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Ethnic disparities in COVID-19 vaccine uptake among among 55+ year-old Canadians: Exploring the role of racial discrimination, chronic disease comorbidities, and conspiracy beliefs

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ABSTRACT

Background: Canada's COVID-19 vaccination program achieved high overall coverage, yet older racialized and Indigenous people experienced lower uptake and far higher infection and mortality rates. Structural inequities, low health literacy, mistrust, and misinformation contributed to these gaps. Despite early vaccine prioritization, little disaggregated data exist for racialized and Indigenous older adults. This study examines vaccine uptake in these underserved groups to inform more equitable public health strategies and strengthen future pandemic responses.

Methods: We conducted a Canada-wide cross-sectional online survey of adults aged ≥55 years in March 2025 using Computer-Assisted Web Interviewing. Participants completed measures assessing COVID-19 vaccination doses, experiences of major racial discrimination, conspiracy beliefs, health literacy, chronic conditions, and sociodemographic characteristics.

Results: Of the 581participants, 90,3% received at least one dose. Black and Indigenous people were more often unvaccinated (17%), compared to 5.5-6% for Asians and Arabs. Receipt of ≥5 doses was observed in 50% of White, 41.8% of Asian and 13.8% of Black individuals. Older adults (≥65 years) had greater uptake (OR=1.58, 95%CI: 1.07–2.32), as did retirees (OR=2.47) and more highly educated participants (college OR=2.29; Bachelor OR=2.77). Higher conspiracy belief scores were significantly associated with lower odds of receiving higher doses (OR=0.91, 95%CI: 0.89–0.93; $p<0.001$). Additionally, a greater number of chronic diseases was associated with higher odds of being in a higher vaccine-dose category (OR = 1.09, 95% CI: 1.02–1.18).

Conclusion: Despite pandemic efforts, substantial ethnic disparities in COVID-19 vaccine uptake persisted, with lower coverage in racialized and Indigenous groups. Addressing structural inequities, comorbidities, and misinformation is critical to achieving more equitable, culturally responsive vaccination strategies.

1. Background

Since the launch of Canada's COVID-19 vaccination campaign in December 2020 [1], older adults were prioritized due to their markedly elevated risk of severe disease, hospitalization, and death [1,2]. Vaccination substantially reduced infections and mortality in high-risk settings such as long-term care homes, confirming its central role in protecting ageing populations [3]. Although overall vaccine coverage among older adults in Canada was high during the initial rollout, aggregate estimates may obscure important inequities across racialized and Indigenous populations [2].

The pandemic also exposed longstanding structural inequities in Canada. Racialized and Indigenous communities experienced disproportionately high rates of COVID-19 infection and adverse outcomes, reflecting broader barriers to access to care, socioeconomic disadvantages, and discrimination within healthcare systems [4,5]. Evidence

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from Canada and other high-income countries further suggests that vaccination coverage among older adults varies by race, ethnicity, and other social determinants [6,7].

Despite Canada's high COVID-19 vaccination coverage, important gaps remain in understanding who is left behind —particularly among older adults from diverse racialized communities. While several Canadian studies have included age as a covariate or stratification variable in analyses of COVID-19 vaccine uptake [8–10], relatively few have explicitly centred older adults aged 55 and older across racialized groups. As a result, age-specific and race-disaggregated evidence remains scarce. In this context, Beogo et al. [11] stands among the few studies to explicitly focus on older racialized populations and their unique experiences. Using the same survey sample as [11], the present study examines COVID-19 vaccination uptake, measured by the number of doses received, and investigates racial disparities and potentially modifiable factors associated with uptake among older adults, whereas [11] focused on vaccine mistrust. Beyond sociodemographic inequalities, vaccine uptake is shaped by modifiable determinants.

Beyond sociodemographic factors, vaccine uptake is shaped by a constellation of modifiable individual, social, and structural determinants. Lower health literacy has been consistently associated with vaccine hesitancy and reduced confidence in immunization programmes [12,13]. Conspiracy beliefs and mistrust in institutions have similarly been linked to lower COVID-19 vaccine acceptance and uptake [14–16]. In Canada, experiences of racial discrimination may further undermine vaccine trust among racialized and Indigenous populations [17,18]. Chronic diseases may additionally influence vaccination decisions, given the heightened risks associated with COVID-19 [19].

