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# COVID-19 vaccination coverage by immigrant background

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## ORIGINAL ARTICLE

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## BACKGROUND

High vaccination coverage against COVID-19 limits COVID-19-related infections, hospitalisations and deaths. Studies have shown varying vaccine willingness and vaccine coverage in different minority groups. This study investigates the vaccination coverage among persons with various immigration and country backgrounds in Norway.

## MATERIAL AND METHOD

The study includes all persons over 18 years of age resident in Norway with a Norwegian national identity number. We used data from Beredt C19, the Norwegian emergency preparedness register for COVID-19, and investigated the association between vaccine status and immigrant and country background using logistic regression models, adjusted for income, education, sex, age, medical risk group and place of residence.

## RESULTS

Foreign- and Norwegian-born persons with foreign-born parents had a lower COVID-19 vaccine coverage than those who were Norwegian-born with Norwegian-born parents. Vaccination coverage for different country backgrounds varied from around 45 % for persons from Latvia, Bulgaria, Poland, Romania and Lithuania to 92 % for persons from Vietnam, Thailand and Sri Lanka. Those in the former group had from 15 to 18 times (unadjusted) and from 8 to 11 times (adjusted) higher odds of not having been vaccinated as persons with a country background from Norway.

## INTERPRETATION

There is considerable variation in COVID-19 vaccine coverage between different immigrant groups in Norway. The differences can be explained to some extent by income and education, but this does not explain the bulk of the observed differences.

We cannot rule out the possibility that some differences are attributable to weaknesses in the registers.

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High levels of vaccination coverage in the population are important to limit COVID-19-related hospitalisations and deaths. Vaccination coverage in Norway is high, but varies among different sectors of the population. Parts of the immigrant population in Norway have been hard hit by the pandemic and are overrepresented both in terms of confirmed infections and hospitalisations, also after adjusting for socioeconomic status and medical risk factors [\(1, 2\)](#).

In a number of countries, minority groups have shown greater vaccine hesitancy and lower COVID-19 vaccination coverage than the majority population [\(3–8\)](#). A study from the United Kingdom published in early 2021 showed greater vaccine hesitancy among certain minority groups [\(3\)](#), and in June of that year, those same groups showed the lowest vaccination coverage in the country [\(4\)](#). Figures from the Swedish health authorities show vaccination coverage to be significantly lower among individuals born in African countries than among those born in Sweden [\(5\)](#). The European Centre for Disease Prevention and Control has also reported challenges related to vaccination hesitancy among minorities in EU/EEA countries [\(6\)](#). In the United States, ethnic minorities, especially Black people, have shown greater vaccine hesitancy and lower vaccine uptake than other groups [\(7\)](#).

In Norway, surveys conducted in the autumn of 2020 showed that people from Eastern Europe, Africa and West Asia were the least likely to accept a COVID-19 vaccine [\(8\)](#). Among healthcare workers in Norway, those born in Russia, Serbia, Lithuania, Romania, Poland, Eritrea and Somalia have the lowest vaccination coverage [\(9\)](#). This is consistent with findings from the United Kingdom, where differences in vaccination coverage have also been observed between healthcare workers belonging to certain ethnic minority groups and the majority population [\(10\)](#).

Because the supply of vaccines was limited in the early stages of the vaccination programme, the authorities initially prioritised vaccines for the elderly, people at risk of becoming seriously ill with COVID-19, and select groups of healthcare workers [\(11, 12\)](#). At later stages of the vaccine rollout, some municipalities and districts were prioritised over others, before universal access was eventually achieved for the entire population of Norway [\(13\)](#).

Little is known about how COVID-19 vaccination coverage compares among different immigrant groups in Norway. We therefore set out to examine vaccination coverage as of 20 October 2021, stratified by immigration category and country background. Given that access to vaccines has varied with age, medical risk status, occupation and place of residence, we adjusted our analyses for these variables.

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## Material and method

Our analyses were based on data from Beredt C19, a national emergency preparedness register containing individual-level data, established to provide ongoing information about the COVID-19 pandemic in Norway. The data in Beredt C19 are compiled from a variety of sources via encrypted national identity numbers. In this study, we used data

from the Norwegian Immunisation Registry (SYSVAK) (vaccine recipients), the National Population Register (sex, age, place of residence and length of residence), Statistics Norway (immigration category, country background, household income and education) and the Norwegian Patient Registry and Municipal Patient and User Registry (groups at risk of severe illness with COVID-19).

