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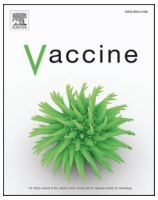

Comparison of parent-reported motivators of non-vaccination for children 5–11 years old in Australia and Canada: Results of the iCARE study

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ABSTRACT

Background: Despite COVID-19 infection being less severe in children compared to adults, vaccination for children from the age of 6 months onwards is recommended in many countries to reduce symptom severity and prevent severe disease. However, vaccination against COVID-19 for children remains controversial and uptake has been low.

Aims: To assess and compare the rate of change of parent-reported COVID-19 vaccine uptake in children aged 5 to 11 years and motivators of vaccine acceptance and non-vaccination among parents/guardians in Canada and Australia.

Methods: As part of the iCARE study, two cross-sectional representative samples in Canada and Australia were collected between May 20 and September 12, 2022 (i.e., 5 and 9 months after the COVID-19 vaccine rollout for children 5–11 years) using online panels. Parents/guardians reported the vaccine status of their children and motivators for vaccine acceptance and non-vaccination. General linear models were used to estimate differences between countries in terms of vaccine uptake and motivators across time.

Results: Parent-reported vaccine uptake for children 5–11 years didn't increase over the study period (T_1 = 87 %, T_2 = 86 %; OR = 0.83; 95 %CI = 0.45–1.54) and was overall lower in Canada (60.8 %) compared to Australia (71.6 %)(OR = 0.56; 95 %CI = 0.33–0.96). In both countries the socioeconomic characteristics of parents who didn't vaccinate their children were similar and having information on either the short- or long-term side effects of the vaccine were important motivators. However, vaccine effectiveness was more important in Canada and trust in the company that developed the vaccine and a recommendation from the child's doctor were more important motivators in Australia.

Conclusion: Parent-reported vaccine uptake for children 5–11 years plateaued early in the vaccine rollout. The main motivators for parents of unvaccinated children varied between the two countries but information on vaccine safety and effectiveness were common to both countries. Findings may inform future tailored vaccine communication efforts and pandemic planning in Australia and Canada to optimize vaccine uptake for primary school children.

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1. Background

Throughout the COVID-19 pandemic, children have been documented to have a lower risk of severe COVID-19 disease [1,2]. As such, recommendations for COVID-19 vaccination for children differ globally and remain controversial. In Canada and Australia, vaccination for children was recommended to reduce the severity of symptoms, prevent severe disease and potentially prevention of long COVID. It was also recommended for the indirect benefits of vaccination including a modest reduction in transmission, enabling children to attend school and engage in their usual activities and travel [2]. This array of factors made decision-making more nuanced for parents/ guardians, hereafter referred to as parents, than vaccination for adults. Vaccination against COVID-19 for children in both countries commenced sequentially according to age group after the adult populations had been offered vaccination (i.e., 12–15 years old, 5–11 years old, then children 6 months to 5 years) [3,4].

Canada and Australia share many demographic, structural and systemic similarities: both are federated nations with provinces/states and territories, have similar healthcare systems, and have a relatively small population compared to their vast continents [5]. The federal governments in both countries were responsible for COVID-19 vaccine approvals, vaccine procurement and provision of advice on vaccine use while the provincial/state governments have been primarily responsible for the administration of the vaccines [6,7]. The two countries implemented numerous public health strategies to reduce transmission including closing international borders between late March 2020 to August 2021 (Canada) and February 2022 (Australia) [8]. However, the two countries experienced vastly different COVID-19 case numbers, particularly in the first two years of the pandemic [9]. Initially Australia, as an isolated country, was very successful at controlling the spread of the virus until the Omicron variant emerged in January 2022 (which accounted for more than 80 % of COVID related deaths in Australia) [10,11]. Canada had more cases at the beginning of the pandemic, with cases increasing steadily from April 2022. As of July 2023, Canada had fewer cumulative COVID-19 cases than Australia relative to the population, but more deaths [12].

Australia is a very pro-vaccination country and has a higher rate of childhood immunization coverage nationally compared to Canada (e.g., in 2021, 96.3 % of 24-month-old children were vaccinated against Hepatitis B in Australia compared to 82.6 % of children in Canada) [13–16]. However, coverage in Australia is measured at different timepoints with Australia documenting coverage at 1, 2 and 5 years compared to Canada where it is measured at 6 months, 2 and 7 years. In Australia, the Pfizer-BioNTech Comirnaty® COVID-19 vaccine for children 5–11 years was approved and the rollout commenced before the start of the school year in 2022 (January 10) when Australia was at the peak of a COVID-19 Omicron wave (Fig. 1) and all preventive measures had been lifted [12,17]. In Canada, the rollout for children 5–11 years commenced in November 2021 (shortly after the beginning of the school year) when Canada was facing a triple threat of respiratory illness (COVID-19, influenza and respiratory syncytial virus). At that time, all COVID-19 preventive measures had been lifted in Canada [18,19]. In both countries, the vaccine was free and available at family health practitioners, pharmacists and vaccination hubs. However, primary school aged children don't routinely receive vaccines in both countries, apart from the influenza vaccine, which made this age group challenging to vaccinate [20]. The structural and systemic similarities of the two countries as well as the difference in their pandemic experience and management informed their selection.

