefer not to describe” (n=3) or “other ethnicity”  
25 (n=20) were classified as other visible minority. Where possible, we made conservative  
26 assumptions to address “prefer not to answer” or “don’t know”, such that any misclassification  
27 would bias any effect to the null. For example, participants who preferred not to describe their  
28 smoking status (n=5) were classified as never having smoked, participants who did not know or  
29 preferred not to answer receipt of the 2019/2020 influenza vaccine were categorized as not  
30 having received it, and participants who preferred not to describe their chronic health conditions  
31 (n=15) were considered not to have any. Only participants with missing outcome data for  
32 COVID-19 vaccination willingness or who preferred not to describe their educational level were  
33 removed (n=12) because no conservative assumptions could be made. Variables identified *a*  
34 *priori* were included in the final logistic regression analysis and crude and adjusted odds ratio  
35 (aOR) with 95% confidence intervals (CI) were calculated to determine factors associated with  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 willingness to receive COVID-19 vaccination. All analyses were performed using R statistical  
4 software (version 4.0.3).  
5  
6  
7  
8  
9

### 10 *Ethics Approval*

11 This study was approved by the McGill University Health Centre Research Ethics Board (REB  
12 #2021-7547).  
13  
14  
15  
16  
17  
18

## 19 **Results**

### 20 *Participants' sociodemographic and clinical characteristics by correctional facility*

21 Overall, 311 people across the three federal prisons were invited to participate (n=88 at MI, n=74  
22 at GVIW, and n=149 at FTC). Of these, 67 (22%) declined participation (Figure 1). An  
23 additional 15 participants were excluded as they either had missing questionnaire data (n=12) or  
24 represented duplicate participants (i.e. same participant was consented twice; n=3), leaving a  
25 total of 229 participants in the analysis.  
26  
27  
28  
29  
30  
31  
32  
33  
34

35 Overall, the median age was 46 years (Table 1). A minority (20%) of participants self-  
36 identified as female, all of whom were incarcerated at GVIW. Indigenous people made up 25%  
37 of the study sample and more than one-third of participants at MI and GVIW; less than one-fifth  
38 of participants were from other visible minority groups. The majority (66%) had a secondary  
39 school level education or less. Half of participants reported no chronic health conditions related  
40 to COVID-19 morbidity and mortality. A minority (8%) of participants reported a history of  
41 COVID-19; however, this percentage was higher at FTC, the site with the largest SARS-CoV-2  
42 outbreak.<sup>24</sup> Approximately half had received the 2019-2020 influenza vaccine, and the majority  
43 (74%) perceived vaccines as not important. had never previously declined another vaccine  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 offered by a health care provider. Seventy-five percent (75%) of the study sample was housed in  
4  
5 medium security. Participant sociodemographic and clinical characteristics differed across  
6  
7 correctional facilities.  
8  
9

### 10 11 12 *COVID-19 vaccine willingness*

13  
14 A total of 189 (83%) participants were willing to receive a COVID-19 vaccine (64 (77%) at MI,  
15  
16 35 (76%) at GVIW, and 90 (90%) at FTC). In the multivariable analyses, there was no  
17  
18 significant association between willingness to receive a COVID-19 vaccine and age, biologic  
19  
20 sex, ethnicity, education, number of chronic health conditions, history of smoking or COVID-19  
21  
22 (Table 2). Participants who received the 2019-2020 influenza vaccine (aOR 4.24, 95% CI 1.61-  
23  
24 12.40; vs. not) and who perceived vaccines to be important (aOR 10.20, 95% CI 4.33-26.00; vs.  
25  
26 not) had higher odds of being willing to receive a COVID-19 vaccine. Conversely, those in  
27  
28 medium security (aOR 0.27, 95% CI 0.07-0.88; vs. minimum security) had lower odds of being  
29  
30 willing to receive a COVID-19 vaccine.  
31  
32  
33  
34  
35  
36  
37

### 38 **Interpretation**

39  
40 Our cross-sectional study explored factors associated with willingness to receive a COVID-19  
41  
42 vaccine among people incarcerated in three Canadian federal prisons – those with historically  
43  
44 low influenza vaccine uptake, and as such, expected to be less receptive towards COVID-19  
45  
46 vaccination. Our study found that incarcerated adults who had previously received influenza  
47  
48 vaccination and those who perceived vaccines as important had four and ten times higher odds of  
49  
50 being willing to receive a COVID-19 vaccine, respectively. These findings may be explained by  
51  
52 increased contact with health care providers, targeted messaging and education to those at higher  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 risk of SARS-CoV-2-related morbidity and mortality, or a higher “perceived risk” of COVID-  
4  
5 19.<sup>15,27</sup> Similar to previous studies,<sup>15,16</sup> we also found that individuals in higher-security settings  
6  
7 (i.e. medium versus minimum) had seven times lower odds of being willing to receive a COVID-  
8  
9 19 vaccine. A recent qualitative study by the research team demonstrated that this may be  
10  
11 explained by feelings of distrust towards correctional employees, limited access to information,  
12  
13 and a lower perceived risk of COVID-19 due to restricted visits and interactions;<sup>28</sup> however,  
14  
15 additional research is needed to better understand and address reasons why incarcerated  
16  
17 individuals are unwilling to receive COVID-19 vaccination as they were not investigated here.  
18  
19  
20