Beredt C19 was established pursuant to Section 2 - 4 of the Health Preparedness Act. The Norwegian Institute of Public Health has conducted a privacy impact assessment with respect to the register, and the project has been approved by the Regional Committee for Medical and Health Research Ethics (9 March 2021, ref. no. 198964).

## Study population

The study population comprises all individuals who are resident in Norway, aged 18 or above with a Norwegian national identity number (N = 4 264 370). Individuals with a temporary identification number ('d number') were not included, as their records lack key information such as country background and it is unknown whether they are still living in Norway (N = 116 734).

## Variables

The outcome variable reveals whether an individual has received at least one dose of a COVID-19 vaccine in the period 28 December 2020–20 October 2021 (yes/no).

Vaccine doses administered abroad must be manually registered retrospectively, and we know that this variable therefore does not capture all individuals who were vaccinated outside Norway.

We examined vaccination coverage stratified by immigration background and country background. Immigration background comprises three categories: *Norwegian-born with Norwegian-born parents* (reference group), *foreign-born*, and *Norwegian-born with foreign-born parents*. Individuals were assigned to the first category if they were born abroad but have at least one Norwegian-born parent; were born in Norway but have only one Norwegian-born parent; or were adopted from abroad. The variable 'country background' refers to the birth country of foreign-born individuals, or of the parents of Norwegian-born individuals with foreign-born parents. All those in the category 'Norwegian-born with Norwegian-born parents' were assigned a country background of Norway. We focused on those country backgrounds for which there were more than 5 000 individuals over the age of 18 resident in Norway.

Regressions were adjusted for the following variables: household income, education, sex (male/female), age, medical risk group, and county (using the county boundaries in place before the 2020 boundary reform). Household income was calculated after tax and was divided by the number of consumption units in the household (EU scale) (14). Household income was operationalised into deciles. The education variable was based on the highest educational level achieved and was categorised as lower secondary school (up to age 16), college/vocational training, higher education short ( $\leq 4$  years), higher education long ( $> 4$  years), no formal education/education unknown, and 18–21 years. Individuals aged 18–21 were placed in a separate education category because their education is probably incomplete. Data on household income and education are from 2018, and there will thus be some inaccuracies in this variable. Age was operationalised into six categories (<29, 30–39, 40–49, 50–59, 60–69, > 70 years) to capture potential non-linear effects. The variable 'risk group' is binary and indicates

whether a person has one or more diseases/conditions that increase the risk of serious illness or death from COVID-19, as defined by the Norwegian Institute of Public Health (15). Because there is a risk that some municipalities will show no variation in the outcome variable and will thus be discarded from the model, we chose to use county as a variable for place of residence, based on the 18 county divisions that were in use in Norway prior to 1 January 2020.

### Statistical model

We investigated the relationship between immigration category and vaccination status using logistic regression. To make the regression models as easy as possible to interpret, we calculated the odds ratio for not having had the vaccine. The association between immigration category and vaccination was examined in four models: model 1 = unadjusted; model 2 = adjusted for age; model 3 = adjusted for age, sex, risk group and county (partial adjustment model), and model 4 = adjusted for age, sex, risk group, county, household income and education (full adjustment model). The same models were used to investigate the association between country background and vaccination coverage, with the exception of the model that adjusts only for age (2). This model was used only for the analysis of immigration category, because the mean age of Norwegian-born individuals with foreign-born parents varied greatly compared to that of individuals in the other groups.

### Sensitivity analysis

The percentage of individuals born in Norway varied among different country backgrounds, as did the length of time that immigrants with different country backgrounds had been resident in Norway. To investigate the impact of these differences, we estimated the full adjustment model separately for Norwegian-born children of immigrants, as well as for immigrants with different lengths of residence (<6 years, 6–10, 11–15, 16+ years of residence).

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## Results

The study population comprised 4 264 370 individuals, with an equal sex distribution across immigration categories (see Appendix 1). The mean age of Norwegian-born individuals with Norwegian-born parents was 50 years (standard deviation (SD) 19), versus 44 (14) years for foreign-born individuals, and 29 (12) years for Norwegian-born individuals with foreign-born parents. Individuals with a non-Norwegian background were more likely to be living in Oslo and had a lower median income than the Norwegian-born with Norwegian-born parents. The proportion of highly educated individuals was greatest among the Norwegian-born with foreign-born parents, and lowest among those who were born abroad.

