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Original article

# Perception of COVID-19 vaccine effectiveness perception in older racialized communities: role of major racial discrimination and health literacy

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ABSTRACT

*Objective:* Vaccination has been scientifically proven to be safe and to prevent infectious diseases. The COVID-19 vaccine has been crucial in combating the pandemic. In Canada, despite widespread vaccine hesitancy, little has specifically addressed older adults from racialized communities. This study investigates perceptions of COVID-19 vaccine effectiveness among older adults by racial background, examining the influence of major racial discrimination and health literacy.
*Study design:* A cross-sectional pan-Canadian study.
*Methods:* Data were collected using Computer-Assisted Web Interviewing (March 2025). The COVID-19 vaccine effectiveness was tested with *t*-tests, ANOVA, and multivariable linear regression.
*Results:* 581 participants were included: Arab (11.5%), Asian (15.8%), Black (16.2%), Indigenous (9%), and White (35.8%); including men (48.2%), women (43.0%), and 8.8% identifying as non-binary. Participants 65 years and above reported significantly greater perceived COVID-19 vaccine effectiveness versus 55–64 years old ($t(579) = 2.17$, $p = .015$)). Asian and White participants were more likely to have a good perception of COVID-19 vaccines versus Black and Indigenous ($F(6,574) = 2.88$, $p = .009$) participants. Multivariable linear regression revealed that major racial discrimination was the strongest predictor of lower perception of vaccine effectiveness ($\beta = -0.42$, $p = .006$), along with literacy ($\beta = 0.09$, $p = .002$) and identifying as Black compared to White ($\beta = -1.49$, $p = .020$).
*Conclusions:* Perceptions of COVID-19 vaccine effectiveness among 55+ in Canada varied substantially across racial groups, with differences linked to experiences of discrimination and literacy levels. These findings highlight the need for targeted, equity-oriented public health strategies that address both structural racism and misinformation to improve vaccine confidence among older adults in marginalized communities.

## 1. Background

Vaccination has been scientifically proven to be safe [1] and effective in preventing infectious diseases [2]. Its effectiveness has been well demonstrated [3,4] and refined through decades of scientific development [5]. Since the establishment of the national programmes for routine immunization in 1974 [6,7] vaccines have played a central role in reinforcing public health, particularly through the achievement of herd immunity. Extensive literature demonstrates that mass vaccination has led to a substantial reduction in global mortality worldwide [8,9]. The World Health Organization estimates that current immunization programmes prevent 2–3 million deaths annually [10], contributing to a significant decline in global mortality among children under 5 years of age, from 93 deaths per 1000 live births in 1990 to 39 deaths per 1000 in 2018. Vaccination remains one of the most effective and cost-efficient public health interventions, preventing millions of deaths each year [11,12]. Despite this, vaccine uptake remains suboptimal [13].

Recent years have seen the catastrophic effects of vaccine-preventable disease outbreaks, particularly measles, which increased by 130% globally between 2016 and 2019 [14]. This serves as a warning regarding the potential impact on routine vaccination programs following the COVID-19 pandemic. This trend warns of the potential

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impact on routine vaccination programmes and vaccine coverage, a decline that began before the COVID-19 pandemic and has accelerated since.

Vaccination has been historically fraught with mistrust and hesitancy. Rather than representing a singular movement [15], vaccine hesitancy reflects complex decision-making processes shaped by scientific information, cultural norms, and personal beliefs [16]. Between 2015 and 2017, over 90% of WHO member states reported experiencing vaccine hesitancy [17]. A substantial body of literature has shown that vaccine hesitancy is as old as vaccination itself; it can be traced back to the introduction of vaccination in the 18th century [18]. Contributing factors include historical medical abuses (e.g., the Tuskegee Syphilis Study [19]), scientific contradiction (e.g., amplified by the now-retracted 1998 claim linking the MMR vaccine to autism[20,21]), institutional mistrust [22], and social biases, including chauvinism [23].

The expansion of mass communication and digital media has further amplified the spread of vaccine-related information and misinformation. A systematic review by Zhang et al. [24] suggests that vaccine literacy is associated with hesitancy, although the nature of this relationship remains unclear. In recognition of its public health impact, the WHO identified vaccine hesitancy as one of the top ten global health threats in 2019 [25].

Miscommunication, misinformation, and conspiracy theories have significantly undermined public trust in science and health institutions [25]. Among Black communities, vaccine hesitancy is deeply rooted in lived experiences of injustice [26] and/or historical injustice [25] including unethical experimentation on slaves (e.g., experimentation of gynecological speculum on Black women [27]). Hesitancy or refusal to be vaccinated often reflects persistent mistrust in medical institutions shaped by ongoing experiences of discrimination [28]. Beyond this colonial legacy[35], COVID-19 vaccine hesitancy among Black women in the United States has also been linked to concerns regarding reproductive health [29]. COVID-19 vaccine perceptions are further influenced by media consumption and literacy. Wu et al.'s [30] found that reliance on digital media was indirectly associated with COVID-19 vaccination through vaccine misperceptions, with this relationship moderated by news literacy behaviors. However, their results evidenced that individuals with stronger news literacy behavior were more susceptible to misinformation [30]. Other studies mediation analyses did not note a significant, direct relationship between perceived health literacy and COVID-19 vaccine receipt after including indirect effects [31].