21  
22 Despite historically low influenza vaccine uptake at the selected study sites, 83% of  
23  
24 participants reported being willing to receive a COVID-19 vaccine. This proportion is  
25  
26 comparable to the Canadian adult population; 74% of the general population had received at least  
27  
28 one dose of a COVID-19 vaccine by September 10, 2021.<sup>29</sup> The relatively high proportion of  
29  
30 participants who reported being willing to receive a COVID-19 vaccine may in part be explained  
31  
32 by a study population that is almost exclusively housed in minimum- and medium-security  
33  
34 prisons (vs. maximum) or due to selection bias during recruitment. Among individuals  
35  
36 approached by CSC nurses, only 22% declined participation – a proportion that is considerably  
37  
38 lower than most Canadian prison-based studies. This suggests the possibility of selection bias,  
39  
40 resulting in a recruited population that may have been more representative of the Canadian  
41  
42 general population (versus the general prison population). We did not collect demographic  
43  
44 information among individuals who declined participation, which could have informed how our  
45  
46 sample deviates from the overall prison populations as well as possible selection bias. Certainly,  
47  
48 while the proportion reporting willingness to get vaccinated was higher than what has been found  
49  
50 in other prison-based studies,<sup>15,30</sup> it may also highlight that prison-based outreach efforts, as was  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



1  
2  
3 done by CSC nurses at all sites, can be effective in increasing COVID-19 vaccine uptake.  
4  
5 Furthermore, individuals with greater contacts – namely those in minimum security – were more  
6  
7 willing to receive the COVID-19 vaccine, underscoring that a step-wise approach (from highest  
8  
9 to lowest risk) to COVID-19 vaccination in correctional settings could be considered where  
10  
11 vaccine supply is limited. That said, given the non-modifiable risk factors that predispose  
12  
13 correctional settings to SARS-CoV-2 outbreaks, all incarcerated individuals should be prioritized  
14  
15 for COVID-19 vaccination,<sup>5,10</sup> particularly in settings where decarceration (i.e. the early release  
16  
17 of incarcerated individuals) is rare.<sup>11</sup>  
18  
19

20  
21         Studies examining determinants of vaccination decision-making have resulted in several  
22  
23 proposed models of acceptance and refusal.<sup>26,31-38</sup> The various models illustrate the difficulty of  
24  
25 categorizing attitudes about vaccination. That said, it is clear that attitudes towards vaccination  
26  
27 are the result of complex interactions between different social, cultural, political, and personal  
28  
29 factors in vaccine decision-making.<sup>27</sup> We found that incarcerated individuals who did not  
30  
31 perceive vaccines as important were less likely to be willing to accept COVID-19 vaccination.  
32  
33 This finding has important implications going forward. First, additional studies are urgently  
34  
35 needed to better understand the reasons contributing to vaccine hesitancy among incarcerated  
36  
37 populations. Given the unique environment, these reasons (e.g. trust with correctional  
38  
39 employees, risk perception in congregate settings, etc.) are expected to differ significantly from  
40  
41 those in the general population, precluding the generalizability of population-based studies to  
42  
43 people in prison. Using the data generated from prison-based studies, focused interventions may  
44  
45 seek to address *modifiable* individual-, interpersonal-, and system-level factors. Second, vaccine-  
46  
47 hesitant individuals may refuse some vaccines, but agree to others. These studies may  
48  
49 additionally contribute to our understanding of vaccine hesitancy for other vaccines routinely  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 offered in prison such as hepatitis A and B or influenza, thereby potentially impacting overall  
4 vaccine uptake. Finally, vaccine hesitancy is not fixed and may change with shifting contexts or  
5 when a vaccine and its related information are offered multiple times. Therefore, consideration  
6 must be given to different multi-modal approaches for offering COVID-19 vaccination,  
7 particularly among vaccine-hesitant populations.  
8  
9