This article focuses on the 41 country backgrounds in the dataset for which there were more than 5 000 people over the age of 18 resident in Norway. The proportion of women differed among country backgrounds, from under 40 % (Afghanistan, Syria, UK and Poland) to over 60 % (Finland, Russia, Ukraine, the Philippines, Thailand and Brazil). Mean age varied from under 40 years (Lithuania, Eritrea, Ethiopia, Somalia, Afghanistan and Syria) to over 50 (Denmark, Finland, UK and USA), and median

income from NOK 186 000 (Syria) to NOK 405 000 (Sweden). The proportion of individuals with higher education varied from 10 % (Eritrea and Somalia) to 62 % (USA), and the proportion living in Oslo from 7 % (Lithuania) to 66 % (Morocco).

The percentage of individuals who had received at least one dose of a COVID-19 vaccine also varied between immigrant groups (Table 1). In total, 94 % of Norwegian-born individuals with Norwegian-born parents had received at least one vaccine dose, compared with 73 % of foreign-born individuals and 82 % of Norwegian-born individuals with foreign-born parents. There were also large differences in vaccination coverage between different country backgrounds. Some had high coverage of around 90 %, including Vietnam (93 %), Sri Lanka (91 %), Thailand (91 %), Denmark (89 %), the Philippines (89 %), India (88 %), the UK (88 %), Sweden (88 %) and Iran (87 %), whereas others had relatively low coverage, particularly Latvia (44 %), Bulgaria (45 %), Romania (45 %), Poland (46 %) and Lithuania (47 %).

**Table 1**

Total frequency of inhabitants by immigration category and country background, and percentage who had received at least one dose of COVID-19 vaccine as of 20 October 2021.

	Frequency (N)	Vaccinated with (at least) one dose (%)
<b>Immigration category</b>		
Total	4 264 370	90
Norwegian-born	3 518 308	93
Norwegian-born with foreign-born parents	57 153	82
Foreign-born	689 540	73
<b>Country background</b>		
Norway	3 518 134	93
Vietnam	19 222	93
Sri Lanka	12 561	91
Thailand	19 572	91
Denmark	18 153	89
Philippines	21 244	89
India	13 929	88
United Kingdom	13 936	88
Sweden	33 348	88
Iran	19 024	87
Iceland	6 071	86
Pakistan	30 968	86
Brazil	4 962	85

	Frequency (N)	Vaccinated with (at least) one dose (%)
Finland	6 245	85
Netherlands	7 441	85
USA	8 296	85
Afghanistan	15 960	82
Bosnia-Herzegovina	15 063	82
Chile	7 212	82
China	8 946	81
Kosovo	12 069	81
Turkey	15 636	80
Germany	22 905	80
Ethiopia	7 789	78
Iraq	23 712	78
Other country backgrounds	107 136	75
Syria	22 945	75
Morocco	8 167	74
Spain	5 199	73
Eritrea	20 580	71
France	5 047	71
Serbia	6 495	70
Ukraine	5 400	70
Somalia	27 426	67
Croatia	5 002	66
Russia	16 904	62
Lithuania	34 512	47
Poland	88 891	46
Bulgaria	6 204	45
Romania	13 118	45
Latvia	9 171	44

## Main analysis

Table 2 shows estimated odds ratios (OR) by immigration category. The full set of estimated odds ratios with standard errors is presented in Appendix 2a. The odds of being unvaccinated against COVID-19 were higher for foreign-born individuals, and

for Norwegian-born individuals with foreign-born parents, than for Norwegian-born individuals with Norwegian-born parents, both before and after adjusting for socioeconomic and demographic factors. For foreign-born- and Norwegian-born individuals with foreign-born parents, the odds ratios were highest in the unadjusted model, with the odds of being unvaccinated more than 5 and 3 times higher, respectively, than for people born in Norway to Norwegian-born parents. Odds ratios were somewhat lower in the full adjustment model, but were still more than triple or double, respectively, those of Norwegian-born individuals with Norwegian-born parents. For foreign-born individuals, the greatest reduction in odds was seen with the full adjustment model, whereas for Norwegian-born individuals with foreign-born parents, the greatest reduction was seen in the model that adjusted only for age.

