



Higher educational attainment associated with higher confidence in influenza vaccination in Norway

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A B S T R A C T

Aims: To explore public confidence in influenza vaccination through the use of attitudinal indicators, and study whether educational attainment is related to attitudes towards influenza vaccination.

Methods: Confidence in influenza vaccination was measured with three questions adapted from the Vaccine Confidence Project. These questions have been included in four study years of a Norwegian nationally representative telephone survey that cover influenza seasons 2016/17, 2019/20, 2020/21 and 2021/22. Over these four years, a total of 8 436 individuals aged 18–79 years responded to the survey and are included in the analysis. Risk differences (RDs) with 95 % confidence intervals were estimated using multivariable Poisson regression.

Results: Influenza vaccine confidence increased over time, with approximately 80 % of the general population expressing trust in the vaccine in the 2021/22 season. There was a tendency towards higher confidence in the oldest age group (65–79 years). Moreover, confidence increased with increasing educational attainment. The proportion of participants who agreed that influenza vaccine is compatible with their basic values was close to 20 percentage points lower among those with only compulsory education than among those with higher education at graduate level, RD = −18.4 % (95 % CI −21.4 % to −15.5 %). Educational attainment was consistently associated with influenza vaccine confidence in all seasons, among risk groups 18–64 years, and among health care workers.

Conclusions: We observed an increase in confidence in influenza vaccination over the seasons examined in the study. However, the increase has not been equal in all groups and there is a clear educational gradient in influenza vaccine confidence. These findings indicate that despite efforts to increase influenza coverage over several years, the implemented measures have failed to reach all parts of the population.

1. Introduction

Recommendations for annual influenza vaccination in Norway includes the medical risk groups (RGs), which are defined as individuals with certain chronic medical conditions and/or age 65 years and older, as well as health care workers with direct patient contact (HCWs) [1]. While HCWs have been entitled to free vaccinations provided by their employer for many years, there is normally no regulated price for RGs. The cost varies between 150 and 500 Norwegian kroner (NOK) for the annual vaccination, depending on place of vaccination (150–500 NOK corresponded to approximately 15–50 € in the study period).

As previously described [2], influenza vaccination coverage has increased substantially in Norway in recent years, but it is still suboptimal – at approximately 50–60 % among both RGs and HCWs. Initially, the increase followed public campaigns on influenza awareness and vaccine effectiveness, extensive influenza-specific educational measures

targeted specifically at HCWs, and a severe influenza season in 2017/18. This increase in coverage was first seen among the elderly, HCWs and individuals with higher education, resulting in significant educational differences in vaccination coverage in seasons 2018/19 and 2019/20 (2). While coverage continued to increase in the following seasons (2020/21 and 2021/22) when the influenza vaccine was funded for the RGs as part of the pandemic response, the educational differences in coverage diminished. However, individuals with lower education still reported comparatively lower coverage even when the vaccine was free of charge. We also observed an educational pattern in vaccination coverage among HCWs, which have been entitled to free vaccinations for years. This indicates the presence of other barriers structuring the individual's vaccination choices, apart from ease of access and costs [2]. We therefore wanted to explore public confidence in influenza vaccination through the use of attitudinal indicators, and to study whether educational attainment is related to attitudes towards influenza

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vaccination. As our data set spans several influenza seasons, specifically 2016/17 and 2019/20–2021/22, we also wanted to study whether public confidence in influenza vaccination has seen changes over time.

2. Methods

2.1. Data

This study is based on data from Statistics Norway's Travel & Vacation survey - a quarterly survey of repeated cross-sectional design which collects data for official statistics, including travel behaviour and influenza vaccination [3]. The survey is conducted as interviewer-administered, computer-assisted telephone interviews. The sampling frame is the Norwegian National Registry, where every citizen has a unique identifier, and the target population is all Norwegian residents aged 16–79 years. Each quarter, Statistics Norway draws a new sample of 2000 individuals by way of stratified random sampling – based on place of residence, sex and 10-year age groups – to ensure that the age and sex structure of the sample mirrors the distribution in the target population in each county [3]. Questions on influenza vaccination has been included in the second and third quarter (Q2 & Q3) since 2015. This analysis includes the four study years, covering influenza seasons 2016/17, 2019/20, 2020/21 and 2021/22, that included questions on the respondents' confidence in the influenza vaccine. The present study therefore allows for a comparison of attitudes towards influenza vaccination in Norway before and during the COVID-19 pandemic.

Of 15 972 eligible individuals, 8 839 responded to the survey. The overall response rate was 55.3 % (55.9 % in 2016/17; 61.7 % in 2019/20; 53.7 % in 2020/21, and 50.1 % in 2021/22) [3]. Restricting the sample to adults 18–79 years excluded 310 respondents. After further exclusion of 93 individuals with missing information on one or more of the self-reported variables the net sample comprised 8 436 respondents.

2.2. Variable definitions – Outcome variables

Confidence in influenza vaccination was measured with three questions adapted from the global State of Vaccine Confidence Project [4]. Respondents were asked to rate agreement, on a five-point Likert scale (*strongly agree, tend to agree, neither agree nor disagree, tend to disagree, strongly disagree*), with the following statements: “Overall, I think influenza vaccines are safe”, “Overall, I think influenza vaccines provide protection against influenza”, and “Overall, influenza vaccines are compatible with my basic values”. These variables were recoded as dichotomous variables to be used as dependent variables in this analysis, separating respondents expressing agreement (*strongly agree and tend to agree*) from those responding to the other alternatives (*neither agree nor disagree, tend to disagree, strongly disagree*).