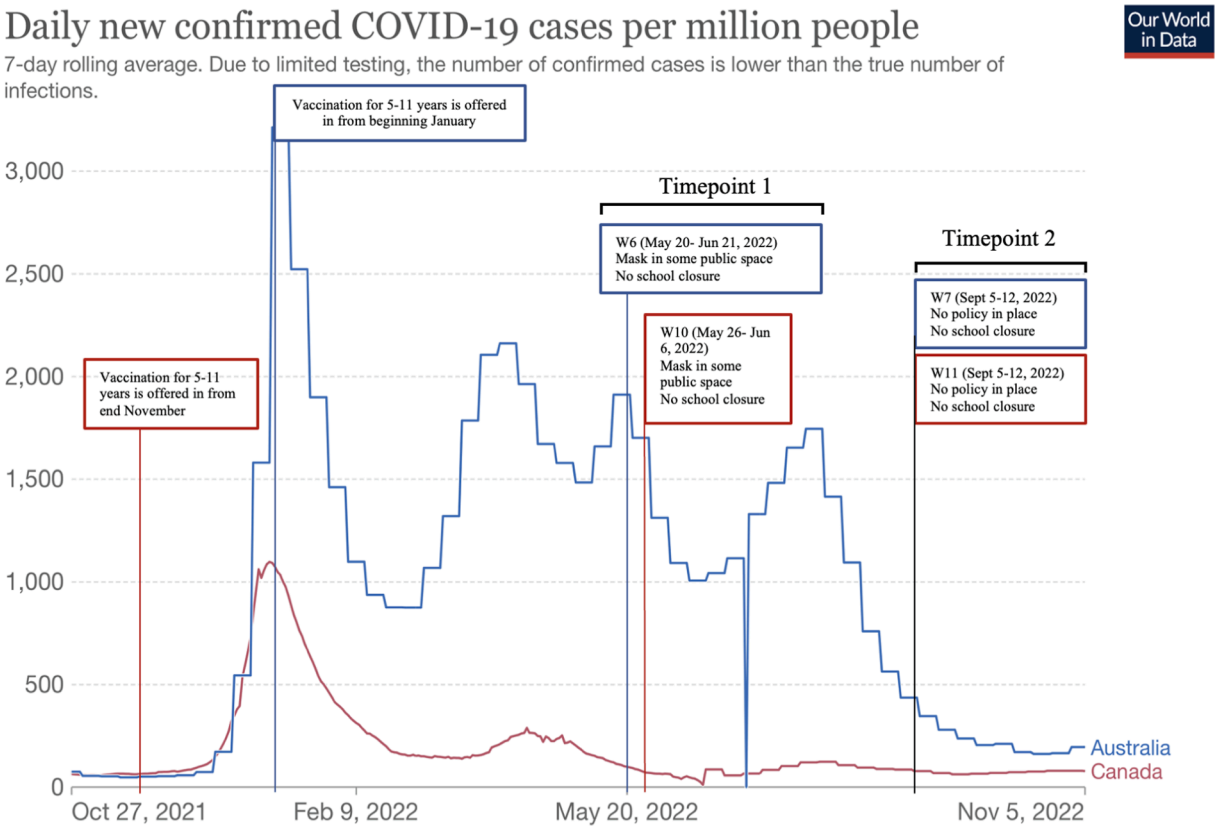

Fig. 1. Timeline of the study accordingly to the rollout of the vaccination for children 5–11 years old and the number of COVID-19 cases. Note: The graph of number of cases was taken from https://ourworldindata.org (Assessed June 20, 2023) and was adapted to show the timeline of the study; Mathieu, E., Ritchie, H., Rodés-Guirao, L., Appel, C., Giattino, C., Hasell, J., Macdonald, B., Dattani, S., Beltekian, D., Ortiz-Ospina, E., & Roser, M. (2020). Coronavirus Pandemic (COVID-19). *Our World in Data*. https://ourworldindata.org/covid-stringency-index.

Several studies highlighted hesitancy among parents to have their children vaccinated against COVID-19, with the main barriers being concerns about vaccine safety and effectiveness [21–24]. However, there are multiple social determinants of vaccine hesitancy including the historical, political and socio-cultural context in which vaccination occurs. Vaccine hesitancy is also influenced by trust in three domains, including trust in public health and vaccine policies, trust in health professionals' and recommendations and trust in information conveyed by the media [25,26]. Individual studies on COVID-19 vaccination intentions in Canada and Australia showed that the most common reasons for parents to get their children vaccinated were to protect the child and community members and help them return to a "normal" life, but direct comparisons between motivators for vaccination in both countries have not been made [22,27]. This study will help to identify how the historic, political and socio-cultural context of the two countries affected vaccine hesitancy. Furthermore, reasons for the plateau in uptake in both countries soon after the rollout commenced have not been explored, including the potential impact of pandemic management strategies in both countries. As such, we aimed to explore the main motivators of parents' decision-making and reported uptake of COVID-19 vaccines for children 5–11 years old in Canada and Australia over the first 9 months of the vaccine rollout. We aimed to: 1) assess and compare the rate of change of parent-reported COVID-19 vaccine uptake; and 2) compare motivators of child vaccine uptake among parents of vaccinated and unvaccinated children in each country. These findings can be used to inform recommendations for public health agencies and governments to optimize COVID-19 vaccine uptake and potentially inform future pandemic planning in both countries for this age group.

2. Method

2.1. Study design

This project is part of the International COVID-19 Awareness and Responses Evaluation (iCARE) Study (www.icarestudy.com), which is an ongoing international, cross-sectional, multi-wave observational study that aims to examine public awareness, attitudes, and responses to COVID-19 public health policies. The study is led by the Montreal Behavioural Medicine Centre (MBMC: www.mbmc-cmcm.ca) which received ethical approval from the Research Ethics Board of the Centre intégré universitaire de santé et de services sociaux du Nord-de-l'île-de-Montréal (CIUSSS-NIM), REB#: 2020–2099 / 25–03-2020). The project was also granted ethics approval by the Monash University Human Research Ethics Committee (MUHREC Project ID: 24449). The study encompasses a series of online surveys; the methodological details of the iCARE study (e.g., survey construction) have been published elsewhere [28].

2.2. Setting and context

In this study, we analyzed data from two cross-sectional representative samples in Canada (Wave 10 and 11 of the Canadians survey; N = 6119 and ≈ 3000 per wave consecutively) and in Australia (Wave 6 and 7 of the Australian survey; N = 2053, ≈1000 per wave consecutively). The two timepoints correspond to approximately 5 months (May 20-June 21, 2022) and 9 months (September 5–12, 2022) after the start of the vaccine rollout for the 5–11 age group in both countries (see Fig. 1) [17,19,29,30]. The Canadian rollout started earlier, in November 2021, compared to the Australian rollout which commenced in January 2022, at the peak of the COVID-19 Omicron wave [18]. At the first time point, Canada had between 50–99 daily new confirmed cases per million people compared to 1042–1701 cases in Australia. At the time of the second timepoint, Canada had 69–78 daily new confirmed cases per million people compared to 280–346 in Australia (see Fig. 1) [12]. For both countries, during the timeline of the study, almost all preventive measures had been lifted, masks were not mandatory in schools and no widespread lockdowns occurred [31,32]. However, school closures still occurred in some Australian states during this time.

2.3. Sample and recruitment

Canadian participants were recruited through the proprietary online panel of Léger Opinion polling firm (LégerWeb.com). This panel of participants included over 400,000 Canadians, the majority of whom (61 %) were recruited within the past 10 years (i.e., two-third recruited randomly by telephone vs one-third via social media). Respondents were invited to complete the survey by email and did so voluntarily. Participants provided online consent prior to completing the survey and were offered compensation through the polling firm on completion of the survey (participants collect points that can be traded in for gift cards).