Against this backdrop, an important question remains: does the generally higher COVID-19 vaccine uptake observed with increasing age extend equally across racialized and ethnic minority groups? This study addresses this question among Canadians aged 55 years and older by (1) examining vaccination prevalence across racial groups and sociodemographic characteristics; and (2) identifying factors associated with vaccination, including chronic diseases, conspiracy beliefs, health literacy, and experiences of racial discrimination. By examining these factors jointly, the study provides race-disaggregated evidence on whether vaccination disparities persist among older racialized.

2. Methods

2.1. Data collection and design

We conducted a cross-sectional survey titled *Vaccine Hesitancy Among Racially Diverse People Aged 55 Years and Older in Canada* between March 18 and March 28, 2025. Participants self-identified as Arab, Asian, Black, Indigenous, White, or Mixed and were recruited through Computer-Assisted Web Interviewing (CAWI) using Léger's national online panel of over 420,000 members. Of 8,755 invitations sent, 1,127 individuals accessed the survey; 868 were eligible, and 581 participated (response rate: 66.9%). Eligible participants were Canadian residents aged ≥55 years, able to complete the survey in English or French. The pretested questionnaire required approximately 23 minutes to complete, consistent with the observed median duration.

2.2. Measures

COVID-19 vaccination doses were assessed in two steps. Participants first indicated whether they had received any COVID-19 vaccination (Yes/No). Those responding "Yes" subsequently reported the number of doses received (one, two, three, four, five or more). Participants reported their COVID-19 vaccination status based on their vaccination experience up to survey completion, without a predefined vaccination date range due to the absence of an established official end date for the pandemic. For descriptive analyses, a binary vaccination variable was used to estimate prevalence and corresponding 95% confidence intervals. For multivariable modelling, vaccination uptake was operationalized as an ordinal outcome reflecting the number of doses received. Due to sparse data for single-dose recipients, the first- and second-dose categories were combined.

Experience of major racial discrimination was measured using a 7-item binary (Yes/No) scale adapted from Papakyriakopoulos et al. [20]. The instrument captures experiences across key domains, including education, employment, healthcare, and the justice system (e.g., "Have you been treated unfairly in a hospital or other health service?"). The scale demonstrated good internal consistency in this study (Cronbach's $\alpha = 0.75$) and has been widely used among racialized populations in Canada [21].

Conspiracy Beliefs were assessed using the 10-item COVID-19 Conspiracy Belief Scale [22]. Items (e.g., "COVID-19 was deliberately created by scientists in a laboratory") were rated on a five-point Likert scale. Higher scores indicate stronger endorsement of conspiracy beliefs. The scale demonstrated excellent internal consistency (Cronbach's $\alpha = 0.94$) and has been previously applied in studies involving racialized populations in Canada [23].

Health Literacy. Health literacy was assessed using an 8-item Health Literacy Scale rated on a five-point Likert scale (HLS) [24], 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") [25]. Higher scores indicate greater health literacy (Cronbach's alpha = .95). The Health Literacy Scale has been used in several publications focusing on racialized communities in Canada [26].

Chronic disease assessment. Participants reported whether they had been diagnosed with various chronic conditions, including respiratory, cardiovascular, musculoskeletal, neurological, digestive, and other health conditions. A total chronic disease score was calculated by summing all reported conditions, generating a continuous indicator of multimorbidity included as a predictor in the analyses.

Vaccine uptake was operationalized as the cumulative number of COVID-19 vaccine doses received. As a population-based study, we adopted this conservative approach to reflect the evolving nature of COVID-19 vaccination recommendations over time.

Indeed, during the COVID-19 pandemic, vaccine eligibility criteria changed substantially in Canada and internationally. Starting from programs that prioritized healthcare workers, long-term care residents, older adults, and individuals at high risk of severe disease, it has evolved as vaccine availability increased and evidence on vaccine safety and effectiveness accumulated; eligibility gradually expanded to younger age groups and eventually to the broader population [27–29].

The evolution of eligibility criteria was also influenced by the characteristics of different vaccine platforms. mRNA vaccines, such as Pfizer-BioNTech and Moderna, and protein-based vaccines, such as Novavax, received authorization for specific age groups and populations according to clinical trial evidence, safety profiles, immunogenicity, and effectiveness data [30–32]. Booster doses were particularly recommended for individuals who completed a primary mRNA vaccine series and for immunocompromised populations [33]. Vaccination policies further varied according to factors such as age [34,35], the emergence of SARS-CoV-2 variants, and vaccine type, including mRNA and protein-based vaccines [36,37]. Overall, COVID-19 vaccination strategies represented a dynamic and evidence-based process in which eligibility criteria and booster recommendations were continuously adapted to maximize population protection and address evolving public health needs.