Despite evidence of vaccine hesitancy across Canada, there is a lack of research on how perceptions of COVID-19 vaccine effectiveness vary among older adults from different racial groups, including racialized, Indigenous, and White people. To fill this gap, the present study aims to investigate perceptions of COVID-19 vaccine effectiveness among Arab, Asian, Black, Indigenous, and White older adults aged 55 and above. This study also examines the roles of major racial discrimination and conspiracy beliefs on participant perspectives.

## 2. Methods

This cross-sectional study stemmed from the large project "*Vaccine Hesitancy Among Racially Diverse People Aged* ≥55 *years old above in Canada*".

### 2.1. Data collection

Data for this study were collected between March 18 to March 28, 2025. Data were collected using Computer-Assisted Web Interviewing (CAWI), administered and facilitated by Léger (LÉO), Canada's largest research firm. The median time to complete the survey was 23 min and 09 s. Eligible participants included people residing in Canada during the pandemic, fluent in English or French. A consecutive sample of individuals aged 55 years and above took part in the study via email, with each participant receiving a personalized invitation link that was restricted to a single participant's use.

### 2.2. Measures

#### 2.2.1. COVID-19 vaccine effectiveness perception

Participants' perceptions regarding COVID-19 vaccine effectiveness and acceptance were measured using a 10-item questionnaire [32]. Respondents indicated their level of agreement on a five-point Likert scale: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree (with an additional I don't know/I prefer not to answer option). Several items were reverse-coded as indicated (e.g., "Vaccines are important for my health," "Vaccines are effective," "Getting vaccinated is important for the health of other members of my community"). The questionnaire demonstrated acceptable internal consistency in the current study (Cronbach's $\alpha = 0.78$).

#### 2.2.2. Experience of major racial discrimination

Racial discrimination was assessed using a 7-item binary scale (Yes/No) adopted from Papakyriakopoulos et al. [33], covering domains such as education, employment, healthcare, and the justice system (e.g., "Have you been treated unfairly in a hospital or other health service?") (Cronbach's alpha = 0.75). This questionnaire was widely used in Canada among racialized individuals [34,35].

#### 2.2.3. Conspiracy beliefs

Conspiracy beliefs were measured using the 10-item COVID-19 Conspiracy Belief Scale (e.g., "COVID-19 was deliberately created by scientists in a laboratory"), with responses rated on a five-point Likert scale. Higher scores indicate stronger belief in conspiracies (Cronbach's alpha = 0.94) [36]. *Conspiracy Beliefs* has been used among racialized people in Canada [37].

#### 2.2.4. Health literacy

Health literacy was assessed using an 8-item Health Literacy Scale rated on a five-point Likert scale (HLS) (Norman & Skinner, 2006), which evaluates individuals' ability to find and interpret health information online (e.g., "I know how to use the Internet to answer my health questions") [38]. Higher scores indicate greater health literacy (Cronbach's alpha = 0.95). The Health Literacy Scale has been used in several publications focusing on racialized communities in Canada [39,40].

### 2.3. Statistical analysis

Descriptive statistics summarized participant characteristics by racial group. Group differences in vaccine effectiveness were assessed using one-way ANOVAs and *t*-tests. Post hoc pairwise comparisons were conducted using Tukey's HSD to adjust for multiple comparisons.

Hierarchical multiple linear regression was used to examine predictors of vaccine effectiveness. Model 1 included sociodemographic factors, literacy, and major racialized discrimination. Model 2 added conspiracy belief. Model fit was assessed using adjusted $R^2$.

Mediation analysis tested whether conspiracy belief mediated the effect of racialized discrimination on vaccine effectiveness, using the mediation package in R with 5000 bootstrap simulations. Statistical significance was set at $p < .05$. Analyses were conducted using SPSS Statistics 29 (IBM Corp.) and R 4.3.2 (R Core Team).

## 3. Results

Table 1 summarizes the sociodemographic characteristics of the 581 participants. The racial composition included participants identifying as White (35.8%), Black (16.2%), Asian (15.8%), and Arab (11.5%), among other categories. A higher proportion of White participants were in the older age group (≥65), while unemployment was most common among Arab participants (17.9%), and Black participants were over-represented in the lowest income bracket (19.9%). Other characteristics

**Table 1**
Frequency and proportion of sociodemographic variables across racial groups- values are shown as count (percentage).