10  
11 Although we found that vaccine willingness among incarcerated people was relatively  
12 high, ongoing efforts are needed to increase uptake and prevent outbreaks in these congregate  
13 settings. Experts have argued that educational interventions will be key to reinforce trust in  
14 science-based interventions like vaccination,<sup>39,40</sup> particularly as a result of the medical mistrust  
15 that emerged from disruptions caused by the COVID-19 pandemic. In fact, studies have  
16 confirmed that prison-based vaccination programs have the potential to increase vaccine uptake  
17 if partnered with education.<sup>41-43</sup> However, while education may be necessary, studies have shown  
18 only modest improvements in vaccine uptake with education,<sup>44,45</sup> underscoring that education  
19 will likely need to be paired with other interventions to achieve increased uptake. While  
20 alternative strategies (e.g., other providers such as peers, media or content) could be developed  
21 simultaneously and tailored to the needs of incarcerated people who express vaccine  
22 hesitancy,<sup>46,47</sup> building trust with those incarcerated will be critical moving forward.<sup>48</sup> Nurses, as  
23 “trusted individuals”, could also be considered valuable resources to increasing COVID-19  
24 vaccination rates in Canadian correctional settings.  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48

#### 49 *Limitations*

50  
51 There are limitations to our study. First, we restricted our study sample to individuals  
52 incarcerated in three of 43 Canadian correctional facilities. Our results may thus not be  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 generalizable to other CSC correctional facilities, including maximum security, and where the  
4 demographic characteristics of those incarcerated differs. Second, the proportion willing to  
5 receive a COVID-19 vaccine was higher than what has been found in other prison-based  
6 studies,<sup>15,30</sup> which may be attributable to outreach efforts made by CSC and selection bias. Thus,  
7 our findings may not be generalizable to Canadian provincial prisons, where the turnover of  
8 incarcerated people is much higher. Third, study consent and data collection were obtained by  
9 CSC nurses, which may have introduced response biases such as acquiescence, social  
10 desirability, and dissent biases; however, the impact of these biases was limited with the use of  
11 self-administered questionnaires, and the inclusion of CSC nurses as trusted allies in the consent  
12 process. Fourth, the primary outcome, COVID-19 vaccine willingness, was used as a proxy for  
13 vaccine acceptance. As individual-level data was not available, we could not perform a  
14 sensitivity analysis using COVID-19 vaccine uptake as the dependent variable.  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32

### 33 *Conclusion*

34 We identified key factors associated with COVID-19 vaccine willingness among people  
35 incarcerated in Canadian federal prisons. While the majority of participants were willing to  
36 receive a COVID-19 vaccine prior to vaccine roll-out, efforts focused on those who do not  
37 perceive vaccines as important and those in high-security prisons may improve vaccine  
38 willingness going forward.  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 **Declaration of Competing Interest:** KR, BL<sup>1</sup>, HP, CD, OV, JW, NEB, SEM, and SJI have not  
4 conflicts of interest to declare. JC has research funding from ViiV Healthcare and Gilead  
5 Sciences, and reports remuneration for advisory work (ViiV Healthcare, Gilead Sciences and  
6 Merck Canada). BL<sup>2</sup> reports research funding from Gilead Sciences, Merck and ViiV  
7 Healthcare, advisory fees from Gilead Sciences, ViiV Healthcare, Merck, and speaker fees from  
8 Gilead Sciences, ViiV Healthcare and Merck. NK reports research funding from Gilead  
9 Sciences, advisory fees from Gilead Sciences, ViiV Healthcare, Merck and Abbvie, and speaker  
10 fees from Gilead Sciences and Merck.  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23

24 **Contributors:** Nadine Kronfli and Nicole Basta were involved in study conceptualization and  
25 design. Kathryn Romanchuk analyzed and interpreted the data. Kathryn Romanchuk and Nadine  
26 Kronfli drafted the manuscript. All of the authors critically reviewed the manuscript for  
27 important intellectual content and approved the final manuscript as submitted.  
28  
29  
30  
31  
32  
33  
34

35 **Funding:** This work was supported by a grant from the McGill Interdisciplinary Initiative in  
36 Infection and Immunity. NEB is supported by a Canada Research Chair (Tier 2) in Infectious  
37 Disease Prevention. BL<sup>2</sup> holds a Canadian Institutes for Health Research, Strategy for Patient-  
38 Oriented Research Mentorship Chair in Innovative Clinical Trials for HIV Care and also  
39 supported by a career award, LE 250, from the Quebec's Ministry of Health for researchers in  
40 Family Medicine. NK is supported by a career award from the *Fonds de Recherche Québec –*  
41 *Santé (FRQ-S; Junior I).*  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 **Acknowledgements:** We would like to thank the site teams at Matsqui Institution, Grand Valley  
4  
5 Institution for Women, and Federal Training Centre for assisting with recruitment.  
6  
7  
8  
9

10 **Data sharing:** The study protocol, statistical analysis plan, and informed consent forms are  
11  
12 available on request to the corresponding author. Individual-level data cannot be made available  
13  
14 by the authors.  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Confidential