2.3. Statistical analysis

Missing values were imputed using the expectation–maximization (EM) algorithm in SPSS. Missingness was highest for conspiracy beliefs (27.0%) and the number of vaccine doses (10.0%), while missingness for other variables was generally low. Descriptive statistics were computed using frequencies and percentages to summarize sociodemographic

characteristics. Prevalence and corresponding 95% confidence intervals (CIs) for vaccination status were estimated for the total sample and across covariate levels, with associations assessed using Chi-square or Fisher's exact tests, as appropriate. For higher-order doses, prevalence estimates were reported for grouped categories (1–2, 3, 4, and ≥5 doses).

For multivariable analyses, the number of vaccine doses was treated as an ordinal outcome with five ordered categories: 0 doses (unvaccinated), 1–2 doses, 3 doses, 4 doses, and ≥5 doses. Thus, unvaccinated participants were included in the ordinal regression analyses as the lowest outcome category. Ordinal logistic regression models were fitted using the *polr()* function from the MASS package in R, using maximum likelihood estimation. Model 1 (N=579) included age group, gender, ethnicity, education, marital status, employment status, and number of chronic conditions, as well as major experiences of racial discrimination and health literacy. Model 2 (N=579) additionally incorporated conspiracy beliefs. Covariates were selected based on their potential relevance to COVID-19 vaccination and vaccine-related outcomes, informed by previous literature and the study objectives. Multicollinearity among covariates included in the multivariable models was assessed using the generalized variance inflation factor (GVIF) calculated using the *vif()* function from the *car* package in R. The adjusted GVIF values ranged from 1.05 to 1.27, indicating no evidence of problematic multicollinearity. The proportional-odds assumption was assessed using likelihood-ratio tests comparing models with and without nominal (category-specific) effects. Marital status showed evidence of non-proportionality; sensitivity analyses excluding marital status showed no evidence of non-proportionality among the remaining covariates, with the main findings materially unchanged.

Regression coefficients were exponentiated to obtain odds ratios (ORs) and 95% CIs.

Statistical significance was assessed using the t-statistics, with p-values reported by *polr()*. ORs greater than one indicated higher odds of being in a higher vaccination category. Model fit was evaluated using log-likelihood, Akaike Information Criterion (AIC), and McFadden's pseudo-R^2, where lower AIC and higher pseudo-R^2 values indicated superior fit. Statistical significance was set at $p < 0.05$.

All analyses were conducted in *R* (version 4.4.2; R Foundation for Statistical Computing, Vienna, Austria) and IBM SPSS Statistics (version 20), using the imputed analytic dataset.

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 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/Homemaker	240 (41.3)	41 (17.1)	45 (18.8)	53 (22.1)	25 (10.4)	14 (5.8)	10 (4.2)	52 (21.7)
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)
Retired	302 (52)	19 (6.3)	41 (13.6)	38 (12.6)	24 (7.9)	28 (9.3)	10 (3.3)	142 (47)
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)	0	0	5 (13.5)	0
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)

Note: Only valid categories are reported

3. Results

The study sample comprised 581 participants: 43.0% women, 8.8% non-binary participants. Regarding race/ethnicity, 36% identified as White, 16.2% as Black and 15.8% as Asian, Arab (11.5%), Indigenous (9.0%), and Mixed (8.1%). Participants were evenly split between ages 55–64 and 65 or older. Overall, the sample reflects diverse sociodemographic and socioeconomic characteristics; full distributions across racial groups are presented in Table 1.

Among participants, 90.3% (95%CI: 87.6–92.5) received ≥1 COVID-19 vaccine dose (Table 2). Vaccination prevalence differed by age group ($\chi^2(1)=7.86$, $p = 0.005$), with higher coverage among adults aged ≥65 years (94.0%, 95%CI: 90.6–96.2) compared with those aged 55–64 years (86.8%, 95%CI: 82.4–90.2).

As for employment status (Fisher's exact test, $p = 0.015$), retired participants (93.4%, 95%CI: 90.0–95.7) had higher coverage than among employed/home-makers (87.9%, 95%CI: 83.1–91.4) and unemployed participants (82.1%, 95%CI: 67.3–91.0).

Differences were observed by marital status, with higher vaccination prevalence among married or common-law participants (91.4%, 95%CI: 88.1–93.8) compared with single participants (80.7%, 95%CI: 71.0–87.8).