Australian participants were recruited by the online sampling provider Online Research Unit (https://www.theoru.com). Their panel included more than 350,000 Australians who were recruited both offline (53 %) (i.e., telephone, post, print) and online (47 %) (i.e., email, mobile, social media). A representative sample was invited to participate in the survey using a stratified random sampling procedure according to the Australian Bureau of Statistics (ABS) demographic and geographic data. Respondents were incentivized based on the survey length by the sampling company in the form of gift vouchers. Stratified sampling by gender (male or female) and age groups (18–29 years old, 30–49 years, 50–69 years, 70 + years) was used.

The subset of participants that reported having children of 5–11 years old were eligible for this study.

2.4. Data collection

The survey included approximately 75 questions and took between 15–20 min to complete. It was designed based on two established behavioural theories: The *Capability, Opportunity, Motivation – Behaviour (COM-B) Model*, and the *Health Belief Model* [33,34]. All questions were chosen to facilitate data harmonisation with international studies led by the NIH and the WHO [35]. The questions were the same across surveys, with only minor adaptations to capture changes in the evolution of the pandemic over time and context related to country-specific policies and regulations. Questions were presented in the same order across surveys within a country, but the response set order was randomized for questions with multiple subitems to reduce bias. Some questions were conditionally displayed based on responses to previous items to reduce the number and complexity of the items. Completing all questions was mandatory in order to move forward, although many questions included the option "I don't know/ prefer not to answer". A detailed description and copy of all surveys can be found at the following weblink (https://osf.io/nswcm). For the present study, we extracted the following variables from the Canadian representative sample survey 10–11 and the Australian representative sample survey 6–7 (May 20-September 12, 2022): sociodemographic variables; trust toward diverse sources of information during the pandemic; parent-reported uptake; and motivators and intentions of COVID-19 vaccination for children of 5–11 years old. Details of the questions specific to this study are included in Supplementary Table S2.

2.5. Measures

Vaccine uptake (yes/no) and intention were self-reported by parents. Intention was measured on a 4-point scale (Extremely likely, somewhat likely, somewhat unlikely, extremely unlikely). Participants were asked to respond to a list of 14 different motivators that may have influenced their decision to vaccinate their child, using a 4-point scale with the following response options "*To a great extent, somewhat, very little, not at all, I don't know/I prefer not to answer, Not applicable*". Participants who reported not vaccinating their child were provided with the list of motivators formatted with "To what extent **would** the following influence

your decision to get your child vaccinated?". Participants who reported vaccinating their child were provided with the same list of motivators formatted with "To what extent **did** the following influence your decision to get your child vaccinated?". Many questions included the answer "*I don't know/ I prefer not to answer*" which were coded as missing values in the analyses.

2.6. Statistical analyses

Sociodemographic characteristics of the parents were summarized using means (Standard Deviation) and proportions (number) to describe the study sample by parent-reported uptake of child vaccination, country, and timepoint. To assess the differences in parent-reported uptake between timepoints or countries, a binary logistic model was fitted with uptake as the dependent variable and country and timepoint as the independent variables. An interaction between country and timepoints was also examined. The marginal probabilities of parent-reported uptake were calculated using the fitted model as a function of country and timepoints. A binary model was also fitted to assess the difference in intention of vaccination of parents of 5–11 years old across country and timepoint, including an interaction term of country and timepoint.

A series of logistic regressions were conducted to compare each vaccine motivator (dependent variable; "to a great extent and somewhat" vs "very little and not at all") among parents of unvaccinated children of 5–11 years old as a function of country and timepoints (independent variables). Models were repeated adding an interaction between the variable country and timepoint. Subgroup analyses were only reported if the interaction effect was significant. Marginal probabilities of participants who reported being motivated "to a great extent and somewhat" (compared to "very little and not at all") for each motivator were calculated using the fitted model as a function of uptake, timepoint, and countries.

All estimates were weighted according to the country-specific estimated population. Australia-specific estimates were weighted based on age, sex, state, urban/rural region based on the 2021 census by the Australian Bureau of Statistics (ABS) population characteristics [36]. Similarly, Canada-specific estimates were weighted by Léger within each province according to sex, age, education, language, region and number of children in the household in order to make their profiles representative of the current population within each Canadian province (excluding the three territories) based on data from Statistics Canada. The weight of each province was further adjusted to represent their actual weight within the 10 Canadian provinces.

The analyses were performed using STATA, version 18.0. Results were presented according to the Checklist for Reporting Results of Internet E-Surveys (CHERRIES, see Supplementary Table S1) [37].

3. Results

3.1. Sample description

The study sample included 919 (11.25 %) parents of children aged 5–11 years from a total 8172 survey participants. Sample characteristics of parents of children 5–11 years old by parent-reported uptake and country are presented in Table 1. The demographic characteristics between Canada and Australia were similar with the majority of parents being between 26–50 years old; most had a college or university degree, a perceived income in the middle tertile, and 1 or 2 children and without a chronic disease for both countries. However, the Canadian sample was less educated compared to the Australian sample (28.3 % reported having a high school diploma or less in Canada compared to 12.3 % in Australia).

Table 1
Sociodemographic of parents/guardians of children of 5–11 years old by parent-reported uptake and countries.

	Canada			Australia		
Parent-reported uptake	No (n = 211)	Yes (n = 422)	Total (n = 633)	No (n = 99)	Yes (n = 187)	Total (n = 286)
	n (%)	n (%)	n(%)	n (%)	n (%)	n (%)
Sex						
Male	86 (40.8 %)	210 (49.8 %)	296 (46.8 %)	39 (39.4 %)	105 (56.1 %)	144 (50.3 %)
Female	125 (59.2 %)	211 (50.0 %)	336 (53.1 %)	60 (60.6 %)	81 (43.3 %)	141 (49.3 %)
Missing	0	1	1	0	1	1
Age						
Less than 25 years	11 (5.2 %)	9 (2.1 %)	20 (3.2 %)	3 (3.0 %)	7 (3.7 %)	10 (3.5 %)
26–50 years	187 (88.6 %)	382 (90.5 %)	569 (89.9 %)	91 (91.9 %)	165 (88.2 %)	256 (89.5 %)
51 years or more	13 (6.2 %)	28 (6.6 %)	41 (6.5 %)	5 (5.1 %)	15 (8.0 %)	20 (7.0 %)
Missing	0	3	3	0	0	0
Education						
High school diploma and less	75 (35.5 %)	104 (24.6 %)	179 (28.3 %)	16 (16.2 %)	21 (11.2 %)	37 (12.9 %)
College or University	135 (64.0 %)	316 (74.9 %)	451 (71.2 %)	83 (83.8 %)	165 (88.2 %)	248 (86.7 %)
Missing	1	2	3	0	1	1
Perceived income						
Bottom tertile	49 (23.2 %)	83 (19.7 %)	132 (20.9 %)	27 (27.3 %)	28 (15.0 %)	55 (19.2 %)
Middle tertile	112 (53.1 %)	238 (56.4 %)	350 (55.3 %)	52 (52.5 %)	104 (55.6 %)	156 (54.5 %)
Top tertile	15 (7.1 %)	57 (13.5 %)	72 (11.4 %)	4 (4.0 %)	32 (17.1 %)	36 (12.6 %)
Missing	35	44	79	16	23	39
Parent/ guardian of the children						
No	0	0	0	2 (2.0 %)	12 (6.4 %)	14 (4.9 %)
Yes	211 (100.0 %)	422 (100.0 %)	633 (100.0 %)	97 (98.0 %)	174 (93.0 %)	271 (94.8 %)
Missing	0	0	0	0	1	1
Number of kids at home						
1–2	156 (73.9 %)	335 (79.4 %)	491 (77.6 %)	73 (73.7 %)	151 (80.7 %)	224 (78.3 %)
3+	55 (26.1 %)	87 (20.6 %)	142 (22.4 %)	26 (26.3 %)	36 (19.3 %)	62 (21.7 %)
Healthcare worker						