2.3. Variable definitions – Explanatory variables

Data on age and sex were obtained from the Norwegian National Registry, while educational attainment was obtained from the National Education Database and categorised as lower education (compulsory (0–10th class level) or unspecified education, i.e. educational level not recorded in the register), intermediate education (11th–14th class level), higher education of undergraduate level (14th–17th class level), or higher education of graduate level (18th–20th + class level) [5]. Indication for the influenza vaccine due to medical conditions or professional status was measured by self-report. Respondents were coded as belonging to the medical RG for influenza if they confirmed that they had at least one of the following chronic conditions; chronic respiratory or cardiovascular disease, liver or renal failure, chronic neurological disease or injury, immunosuppression, diabetes mellitus or severe obesity (BMI ≥ 40), regardless of age [1]. Respondents that affirmed that they worked in health care and had direct contact with patients, were categorised as HCWs [2].

2.4. Statistical analysis

We calculated the weighted proportions with 95 % confidence intervals (CIs) of respondents expressing agreement with each of the three attitudinal statements for each group of the explanatory variables. The weights are generated by Statistics Norway to account for non-response error or underrepresentation of groups by age, sex, county and educational attainment in the data set compared to the distribution in the general population, and the proportions are therefore considered representative for the national population 18–79 years.

To assess the association between potential explanatory factors and each of the attitudinal variables, we calculated risk differences (RDs) with 95 % CIs. Due to convergence problems with binomial regression, we used Poisson regression with robust standard deviation [6]. The models included sex, age group (18–44, 45–64, and 65–79 years), educational attainment, status as RG and/or HCW, and influenza season. We did not apply weights in the multivariable models because the weighting variables age, sex and educational attainment were included in the model. To assess whether the impact of education or indication for the influenza vaccine changed over time, we also performed analyses stratified by influenza season.

In addition to the analyses on the sample as a whole, we also performed subgroup analyses for the groups with indication for annual influenza vaccination according to the current national recommendations in Norway, namely those 65 years or over, individuals 18–64 in the RG, and the HCWs. Analyses were performed in StataSE version 15.

3. Results

Characteristics of the 8 436 respondents included in the net sample are presented in Table 1. The proportion of the sample aged 65–79 years increased over time, due to an aging population. The proportion with higher educational attainment also increased, again this was expected, as there has been a general increase in educational level in the population over time [7]. While the proportion reporting to be HCWs has decreased over the study period, the sex distribution in this group (75 % women) remains the same.

3.1. Confidence in influenza immunisation over time

The general population within Norway expressed a high level of confidence in influenza vaccines, as measured by the proportion of the overall sample that agreed with the statements that influenza vaccines are *safe* (77.5 %), *protective* (79.3 %) and *compatible with their basic values* (78.0 %) in descriptive analyses on all influenza seasons combined (Tables 2–4).

For all three measures, we observed an increase from the first (2016/17) to the last (2021/22) influenza season (Tables 2–4, Fig. 1 A–C). The increase was largest (from 63.7 % (95 % CI 61.5 %–65.8 %) to 84.0 % (95 % CI 82.1 %–85.7 %)) for the question on *safety*, which was the measure with the lowest scores in the first influenza season (Table 2). The smallest increase (from 68.1 % (95 % CI 66.0 %–70.2 %) to 78.6 % (95 % CI 76.6 %–80.5 %)) was observed for the question on *compatibility with basic values* - which initially increased from 2016/17 until 2020/21 and then saw a drop in the last influenza season, 2021/22 (Table 4).

3.2. Factors independently associated with confidence in influenza immunisation

Descriptive analyses did not indicate consistent differences in influenza vaccine confidence according to sex, belonging to the RG, or being a HCW for any of the three attitudinal measures (Tables 2–4). There was, however, a tendency towards higher confidence in the oldest age group. There was also a clear educational pattern; the proportion reporting agreement with the attitudinal statements increased with educational attainment for all three measures (Fig. 1 D–F, Tables 2–4).

Table 1

Characteristics of the study participants, Statistics Norway’s Travel & Vacation-survey Q2 & Q3, influenza seasons 2016/17, 2019/20–2021/22. Proportions are weighted.

Variables	All study years combined, 2016/17 – 2021/22		2016/17		2019/20		2020/21		2021/22	
	N	%	N	%	N	%	N	%	N	%
Sample	8 436	100.0	2 127	100.0	2 363	100.0	2 039	100.0	1 907	100.0
Men	4 311	50.9	1 075	50.8	1 189	50.8	1 054	51.4	993	50.7
Women	4 125	49.1	1 052	49.2	1 174	49.2	985	48.9	914	49.3
<i>Age group (years)</i>										
18–44	3 694	47.7	939	48.5	1 047	47.2	896	47.1	812	48.0
45–64	3 077	34.4	791	34.7	866	34.9	743	34.7	677	33.2
65–79	1 665	18.0	397	16.8	450	18.0	400	18.2	418	18.8
<i>Educational attainment</i>										
Compulsory or unknown	1 641	25.9	431	26.6	495	27.3	401	25.0	314	24.5
Intermediate	3 405	40.2	859	41.0	973	40.0	805	40.6	768	39.1
Higher education, undergraduate level	2 359	23.5	603	23.2	632	23.1	568	23.2	556	24.5
Higher education, graduate level	1 031	10.5	234	9.1	263	9.7	265	11.1	269	11.9
<i>Medical risk factors</i>										
Yes	1 752	20.6	446	20.8	478	20.3	413	20.4	415	20.8
No	6 684	79.4	1 681	79.2	1 885	79.7	1 626	79.6	1 492	79.2
<i>Health care worker</i>										
Yes	999	11.6	264	12.3	291	11.8	235	11.2	209	11.0
No	7 437	88.4	1 863	87.7	2 072	88.2	1 804	88.8	1 698	89.0