Vaccination prevalence significantly varied by race (Fisher's exact test, $p = 0.011$). Asian participants had slightly higher vaccination coverage (94.6%, 95% CI: 87.9–97.7), followed by Arab (94.0%, 95% CI: 85.4–98.3) and White participants (93.8%, 95% CI: 89.6–96.3), while Black participants had the lowest (83.0%, 95% CI: 74.1–89.2). Indigenous (82.7%, 95% CI: 70.3–90.6) and Mixed-race participants (84.8%, 95%CI: 71.8–92.4) also showed lower coverage relative to White participants. The proportion of the total sample with ≥5 doses was highest among White participants (50.0%, 95% CI: 43.0–57.0), compared with Black participants (13.8%, 95% CI: 7.6–22.5) and Indigenous participants (30.8%, 95% CI: 18.7–45.1).

Table 3 presents ordinal logistic regression results for factors associated with COVID-19 vaccine dose uptake. In Model 1 (log-likelihood = −796.12, AIC = 1,638.25, McFadden's $R^2 = 0.094$), higher vaccine dose uptake was significantly associated with older age and retirement status. Participants aged ≥65 years had higher odds of being in a higher dose category than those aged 55–64 years (OR = 1.58, 95%CI: 1.07–2.32; $p = 0.021$), and retired participants had higher odds than employed/home-maker participants (OR = 2.47, 95%CI: 1.67–3.65; $p< 0.001$).

Compared with participants with primary/secondary education, those with college (OR = 2.29, 95%CI: 1.51–3.48; $p< 0.001$), a university certificate or bachelor's degree (OR = 2.77, 95% CI: 1.76–4.36; $p< 0.001$), and a graduate degree (OR = 2.30, 95%CI: 1.40–3.78; $p = 0.001$) had higher odds of receiving more vaccine doses.

Compared with White participants, Black (OR = 0.28, 95%CI: 0.18–0.46; $p< 0.001$) and Arab participants (OR = 0.39, 95% CI: 0.23–0.65; $p< 0.001$) had lower odds of higher dose uptake, whereas Indigenous, Mixed, Asian, and other racial groups did not differ significantly. A greater burden of chronic disease was associated with higher dose uptake (OR = 1.09 per additional condition, 95%CI: 1.02–1.18; $p = 0.018$), and higher exposure to major racial discrimination was associated with lower odds of being in a higher vaccine dose (OR = 0.85, 95% CI: 0.76–0.96; $p = 0.008$).

Model 2, which added conspiracy beliefs, showed improved fit (log-likelihood = −759.56, AIC = 1,567.11, McFadden's $R^2 = 0.135$). Higher conspiracy belief scores were significantly associated with lower odds of receiving higher doses (OR = 0.91, 95%CI: 0.89–0.93; $p < 0.001$). Associations for older age, higher education, retirement status, and number of chronic diseases remained statistically significant. Compared with White participants, Black participants continued to have significantly lower odds of higher dose uptake after adjustment for conspiracy beliefs (OR = 0.36, 95%CI: 0.22–0.59; $p < 0.001$), whereas associations for Arab participants and major racial discrimination were attenuated and no longer significant.

4. Discussion

This study examined the prevalence of COVID-19 vaccine uptake among racialized and Indigenous adults aged 55 years and older in Canada and identified sociodemographic and health-related factors associated with vaccination.

To our knowledge, this is among the first Canadian studies to examine COVID-19 vaccine uptake among racialized and Indigenous adults aged 55 years and older while distinguishing between adults aged 55-64 years and those aged 65 years and older. Our findings reveal important sociodemographic disparities in vaccine uptake, particularly among adults aged 55-64 years. In this subgroup, Black and Indigenous participants, individuals with lower incomes, and those who were single or not living with a partner were more likely to report lower vaccine uptake. Although relatively few studies in Canada have explicitly examined vaccine uptake across ethnic groups among older adults, existing evidence consistently suggests higher uptake with increasing age.

Although evidence on COVID-19 vaccine uptake among racialized older adults in Canada remains limited, existing research consistently demonstrates higher vaccination uptake with increasing age. Our findings align with studies documenting lower vaccination rates among older Black adults [38] and greater vaccine unwillingness among adults aged 50-64 years relative to older age groups [19]. Previous studies have identified persistent vaccination disparities among Black and Arab communities [39], suggesting that social and structural factors may continue to shape vaccine uptake even among older adults.

Our findings also indicate that higher educational attainment is associated with greater vaccine uptake. This aligns with prior Canadian research showing a dose–response relationship between education and vaccine-related perceptions and behaviors [40]. Nevertheless, the role of education is not entirely consistent across contexts. Some studies report no significant association between education and vaccine confidence [41], while others suggest higher education may even correlate with increased vaccine hesitancy globally [42], highlighting the complexity of this relationship.