## References

1. Correctional Service Canada. Testing of inmates in federal correctional institutions for COVID-19. 2021-01-06 [cited 2021 Jan 06]; Available from: <https://www.csc-scc.gc.ca/001/006/001006-1014-fr.shtml>.
2. Gouvernement du Québec. Nombre de cas dans les établissements de détention. 2021-01-06 [cited 2021 Jan 06]; Available from: <https://www.quebec.ca/sante/problemes-de-sante/az/coronavirus-2019/situation-coronavirus-quebec/#c57309>.
3. Government of Canada. Coronavirus disease 2019 (COVID-19): Epidemiology update. 2021-01-06 [cited 2021 Jan 06]; Available from: <https://health-infobase.canada.ca/covid-19/epidemiological-summary-covid-19-cases.html>.
4. Saloner, Parish, Ward, MN, et al. *COVID-19 Cases and Deaths in Federal and State Prisons*. JAMA. 2020;324(6):602-603. doi:10.1001/jama.2020.12528
5. Beaudry, G., et al., *Managing outbreaks of highly contagious diseases in prisons: a systematic review*. BMJ Glob Health, 2020. 5(11).
6. Hawks, Woolhandler, & McCormick. JAMA Intern Med. 2020;180(8):1041-1042. doi:10.1001/jamainternmed.2020.1856. Retrieved from: <https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2765271>
7. Blair, A., A. Parnia, and A. Siddiqi, Testing lags and emerging COVID-19 outbreaks in federal penitentiaries: A view from Canada. medRxiv, 2020: p. 2020.05.02.20086314.
8. Government of Canada. *Preliminary guidance on key populations for early COVID-19 immunization*. 2020-11-03 [cited 2021 Jan 06]; Available from: <https://www.canada.ca/en/public-health/services/immunization/national-advisory-committee-on-immunization-naci/guidance-key-populations-early-covid-19-immunization.html>.