| Variables | Total | Arab | Asian | Black | Indigenous | Mixed | Other | White |
|---|---|---|---|---|---|---|---|---|
| Total | 581 (100) | 67 (11.5) | 92 (15.8) | 94 (16.2) | 52 (9.0) | 47 (8.1) | 21 (3.6) | 208(35.8) |
| Sex | | | | | | | | |
| Men | 280 (48.2) | 29 (10.4) | 48 (17.1) | 44 (15.7) | 25 (8.9) | 23 (8.2) | 10 (3.6) | 101 (36.1) |
| Women | 250 (43) | 32 (12.8) | 35 (14) | 39 (15.6) | 25 (10) | 21 (8.4) | 9 (3.6) | 89 (35.6) |
| Non-binary | 51 (8.8) | 6 (11.8) | 9 (17.6) | 11 (21.6) | 2 (3.9) | 3 (5.9) | 2 (3.9) | 18 (35.3) |
| Age | | | | | | | | |
| Between 55 and 64 | 296 (50.9) | 43 (14.5) | 54 (18.2) | 54 (18.2) | 31 (10.5) | 21 (7.1) | 10 (3.4) | 83 (28) |
| 65 or over | 285 (49.1) | 24 (8.4) | 38 (13.3) | 40 (14) | 21 (7.4) | 26 (9.1) | 11 (3.9) | 125 (43.9) |
| Education | | | | | | | | |
| Primary/Secondary/High School | 141 (24.5) | 7 (5) | 11 (7.8) | 25 (17.7) | 17 (12.1) | 15 (10.6) | 7 (5) | 59 (41.8) |
| College | 185 (32.1) | 19 (10.3) | 19 (10.3) | 31 (16.8) | 21 (11.4) | 17 (9.2) | 6 (3.2) | 72 (38.9) |
| University certificate/Bachelor's degree | 157 (27.3) | 23 (14.6) | 42 (26.8) | 19 (12.1) | 9 (5.7) | 5 (3.2) | 4 (2.5) | 55 (35) |
| Graduate degree (Master's/PhD) | 93 (16.1) | 18 (19.4) | 18 (19.4) | 17 (18.3) | 5 (5.4) | 10 (10.8) | 4 (4.3) | 21 (22.6) |
| Province | | | | | | | | |
| Ontario | 246 (42.3) | 24 (9.8) | 48 (19.5) | 49 (19.9) | 22 (8.9) | 15 (6.1) | 10 (4.1) | 78 (31.7) |
| Québec | 135 (23.2) | 30 (22.2) | 11 (8.1) | 22 (16.3) | 7 (5.2) | 10 (7.4) | 2 (1.5) | 53 (39.3) |
| Prairies and British Columbia/Atlantic | 200 (34.4) | 13 (6.5) | 33 (16.5) | 23 (11.5) | 23 (11.5) | 22 (11) | 9 (4.5) | 77 (38.5) |
| Employment | | | | | | | | |
| Employed | 238 (41) | 40 (16.8) | 44 (18.5) | 53 (22.3) | 25 (10.5) | 14 (5.9) | 10 (4.2) | 52 (21.8) |
| Unemployed | 39 (6.7) | 7 (17.9) | 6 (15.4) | 3 (7.7) | 3 (7.7 | 5 (12.8) | 1 (2.6) | 14 (35.9) |
| Homemaker/Retired | 304 (52.3) | 20 (6.6) | 42 (13.8) | 38 (12.5) | 24 (7.9) | 28 (9.2) | 10 (3.3) | 142 (46.7) |
| Religion | | | | | | | | |
| Christian | 325 (57.9) | 38 (11.7) | 29 (8.9) | 69 (21.2) | 26 (8) | 24 (7.4) | 9 (2.8) | 130 (40) |
| Muslim | 37 (6.6) | 25 (67.6) | 4 (10.8) | 3 (8.1) | NA | NA | 5 (13.5) | NA |
| Other | 63 (11.2) | 3 (4.8) | 23 (36.5) | 9 (14.3) | 4 (6.3) | 8 (12.7) | 1 (1.6) | 15 (23.8) |
| No religion | 136 (24.2) | 1 (0.7) | 33 (24.3) | 8 (5.9) | 20 (14.7) | 12 (8.8) | 4 (2.9) | 58 (42.6) |
| Marital | | | | | | | | |
| Single | 84 (14.5) | 7 (8.3) | 7 (8.3) | 21 (25) | 6 (7.1) | 6 (7.1) | 4 (4.8) | 33 (39.3) |
| Married/Common-law partner | 382 (65.9) | 37 (9.7) | 77 (20.2) | 53 (13.9) | 35 (9.2) | 35 (9.2) | 15 (3.9) | 130 (34) |
| Divorced/Widowed | 114 (19.7) | 23 (20.2) | 8 (7) | 20 (17.5) | 11 (9.6) | 6 (5.3) | 2 (1.8) | 44 (38.6) |
| Income | | | | | | | | |
| Below $50,000 | 176 (32.5) | 21 (11.9) | 14 (8) | 35 (19.9) | 17 (9.7) | 16 (9.1) | 7 (4) | 66 (37.5) |
| $50,000 to $99,999 | 199 (36.8) | 26 (13.1) | 37 (18.6) | 39 (19.6) | 16 (8) | 13 (6.5) | 8 (4) | 60 (30.2) |
| $100,000 and above | 166 (30.7) | 19 (11.4) | 31 (18.7) | 17 (10.2) | 18 (10.8) | 14 (8.4) | 4 (2.4) | 63 (38) |

such as gender, education, marital status, province, and religion are presented in Table 1.

Table 2 presents vaccine effectiveness perception scores (mean, 95% CI) across sociodemographic groups ($N$ = 581). Perceived vaccine effectiveness differed significantly by race ($F(6,574) = 2.88$, $p = .009$), with White participants reporting the highest scores and Black and Indigenous participants the lowest; post hoc tests confirmed a significant gap between White and Black participants (mean difference (MD) = 2.00, $p = .014$). A gender difference was also found ($F(2,578) = 3.23$, $p = .040$), with men scoring higher than women and non-binary individuals. Provincially, although overall differences were non-significant, subgroup effects emerged in Ontario ($F(5, 230) = 2.65$, $p = .024$), Québec ($F(2,102) = 6.48$, $p = .002$), and among White participants ($F(2, 205) = 3.64$, $p = .028$), with Québec showing the highest scores. Additional differences by age, education, employment, religion, marital status, and income —particularly within subgroups— are detailed in Table 2.