(*continued on next page*)

Table 1 (*continued*)

	Canada			Australia		
Parent-reported uptake	No (n = 211)	Yes (n = 422)	Total (n = 633)	No (n = 99)	Yes (n = 187)	Total (n = 286)
	n (%)	n (%)	n(%)	n (%)	n (%)	n (%)
No	40 (19.0 %)	86 (20.4 %)	126 (19.9 %)	9 (9.1 %)	25 (13.4 %)	34 (11.9 %)
Yes	14 (6.6 %)	42 (10.0 %)	56 (8.8 %)	7 (7.1 %)	18 (9.6 %)	25 (8.7 %)
Missing	157	294	451	83	144	227
Essential service worker						
No	99 (46.9 %)	218 (51.7 %)	317 (50.1 %)	51 (51.5 %)	106 (56.7 %)	157 (54.9 %)
Yes	55 (26.1 %)	130 (30.8 %)	185 (29.2 %)	16 (16.2 %)	43 (23.0 %)	59 (20.6 %)
Missing	57	74	131	32	38	70
Chronic disease						
No	153 (72.5 %)	289 (68.5 %)	442 (69.8 %)	66 (66.7 %)	127 (67.9 %)	193 (67.5 %)
Yes	58 (27.5 %)	133 (31.5 %)	191 (30.2 %)	33 (33.3 %)	60 (32.1 %)	93 (32.5 %)
Trust in my national political leader						
I trust to a great extent	8 (4.0 %)	49 (12.5 %)	57 (9.0 %)	12 (13.2 %)	36 (20.0 %)	48 (16.8 %)
I trust somewhat	40 (20.1 %)	189 (48.3 %)	229 (36.2 %)	36 (39.6 %)	100 (55.6 %)	136 (47.6 %)
I do not trust	49 (24.6 %)	86 (22.0 %)	135 (21.3 %)	23 (25.3 %)	27 (15 %)	50 (17.5 %)
I do not trust at all	102 (51.3 %)	67 (17.1 %)	169 (26.7 %)	20 (22.0 %)	17 (9.4 %)	37 (12.9 %)
Missing	12	31	43	8	7	15
Trust in my doctor or healthcare professional						
I trust to a great extent	39 (19.7 %)	243 (59 %)	182 (28.8 %)	20 (21.7 %)	100 (54.6 %)	120 (42.0 %)
I trust somewhat	118 (59.6 %)	154 (37.4 %)	294 (46.4 %)	47 (51.1 %)	63 (34.4 %)	110 (38.5 %)
I do not trust	28 (14.1 %)	11 (2.7 %)	67 (10.6 %)	14 (15.2 %)	17 (9.3 %)	31 (10.8 %)
I do not trust at all	13 (6.6 %)	4 (1.0 %)	61 (9.6 %)	11 (12.0 %)	3 (1.6 %)	14 (4.9 %)
Missing	13	10	29	7	4	11
Trust in my local health authorities						
I trust to a great extent	22 (11.2 %)	160 (39.3 %)	282 (44.5 %)	14 (15.4 %)	72 (39.8 %)	86 (30.1 %)
I trust somewhat	93 (47.2 %)	201 (49.4 %)	272 (43.0 %)	46 (50.5 %)	75 (41.4 %)	121 (42.3 %)
I do not trust	37 (18.8 %)	30 (7.4 %)	39 (6.2 %)	16 (17.6 %)	21 (11.6 %)	37 (12.9 %)
I do not trust at all	45 (22.8 %)	16 (3.9 %)	17 (2.7 %)	15 (16.5 %)	13 (7.2 %)	28 (9.8 %)
Missing	14	15	23	8	6	14
COVID-19 vaccine						
No	69 (36.7 %)	11 (3.9 %)	80 (12.4 %)	16 (18.3 %)	2 (1.6 %)	18 (4.2 %)
Yes	141 (63.3 %)	411 (96.1 %)	552 (87.6 %)	83 (81.7 %)	184 (98.4 %)	267 (95.8 %)
Missing	1	0	1	0	1	1

3.2. Parent-reported uptake and intention

Parent-reported vaccine uptake by timepoints and country is presented in Table 3. Parent-reported uptake didn't increase from 5 to 9 months after the rollout of the vaccine (T_1 = 87 %, T_2 = 86 %; OR = 0.83; 95 % CI = 0.45–1.54). In other words, it plateaued 5 months after the commencement of the rollout. Parent-reported uptake was lower in Canada (n = 422; 60.8 %) compared to Australia (n = 187; 71.6 %) (OR = 0.56; 95 % CI = 0.33–0.96). The interaction between country and timepoint was not statistically significant, so the difference between the Australian and Canadian rates at the two timepoints couldn't be determined (OR = 1.22, 95 % CI = 0.57–2.63).

Among those who didn't vaccinate their children, 84.6 % (weighted, n = 158) in Canada reported being "somewhat or extremely unlikely" to vaccinate their children compared to 62.5 % (weighted, n = 64) in Australia. The multivariable model showed some evidence to suggest that Australian parents had higher intention to vaccinate compared to Canadian parents (OR = 2.74; 95 % CI = 1.00–7.50).