- 1  
2  
3 9. Nancy, V.-A., et al. Vaccination Coverage among Prisoners: A Systematic Review.  
4  
5 International Journal of Environmental Research and Public Health, 2020. 17, DOI:  
6  
7 10.3390/ijerph17207589.  
8  
9
- 10 10. Kronfli, N. and M.J. Akiyama, Prioritizing incarcerated populations for COVID-19  
11  
12 vaccination and vaccine trials. EClinicalMedicine, 2021. 31.  
13
- 14 11. Malakieh, J., Adult and youth correctional statistics in Canada, 2018/2019. Juristat: Canadian  
15  
16 Centre for Justice Statistics, 2020: p. 3-23  
17  
18
- 19 12. Nowotny, K.M. and A. Kuptsevych-Timmer, *Health and justice: framing incarceration as a*  
20  
21 *social determinant of health for Black men in the United States*. Sociology Compass, 2018.  
22  
23 **12**(3): p. e12566.  
24  
25
- 26 13. Singh, D., S. Prowse, and M. Anderson, *Overincarceration of Indigenous people: a health*  
27  
28 *crisis*. CMAJ, 2019. **191**(18): p. E487-E488.  
29  
30
- 31 14. Wang, E.A., J. Zenilman, and L. Brinkley-Rubinstein, Ethical Considerations for COVID-19  
32  
33 Vaccine Trials in Correctional Facilities. JAMA, 2020. 324(11): p. 1031-1032.  
34  
35
- 36 15. Chin, Leidner, Obispo, Ryckman, Liu, Prince, Alarid-Escudero, Andrews, Salomon,  
37  
38 Goldhaber-Fiebert, & Studdert. Covid-19 Vaccine Acceptance in California State Prisons.  
39  
40 The New England Journal of Medicine. 2021. Available from:  
41  
42 <https://www.nejm.org/doi/full/10.1056/NEJMc2105282>  
43  
44
- 45 16. Stern, M., Piasecki, A., Strick, L., Rajeshwar, P., Tyagi, E., Dolovich, S., Patel, P.,  
46  
47 Fukunaga, R., & Furukawa, N. *Willingness to Receive a COVID-19 Vaccination Among*  
48  
49 *Incarcerated or Detained Persons in Correctional and Detention Facilities: Four States,*  
50  
51 *September–December 2020*. Morbidity and Mortality Weekly. 2021. Available from:  
52  
53 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8022882/>  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 17. Kourlaba, Kourkouni, Maistreli, Tsopela, Molocha, Triantafyllou, Koniordou, Kopsidas,  
4 Chorianopoulou, Maroudi-Manta, Filippou, & Zaoutis. *Willingness of Greek general*  
5 *population to get a COVID-19 vaccine* Global Health Research and Policy. 2021.  
6  
7  
8 doi: [10.1186/s41256-021-00188-1](https://doi.org/10.1186/s41256-021-00188-1) Available from:  
9  
10  
11  
12 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7843240/>  
13  
14  
15 18. Quach, Hamid, Pereira, Heidebrecht, Deeks, Crowcroft, Quan, Brien & Kwong. Influenza  
16  
17 vaccination coverage across ethnic groups in Canada. CMAJ Group. 2012. Available from:  
18  
19 <https://www.cmaj.ca/content/184/15/1673.short>  
20  
21  
22 19. Thorneloe, Wilcockson, Lamb, Jordan, Arden. *Willingness to receive a COVID-19 vaccine*  
23 *among adults at high-risk of COVID-19: a UK-wide survey*. In print: PsyArXiv. 2020. DOI:  
24  
25 10.31234/osf.io/fs9wk.  
26  
27  
28 20. Lazarus, Ratzan, Palayew, Gostin, Larson, Rabin, Kimball & El-Mohandes. A global survey  
29  
30 of potential acceptance of a COVID-19 vaccine. Nature Medicine. 2021. Available from:  
31  
32 <https://www.nature.com/articles/s41591-020-1124-9>  
33  
34  
35 21. Fisher, Bloomstone, Walder, Crawford, Fouayzi, & Mazor. *Attitudes Toward a Potential*  
36 *SARS-CoV-2 Vaccine: A survey of U.S. adults*. Annals of Internal Medicine. 2020. Available  
37  
38 from: <https://www.acpjournals.org/doi/full/10.7326/M20-3569>  
39  
40  
41  
42 22. Crawshaw, J., et al. Factors affecting COVID-19 vaccination acceptance and uptake among  
43  
44 the general public: a living behavioural science evidence synthesis. 2021 April 30, 2021  
45  
46 [cited 2021 May 27]; Available from: [https://www.mcmasterforum.org/docs/default-](https://www.mcmasterforum.org/docs/default-source/product-documents/living-evidence-syntheses/covid-19-living-evidence-synthesis-4.1---factors-affecting-covid-19-vaccination-acceptance-and-uptake-among-the-general-public.pdf?sfvrsn=5368712f_7)  
47  
48 [source/product-documents/living-evidence-syntheses/covid-19-living-evidence-synthesis-](https://www.mcmasterforum.org/docs/default-source/product-documents/living-evidence-syntheses/covid-19-living-evidence-synthesis-4.1---factors-affecting-covid-19-vaccination-acceptance-and-uptake-among-the-general-public.pdf?sfvrsn=5368712f_7)  
49  
50 [4.1---factors-affecting-covid-19-vaccination-acceptance-and-uptake-among-the-general-](https://www.mcmasterforum.org/docs/default-source/product-documents/living-evidence-syntheses/covid-19-living-evidence-synthesis-4.1---factors-affecting-covid-19-vaccination-acceptance-and-uptake-among-the-general-public.pdf?sfvrsn=5368712f_7)  
51  
52 [public.pdf?sfvrsn=5368712f\\_7](https://www.mcmasterforum.org/docs/default-source/product-documents/living-evidence-syntheses/covid-19-living-evidence-synthesis-4.1---factors-affecting-covid-19-vaccination-acceptance-and-uptake-among-the-general-public.pdf?sfvrsn=5368712f_7)  
53  
54  
55  
56  
57  
58  
59  
60