Table 3 summarizes the multiple linear regression results. Model 1 included sociodemographic variables (sex, age, province, education, employment, race), literacy, and major racialized discrimination. Most predictors were not statistically significant. However, major racialized discrimination emerged as the strongest predictor of lower vaccine effectiveness ($\beta = -0.42$, $p = .006$), along with literacy ($\beta = 0.09$, $p = .002$) and identifying as Black compared to White ($\beta = -1.49$, $p = .020$). College education also showed a modest positive effect ($\beta = 1.41$, $p = .011$). Overall model fit was modest, with Model 1 explaining approximately 6% of the variance (adjusted $R^2 = 0.06$).

Model 2 added belief in conspiracy theories. This addition substantially changed the results: the effect of major racialized discrimination became non-significant ($\beta = 0.07$, $p = .641$), while conspiracy belief emerged as a strong negative predictor ($\beta = -0.31$, $p < .001$). Sex (women vs. men; $\beta = -1.02$, $p = .013$) and literacy ($\beta = 0.08$, $p = .007$) remained significant. Model 2 showed a substantial improvement in model fit, explaining approximately 33% of the variance (adjusted $R^2 = 0.33$).

Mediation analysis tested whether conspiracy beliefs mediated the relationship between major racialized discrimination and vaccine effectiveness (Fig. 1). The analysis confirmed a significant mediation (indirect) effect of conspiracy belief ($\beta = -0.241$, 95% CI: $-0.380$ to $-0.103$, $p < .001$) on vaccine effectiveness perception. The direct effect of major discrimination on vaccine effectiveness perception was non-significant ($\beta = -0.193$, $p = .222$), and the total effect of major racial discrimination on the vaccine effectiveness perception remained significant ($\beta = -0.434$, $p = .012$), with over half the effect (55.5%) mediated (Table 4). This supports the role of conspiracy beliefs as a key mechanism linking racial discrimination to reduced vaccine effectiveness. The mediator model predicting conspiracy beliefs accounted for 14% of the variance (adjusted $R^2 = 0.14$), while the outcome model predicting vaccine effectiveness accounted for 33% of the variance (adjusted $R^2 = 0.33$).

## 4. Discussion

This study examined COVID-19 vaccine effectiveness perceptions among adults and older adults in Canada —as defined by the WHO and Canada [41,42]—, focusing on racial differences, major racialized discrimination, health literacy, and conspiracy beliefs. The findings indicate that perceptions vary significantly by racial group and gender, and that conspiracy beliefs mediate the relationship between discrimination and lower vaccine confidence. These results are consistent with growing evidence that vaccine attitudes are shaped by a complex interplay of structural, psychosocial, and informational factors rather than by knowledge alone [43,44].

**Table 2**
COVID-19 vaccine effectiveness means with confidence intervals across sociodemographic variables ($N = 581$).