In the multivariable analysis, women expressed lower confidence than men in the influenza vaccine’s *compatibility with basic values* in 2021/22 (RD -5.2% (95% CI -8.9% to -1.5%); [Table 7](#)). For the other seasons and the other measures, the difference between men and women was generally small. Being 65 years or older were generally associated with higher vaccine confidence for all three attitudinal measures in the combined analyses compared to those aged 18–44, but it was not a consistent finding across every season ([Tables 5–7](#)).

Educational attainment was associated with confidence in influenza vaccination also in multivariable analyses. Compared to the reference group of higher education, graduate level, the confidence in influenza vaccination was lower in the other categories, for all three measures ([Tables 5–7](#)). The largest differences was observed for *compatibility with basic values*; for all study years combined RD was -18.4% (95% CI -21.4% to -15.5%) for compulsory education, -12.8% (95% CI -15.2% to -10.3%) for intermediate education, and -5.2% (95% CI -7.7% to -2.7%) for higher education, undergraduate level ([Table 7](#)). Decreasing confidence with decreasing educational attainment was also observed for the other measures, but the differences were slightly smaller. Moreover, a similar pattern was consistently observed in the analyses for each season separately.

Belonging to the RG or being a HCW was generally not associated with the level of vaccine confidence, with the exception that HCWs expressed higher confidence in *vaccine safety* in season 2021/22 (RD 4.9% , 95% CI 0.1% – 9.7% , [Table 5](#)), and that the RGs had higher confidence in both *safety* (RD 4.9% , 95% CI 1.3% – 8.5%) and *compatibility with basic values* (RD 6.1% , 95% CI 1.9% – 10.4% , [Tables 5 and 7](#)) in the same season (2021/22).

Lastly, in combined analyses on all influenza seasons, we found that confidence in the influenza vaccine was higher in the 2021/22-season compared to 2016/17, RD 19.8% (95% CI 17.1% – 22.3%) for *safety*, RD 14.2% (95% CI 11.7% – 16.8%) for *protective effect*, and RD 9.6% (95% CI 6.9% – 12.3%) for *compatibility with basic values* ([Tables 5–7](#)). However, for both the *protective effect of influenza vaccines* ([Table 6](#)) and especially the *vaccine’s compatibility with basic values* ([Table 7](#)), confidence decreased from season 2020/21 to 2021/22.

3.3. Subgroup analyses of attitudes to influenza vaccines in groups with indication for the vaccine

The association between educational level and attitudes to influenza vaccine was weaker among those over 65 years than in the general sample ([Supplementary Table 1](#)). In contrast, we observed a stronger association among the RGs aged 18–64 years ([Supplementary Table 2](#)). Lastly, we also observed pronounced educational differences in attitudes to influenza vaccine among the HCWs. For all three measures, confidence in influenza vaccine was more than 20 percentage points lower among HCWs with only compulsory education than among HCWs with higher education, graduate level ([Supplementary Table 3](#)).

4. Discussion

This study showed that confidence in the influenza vaccine, as measured here by agreement to statements that the vaccine is *safe*, *protective* and *compatible with the respondents’ basic values*, was strengthened over time in Norway, with the result that approximately 80% of the general population expressed trust in the vaccine in the 2021/22 influenza season. The increase was largest for confidence in *vaccine safety*, and smallest for *compatibility with basic values* - which also seemed to suffer a setback in the last COVID-19 pandemic season of 2020/21.

When we explored sociodemographic associations of confidence in the influenza vaccine, we found a tendency towards higher confidence in the oldest age group (65–79 years). We also found that the group that consistently expressed the highest level of confidence were those with higher education at graduate level, and that there was an attitudinal pattern where higher educational attainment was associated with higher confidence. This stepwise increase was observed across *all* educational groups in combined analyses on the whole sample for all three attitudinal measures, in the subgroup analyses on the RGs aged 18–64 years, and in several of the analyses on separate seasons.

Table 2

Number and proportion agreeing to the statement "Overall, I think influenza vaccines are safe", in various groups of the sample. Proportions and 95% CIs are weighted.