Among Black individuals, the observed associations with increased vaccine uptake remained after accounting for conspiracy beliefs (Table 3, Models 1 & 2). Without a race × conspiracy-belief interaction test, these findings do not demonstrate that the effect differs by race. Instead, the persistence of these associations after adjustment suggests that factors beyond conspiracy beliefs may contribute to differences in vaccine uptake. While the specific determinants remain unclear, prior research suggests that vaccine uptake varies across health conditions and contexts. For example, an Ontario cohort of 20,903 people living with HIV reported high vaccine uptake (≥2 doses: 85.4%) [43], consistent with public health recommendations for high-risk populations [44]. In contrast, studies from the United States have reported lower vaccination rates among individuals with chronic conditions [45]. Together, these findings highlight the complexity of vaccine decision-making and the need for further research to identify factors influencing uptake across populations.

About ethnicity, our study found that White participants demonstrated higher uptake of five or more vaccine doses (50.0%), followed by Asian participants (41.8%), while other groups showed substantially lower uptake. This pattern is consistent with Canadian literature reporting higher vaccination coverage among White populations compared with other racialized groups [46], as well as international findings [47]. However, some Canadian studies have reported particularly high uptake among Asian populations [9], suggesting variability within racialized groups.

Population-level Canadian data indicate that, between June 2021 and February 2022, approximately 93% of individuals who were neither Indigenous nor part of visible minority groups had received at least one vaccine dose, compared with 82% of Black individuals and 85% of Arab individuals, while South Asian individuals showed higher uptake (96%)

Table 2
COVID-19 Vaccination Status and Dose Distribution by Demographic and Socioeconomic Characteristics