- 1  
2  
3 23. Fridman, Gershon, & Gneezy. COVID-19 and vaccine hesitancy: A longitudinal study. Plos  
4  
5 One. 2021. Available from:  
6  
7 <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0250123#pone-0250123->  
8  
9 [g001](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0250123#pone-0250123-g001)  
10  
11  
12 24. Government of Canada. *Testing of inmates in federal correctional institutions for COVID-19.*  
13  
14 2021. Available from: <https://www.canada.ca/en/correctional-service/campaigns/covid->  
15  
16 [19/inmate-testing.html](https://www.canada.ca/en/correctional-service/campaigns/covid-19/inmate-testing.html)  
17  
18  
19 25. Government of Canada. *Correctional Service Canada COVID-19 Vaccine Roll-out.* 2021.  
20  
21 Available from: <https://www.canada.ca/en/correctional-service/news/2021/01/correctional->  
22  
23 [service-canada-covid-19-vaccine-roll-out.html](https://www.canada.ca/en/correctional-service/news/2021/01/correctional-service-canada-covid-19-vaccine-roll-out.html)  
24  
25  
26 26. Kashyap, Dhasmana, Massey, Kotnala, Zafar, Jaggi, Yallapu, & Chauhan. *Smoking and*  
27  
28 *COVID-19: Adding Fuel to the Flame.* International Journal of Molecular Sciences. 2020.  
29  
30 Available from: Available from: <https://www.mdpi.com/1422-0067/21/18/6581/htm>  
31  
32  
33 27. Dubé E, Laberge C, Guay M, Bramadat P, Roy R, Bettinger J. Vaccine hesitancy: an  
34  
35 overview. Human Vaccines Immunotherapeutics. 2013. doi: 10.4161/hv.24657. Available  
36  
37 from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3906279/>  
38  
39  
40 28. Ortiz-Paredes, D., Varsaneux, O., Worthington, J., Park, H., MacDonald, S., Basta, N.,  
41  
42 Lebouché, B., Cox, J., Ismail, S., & Kronfli, N. *Reasons for COVID-19 Vaccine Refusal*  
43  
44 *Among People Incarcerated in Canadian Federal Prisons.* Submitted to Health Psychology.  
45  
46 2021.  
47  
48  
49 29. Government of Canada. COVID-19 vaccination in Canada. 2021. Available from:  
50  
51 <https://health-infobase.canada.ca/covid-19/vaccination-coverage/>  
52  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 30. Berk, Murphy, Chan, Kane, Rich, Brinkley-Rubinstein. SARS-CoV-2 Vaccination Uptake in  
4 a Correctional Setting. In print: MedRxiv. 2021. Available from:  
5  
6  
7 <https://doi.org/10.1101/2021.04.27.21252790>  
8  
9
- 10 31. Benin AL, Wisler-Scher DJ, Colson E, Shapiro ED, Holmboe ES. Qualitative analysis of  
11 mothers' decision- making about vaccines for infants: the importance of trust. *Pediatrics*  
12 2006; 117:1532-41; PMID:16651306; <http://dx.doi.org/10.1542/peds.2005-1728>.  
13  
14  
15  
16
- 17 32. Brown K, Fraser G, Ramsay M, Shanley R, Cowley N, van Wijgerden J, et al. Attitudinal  
18 and demographic predictors of measles-mumps-rubella vaccine (MMR) uptake during the  
19 UK catch-up campaign 2008-09: cross-sectional survey. *PLoS One* 2011; 6:e19381;  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39
- 40 33. Burton-Jeangros C, Golay M, Sudre P. Compliance and resistance to child vaccination: a  
41 study among Swiss mothers. *Rev Epidemiol Sante Publique* 2005; 53:341- 50;  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
35. Halperin SA. How to Manage Parents Unsure About Immunization. *Can J Contin Med Educ*  
2000; 2000:62-75.
36. Nichter M. Vaccinations in the Third World: a consideration of community demand. *Soc Sci*  
*Med* 1995; 41:617-32; PMID:7502096; [http://dx.doi.org/10.1016/0277-9536\(95\)00034-5](http://dx.doi.org/10.1016/0277-9536(95)00034-5).
37. Rogers A, Pilgrim D, Gust ID, Stone DH, Menzel PT. The pros and cons of immunisation.  
*Health Care Anal* 1995; 3:99-115; PMID:10143365; <http://dx.doi.org/10.1007/BF02198210>.