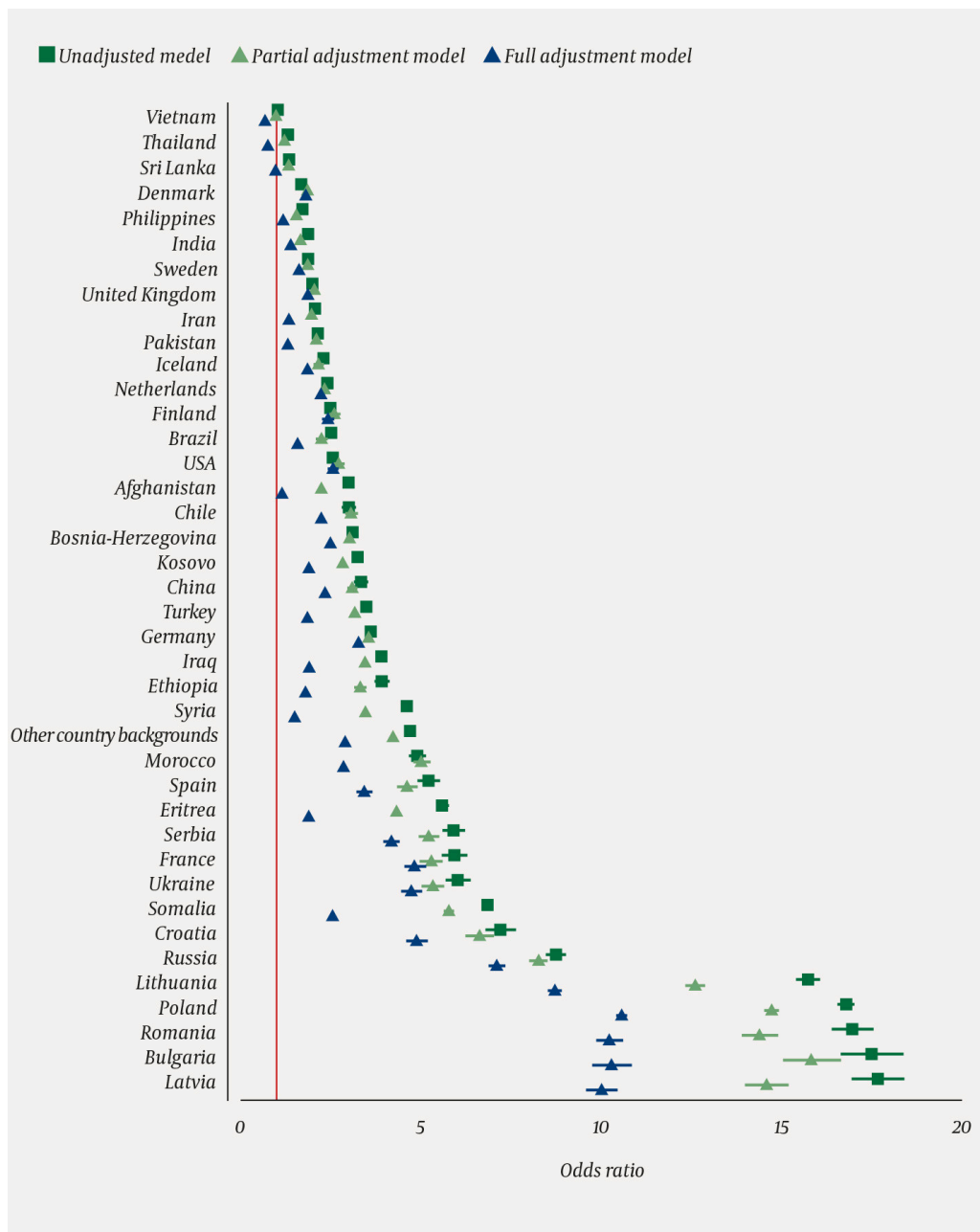
**Table 2**

Odds ratio for not having received at least one dose of COVID-19 vaccine as of 21 October 2021 by immigration category. Unadjusted model; model adjusted for age; partial adjustment model (adjusted for age, sex, risk group and county); full model (adjusted for age, sex, risk group, county, household income and education). Presented as odds ratios, with Norwegian-born with Norwegian-born parents as the reference group.