			Unvaccinated	Vaccinated	Vaccination status and dose categories, Percent (95% CI)*			
		Total	Percent(95%CI)	Percent(95%CI)	1-2 doses	3 doses	4 doses	5+ doses
Predictor	Level	581	9.7 (7.5–12.3)	90.3 (87.6–92.5)	17.1 (14.1–20.4)	19.3 (16.2–22.8)	17.3 (14.3–20.6)	36.6 (32.7,40.7)
Gender	Men	280	10.4 (7.3–14.5)	89.6 (85.5–92.7)	15.4 (11.3–20.1)	18.6 (14.2–23.6)	17.5 (13.2–22.5)	38.2 (32.5–44.2)
	Women	250	8.4 (5.6–12.5)	91.6 (87.5–94.4)	18.5 (13.9–24.0)	18.1 (13.6–23.5)	17.3 (12.8–22.6)	37.5 (31.5–43.8)
	Non-binary	51	11.8 (5.5–23.4)	88.2 (76.6–94.5)	19.6 (9.8–33.1)	29.4 (17.5–43.8)	15.7 (7.0–28.6)	23.5 (12.8–37.5)
	Between 55 and 64	296	13.2 (9.8–17.5)	86.8 (82.5–90.2)	25.1 (20.2–30.4)	20.7 (16.2–25.8)	14.6 (10.8–19.1)	26.4 (21.5–31.9)
Age group	65 or over	285	6.0 (3.8, 9.3)	94.0 (90.7–96.2)	8.8 (5.8–12.7)	18.0 (13.7–22.9)	20.1 (15.6–25.2)	47.2 (41.3–53.2)
	Ontario	246	11.0 (7.7–15.6)	89.0 (84.5–92.3)	14.3 (10.2–19.3)	21.6 (16.6–27.3)	15.9 (11.6–21.1)	37.1 (31.1–43.5)
	Quebec	135	7.4 (4.1–13.1)	92.6 (86.9–95.9)	15.6 (9.9–22.8)	22.2 (15.5–30.2)	22.2 (15.5–30.2)	32.6 (24.8–41.2)
Province	Other	200	9.5 (6.2–14.4)	90.5 (85.6–93.8)	21.6 (16.1–28.0)	14.6 (10.0–20.3)	15.6 (10.8–21.4)	38.7 (31.9–45.8)
	Primary/Secondary/High School	141	15.0 (10.0–21.8)	85.0 (78.3–90.0)	22.1 (15.6–29.9)	17.9 (11.9–25.2)	17.9 (11.9–25.2)	27.1 (20.0–35.3)
	College	185	8.6 (5.4–13.5)	91.4 (86.5–94.6)	11.9 (7.6–17.4)	24.3 (18.3–31.2)	16.8 (11.7–22.9)	38.4 (31.3–45.8)
	University certificate/Bachelor's degree	156	8.2 (4.8–13.5)	91.9 (86.6–95.2)	15.4 (10.1–22.0)	15.4 (10.1–22.0)	16.7 (11.2–23.5)	44.2 (36.3–52.4)
Education	Graduate degree (Master's/PhD)	93	6.4 (3.0–13.2)	93.6 (86.8–97.0)	21.5 (13.7–31.2)	18.3 (11.0–27.6)	19.4 (11.9–28.9)	34.4 (24.9–45.0)
	Employed/Home maker	240	12.1 (8.6–16.9)	87.9 (83.2–91.5)	27.2 (21.7–33.3)	24.3 (19.0–30.2)	15.9 (11.5–21.2)	20.5 (15.6–26.2)
	Unemployed	39	17.9 (9.0–32.7)	82.1 (67.3–91.0)	20.5 (9.3–36.5)	17.9 (7.5–33.5)	20.5 (9.3–36.5)	23.1 (11.1–39.3)
Employment	Retired	301	6.6 (4.3–10.0)	93.4 (90.0–95.7)	8.6 (5.7–12.4)	15.6 (11.7–20.2)	17.9 (13.8–22.8)	51.2 (45.4–56.9)
	Christian	325	10.1 (7.3–13.8)	90.0 (86.2–92.8)	18.8 (14.7–23.5)	20.7 (16.4–25.5)	16.7 (12.8–21.2)	34.0 (28.8–39.4)
	Muslim	37	5.1 (0.6–17.3)	95.0 (83.1–99.4)	29.7 (15.9–47.0)	35.1 (20.2–52.5)	5.4 (0.7–18.2)	27.0 (13.8–44.1)
	Other	63	12.7 (6.0–21.2)	88.4 (78.8–94.0)	11.1 (4.6–21.6)	15.9 (7.9–27.3)	22.2 (12.7–34.5)	38.1 (26.1–51.2)
Religion	No religion	136	9.1 (5.4–14.9)	90.9 (85.1–94.6)	12.6 (7.6–19.2)	15.4 (9.9–22.4)	17.5 (11.6–24.7)	45.5 (37.1–54.0)
	Single	84	19.3 (12.2–29.0)	80.7 (71.3–87.9)	12.0 (5.9–21.0)	16.9 (9.5–26.7)	16.9 (9.5–26.7)	34.9 (24.8–46.2)
	Married/Common-law partner	382	8.6 (6.2–11.9)	91.4 (88.1–93.8)	18.8 (15.0–23.1)	19.1 (15.3–23.4)	19.4 (15.5–23.7)	34.0 (29.3–39.0)
Marital status	Divorced/Widowed	114	6.2 (3.0–12.2)	93.9 (87.9–97.0)	15.0 (9.0–23.0)	22.1 (14.9–30.9)	10.6 (5.6–17.8)	46.0 (36.6–55.6)
	White	208	6.2 (3.7–10.4)	93.8 (89.6–96.3)	9.6 (6.0–14.5)	19.7 (14.5–25.8)	50.0 (43.0–57.0)	
	Arab	67	6.0 (1.7–14.6)	94.0 (85.4–98.3)	28.4 (18.0–40.7)	34.3 (23.2–46.9)	19.4 (11.9 (5.3–22.2)	(10.8–30.9)
	Asian	92	5.5 (2.4–12.2)	94.6 (87.9–97.7)	16.5 (9.5–25.7)	19.8 (16.5 (9.5–25.7)	41.8 (12.2–29.4)	(31.5–52.6)
	Black	94	17.0 (10.8–25.9)	83.0 (74.1–89.2)	33.0 (23.6–43.4)	23.4 (15.3–33.3)	12.8 (6.8–21.2)	13.8 (7.6–22.5)
	Indigenous	52	17.3 (9.4–29.7)	82.7 (70.3–90.6)	15.4 (6.9–28.1)	17.3 (8.2–30.3)	19.2 (9.6–32.5)	30.8 (18.7–45.1)
	Mixed	47	15.2 (7.6–28.2)	84.8 (71.8–92.4)	6.5 (1.4–17.9)	17.4 (7.8–31.4)	15.2 (6.3–28.9)	45.7 (30.9–61.0)
Race	Other	21	9.5 (1.2–30.4)	90.5 (69.6–98.8)	14.3 (3.0–36.3)	23.8 (8.2–47.2)	19.0 (5.4–41.9)	33.3 (14.6–57.0)
	Below $50,000	176	11.2 (7.5–16.6)	88.8 (83.6–92.6)	11.4 (7.1–16.7)	22.5 (16.7–29.1)	17.6 (12.5–23.9)	37.4 (30.5–44.8)
	$50,000 to $99,999	199	10.7 (7.2–15.5)	89.3 (84.5–92.8)	21.4 (16.1–27.5)	17.2 (12.4–22.9)	19.5 (14.5–25.5)	31.2 (25.0–37.8)
Income category	$100,000 and above	166	6.8 (3.9–11.5)	93.2 (88.5–96.1)	18.1 (12.7–24.6)	18.6 (13.2–25.2)	14.1 (9.4–20.1)	42.4 (35.0–50.0)