3.3. Motivators for parents of unvaccinated children, by country

Overall, the three main motivators reported by parents of ***unvaccinated children*** were different between the two countries. For most Canadian parents the three main motivators that would influence them to vaccinate their children "to a great extent or somewhat" were (i) having information on vaccine safety and the likelihood of short-term side effects (31.6 % weighted, n = 74), (ii) overall vaccine effectiveness (30.3 % weighted, n = 70) and (iii) vaccine effectiveness against new COVID-19 variants (31.2 % weighted, n = 65). In contrast, the three main motivators that would influence Australian parents' vaccine decision-making "to a great extent or somewhat" were (i) getting a recommendation from their child's doctor (51.4 % weighted, n = 39), (ii) trusting the company who developed the vaccine (47.6 % weighted, n = 45) and (iii) having information on vaccine safety and the likelihood of any major long-term side-effects (46.9 % weighted, n = 41). Requiring information on vaccine safety and the likelihood of short-term side effects were uncommon motivators for Australian parents of unvaccinated children (39.0 % weighted, n = 74). Recommendation from their child's doctor was one of the least reported motivators for Canadian parents of unvaccinated children (21.7 % weighted, n = 57).

Table 2
Sociodemographic of parents that didn't vaccinate their 5–11 years old children by country and timepoint.

	[a]Timepoint 1		Timepoint 2	
	Canada (n = 107) n (%)	Australia (n = 51) n (%)	Canada (n = 104) n (%)	Australia (n = 48) n (%)
Sex				
Male	35 (32.7 %)	21 (41.2 %)	51 (49.0 %)	18 (37.5 %)
Female	72 (67.3 %)	30 (58.8 %)	53 (51.0 %)	30 (62.5 %)
Age				
Less than 25 years	6 (5.6 %)	1 (2.0 %)	5 (4.8 %)	2 (4.2 %)
26–50 years	95 (88.8 %)	47 (92.2 %)	92 (88.5 %)	44 (91.7 %)
51 years or more	6 (5.6 %)	3 (5.9 %)	7 (6.7 %)	2 (4.2 %)
Education				
High school diploma and less	34 (31.8 %)	6 (11.8 %)	41 (39.8 %)	10 (20.8 %)
College or University	73 (68.2 %)	45 (88.2 %)	62 (60.2 %)	38 (79.2 %)
Missing			1	
Perceived income				
Bottom tertile	20 (18.7 %)	15 (29.4 %)	29 (34.9 %)	12 (31.6 %)
Middle tertile	67 (62.6 %)	27 (52.9 %)	45 (54.2 %)	25 (65.8 %)
Top tertile	6 (5.6 %)	3 (5.9 %)	9 (10.8 %)	1 (2.6 %)
Missing	14	6	21	10
Parent/ guardian of the children				
Yes	107 (100.0 %)	50 (98.0 %)	104 (100.0 %)	47 (97.9 %)
No		1 (2.0 %)	0 (0.0 %)	1 (2.1 %)
Number of kids at home				
1–2	83 (77.6 %)	38 (74.5 %)	73 (70.2 %)	35 (72.9 %)
3+	24 (22.4 %)	13 (25.5 %)	31 (29.8 %)	13 (27.1 %)
Healthcare worker				
No	18 (16.8 %)	4 (7.8 %)	22 (81.5 %)	5 (55.6 %)
Yes	9 (8.4 %)	3 (5.9 %)	5 (18.5 %)	4 (44.4 %)
Missing	80	44	77	39
Essential service worker				
No	48 (44.9 %)	25 (49.0 %)	51 (65.4 %)	26 (74.3 %)
Yes	28 (26.2 %)	7 (13.7 %)	27 (34.6 %)	9 (25.7 %)
Missing	31	19	26	13
Intention of vaccination				
Extremely likely	3 (2.8 %)	3 (5.9 %)	3 (3.1 %)	3 (7.0 %)
Somewhat likely	21 (19.6 %)	12 (23.5 %)	11 (11.5 %)	10 (23.3 %)
Somewhat unlikely	17 (15.9 %)	14 (27.5 %)	10 (10.4 %)	11 (25.6 %)
Extremely unlikely	57 (53.3 %)	17 (33.3 %)	72 (75.0 %)	19 (44.2 %)
Missing	9	5	8	5
Chronic disease				
No	76 (71.0 %)	35 (68.6 %)	77 (74.0 %)	31 (64.6 %)
Yes	31 (29.0 %)	16 (31.4 %)	27 (26.0 %)	17 (35.4 %)
Trust in my national political leader				
I trust to a great extent	5 (4.9 %)	6 (12.2 %)	3 (3.1 %)	6 (14.3 %)
I trust somewhat	22 (21.6 %)	17 (34.7 %)	18 (18.6 %)	19 (45.2 %)
I do not trust	29 (28.4 %)	14 (28.6 %)	20 (20.6 %)	9 (21.4 %)
I do not trust at all	46 (45.1 %)	12 (24.5 %)	56 (57.7 %)	8 (19.0 %)
Missing	5	2	7	6
Trust in my doctor or healthcare professional				
I trust to a great extent	23 (22.3 %)	11 (22.9 %)	16 (16.8 %)	11 (22.9 %)
I trust somewhat	62 (60.2 %)	25 (52.1 %)	56 (58.9 %)	25 (52.1 %)
I do not trust	11 (10.7 %)	8 (16.7 %)	17 (17.9 %)	8 (16.7 %)
I do not trust at all	7 (6.8 %)	4 (8.3 %)	6 (6.3 %)	4 (8.3 %)
Missing	4	3	9	0
Trust in my local health authorities				
I trust to a great extent	13 (12.6 %)	7 (14.9 %)	9 (9.6 %)	7 (15.9 %)
I trust somewhat	53 (51.5 %)	24 (51.1 %)	40 (42.6 %)	22 (50.0 %)
I do not trust	20 (19.4 %)	8 (17.0 %)	17 (18.1 %)	8 (18.2 %)
I do not trust at all	17 (16.5 %)	8 (17.0 %)	28 (29.8 %)	7 (15.9 %)
Missing	4	4	10	4

Note:
[a] Timepoint 1: May 20 to June 21, 2022; Timepoint 2: September 5–12, 2022

Table 3
Parent-reported vaccine uptake among children of 5–11 years old by country and timepoint.

	Timepoint					
	Time 1		Time 2		Total	
Uptake 5–11 years old	n	%	n	%	n	%
No						
Australia	51	26.79	48	30.49	99	28.41
Canada	107	39.39	104	38.98	211	39.18
Yes						
Australia	101	73.21	86	69.51	187	71.59
Canada	189	60.61	233	61.02	422	60.82
Total						
Australia	152	100	134	100	286	100
Canada	296	100	337	100	633	100
Total	448		471		919	

3.4. Motivators for parents of unvaccinated children, by country and timepoints

Based on the weighted percentages, Australians reported having more motivators that would influence "to a great extent or somewhat" their decision to vaccinate their children compared to Canadians. Fewer participants reported motivators that would influence them "to a great extent or somewhat" at the second timepoint for both countries and for most of the motivators (see Fig. 2).