Variables	All study years combined			Analyses by influenza season									Percentage points increase from 2016/17 to 2021/22			
	2016/17–2021/22 N = 8 436			2016/17 N = 2 127			2019/20 N = 2 363			2020/21 N = 2 039				2021/22 N = 1 907		
	n	%	95 % CI	n	%	95 % CI	n	%	95 % CI	n	%	95 % CI	n	%	95 % CI	
Sample	6 638	77.5	76.6–78.5	1 382	63.7	61.5–65.8	1 901	79.5	77.8–81.2	1 726	83.3	81.5–85.0	1 629	84.0	82.1–85.7	20.3
<i>Men</i>	3 373	77.0	75.6–78.3	683	62.0	58.9–64.9	950	79.0	76.5–81.3	894	83.7	81.2–86.0	846	83.2	80.5–85.6	21.2
<i>Women</i>	3 265	78.2	76.9–79.5	699	65.4	62.3–68.3	951	80.0	77.5–82.3	832	82.9	80.2–85.3	783	84.7	82.1–87.0	19.3
<i>Age group (years)</i>																
18–44	2 878	76.4	74.9–77.8	603	62.5	59.2–65.7	856	80.5	77.8–82.9	735	80.3	77.3–83.1	684	82.7	79.7–85.3	20.2
45–64	2 366	76.2	74.6–77.7	502	62.4	58.9–65.8	664	75.8	72.8–78.6	629	83.7	80.7–86.3	571	83.1	79.9–85.9	20.7
65–79	1 394	83.5	81.6–85.2	277	69.5	64.7–73.9	381	84.2	80.4–87.4	362	90.4	87.1–93.0	374	88.6	85.0–91.5	19.1
<i>Educational attainment</i>																
Compulsory or unknown	1 170	70.5	68.2–72.8	260	58.7	53.8–63.5	368	73.8	69.6–77.5	305	75.2	70.5–79.5	237	74.9	69.7–79.5	16.2
Intermediate	2 606	76.2	74.7–77.6	524	60.8	57.4–64.0	756	77.4	74.7–80.0	677	83.3	80.5–85.8	649	84.0	80.5–85.8	23.2
Higher education, undergraduate level	1 964	83.4	81.8–84.8	426	70.5	66.7–74.0	544	86.0	83.1–88.5	499	87.7	84.7–90.2	495	89.0	86.1–91.4	18.5
Higher education, graduate level	898	87.3	85.2–89.2	172	73.7	67.6–78.9	233	88.7	84.3–92.0	245	92.4	88.5–95.1	248	92.4	88.5–95.1	18.7
<i>Medical risk factors</i>																
Yes	1 410	79.6	77.6–81.5	301	65.8	61.1–70.2	390	80.9	77.0–84.3	347	83.3	79.1–86.7	372	88.7	85.0–91.6	22.9
No	5 228	77.1	76.0–78.1	1 081	63.1	60.6–65.5	1 511	79.2	77.2–81.0	1 379	83.4	81.3–85.2	1 257	82.7	80.5–84.7	19.6
<i>Health care worker</i>																
Yes	801	79.0	76.1–81.5	181	66.5	60.2–72.2	236	80.3	75.1–84.6	196	82.1	76.3–86.7	188	88.4	82.6–92.4	21.9
No	5 837	77.4	76.4–78.4	1 201	63.3	60.9–65.5	1 665	79.4	77.5–81.2	1 530	83.5	81.6–85.3	1 441	83.4	81.4–85.2	20.1

The observed increase from the first to the last study season is given in percentage points in the last column.

Data from Statistics Norway, T&V-survey Q2 & Q3, influenza seasons 2016/17 & 2019/20–2021/22.

Table 3
Number and proportion agreeing to the statement “Overall, I think influenza vaccines provide protection against influenza”, in various groups of the sample.

Variables	All study years combined			Analyses by influenza season												Percentage points increase from 2016/17 to 2021/22
	2016/17–2021/22 N = 8 436			2016/17 N = 2 127			2019/20 N = 2 363			2020/21 N = 2 039			2021/22 N = 1 907			
	n	%	95 % CI	n	%	95 % CI	n	%	95 % CI	n	%	95 % CI	n	%	95 % CI	
Sample	6 776	79.3	78.3–80.2	1 472	68.0	65.9–70.0	1 958	81.9	80.2–83.4	1 743	84.5	82.7–86.1	1 603	82.8	80.9–84.6	14.8
<i>Men</i>	3 455	78.9	77.6–80.2	727	66.0	62.9–68.8	990	82.0	79.6–84.2	894	83.9	81.4–86.1	844	83.8	81.2–86.1	17.8
<i>Women</i>	3 321	79.6	78.3–80.9	745	70.1	67.1–72.9	968	81.7	79.3–83.9	849	85.1	82.5–87.4	759	81.8	79.0–84.3	11.7
<i>Age group (years)</i>																
18–44	2 922	77.7	76.2–79.1	650	67.5	64.2–70.6	862	81.1	78.5–83.5	740	81.4	78.4–84.0	670	81.3	78.3–84.0	13.8
45–64	2 437	78.4	76.8–79.9	522	65.0	61.5–68.3	703	80.3	77.4–82.9	642	85.7	82.8–88.1	570	83.0	79.7–85.8	18.0
65–79	1 417	85.0	83.1–86.6	300	75.6	71.1–79.6	393	87.0	83.4–89.8	361	90.3	86.9–92.8	363	86.4	82.6–89.5	10.8
<i>Educational attainment</i>																
Compulsory or unknown	1 213	72.9	70.6–75.1	277	62.5	57.6–67.1	378	75.4	71.3–79.1	315	77.9	73.2–81.9	243	76.5	71.3–81.0	14.0
Intermediate	2 672	78.2	76.8–79.6	569	66.2	62.9–69.3	779	80.0	77.3–82.4	686	84.5	81.8–86.9	638	82.5	79.6–85.1	16.3
Higher education, undergraduate level	1 989	84.3	82.8–85.7	444	73.5	69.8–76.9	564	89.2	86.5–90.9	503	88.5	85.6–90.9	478	85.9	82.8–88.6	12.4
Higher education, graduate level	902	87.7	85.5–89.6	182	78.0	72.2–82.8	237	90.2	86.0–93.3	239	90.5	86.4–93.5	244	90.4	86.2–93.4	12.4
<i>Medical risk factors</i>																
Yes	1 427	80.5	78.5–82.4	311	68.3	63.6–72.6	404	84.0	80.4–87.1	353	84.6	80.6–87.9	359	85.4	81.3–88.7	17.1
No	5 349	78.9	77.9–80.0	1 161	67.9	65.5–70.2	1 554	81.3	79.4–83.1	1 390	84.4	82.4–86.2	1 244	82.2	80.0–84.1	14.3
<i>Health care worker</i>																
Yes	806	79.5	76.7–82.0	190	70.3	64.2–75.8	240	81.6	76.5–85.8	196	82.7	77.1–87.2	180	84.1	77.7–88.9	13.8
No	8 970	79.2	78.2–80.2	1 282	67.6	65.4–69.8	1 718	81.9	80.1–83.6	1 547	84.7	82.8–86.4	1 423	82.7	80.7–84.5	15.1