* Percentages for vaccination status and dose categories are calculated using the total number of participants within each predictor category as the denominator. Analyses were conducted using the imputed dataset.

Table 3
Ordinal Logistic Regression Models with and without Conspiracy Beliefs

Variable	Model 1: Without Conspiracy beliefs			Model 2: With Conspiracy beliefs		
	OR (95% CI)	*t-value*	*p-value*	OR (95% CI)	*t-value*	*p-value*
Age group (ref.: 55-64 years)						
65 or over years	1.58 (1.07, 2.32)	2.303	0.021	1.55 (1.05, 2.29)	2.211	0.0270
Gender (ref.: Men)						
Women	0.89 (0.64, 1.23)	-0.709	0.478	0.77 (0.55, 1.07)	-1.559	0.1191
Non-binary	0.71 (0.41, 1.22)	-1.249	0.212	0.79 (0.45, 1.37)	-0.848	0.3964
Education (ref.: Primary/ Secondary/High School)						
College	2.29 (1.51, 3.48)	3.892	< 0.001	2.14 (1.40, 3.27)	3.533	< 0.001
University certificate/ Bachelor's	2.77 (1.76, 4.36)	4.399	< 0.001	2.31 (1.45, 3.65)	3.555	< 0.001
Graduate degree (Master's/PhD)	2.30 (1.40, 3.78)	3.290	0.001	1.91 (1.16, 3.16)	2.528	0.012
Marital status (ref.: Single Married/ Common-law partner)						
Married/ Common-law partner	0.77 (0.48, 1.22)	-1.123	0.261	0.91 (0.57, 1.46)	-0.383	0.702
Divorced/ Widowed	1.25 (0.71, 2.20)	0.787	0.432	1.55 (0.87, 2.76)	1.500	0.134
Employment status (ref.: Employed/ Homemaker)						
Unemployed	1.15 (0.61, 2.16)	0.433	0.665	1.11 (0.59, 2.10)	0.323	0.747
Retired	2.47 (1.67, 3.65)	4.538	< 0.001	2.44 (1.65, 3.62)	4.434	< 0.001
Race (ref.: White)						
Arab	0.39 (0.23, 0.65)	-3.590	< 0.001	0.62 (0.36, 1.07)	-1.730	0.084
Asian	0.95 (0.58, 1.56)	-0.196	0.8449	1.30 (0.79, 2.16)	1.032	0.302
Black	0.28 (0.18, 0.46)	-5.155	< 0.001	0.36 (0.22, 0.59)	-4.070	< 0.001
Indigenous	0.65 (0.36, 1.18)	-1.419	0.156	0.76 (0.42, 1.38)	-0.898	0.369
Mixed	0.92 (0.49, 1.70)	-0.277	0.782	0.90 (0.48, 1.69)	-0.331	0.741
Other	0.70 (0.31, 1.58)	-0.852	0.394	0.94 (0.41, 2.14)	-0.150	0.881
Number of chronic diseases	1.09 (1.02, 1.18)	2.370	0.018	1.08 (1.00, 1.17)	2.075	0.038
Major racial discrimination	0.85 (0.76, 0.96)	-2.668	0.008	0.92 (0.82, 1.04)	-1.287	0.198
Health literacy	1.01 (0.99, 1.04)	1.105	0.269	1.01 (0.99, 1.04)	1.232	0.218
Conspiracy beliefs	—	—	—	0.91 (0.89, 0.93)	-8.319	< 0.001

Note: Odds ratios (OR) > 1 indicate higher odds of being in a higher vaccine dose category. Threshold (cut-point) estimates from the ordinal logistic models are not shown.

[48]. By focusing specifically on adults aged 55 years and older, our study provides a more detailed understanding of higher-order dose uptake in older populations.