	Unadjusted model	Model adjusted for age	Partial adjustment model	Full adjustment model
Foreign-born	5.3	4.7 <sup>1</sup>	4.9 <sup>1</sup>	3.2 <sup>1</sup>
95 % confidence interval	5.3–5.3	4.7–4.7	4.8–4.9	3.1–3.2
Norwegian-born with Norwegian-born parents	3.1 <sup>1</sup>	2.2 <sup>1</sup>	2.4 <sup>1</sup>	2.0 <sup>1</sup>
95 % confidence interval	3.0–3.2	2.1–2.2	2.4–2.5	2.0–2.1

<sup>1</sup>  $p < 0.001$

Figure 1 shows estimated odds ratios by country background. A full set of estimated odds ratios with standard errors is presented in Appendix 2b. The odds ratios varied greatly among country backgrounds in both the unadjusted and adjusted models. The country backgrounds with the highest unadjusted odds ratios were Latvia (OR = 17.7; 95 % CI 17.0–18.4), Bulgaria (OR = 17.5; 95 % CI 16.6–18.4), Romania (OR = 17.0; 95 % CI 16.3–17.6), Poland (OR = 16.8; 95 % CI 16.6–17.0) and Lithuania (OR = 15.7; 95 % CI 15.4–16.0). The odds of individuals with these country backgrounds being unvaccinated were 15–18 times higher than for individuals with a Norwegian background. Individuals with a Vietnamese background had the lowest odds ratio, at 1.0 (95 % CI 1.0–1.1) in the unadjusted model, indicating roughly the same odds of having been vaccinated as a person with a Norwegian background. Adjusting for age, sex, risk group and county reduced the odds ratios for most country backgrounds – compared to the unadjusted model – but did not greatly affect the overall results.



**Figure 1** Odds ratio for not having received at least one dose of COVID-19 vaccine as of 21 October 2021 by country background, with associated 95 % confidence intervals (horizontal lines). Unadjusted model; partial adjustment model (adjusted for age, sex, risk group and former county) and full adjustment model (adjusted for age, sex, risk group, county, household income and education).

Adjusting for household income and education in the full adjustment model reduced the odds ratio for the vast majority of country backgrounds (see Appendix 2b). On average, the odds ratio was reduced by 32 % from the unadjusted to the full adjustment model, with the relative reduction greatest for Syria (67 %) and lowest for Denmark (7 % increase). Although there were some differences in the extent to which the odds ratio was affected, the overall picture remained unchanged. The odds ratios remained highest for individuals with backgrounds from Latvia (OR = 10.0; 95 % CI 9.6–10.5), Bulgaria (OR = 10.3; 95 % CI 9.7–10.9), Romania (OR = 10.2; 95 % CI 9.9–10.7), Poland (OR = 10.6; 95 % CI 10.4–10.7) and Lithuania (OR = 8.7; 95 % CI 8.5–8.9), with the odds of these individuals being unvaccinated some 8–11 times higher than for

the reference group. At the opposite end of the scale, individuals with a background from Vietnam (OR = 0.7; 95 % CI 0.6–0.7) or Thailand (OR = 0.8; 95 % CI 0.7–0.8) were less likely to be unvaccinated than people with a Norwegian background.

The length of time that immigrants have been resident in Norway varies for different country backgrounds, as does the proportion of individuals with each country background who were born in Norway. A sensitivity analysis examining the effect of differences in length of residence is presented in Appendix 3 and shows some significant differences. For a number of the countries with the lowest vaccination rates, including Bulgaria, Lithuania, Romania and Latvia, the highest odds ratios for being unvaccinated were in individuals who had been resident in Norway for relatively short periods of time.

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## Discussion

Foreign-born individuals and Norwegian-born individuals with foreign-born parents had lower vaccination coverage against COVID-19 than Norwegian-born individuals with Norwegian-born parents, both before and after adjusting for demographic and socioeconomic factors. However, vaccination coverage varies greatly among those with different country backgrounds. Individuals with country backgrounds from Latvia, Bulgaria, Poland, Romania and Lithuania have the lowest vaccination rates, whereas those with country backgrounds from Vietnam, Thailand and Sri Lanka have the highest rates, similar to those of people with a Norwegian background. In the fully adjusted model, the odds ratios for these countries were equal to or only slightly lower than that of Norway.