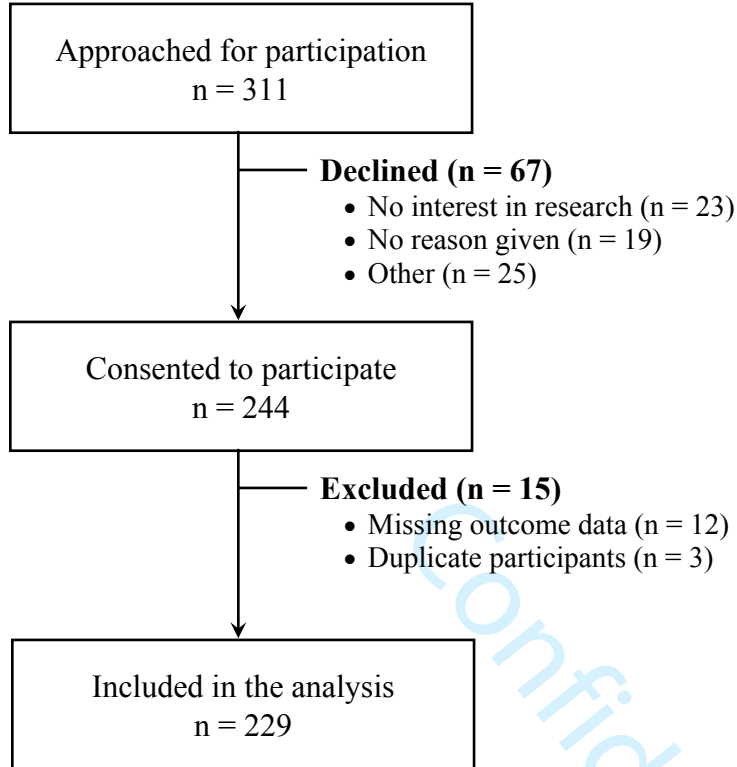
- 1  
2  
3 38. Streefland P, Chowdhury AMR, Ramos-Jimenez P. Patterns of vaccination acceptance. Soc  
4  
5 Sci Med 1999; 49:1705-16; PMID:10574240; <http://dx.doi.org/10.1016/S0277->  
6  
7 9536(99)00239-7.  
8  
9
- 10 39. Dawson, A., et al., Key Ethical Concepts and Their Application to COVID-19 Research.  
11  
12 Public Health Ethics, 2020. 13(2): p. 127-132.  
13
- 14 40. Rutjens, B.T., S. van der Linden, and R. van der Lee, Science skepticism in times of COVID-  
15  
16 19. Group Processes & Intergroup Relations, 2021. 24(2): p. 276-283.  
17  
18
- 19 41. Buck, J., et al., Hepatitis B Vaccination in Prison: The Perspectives of Formerly Incarcerated  
20  
21 Men. Journal of Correctional Health Care, 2006. 12(1): p. 12-23.  
22  
23
- 24 42. Devine, A., M. Karvelas, and V. Sundararajan, Evaluation of a prison-based hepatitis B  
25  
26 immunisation pilot project. Australian and New Zealand Journal of Public Health, 2007.  
27  
28 31(2): p. 127-130.  
29  
30
- 31 43. Winter, R.J., et al., A nurse-led intervention improved blood-borne virus testing and  
32  
33 vaccination in Victorian prisons. Aust N Z J Public Health, 2016. 40(6): p. 592-594.  
34
- 35 44. Piedimonte, S., et al., Impact of an HPV Education and Vaccination Campaign among  
36  
37 Canadian University Students. Journal of obstetrics and gynaecology Canada : JOGC =  
38  
39 Journal d'obstetrique et gynecologie du Canada : JOGC, 2018. 40(4): p. 440-446.  
40  
41
- 42 45. Yu, H., L. Qian, and C. Yaping Evaluation of two health education interventions to improve  
43  
44 the varicella vaccination: a randomized controlled trial from a province in the east China.  
45  
46 BMC Public Health, 2018. 18, 144 DOI: 10.1186/s12889-018-5070-0.  
47  
48
- 49 46. Cataldi, J.R., M.E. Kerns, and S.T. O'Leary, Evidence-based strategies to increase  
50  
51 vaccination uptake: a review. Current Opinion in Pediatrics, 2020. 32(1).  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 47. Paul, E., A. Steptoe, and D. Fancourt, Attitudes towards vaccines and intention to vaccinate  
4  
5 against COVID-19: Implications for public health communications. *Lancet Reg Health Eur*,  
6  
7 2021. 1: p. 100012.  
8  
9

10 48. Gagnon, D. and È. Dubé. Literature Review on Effective Strategies to Improve Vaccine  
11  
12 Acceptance and Uptake. 2019 [cited 2021 July 2]; Available from:  
13  
14 [https://canvax.ca/sites/default/files/2019-](https://canvax.ca/sites/default/files/2019-02/Literature%20Review%20on%20Effective%20Strategies%20to%20Improve%20VAU_3.pdf)  
15  
16 [02/Literature%20Review%20on%20Effective%20Strategies%20to%20Improve%20VAU\\_3.](https://canvax.ca/sites/default/files/2019-02/Literature%20Review%20on%20Effective%20Strategies%20to%20Improve%20VAU_3.pdf)  
17  
18 pdf  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Confidential

1  
2  
3 **Figure 1. Sample selection flow chart**  
4



**Table 1: Baseline participant characteristics by correctional facility**

	<b>Correctional facility</b>			
	MI n = 83 (36%)	GVIW n = 46 (20%)	FTC n = 100 (44%)	Total n = 229
<b>Demographic characteristics</b>				
<b>Age (median [IQR])</b>	42 [36, 52]	35.5 [30, 44]	53 [44, 61]	46 [36, 56]
<b>Biologic sex</b>				
Female	0 (0%)	45 (98%)	0 (0%)	45 (20%)
Male	83 (100%)	1 (2%)	100 (100%)	184 (80%)
<b>Ethnicity</b>				
White	37 (45%)	19 (41%)	74 (74%)	130 (57%)
Indigenous	29 (35%)	18 (39%)	11 (11%)	58 (25%)
Other visible minority	17 (20%)	9 (20%)	15 (15%)	41 (18%)
<b>Education</b>				
Secondary or less	64 (77%)	34 (74%)	52 (52%)	150 (66%)
College or higher	19 (23%)	12 (26%)	48 (48%)	79 (40%)
<b>Clinical characteristics</b>				
<b>Chronic health conditions*</b>				
None	50 (60%)	21 (45%)	44 (44%)	115 (50%)
One or more	33 (40%)	25 (55%)	56 (56%)	114 (50%)
<b>Smoking history</b>				