Similar disparities have been observed internationally. In the United States, lower vaccination rates have been reported among Black older adults [7]. In England, marked ethnic inequalities were also observed, with Black African and Black Caribbean populations having significantly lower vaccination rates than White British groups [6]. These consistent patterns highlight the persistent and global nature of ethnic disparities in COVID-19 vaccination uptake.

A substantial body of literature has examined barriers to COVID-19 vaccine uptake among racialized populations, with health literacy frequently identified as a key determinant. In the present study, however, health literacy was not significantly associated with vaccine uptake in either model. While comparative evidence specific to older adults remains limited, broader research consistently links lower health literacy to increased vaccine hesitancy [12,13]. In Canada, it has been estimated that 60% of adults and up to 88% of older adults lack adequate health literacy, underscoring a structural vulnerability [49].

Another important finding was the significant negative association between conspiracy beliefs and vaccine uptake (OR = 0.91, 95% CI: 0.89–0.93; $p < 0.001$). Although intuitive, most existing evidence on this relationship has focused on younger populations [15,50], leaving a gap in understanding among older adults. Vaccine-related conspiracy narratives —such as claims regarding falsified safety data or harmful side effects [51]— have been shown to reduce willingness to vaccinate [14,52]. While some of these narratives (e.g., autism-related concerns) may be less directly relevant to older adults, misinformation and mistrust remain influential drivers of vaccine hesitancy in this population. We hypothesize that the situation may be worse for minority seniors regarding complexity in navigating our health system, as contended by Funk [53].

Many Canadian knowledge syntheses demonstrated how health literacy conspiracy theories, mistrust in health institutions, and injustice experienced by those communities [54,55] have impacted trust toward vaccine acceptance [54,55]. The long-lasting trauma associated with slavery, discrimination, and racism constitute an explanation. Also, the exposure to conspiracy theories [56–58], namely in minority communities, seniors included, may have an impact on the very low vaccine uptake when compared to Caucasians, Asians, and Arabs.

Notably, our findings suggest that the influence of conspiracy beliefs may vary across groups, with a statistically significant association observed particularly among Black participants. This aligns with a growing body of literature indicating that conspiracy beliefs play a critical role in shaping vaccine attitudes and uptake among racialized populations [59,60]. Evidence from large-scale cohort studies in the United States has similarly highlighted persistent disparities in booster

uptake among older adults, often attributed to vaccine hesitancy [61].

A continuous review of COVID-19 literature by Young et al. [62] shows that, in Canada and globally, facilitators, barriers, and hesitancy patterns are largely similar. Older age and healthcare provider recommendations were key drivers of booster uptake. However, evidence remains limited among underrepresented groups (e.g., visible minorities, Indigenous people, children, 2SLGBTQI+), highlighting persistent research gaps. Overall, our findings reinforce that vaccine uptake among racialized seniors is shaped by complex structural, informational, and sociohistorical factors.

5. Strengths and limitation

This study has several strengths. First, measuring COVID-19 vaccination by the number of doses provides a consistent and flexible indicator of vaccine uptake. Second, it contributes to the limited Canadian evidence on vaccination among racialized and Indigenous older adults. However, several limitations warrant consideration. Self-reported vaccination history may be subject to recall bias, particularly given the time elapsed since initial immunization. The online survey may also have introduced selection and coverage biases, as participation required digital access, familiarity with online tools, and sufficient English or French proficiency. Consequently, digitally connected and linguistically proficient older adults may be overrepresented, limiting generalizability. This concern is particularly important for Indigenous participants, whose small subgroup may not reflect the diversity of Indigenous older adults across Canada; findings for this group should therefore be interpreted cautiously. Finally, small subgroup sizes may have limited statistical power. Future studies should use larger samples and culturally and linguistically appropriate recruitment approaches to better capture vaccination patterns among Indigenous and other racialized older adults.

6. Conclusion

This study highlights important disparities in COVID-19 vaccine uptake among racialized and Indigenous adults aged ≥55 years in Canada, with lower uptake compared to White populations despite extensive public health efforts. These findings underscore the need for more community-engaged research to better understand barriers to vaccination in underserved groups experiencing structural inequities, including discrimination in healthcare access. Consistent with prior evidence, greater exposure to conspiracy beliefs —often disseminated through diverse information sources such as social media and informal networks— was associated with lower uptake. Addressing these challenges requires comprehensive, equity-driven strategies that integrate considerations of aging, cultural diversity, and systemic discrimination, while fostering trust and improving access to accurate health information and services.

CRediT authorship contribution statement

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

Ethics statement

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

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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Data availability

Data will be made available on request.

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