| Variables | Total | Arab | Asian | Black | Indigenous | Mixed | Other | White | Test-statistic, *p*-value |
|---|---|---|---|---|---|---|---|---|---|
| Total | 21.6 (21.2,22.0) | 21 (20,22) | 22.2 (21.3, 23) | 20.4 (19.4, 21.4) | 20.5 (19, 22) | 21.2 (19.5, 22.9) | 21.1 (18.5, 23.8) | 22.4 (21.8, 23) | F(6, 574) = 2.88, $p = .009$ |
| Sex | | | | | | | | | |
| Men | 22 (21.4, 22.6) | 22.1 (20.9, 23.4) | 22.8 (21.8, 23.8) | 21.1 (19.7, 22.5) | 20.4 (17.8, 22.9) | 21 (17.9, 24) | SS | 22.7 (21.8, 23.6) | F(5, 264) = 1.81, $p = .111$ |
| Women | 21.3 (20.7, 21.9) | 20.1 (18.5, 21.8) | 21.7 (20.1, 23.2) | 19.8 (18.2, 21.5) | 20.6 (18.4, 22.7) | 21.4 (19, 23.8) | SS | 22.5 (21.6, 23.3) | F(5, 235) = 2.49, $p = .032$ |
| Non-binary | 20.3 (19.1, 21.6) | SS | SS | SS | SS | SS | SS | 19.9 (17, 22.9) | |
| Test-Statistic | F(2,578) = 3.23 | T(59) = 1.92 | T(81) = 1.28 | T(81) = 1.17 | T(48) = −1.26 | T(42) = −0.25 | | T(188) = 0.34 | |
| p-value | 0.040 | 0.059 | 0.203 | 0.245 | 0.901 | 0.804 | | 0.735 | |
| Age | | | | | | | | | |
| Between 55 and 64 | 21.1 (20.6, 21.7) | 20.7 (19.4, 21.9) | 21.6 (20.4, 22.8) | 20.5 (19.3, 21.7) | 21.6 (19.8, 23.4) | 19.9 (17.1, 22.7) | SS | 21.6 (20.4, 22.8) | F(5,280) = 0.78, $p = .564$ |
| 65 or over | 22 (21.5, 22.5) | 21.7 (20, 23.4) | 22.9 (21.9, 24) | 20.2 (18.6, 21.8) | 18.8 (16.1, 21.4) | 22.2 (19.9, 24.6) | SS | 22.9 (22.2, 23.6) | F(5,268) = 5.15, $p < .001$ |
| Test-Statistic | T(579) = −2.17 | T(65) = −1.01 | T(90) = −1.56 | T(92) = 0.32 | T(50) = 1.88 | T(45) = −1.33 | | T(206) = −1.88 | |
| p-value | 0.015 | 0.315 | 0.112 | 0.752 | 0.066 | 0.190 | | 0.063 | |
| Province | | | | | | | | | |
| Ontario | 21.6 (21.1, 22.2) | 21.5 (19.8, 23.1) | 22.4 (21.3, 23.5) | 20.2 (18.8, 21.6) | 20.3 (17.9, 22.7) | 21.3 (18.4, 24.3) | SS | 22.7 (21.9, 23.6) | F(5,230) = 2.65, $p = .024$ |
| Québec | 21.8 (21, 22.6) | 20.3 (18.7, 22) | SS | 20.4 (18.8, 21.9) | SS | SS | SS | 23.4 (22.2, 24.6) | F(2,102) = 6.48, $p = .002$ |
| Prairies and British Columbia/Atlantic | 21.3 (20.5, 22) | SS | 21.8 (20.4, 23.3) | 20.7 (18.3, 23.2) | 20.6 (18, 23.2) | 21.2 (18.4, 24) | SS | 21.3 (20.2, 22.5) | F(4,173) =0.26, $p = .905$ |
| Test-Statistic | F (2,578) =0.61 | T(52) = 0.95 | T(79) = 0.62 | F(2,91) = 0.09 | T(43) = −0.15 | T(35) = 0.08 | | F(2,205) = 3.64 | |
| p-value | 0.542 | 0.347 | 0.540 | 0.915 | 0.885 | 0.939 | | 0.028 | |
| Education | | | | | | | | | |
| Primary/Secondary/ High School | 20.5 (19.6, 21.5) | SS | SS | 20.1 (18, 22.2) | 20.7 (18.1, 23.3) | 18.4 (14.5, 22.3) | SS | 21.3 (19.8, 22.7) | F(3,112) =1.10, $p = .353$ |
| College | 21.9 (21.2, 22.6) | 22.2 (20.5, 23.8) | 22.8 (21, 24.6) | 19.6 (18, 21.3) | 19.6 (16.9, 22.4) | 22.6 (19.6, 25.6) | SS | 22.9 (21.9, 23.9) | F(5,173) = 3.45, $p = .005$ |
| University certificate/ Bachelor's degree | 21.7 (21, 22.4) | 19.9 (18.4, 21.4) | 21 (19.7, 22.4) | 21 (18.4, 23.6) | SS | SS | SS | 22.7 (21.6, 23.8) | F(3,135) = 2.53, $p = .060$ |
| Graduate degree (Master's/PhD) | 22.1 (21.4, 22.9) | 22.9 (21.1, 24.6) | 22.8 (20.9, 24.7) | 21.3 (19.7, 23) | SS | SS | SS | 22.8 (21.1, 24.4) | F(3,70) = 0.80,$p = .497$ |
| Test-Statistic | F(3,572) =3.09 | F(2,57) = 4.21 | F(2,76) = 1.54 | F(3,88) = 0.77 | T(36) = 0.59 | T(30) = −1.86 | | F(3,203) = 1.57 | |
| p-value | 0.027 | 0.02 | 0.220 | 0.517 | 0.558 | 0.072 | | 0.198 | |
| Employment | | | | | | | | | |
| Employed | 21.3 (20.7, 21.9) | 21.9 (20.8, 23) | 22 (20.8, 23.1) | 20 (18.6, 21.4) | 21.5 (19.5, 23.6) | SS | SS | 22.1 (20.8, 23.3) | F(4,211) = 1.91, $p = .111$ |
| Unemployed | 19.9 (18.2, 21.6) | SS | SS | SS | SS | SS | SS | SS | |
| Retired/Homemaker | 22 (21.4, 22.5) | 20.6 (18.6, 22.6) | 22.3 (20.9, 23.7) | 20.9 (19.5, 22.3) | 19.2 (16.6, 21.7) | 22.6 (20.7, 24.4) | SS | 22.8 (22.1, 23.5) | F(5,286) = 3.69, $p = .003$ |
| Test-Statistic | F (2,578) =3.96 | T(58) = 1.23 | T(84) = −0.32 | T(89) = −0.93 | T(47) = 1.48 | | | T(192) = −1.02 | |
| p-value | 0.020 | 0.226 | 0.754 | 0.357 | 0.145 | | | 0.311 | |
| Religion | | | | | | | | | |
| Christian | 21.4 (20.8, 21.9) | 20.5 (19.3, 21.8) | 21.4 (19.8, 23) | 20.4 (19.2, 21.5) | 21.7 (19.4, 24) | 20.6 (17.7, 23.5) | SS | 22.2 (21.4, 23.1) | F(5,310) = 1.59, $p = .164$ |
| Muslim | 22.1 (20.8, 23.5) | 21.6 (19.8, 23.5) | SS | SS | NA | NA | SS | SS | |
| Other | 21.3 (20.3, 22.4) | SS | 22.2 (20.6, 23.9) | SS | SS | SS | SS | 20.2 (17.9, 22.6) | T(36) = −1.99, $p = .055$ |
| No religion | 21.9 (21.2, 22.7) | NA | 22.4 (21, 23.8) | SS | 18.9 (16.6, 21.2) | 21.3 (18.1, 24.5) | SS | 23.4 (22.6, 24.1) | F(3,119) = 6.40, $p < .001$ |
| Test-Statistic | F (3,557) =0.95 | T(61) = −1.03 | F(2,82) = 0.767 | | T(44) = 1.68 | T(34) = −0.62 | | F(2,200) = 3.79 | |
| p-value | 0.419 | 0.307 | 0.468 | | 0.100 | 0.540 | | 0.024 | |
| Marital status | | | | | | | | | |
| Single | 21.2 (20.1, 22.4) | SS | SS | 19.5 (17.2, 21.8) | SS | SS | SS | 22.6 (20.8, 24.5) | T(52) = 2.12, $p = .039$ |
| Other | 21.5 (21,22) | 20.6 (19.2, 21.9) | 22.1 (21.1, 23) | 20.8 (19.6, 22) | 21 (19.3, 22.7) | 22.2 (20.4, 24.1) | SS | 21.9 (21, 22.7) | F(5,361) = 1.10, $p = .360$ |
| Divorced/Widowed | 21.9 (21.1, 22.8) | 22 (20.3, 23.7) | SS | 20.1 (17.6, 22.7) | SS | SS | 20.1 (16.8, 23.3) | 23.7 (22.9, 24.5) | F(3,89) = 7.25, $p < .001$ |
| Test-Statistic | F (2,577) = 0.55 | T(58) = −1.37 | | F(2,91) = 0.57 | | | | F(2,204) = 2.93 | |