Proportions and 95% CIs are weighted. The observed increase from the first to the last study season is given in percentage points in the last column. Data from Statistics Norway, T&V-survey Q2 & Q3, influenza seasons 2016/17 & 2019/20–2021/22.

Table 4
Number and proportion agreeing to the statement “Influenza vaccines are compatible with my basic values”, in various groups of the sample.

	All study years combined			Analyses by influenza season										Percentage points increase from 2016/17 to 2021/22		
	2016/17–2021/22			2016/17			2019/20			2020/21			2021/22			
	N = 8 436			N = 2 127			N = 2 363			N = 2 039			N = 1 907			
	n	%	95 % CI	n	%	95 % CI	n	%	95 % CI	n	%	95 % CI	N	%	95 % CI	
Sample	6 677	78.0	77.0–78.9	1 473	68.1	66.0–70.2	1 940	81.1	79.4–82.7	1 743	84.2	82.4–85.8	1 521	78.6	76.6–80.5	10.5
Men	3 442	78.5	77.2–79.8	741	67.3	64.3–70.2	988	82.0	79.6–84.1	902	84.4	82.0–86.6	811	80.4	77.6–82.8	13.1
Women	3 235	77.4	76.0–78.7	732	68.9	65.9–71.8	952	80.1	77.6–82.4	841	83.9	81.3–86.3	710	76.7	73.7–79.5	7.8
Age group (years)																
18–44	2 902	77.0	75.5–78.4	647	67.4	64.1–70.4	866	81.2	78.5–83.6	747	81.7	78.8–84.3	642	78.2	75.0–81.0	10.8
45–64	2 386	76.6	75.1–78.2	534	66.6	63.1–69.9	682	78.1	75.1–80.8	643	85.6	82.7–88.0	527	76.3	72.8–79.5	9.6
65–79	1 389	83.1	81.1–84.8	292	73.5	68.8–77.6	392	86.6	83.0–89.5	353	87.9	84.2–90.8	352	83.6	79.6–86.9	10.1
Educational attainment																
Compulsory or unknown educational level	1 162	70.3	68.0–72.6	273	62.5	57.6–67.1	368	73.7	69.5–77.4	293	73.1	68.3–77.4	228	72.3	67.0–77.1	9.8
Intermediate education	2 625	76.8	75.3–78.2	565	65.7	62.4–68.8	770	79.1	76.4–81.5	691	85.2	82.5–87.6	599	77.5	74.3–80.3	11.8
Higher education, undergraduate level	1 972	83.5	81.9–84.9	448	74.3	70.6–77.6	559	88.5	85.7–90.7	508	89.2	86.3–91.5	457	82.1	78.7–85.1	7.8
Higher education, graduate level	918	89.0	87.0–90.8	187	80.0	74.3–84.6	243	92.4	88.6–95.1	251	94.9	91.6–97.0	237	87.8	83.2–91.2	7.8
Medical risk factors																
Yes	1 408	79.2	77.1–81.1	319	70.2	65.6–74.4	392	80.9	77.0–84.3	345	82.6	78.4–86.1	352	83.2	78.9–86.8	13.0
No	5 269	77.7	76.6–78.7	1 154	67.6	65.2–69.9	1 548	81.1	79.2–82.9	1 398	84.6	82.6–86.4	1 169	77.4	75.0–79.5	9.8
Health care worker																
Yes	786	77.3	74.4–79.9	181	66.8	60.6–72.5	237	80.5	75.3–84.8	194	81.3	75.4–86.0	174	81.6	75.2–86.6	14.8
No	5 891	78.1	77.1–79.0	1 292	68.3	66.1–70.5	1 703	81.1	79.3–82.8	1 549	84.6	82.7–86.3	1 347	78.2	76.1–80.2	9.9

Proportions and 95% CIs are weighted. The observed increase from the first to the last study season is given in percentage points in the last column. Data from Statistics Norway, T&V-survey Q2 & Q3, influenza seasons 2016/17 & 2019/20–2021/22.