Current smoker	36 (43.5%)	20 (44%)	21 (21%)	77 (34%)
Former smoker	36 (43.5%)	19 (41%)	56 (56%)	111 (48%)
Never smoker	11 (13%)	7 (15%)	23 (23%)	41 (18%)
<b>Self-reported history of COVID-19</b>				
No	82 (99%)	44 (96%)	85 (85%)	211 (92%)
Yes	1 (1%)	2 (4%)	15 (15%)	18 (8%)
<b>Vaccine-related characteristics</b>				
<b>Receipt of the 2019-2020 seasonal influenza vaccination</b>				
No	47 (57%)	24 (52%)	49 (49%)	120 (52%)
Yes	36 (43%)	22 (48%)	51 (51%)	109 (48%)
<b>Vaccine importance</b>				
No	57 (69%)	32 (70%)	81 (81%)	170 (74%)
Yes	26 (31%)	14 (30%)	19 (19%)	59 (26%)
<b>Carceral characteristics</b>				
<b>Security level</b>				
Minimum	0 (0%)	9 (20%)	46 (46%)	56 (25%)
Medium <sup>†</sup>	83 (100%)	37 (80%)	54 (54%)	173 (75%)

1  
2  
3 FTC = Federal Training Centre; GVIW = Grand Valley Institution for Women; IQR =  
4  
5 Interquartile range; MI = Matsqui Institution.  
6

7  
8 \*Chronic health conditions include asthma, cancer, chronic blood disorder, congestive heart  
9  
10 disease, chronic kidney disease, chronic lung disease, chronic neurological disorders, diabetes,  
11  
12 HIV, hypertension, other immunocompromised condition, and liver disease  
13

14 † Includes two participants in maximum security  
15

16  
17 Note: Percentages rounded to the nearest whole number  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Confidential



**Table 2: Association between multiple factors of interest and willingness to receive COVID-19 vaccination among adults incarcerated in Canada (n=229)**

Variable	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
<b>Demographic characteristics</b>		
<b>Age</b>		
18 years (continuous)	<i>Reference</i> 1.03 (1.00-1.05)	<i>Reference</i> 0.98 (0.94-1.02)
<b>Biologic sex</b>		
Male	<i>Reference</i>	<i>Reference</i>
Female	0.65 (0.31-1.45)	0.45 (0.16-1.29)
<b>Ethnicity</b>		
White	<i>Reference</i>	<i>Reference</i>
Indigenous	0.42 (0.20-0.91)	0.49 (0.18-1.35)
Other visible minority	0.47 (0.20-1.11)	0.44 (0.14-1.45)
<b>Education</b>		
Secondary or less	<i>Reference</i>	<i>Reference</i>
Trade/college diploma	1.34 (0.65-2.90)	1.07 (0.42-2.80)
<b>Clinical characteristics</b>		
<b>Chronic health conditions</b>		
None	<i>Reference</i>	<i>Reference</i>
One or more	<b>1.96 (1.01-3.91)</b>	1.78 (0.73-4.53)
<b>Smoking history</b>		
Never Smoker	<i>Reference</i>	<i>Reference</i>

Former Smoker	0.61 (0.21-1.52)	0.25 (0.05-1.00)
Current Smoker	0.64 (0.21-1.72)	0.53 (0.11-2.27)
<b>Self-reported history of</b>		
<b>COVID-19</b>	<i>Reference</i>	<i>Reference</i>
No		
Yes	4.59 (0.91-83.60)	2.53 (0.33-54.20)
<b>Vaccine-related characteristics</b>		
<b>Receipt of the 2019-2020</b>		
<b>seasonal influenza</b>		
<b>vaccination</b>		
No	<i>Reference</i>	<i>Reference</i>
Yes	<b>6.16 (2.77-15.70)</b>	<b>4.24 (1.61-12.40)</b>
<b>Vaccine importance</b>		
No	<i>Reference</i>	<i>Reference</i>
Yes	<b>11.90 (5.73-25.80)</b>	<b>10.20 (4.33-26.00)</b>
<b>Carceral characteristics</b>		
<b>Security level</b>		
Minimum	<i>Reference</i>	<i>Reference</i>
Medium	<b>0.26 (0.08-0.70)</b>	<b>0.27 (0.07-0.88)</b>

CI = Confidence interval; OR = odds ratio.

\*Chronic health conditions include asthma, cancer, chronic blood disorder, congestive heart disease, chronic kidney disease, chronic lung disease, chronic neurological disorders, diabetes, HIV, hypertension, other immunocompromised condition, and liver disease

1  
2  
3 †Includes two participants in maximum security  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Confidential