(*continued on next page*)

**Table 2** (*continued*)

| Variables | Total | Arab | Asian | Black | Indigenous | Mixed | Other | White | Test-statistic, *p*-value |
|---|---|---|---|---|---|---|---|---|---|
| p-value | 0.579 | 0.175 | | 0.569 | | | | 0.056 | |
| Income | | | | | | | | | |
| Below $50,000 | 21.7 (21, 22.5) | 21.2 (19.3, 23.1) | 21.9 (19.4, 24.5) | 21 (19.4, 22.6) | 18.8 (15.8, 21.9) | 20.8 (17.3, 24.3) | SS | 23.2 (22.1, 24.2) | F(5,163) = 2.14, $p$ = .063 |
| $50,000 to $99,999 | 21.2 (20.6, 21.9) | 21.4 (19.7, 23) | 22 (20.5, 23.4) | 20.1 (18.9, 21.4) | 20.3 (17.4, 23.2) | 19.1 (15.5, 22.6) | SS | 22.2 (21.1, 23.3) | F(5,185) = 1.99, $p$ = .083 |
| $100,000 and above | 21.7 (21.1, 22.4) | 20.4 (18.4, 22.3) | 22.5 (21.5, 23.4) | 19.7 (16.8, 22.6) | 22.2 (20, 24.5) | 23.8 (21.9, 25.7) | SS | 21.8 (20.7, 22.8) | F(5,156) = 3.11, $p$ = .011 |
| Test-Statistic | F (2,538) =0.34 | F(2,63) = 0.28 | F(2,79) = 0.21 | F(2,88) = 0.60 | F(2,48) = 1.64 | F(2,40) = 2.49 | | F(2,186) = 0.74 | |
| p-value | 0.336 | 0.756 | 0.809 | 0.550 | 0.205 | 0.095 | | 0.480 | |

Note: Estimates for Levels of variables with fewer than 15 observations were colored red. SS: cells with single observation, NA stands for not applicable: the cell did not have the indicated categories.

**Table 3**
Results from multiple linear regression models ($N$ = 581 participants).

| | Model 1 | | | Model 2 | | |
|---|---|---|---|---|---|---|
| | β | t | p-value | β | t | p-value |
| Intercept | 19.13 | 17.16 | < 0.001 | 25.66 | 22.17 | < 0.001 |
| Sex (ref: Men) | | | | | | |
| Women | −0.48 | −1.12 | 0.265 | −1.02 | −2.49 | 0.013 |
| Non-binary | −1.43 | −1.88 | 0.061 | 0.09 | 0.12 | 0.907 |
| Age group (reference: 55–64) | | | | | | |
| 65 and over | 0.74 | 1.46 | 0.14 | 0.38 | 0.80 | 0.424 |
| Province (Ref: Ontario) | | | | | | |
| Quebec | 0.13 | 0.25 | 0.807 | −0.21 | −0.40 | 0.689 |
| Other | −0.38 | −0.81 | 0.417 | −0.48 | −1.09 | 0.278 |
| Education (Ref: Primary/ Secondary/High School) | | | | | | |
| College University certificate/ bachelor's degree | 1.41 | 2.56 | 0.011 | 0.78 | 1.43 | 0.154 |
| Graduate degree (Master's/PhD) | 0.97 | 1.65 | 0.100 | 0.41 | 0.71 | 0.476 |
| Employment (Ref: Employed) | 1.20 | 1.80 | 0.073 | 0.65 | 0.98 | 0.327 |
| Unemployed | −1.00 | −1.18 | 0.238 | −1.55 | −1.72 | 0.086 |
| Retired | 0.06 | 0.11 | 0.913 | −0.73 | −1.49 | 0.138 |
| Race (Ref: White) | | | | | | |
| Arab | −1.13 | −1.58 | 0.114 | 0.61 | 0.87 | 0.386 |
| Asian | −0.23 | −0.37 | 0.709 | 0.25 | 0.41 | 0.682 |
| Black | −1.49 | −2.34 | 0.020 | 0.24 | 0.37 | 0.714 |
| Indigenous | −1.35 | −1.72 | 0.085 | −0.84 | −1.12 | 0.263 |
| Mixed | −1.14 | −1.48 | 0.141 | −1.06 | −1.48 | 0.140 |
| Other | −1.20 | −1.09 | 0.276 | 0.39 | 0.35 | 0.729 |
| Literacy | 0.09 | 3.12 | 0.002 | 0.08 | 2.72 | 0.007 |
| Major Racial Discrimination | −0.42 | −2.74 | 0.006 | 0.07 | 0.47 | 0.641 |
| Conspiracy | – | – | – | −0.31 | −13.25 | <0.001 |