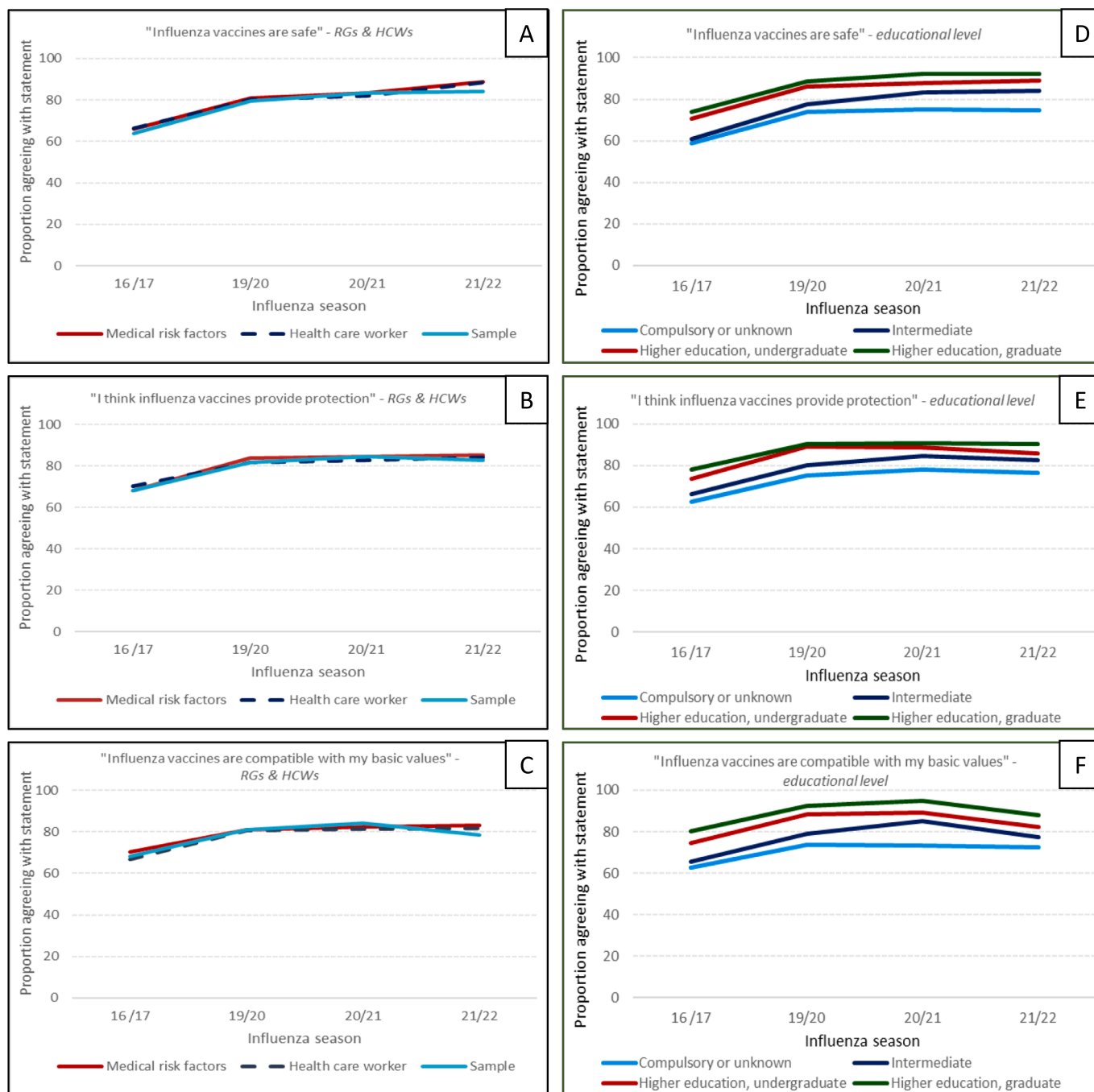


Fig. 1. Proportion of the respondents reporting agreement with the statements “Overall, I think influenza vaccines are safe”, “Overall, I think influenza vaccines provide protection against influenza”), and “Influenza vaccines are compatible with my basic values” - by influenza season and for the general sample, the RGs and the HCWs (Graph A–C) and for different levels of educational attainment (Graph D–F) respectively. Proportions are weighted. Data from Statistics Norway’s Travel & Vacation-survey, Q2 & Q3, 2016/17 & 2019/20–2021/22.

4.1. Influenza vaccine confidence in Norway compared to other national/ EU estimates

Confidence in vaccines in general, and in the influenza vaccine specifically, varies by time and place, but the Norwegian estimates of confidence in *influenza vaccine safety* is comparable to estimates based on the same question from the European Union Vaccine Confidence Study [8,9]. The Norwegian estimate of 64 % from season 2016/17 was slightly lower than the European average of 68 % in the European survey of 2018 [8]. Confidence in *influenza vaccine safety* increased over time, to a reported 81 % in the EU in 2022 [9], similar to the observed 84 %

agreement in season 2021/22 in the present study. And – allowing for differences in the phrasing of the other two questions – the Norwegian estimates of confidence in *influenza vaccine protection* (83 %) and *compatibility with basic values* (79 %) in 2021/22 was again similar to the EU averages for *vaccine effectiveness* (77 %) and the *influenza vaccine’s compatibility with religious, personal or philosophical beliefs* (82 %) in 2022 [9].