The three main motivators for parents of ***unvaccinated children*** were different between the two countries and across timepoints (See Fig. 2). Having information about vaccine effectiveness against variants was a main motivator in both countries during at least one timepoint ($CAN_{T1} = 41.0$ %, $AUS_{T2} = 53.2$ %). Both countries had one motivator

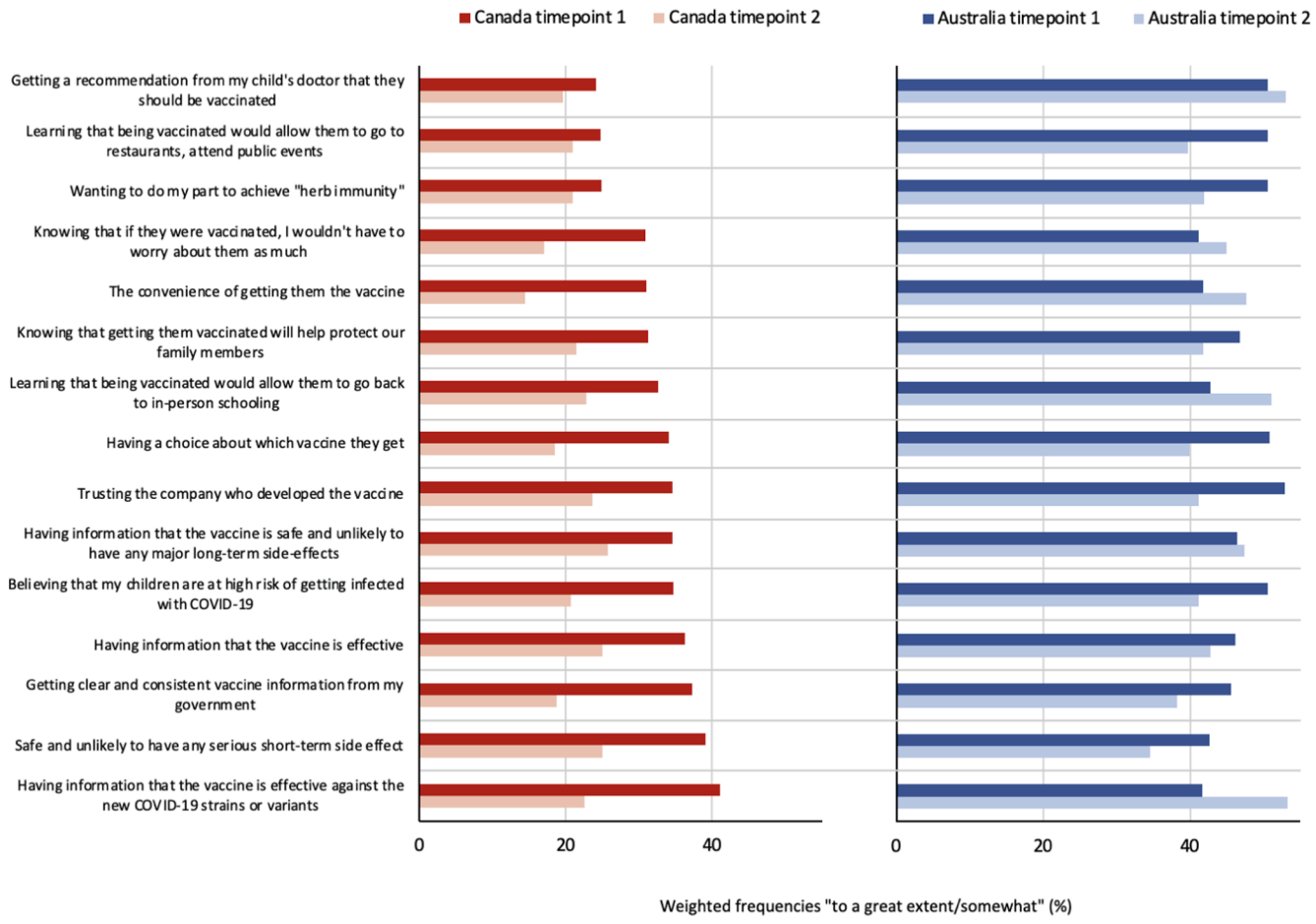

Fig. 2. Reported motivators of vaccination "to a great extent/somewhat" among parents/guardians of unvaccinated children of 5–11 years old as a function of country and timepoint.

that was consistent across time. For Australia, it was getting a recommendation from my child's doctor (AUS_{T1} = 50.6 %, AUS_{T2} = 53.0 %) and for Canada, it was knowing that the vaccine is safe and unlikely to have any serious short-term side effects (CAN_{T1} = 39.10 %, CAN_{T2} = 25.0 %). The least influential motivators in both countries at both timepoints were requiring a vaccine passport (e.g., vaccination allowing access to activities) (CAN_{T1} = 24.8 %, AUS_{T1} = 46.8 %, CAN_{T2} = 21 %, AUS_{T2} = 39.7 %) and the convenience of getting the vaccine (CAN_{T1} = 31.3 %, AUS_{T1} = 41.8 %, CAN_{T2} = 14.4 %, AUS_{T2} = 47.6 %), (see Fig. 2).

The multivariable modelling confirmed a significant effect of the country for the four following motivators of parents of unvaccinated children, with Australians more likely to report the influence of: trust in the company who developed the vaccine (OR = 2.59, 95 % CI = 1.01–6.61); getting a recommendation from their child's doctor (OR = 2.93, 95 % CI = 1.14–7.52); learning that being vaccinated would allow them to go to restaurants, attend public events (OR = 3.52, 95 % CI = 1.34–9.23); and wanting to achieve 'herd immunity' (OR = 3.52, 95 % CI = 1.34–9.23). There was no significant effect of timepoint or interaction effect of timepoint and country for these motivators, though there was a trend for an interaction between time and country for having information about the effectiveness of the vaccine against variants (OR = 3.95, 95 % CI = 0.98–15.74), (see Table 4). Graphics of marginal effects for each motivator can be found in Supplementary Figs. S1-S15. The results of the modelling without the interaction term between country and timepoint can be found in Supplementary Table S4.

3.5. Sociodemographic characteristics of parents of unvaccinated children

Sociodemographic information for parents ***who did not vaccinate*** their children at timepoint two (9 months after commencement of the rollout) was generally similar across the two countries (see Table 2). Although, in Australia, there were more highly educated parents that reported not having vaccinated their children (AUS = 79.2 % n = 38 vs CAN = 60.2 % n = 62) and more parents that were healthcare workers compared to Canada (AUS = 44.4 % n = 4 vs CAN = 18.5 % n = 5). More Canadian parents reported "not trusting at all" their national political leader (CAN = 57.7 % vs AUS = 19.0 %) and local health authorities (CAN = 29.8 %, AUS = 15.9 %) compared to Australian parents.