Participants 65 years and older tend to have better COVID-19 Vaccine Effectiveness Perception. While increasing age has consistently been identified as a predictor of higher vaccine coverage in Canadian cohorts [45], some studies have paradoxically reported lower perceived vaccine safety among older adults in Ontario. For example, a survey of 167 community-dwelling older adults conducted as part of a longitudinal observational cohort study on health behaviors found that individuals aged over 50 reported higher COVID-19 vaccine hesitancy compared with younger participants [46]. Consistent with the findings of the present study, lower educational attainment, specifically having less than a bachelor's degree, was also associated with lower perceptions of COVID-19 vaccine safety.

With respect to education level, our findings indicate a clear dose–response relationship with perceived vaccine effectiveness, though in the multivariable analysis, only college-level education was associated with a positive but modest increase in perceived vaccine effectiveness in Model 1 (β = 1.41, $p$ = .011). This suggests that higher educational attainment is linked to slightly more favourable perceptions of vaccines. These findings align with prior research examining perceptions of COVID-19 vaccine safety and general vaccine safety. One study [46] conducted among 1367 community-dwelling adults in Ontario reported that participants with higher educational attainment consistently demonstrated greater confidence in both COVID-19 vaccines and vaccines overall, with perceptions improving incrementally across increasing education levels.

Regarding racial and sociodemographic differences in COVID-19 vaccine effectiveness perceptions, findings, though scarce, demonstrated that perceived vaccine effectiveness differed significantly by

**Table 4**
Adjusted mediation analysis of major discrimination and vaccination effectiveness with conspiracy beliefs as the mediator.

| Type of effect | Estimate | Lower 95% CI | Upper 95% CI | p-value |
|---|---|---|---|---|
| Indirect effect | −0.241 | −0.380 | −0.103 | <0.001 |
| Direct effect | −0.193 | −0.529 | 0.095 | 0.222 |
| Total Effect | −0.434 | −0.763 | −0.126 | 0.012 |
| Proportion Mediated | 0.555 | 0.209 | 1.485 | 0.012 |

*Note.* Mediation models were adjusted for sex, age group, province, education, employment status, race, and literacy.

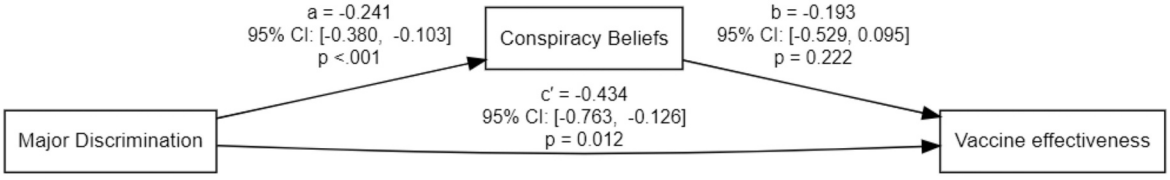



**Fig. 1.** Mediation model of major experience of discrimination, health literacy on COVID-19 vaccine effectiveness through conspiracy beliefs.

race, with White participants reporting higher scores than Black and Indigenous participants. Similar patterns have been documented in the Canadian context [47,48], where racialized minorities exhibit lower COVID-19 vaccine confidence. These disparities are often linked to long-lasting discrimination, systemic racism, and medical mistrust rooted in historical medical abuses involving Black populations —e.g., the Tuskegee Syphilis Study [49,50] and non-consensual gynecological experimentation on enslaved women [51]—have contributed to long-standing mistrust of medical institutions. This legacy has been shown to influence contemporary health behaviors and perceptions, including vaccine confidence, participation in clinical research, and trust in public health interventions. This weak perception towards vaccine effectiveness applies to other vaccines, such as influenza immunization [52].

A previous cross-sectional survey of 2528 Canadian parents by Cénat et al. [47] provides complementary evidence where Black ($M = 19.80$, $SD = 4.85$) and White parents ($M = 18.91$, $SD = 5.66$) reported lower perceived COVID-19 vaccine effectiveness compared with Asian, Arab, and Indigenous parents. These findings suggest that parents may adopt a distinct positionality in decision-making regarding COVID-19 vaccination for their children, which differs from the long-standing success of the Expanded Programme on Immunization (established in 1974 [6]) that has historically focused on children and women of reproductive age [53,54]. Older adults remain at elevated risk of COVID-19 infection [55] and COVID-19–related complications [56] and therefore stand to require a substantial number of vaccine doses [47]. Generally, as stated by the updated report from the Government of Canada (as of June 30, 2024) [57] and other literature [58], COVID-19 vaccine uptake increases with age, with a steady augmentation to the recommended coverage by the 70's.