The influenza vaccine tend to get a lower confidence score in comparison with other vaccines. In their systematic review on influenza vaccine hesitancy from 2017, Schmid et al. [10] point out that some of the qualities of the influenza vaccine, such as its varying and often

Table 5

Multivariable poisson regression analyses on **confidence in the safety of influenza vaccines**. Dependent variable agreement to statement “Overall, I think influenza vaccines are safe”. Results given as risk difference (RD) for all study years combined and for each year separately. Data from Statistics Norway, T&V-survey Q2 & Q3, influenza seasons 2016/17 & 2019/20–2021/22.

Variables	16/17—21/22 N = 8 436		2016/17 N = 2 127		2019/20 N = 2 363		2020/21 N = 2 039		2021/22 N = 1 907	
	RD (%)	95 % CI	RD (%)	95 % CI	RD (%)	95 % CI	RD (%)	95 % CI	RD (%)	95 % CI
Sex										
Men (ref.)	0		0		0		0		0	
Women	0.1	−1.8–1.9	1.7	−2.5–5.9	0.1	−3.2–3.5	−1.4	−4.7–1.9	−0.5	−3.8–2.8
Age group (years)										
18–44 (ref.)	0		0		0		0		0	
45–64	−1.5	−3.6–0.6	−1.3	−5.9–3.4	−5.2	−9.0– −1.5	2.4	−1.3–6.1	−1.38	−5.1–2.4
65–79	6.0	3.5–8.4	6.6	0.6–12.7	3.1	−1.3–7.4	9.4	5.3–13.5	4.61	0.4–8.8
Educational attainment										
Compulsory	−15.2	−18.3– −12.2	−13.6	−20.9– −6.2	−14.7	−20.1– −9.2	−17.0	−22.5– −11.6	−17.28	−23.1– −11.5
Intermediate	−11.1	−13.7– −8.5	−13.4	−20.0– −6.8	−11.0	−15.7– −6.3	−10.2	−14.5– −5.8	−8.97	−13.2– −4.8
Higher (undergraduate)	−3.5	−6.1– −0.9	−3.3	−10.0–3.5	−2.5	−7.2–2.3	−4.9	−9.1– −0.7	−3.97	−8.2–0.3
Higher (graduate; ref.)	0		0		0		0		0	
Medical risk factors										
Yes	2.2	−0.1–4.4	2.9	−2.4–8.2	2.1	−2.0–6.2	−1.2	−5.4–2.9	4.90	1.3–8.5
No (ref.)	0		0		0		0		0	
Health care worker										
Yes	1.5	−1.3–4.4	3.5	−2.8–9.8	−0.3	−5.4–4.8	−2.0	−7.4–3.3	4.93	0.1–9.7
No (ref.)	0		0		0		0		0	
Influenza season										
2016/17 (ref.)	0									
2019/20	15.6	13.0–18.2								
2020/21	19.5	16.9–22.1								
2021/22	19.8	17.1–22.3								

suboptimal effectiveness and that it must be renewed annually, may lead to a specific lack of confidence and negative attitudes towards this vaccine. In a previous study on confidence in the childhood immunisation programme from Norway, Steens et al. found that 93 % agreed that *vaccines are safe*, that 96 % agreed that *vaccines offer protection*, and that 93 % stated that vaccines were *compatible with their basic values* [11]. These estimates were considerably higher than the estimates for *influenza vaccine safety* (64 %–84 %), *protection* (68 %–83 %) and *compatibility with basic values* (68 %–79 %) for the whole period of 2016/17 to 2021/22 found in the present study.

4.2. Influenza vaccine confidence has increased, but educational differences remain

Both influenza vaccine coverage and confidence have strengthened in the general population in Norway during the study period – coinciding with measures that aimed to increase knowledge about influenza and the influenza vaccine (focusing on RGs and especially HCWs), improve access to influenza vaccination for all groups with an indication for the annual vaccine, and strengthen the health services’ incentives to offer the vaccine to employees and patients [2]. However, while the development in coverage has been favorable, especially as educational differences also diminished while the influenza vaccine was funded for the RGs, the measures implemented to increase coverage rates have not been able to reduce the clear educational pattern in influenza vaccine confidence.

Although previous reviews have found varying results for the direction and strength of the association between education and influenza vaccine coverage in different populations [12–14], several studies have found higher educational attainment to be an enabling factor in influenza vaccination [15–17]. Furthermore, individuals with lower

educational attainment are more likely to have inadequate health- [18–21] and vaccination literacy [22,23]. As increased knowledge of the influenza vaccine is related to increased vaccine confidence and vaccination coverage [15,19,24], we find that measures to improve vaccination communication to all members of Norwegian society is not only a question of equity, but also important to stem the tide of vaccine misinformation.

We recently found that while being an HCW is strongly associated with higher influenza vaccination coverage in Norway, vaccination coverage is lower among HCWs of lower or intermediate educational level compared to HCWs of higher education [2]. Correspondingly, the current study also indicates an educational pattern among HCWs regarding vaccine confidence. This is in line with findings from an Italian study where HCWs with lower levels of education were found to have lower levels of influenza vaccination compared to HCWs with higher levels of education [25]. Additionally, a recent study measuring influenza vaccination coverage among Italian HCWs over a three-year period found that the highest increase in vaccination coverage were among physicians, with nurses and older HCWs being less likely to follow influenza vaccination recommendations [26].