3.6. Motivators for parents of vaccinated children

Weighted percentages show that the main motivators among parents that ***did vaccinate*** their children 5–11 years were similar in both countries. They were: having information on vaccine safety and the likelihood of short-term side effects (CAN = 86.77 % weighted n = 354, AUS = 88.08 % weighted n = 157); major long-term side-effects (CAN = 85.09 % weighted n = 345 vs AUS = 91.52 % weighted n = 161); effectiveness (CAN = 85.44 % weighted n = 349, AUS = 87.79 % weighted n = 157); and contributing to herd immunity (CAN = 84.08 % weighted n = 332, AUS = 87.96 weighted n = 152); (see in Supplementary Table S6). The first two motivators were main motivators at both timepoints for each country. In Canada, two motivators were consistent with the motivators of vaccination among parents of unvaccinated children (i.e., having information on long-term side-effects and the effectiveness of the vaccine).

Table 4
Weighted* odds ratio of reporting motivators "to a great extent/ somewhat" as a function of country and timepoint with interaction term.

Motivators Reference: To a great extent/ somewhat	Trust in the company who developed the vaccine			Having information that the vaccine is safe and unlikely to have any major long-term side-effects			Having information that the vaccine is effective			Believing that my children are at high risk of getting infected with COVID-19			Getting a recommendation from my child's doctor that they should be vaccinated			The convenience of getting them the vaccine			Knowing that getting them vaccinated will help protect our family members			Learning that being vaccinated would allow them to go to restaurants, attend public events		
	[a]OR	95 % IC		OR	95 % IC		OR	95 % IC		OR	95 % IC		OR	95 % IC		OR	95 % IC		OR	95 % IC		OR	95 % IC	
		Lower	Upper			Upper		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
Country																								
Canada	1			1			1			1			1			1			1			1		
Australia	**2.59**	1.01	6.61	1.87	0.74	4.71	1.64	0.64	4.20	1.77	0.69	4.54	**2.93**	1.14	7.52	2.37	0.90	6.28	1.80	0.70	4.62	**3.52**	1.34	9.23
Timepoint[b]																								
Timepoint 1	1			1			1			1			1			1			1			1		
Timepoint 2	0.56	0.24	1.32	0.63	0.28	1.45	0.56	0.24	1.31	0.46	0.19	1.09	0.81	0.33	1.96	0.49	0.19	1.26	0.61	0.25	1.45	0.71	0.28	1.78
Country*timepoint	0.83	0.21	3.32	1.57	0.41	5.98	1.65	0.42	6.38	1.70	0.43	6.71	1.33	0.33	5.30	1.53	0.37	6.36	1.29	0.33	5.16	0.60	0.14	2.53

Motivators Reference: To a great extent/ somewhat	Wanting to do my part to achieve 'herd immunity'			Knowing that if they were vaccinated, I wouldn't have to worry about them as much			Having information that the vaccine is effective against the new COVID-19 strains or variants			Having a choice about which vaccine they get			Getting clear and consistent vaccine information from my government			Learning that being vaccinated would allow them to go back to in-person schooling			Safe and unlikely to have any serious short-term side effects		
	OR	95 % IC		OR	95 % IC		OR	95 % IC		OR	95 % IC		OR	95 % IC		OR	95 % IC		OR	95 % IC	
		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
Country																					
Canada	1			1			1			1			1			1			1		
Australia	**3.45**	1.33	8.99	2.04	0.78	5.31	1.20	0.47	3.05	1.48	0.58	3.78	1.25	0.49	3.21	1.31	0.52	3.3	1.41	0.56	3.55
Timepoint																					
Timepoint 1	1			1			1			1			1			1			1		
Timepoint 2	0.80	0.32	2.00	0.57	0.24	1.38	0.4	0.17	0.97	0.48	0.20	1.15	0.40	0.17	0.95	0.57	0.24	1.33	0.50	0.22	1.17
Country*timepoint	0.67	0.16	2.77	1.67	0.41	6.77	3.93	0.98	15.74	1.54	0.39	6.16	2.57	0.64	10.3	2.27	0.58	8.84	1.40	0.36	5.42

Note. Bold denotes significance ($p < 0.05$),
[a] OR: Odds ratio, CI: Confidence Interval,
[b] Timepoint: May 20 to June 21, 2022; Timepoint 2: September 5–12, 2022.
* Weighted based on age, sex, state, region and number of children

4. Discussion

Results of this study show that parent-reported vaccination uptake of children 5–11 years didn't increase after the first five months of the COVID-19 vaccine rollout and that reported uptake was higher in Australia compared to Canada. Parents who did not vaccinate their children were demographically similar between the two countries. The main motivators for parents *who didn't vaccinate* their children varied between countries but the need for information about vaccine safety (i.e., short/long-term side effects) and effectiveness (i.e., overall effectiveness of the COVID-19 vaccine and effectiveness against new strains) were common motivators for both countries. More Australians reported motivators would influence "to a great extent or somewhat" their decision to vaccinate their children compared to Canadians.

Parent-reported vaccine uptake was higher in Australia. The sociodemographic characteristics of parents who didn't vaccinate their children 9 months after the rollout were broadly similar across the two countries but Australian parents were more likely to be healthcare workers, which may have influenced their decision-making [38]. Canadian parents reported a lower level of trust in their national political leaders and health authorities which has been shown in previous studies, highlighting low trust in the government and in the COVID-19 vaccine as common reasons for parental hesitancy [39]. Parent-reported uptake in the sample was higher than government vaccination coverage reported in both countries but it was similar between countries and across time. This highlights a difference between the iCARE data and the actual reported rate of vaccination. In Australia, 52.4 % of children received one dose and 39.3 % had received two doses of COVID-19 vaccine as of 19 June 2022 (which is aligned with the timepoint one of the study) compared to 50.06 % of one dose and 42.34 % of two doses in Canada [40,41]. As of September 2022, in Australia, 51.3 % of vaccinated children received one dose and 40.4 % received two doses compared to 56.5 % and 41.8 % of children who received one and two doses in Canada [42,43]. Uptake did not increase over time suggesting that those who didn't vaccinate their children at the beginning of the rollout were less likely to do so subsequently. The history of COVID-19 vaccine approval of each country did not seem to have an effect on the uptake [17,19].