Major racial discrimination emerged as the strongest predictor of lower vaccine effectiveness ($\beta = -0.42$, $p = .006$), along with literacy ($\beta = 0.09$, $p = .002$) and identifying as Black compared to White ($\beta = -1.49$, $p = .020$). These results are concordant with previous ones that show that COVID-19 vaccine uptake in the socio-demographic groups may be influenced in part by vaccine hesitancy associated in under-represented Canadian individuals with concerns on vaccine safety, mistrust, effectiveness, and experiences of racial discrimination in health settings [59–61]. Regarding specifically Black communities, the scoping review of Olanlesi-Aliu et al. [62] found that despite having higher rates of COVID-19 infection, the lower rate of COVID-19 screening as well as vaccine uptake among Black Canadians was associated with the pre-COVID-19 experiences of institutional and structural racism. Health inequities and a mistrust of health care professionals may have further impeded access to health care.

The function of conspiracy beliefs towards COVID-19 vaccination has been extensively studied but remains inconclusive. One study that meta-analyzed 93 independent samples in 23 countries ($n = 78,625$) [63] explained that lower vaccination and social distancing responses were unrelated to mask wearing and hygiene responses. Such results portray the complexity in intercepting determinants of COVID-19 vaccination. The reluctance to take a COVID-19 vaccine (versus mask wearing) could be associated with fears regarding intramuscular injections. This may add to the numerous fears reported in the literature, including the concerns regarding compromised reproductive health [64] or the dangers of a vaccine produced in a rush [65]. Low vaccine uptake among racialized communities is closely tied to their persistent under-representation in COVID-19 vaccine research. Although these groups have faced disproportionately high infection and hospitalization rates, early phase vaccine trials included only 1–9% Black participants, with phase 3 trials reaching just 10% [66]. Such limited inclusion undermines trust: when communities most affected by the virus do not see themselves reflected in the evidence base, skepticism about safety and relevance grows, creating a powerful barrier to vaccination.

Previous research shows that COVID-19 vaccine hesitancy stems from multiple factors, a pattern echoed in this study. For example, reports from the British Broadcasting Corporation [22] and other British scholarly work [67] noted that Chinese-made vaccines were rejected in the UK, where the Oxford-AstraZeneca vaccine was embraced as a national success, illustrating how vaccine origin shapes perceived effectiveness. Similarly, Fridman et al. found that political ideology influences attitudes, with U.S. Republicans expressing more negative views than Democrats [68]. Finally, it is also recognized that fake news and disinformation related to COVID-19 fueled the conspiracy theories and sustaining distress towards government interventions [69].

### 4.1. Limitations

Although few studies have examined perceptions of COVID-19 vaccine effectiveness, particularly among middle-aged and older adults, the present study may not provide an exhaustive or fully representative portrait of the phenomenon under investigation. Furthermore, reliance on self-reported responses may introduce several sources of bias, including imperfect recall, selective responding, and social desirability. Nonetheless, the instruments used in this study align with standardized measures commonly employed in national public health surveillance. Their widespread and sustained use enhances comparability across studies and supports the interpretation of observed trends despite inherent reporting limitations. It should also be noted that data collection occurred approximately two years after the peak of the COVID-19 pandemic, which may have contributed to recall bias among participants. Finally, future research employing diverse methodological approaches would be valuable to more comprehensively capture perceptions of vaccine effectiveness, particularly given the scarcity of studies focusing on racialized populations and the limited empirical literature on older adults in Canada, whether racialized or not.

## 5. Conclusion

In a pan-Canadian study of 581 adults aged 55 years and older, we found that perceptions of COVID-19 vaccine effectiveness varied meaningfully across racial groups and are shaped by social and informational determinants rather than demographics alone. Older age and higher health literacy were associated with more favourable perceptions of vaccine effectiveness. Meanwhile, Black and Indigenous participants reported lower perceived vaccine effectiveness compared with White and Asian participants. Experiences of major racial discrimination emerged as a key factor that predicted perceptions of vaccine ineffectiveness, mediated through conspiracy beliefs. Together, these findings underscore that vaccine confidence among older racialized adults is deeply embedded in lived experiences of structural racism and exposure to misinformation, highlighting the need for equity-oriented, trust-building public health strategies that address discrimination, enhance literacy, and directly counter-conspiracy narratives to improve vaccine confidence and uptake in racialized communities.

## CRediT authorship contribution statement

**Idrissa Beogo:** Conceptualization, Data curation, Methodology, Project administration, Supervision, Visualization, Writing – original draft, Writing – review & editing. **Yan Xu:** Data curation, Methodology, Resources, Writing – original draft, Writing – review & editing. **Taddele Cherinet Kibret:** Data curation, Formal analysis, Methodology, Validation, Writing – review & editing. **Mwali Muray:** Methodology, Validation, Writing – original draft, Writing – review & editing. **Jude Mary Cénat:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Resources, Validation, Writing – original draft, Writing – review & editing.

## Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Jude Mary Cenat reports financial support was provided by Public Health Agency of Canada. If there are other authors, they 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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*Ethics statement*

This study was approved by the University of Ottawa Research Ethics Board (#H-04-23-9199, MOD1-9199).

## Data availability

Data will be made available on request.

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