Surveys conducted shortly before and after COVID-19 vaccines were approved for use in Norway showed large between-group variation in willingness to be vaccinated, with the greatest vaccine hesitancy in those with an Eastern European background (8). The findings from these surveys are consistent with our findings from the registry data. The extent to which differences in vaccination coverage reflect differing attitudes towards vaccines is unclear. A number of factors contribute to vaccination behaviour, and whether or not an individual receives a vaccine depends on far more than them having a positive attitude towards it (16). Practical factors also come into play, such as physical accessibility (distance and opening hours of vaccination centres) and understanding (language and health competence) (17).

An individual's views about a vaccine are shaped both by their close interpersonal relationships (family, friends and colleagues) and by the social and historical contexts in which they live (18). It is therefore to be expected that people who differ greatly in their upbringing and life experiences will also differ greatly in their opinions on and adherence to vaccination programmes. A person's country background may reflect where they grew up and the influences to which they have been exposed over their lifetime, and will thus be a key variable in determining their vaccination status. Being resident in Norway, and having contact with and integrating into Norwegian society, has the potential to modify views that individuals bring with them from their country of birth. People from countries such as Sweden and Denmark that are highly similar in most respects to Norway, and those with country backgrounds often associated with long lengths of residence in Norway, such as Pakistan and Iran, showed strong support

for the vaccination programme. By contrast, people with an Eastern European background, who have typically been resident in Norway for shorter periods of time, showed little support for vaccination; out of all those with the shortest lengths of residence, they also had the highest odds of being unvaccinated. However, these differences should be interpreted with caution, as the sensitivity analyses for length of residence did not take into account the fact that the relative proportions of immigrants from different countries may vary over time.

Socioeconomic factors such as income and education also affected vaccination coverage for some country backgrounds. Vaccines are free and readily available in Norway, and it is therefore unlikely that financial constraints per se pose an obstacle to being vaccinated. However, the level and quality of education received by an individual can affect their ability to access and acquire information about the pandemic in general and about vaccines in particular. The relationships between socioeconomic factors, country background and vaccine uptake are complex, and there may well be factors such as integration and length of residence that affect both socioeconomic factors and willingness to be vaccinated. In the long term, measures aimed at increasing levels of education and health competence among immigrant populations should be considered.

Registry data have the obvious advantage of covering the entire adult population of Norway. Nevertheless, our study also has several weaknesses that must be considered when interpreting the results. We do not know how many people received the vaccine abroad without registering it in Norway. This may be particularly relevant for those from countries with good access to vaccines, and where geographical proximity and cheap ticket prices permit frequent travel between Norway and the country of origin. Although some municipalities have introduced systems for registering vaccines received abroad, in many places this will incur a fee, and there are few incentives for the individual to do so. It is difficult to estimate the extent of this issue at present, but since the individuals in our study are permanent residents, we assume that the numbers affected are unlikely to be large enough to change the main findings.

There are also weaknesses related to the income and education registers, including the fact that the data are from 2018. It is also possible that data may have been entered incorrectly, and that the categories used may not always capture individuals' real economic situations or differences in the quality of education received by different groups. The study provides no information about people who are temporarily employed in Norway, who stay for short periods, or who are resident in Norway without a permit. However, it is extremely unlikely that these weaknesses would alter the main findings of the study.

## **Conclusion**

Individuals who are foreign-born, or Norwegian-born with foreign-born parents, have lower vaccination coverage against COVID-19 than Norwegian-born individuals with Norwegian-born parents, also after adjusting for demographic and socioeconomic factors. Vaccination coverage varies considerably with country background. People from Latvia, Bulgaria, Poland, Romania and Lithuania have the lowest vaccination coverage, while those from Vietnam, Thailand and Sri Lanka have the highest. Socioeconomic factors may explain some of the variation seen for certain country backgrounds, but cannot explain the bulk of the observed differences. Since COVID-19

vaccination coverage varies greatly with country background, measures to increase coverage should be aimed at groups with low vaccination rates rather than immigrants as a whole.

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## **Main findings**

COVID-19 vaccination coverage was lower among foreign-born individuals and Norwegian-born individuals with foreign-born parents than among Norwegian-born individuals with Norwegian-born parents, also after adjusting for demographic and socioeconomic factors.

Vaccination coverage varied greatly among individuals with different country backgrounds.

Vaccination coverage was lowest among individuals of Latvian, Bulgarian, Polish, Romanian and Lithuanian background, and highest among individuals of Vietnamese, Norwegian, Thai and Sri Lankan background.

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