The three main motivators for *parents of unvaccinated children* were different between the two countries and timepoints. This could be explained by the fact that the two countries assessed the risks and benefits of the vaccine for children differently. Previous studies have reported vaccine side effects as common concerns for all parents [24,44]. The mRNA vaccines and speed of vaccine development underpin most COVID-19 vaccine safety concerns [23]. Contributing to herd immunity was an important motivator in Australia whereas in Canada, it was vaccine effectiveness. The main motivator in Canada, was vaccine effectiveness (including variants) and in Australia, it was trust in the vaccine manufacturer and having a recommendation from their doctor to get their child vaccinated. Given uptake didn't increase over the study period, it may be that the risk–benefit ratio perceived by parents was unchanged, with some studies highlighting that parents reported a higher perceived risk of the COVID-19 vaccine than the disease itself for children [24,27].

Vaccine recommendations by a doctor was the strongest motivator for Australian *parents of unvaccinated children* but was one of the least reported motivators among Canadian parents of unvaccinated children [25,45]. This may be explained by low access to general practitioners (GP) in the Canadian healthcare system which was exacerbated during the pandemic. Parents would only consult a GP if their child was sick and if they had access to a GP (i.e., since more than 20 % of the population don't have a GP) [46]. Alternatively, it may be related to the lower level of trust reported by Canadian parents towards healthcare authorities [25]. The infodemic related to COVID-19 has been very focused on childhood vaccination (e.g., side effects) which may have affected the trust in health institutions and the influence of healthcare provider recommendations in Canada [23,47]. This finding seems specific to the Canadian context during the pandemic and may explain some of the differences observed between the pandemic management in the two countries (e.g., Australian government messaging fostered more trust by being more consistent and clear since the beginning of the pandemic compared to Canada) [48].

In this study, Canadian parents were more vaccine hesitant, and motivators of vaccination were less influential compared to Australia. Nine months after the rollout, Canadians reported fewer motivators that would encourage them to vaccinate their children. In our study, more Canadian parents didn't receive a COVID-19 vaccine for themselves compared to Australian parents (CAN = 12.4 % vs AUS = 4.2 %), highlighting a less vaccine accepting population. Parental vaccine acceptance has been shown to be one of the strongest predictors of childhood vaccine hesitancy [23,25,39]. Australia had higher vaccine coverage for most vaccines on the National Immunisation Program (NIP) (e.g., DTaP [4 doses] by 24 months of age in 2021 93.2 % in Australia compared to 77.1 % in Canada; varicella 1 dose by 24 months 93.6 % in Australia compared to 87.5 % in Canada) [14,16]. The lack of trust in institutions or the impact of the management of the pandemic could also explain those results.

The results highlight that COVID-19 parental vaccine hesitancy goes beyond concerns about vaccine safety and effectiveness because uptake didn't increase over time despite the availability of new information on safety and effectiveness. Risk perception of the benefit of vaccination in maintaining health balanced against the risk of disease are well-known determinants of vaccine acceptance [25]. Studies have shown that believing COVID-19 infection is not severe enough for children to need vaccination was a commonly reported reason for parents not to have their children vaccinated [23]. This message was relayed by some health authorities and governments during the rollout which was confusing for parents [11,26]. Risk perception is often closely linked to trust in health professionals, health authorities and governments and low level of trust in the government is related to parental hesitancy [25]. Some vaccine-hesitant individuals value freedom of choice to vaccinate against COVID-19 [49]. The fact that COVID-19 vaccination was framed as a freedom issue (i.e., if you get vaccinated you can attend restaurants, public events, etc.) for adults could have driven parents to resent any governmental encroachment on children's vaccination given no similar policies such as vaccine passports were implemented for children and enforce their parental right to refuse vaccination. Broad communication campaigns are important but tailored messaging for specific hesitant groups (i.e., children) as well as community engagement are key to increasing motivation to vaccinate (both strategies that weren't maximized) [11,26]. Multiple other factors could have impeded vaccination campaigns for children including a lack of effective campaigns promoting children's vaccination, disinformation regarding child vaccines, and the coercive management of the pandemic.

5. Limitations and strengths

The sample was drawn from the larger iCARE study. Therefore, the recruitment was not specific to parents of 5–11 years old children which led to a small sample size for this cohort of children which could affect the accuracy and generalizability of the data. Results were drawn from a series of surveys sent to different participants at each time point meaning the data was cross-sectional and did not track individual responses over time. Data also reflected self-reported answers and may be subject to social desirability and reporting bias. This may explain the higher parent-reported uptake than was reported by government agencies in both countries. Thus, the iCARE data accessed a sample more likely to vaccinate their children and perhaps seek more healthcare than the general public in the government agencies data. We are unable to make a causal inference about the impact of the different policies or circumstances in each country.

Despite some limitations, this study also has a number of important

strengths. The design of the iCARE study allowed us to compare responses in different countries that were assessed during the same time period. Results reflect a sub-analysis of representative data from Canada and Australia from the iCARE study which has collected data from more than 200,000 participants across 190 countries to date. We were able to assess a range of actionable motivators for vaccination and analyses were adjusted for important confounders. This will therefore facilitate international comparison of datasets to contribute to the development of evidence-based interventions and policies.

6. Conclusion

In this study, we found that parent-reported COVID-19 vaccine uptake plateaued early in the vaccine rollout for children 5–11 years in both Canada and Australia. The main motivators for parents of *unvaccinated children* varied between the two countries but need for information about vaccine safety and effectiveness were common motivators to both countries. There was more vaccine hesitancy amongst Canadian parents and motivators seemed less influential than for Australian parents, potentially related to lower trust in government and information sources. These findings may inform future tailored vaccine communication efforts for other vaccine-preventable diseases such as influenza and for pandemic planning in Australia and Canada to optimize vaccine uptake for primary school children. Future, vaccination campaigns should more clearly state the risks and benefits of vaccination, especially for the primary school-aged population.

Community participants

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thics approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This study was reviewed and approved by Monash University Human Research Ethics Committee (MUHREC Project ID: 24449). The Montreal Behavioural Medicine Centre, the lead institution, has research ethics board approval from the Comité d'éthique de la recherche du CIUSSS-NIM (Centre intégré universitaire de santé et de services sociaux du Nord-de-l'île-de-Montréal), approval#: 2020–2099/25–03-2020.

Consent to participate

All participants consented online before completing the survey.

Code availability

All analysis was performed in STATA version 18.0. The codes are available on request by contacting the corresponding authors.

Author contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Frédérique Deslauriers, Monsurul Hoq, Jessica Hoffman, Jacqueline Boyle, Joanne Enticott and Margie Danchin. The first draft of the manuscript was written by Frédérique Deslauriers and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaccine.2024.06.024.

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