4.3. Strengths and limitations

Among the strengths of this study are the high-quality survey data from Statistics Norway, and the comparability of two of the three attitudinal measures (*safety* and *protection*) adapted from the Vaccine Confidence Project [4]. The third measure, *compatibility with basic values*, was modified from the original question “Influenza vaccines are compatible with my religious beliefs” in Larson et al. [4] in an effort to better fit the primarily secular nature of Norwegian society. However, it seems that this question is challenging to answer, and we believe that

Table 6

Multivariable poisson regression analyses on **confidence in the protective effect of influenza vaccines**. Dependent variable agreement to statement “Overall, I think influenza vaccines provide protection against influenza”. Results given as risk difference (RD) for all study years combined and for each year separately. Data from Statistics Norway, T&V-survey Q2 & Q3, influenza seasons 2016/17 & 2019/20–2021/22.

Variables	16/17—21/22 N = 8 436		2016/17 N = 2 127		2019/20 N = 2 363		2020/21 N = 2 039		2021/22 N = 1 907	
	RD (%)	95 % CI	RD (%)	95 % CI	RD (%)	95 % CI	RD (%)	95 % CI	RD (%)	95 % CI
<i>Sex</i>										
Men (ref.)	0		0		0		0		0	
Women	-0.3	-2.0-1.5	2.4	-1.6-6.4	-2.0	-5.1-1.3	0.8	-2.4-4.0	-2.8	-6.2-0.6
<i>Age group (years)</i>										
18-44 (ref.)	0		0		0		0		0	
45-64	-0.4	-2.4-1.6	-3.4	-7.9-1.1	-1.2	-4.8-2.3	3.6	-0.0-7.1	0.7	-3.2-4.6
65-79	6.4	4.0-8.8	8.1	2.4-13.8	5.3	1.1-9.4	8.0	3.8-12.1	4.2	-0.3-8.8
<i>Educational attainment</i>										
Compulsory	-13.4	-16.4- -10.4	-14.1	-21.1- -7.0	-14.1	-19.4- -8.8	-11.9	-17.4- -6.4	-13.6	-19.5- -7.7
Intermediate	-9.8	-12.3- -7.3	-12.5	-18.8- -6.3	-10.8	-15.2- -6.3	-6.4	-11.0- -1.9	-8.8	-13.3- -4.3
Higher (undergraduate)	-3.0	-5.6- -0.5	-4.6	-11.1-1.8	-0.6	-4.9-3.8	-2.0	-6.4-2.5	-5.1	-9.7- -0.6
Higher (graduate; ref.)	0		0		0		0		0	
<i>Medical risk factors</i>										
Yes	1.0	-1.2-3.2	-0.2	-5.4-5.0	2.4	-1.5-6.3	-1.0	-5.0-3.1	2.6	-1.4-6.6
No (ref.)	0		0		0		0		0	
<i>Health care worker</i>										
Yes	0.4	-2.4-3.2	2.9	-3.1-9.0	-1.1	-6.1-3.8	-3.3	-8.6-2.0	3.0	-2.2-8.3
No (ref.)	0		0		0		0		0	
<i>Influenza season</i>										
2016/17 (ref.)	0									
2019/20	13.7	11.3-16.3								
2020/21	16.1	13.6-18.6								
2021/22	14.2	11.7-16.8								

the 2022-version of this question in the Vaccine Confidence Project – “compatibility with religious, personal or philosophical beliefs” – with its more inclusive wording, would have been more appropriate in the Norwegian context. Another important limitation is that the cross-sectional nature of the data limits the ability to discuss causality regarding the associations between sociodemographic variables and vaccine confidence.

4.4. Implications

Despite broad efforts to increase influenza coverage over several years, the present study indicates that the implemented measures have failed to reach all parts of the population. Not only have we observed an educational gradient in influenza vaccine confidence, current data from Norway also implies that individuals with lower education have a consistently lower vaccination coverage [2]. A recent study suggests that increasing vaccination knowledge can help increase vaccination rates [15]. Anastasiou et al. further emphasize the combination of improving knowledge about vaccine effectiveness and safety in combination with offering free vaccines in order to increase vaccination coverage [15]. Hence, to reduce educational differences in influenza vaccination attitudes and coverage and minimize barriers towards vaccination, the vaccine should be funded for the RGs – and future information campaigns need to focus especially on reaching individuals with lower levels of education. Regarding HCWs, Karlsson et al. [24] found that HCWs with higher vaccine confidence are more likely to get vaccinated – and to recommend vaccination to their patients. Similar to our study, they also found confidence in vaccines to be higher among HCWs with higher education, further emphasizing the connection between vaccine confidence and education level.

The differences in confidence in influenza vaccination is concerning,

especially among HCWs working with patients. Their lower vaccination rates and lower confidence in the vaccine can potentially put patients at risk for influenza associated morbidity and mortality. Vaccination in general, and HCW vaccination in particular, should also be included and/or strengthened in the curriculum for all levels of HCWs. Furthermore, employers in health care should implement educational tools for HCW vaccination as part of their employee training – and the practice of establishing vaccine willingness as a criterium in HCW employment processes should be strengthened.

Lastly, qualitative research is needed to more fully understand why confidence varies with educational level and what can be done to increase confidence and vaccination uptake among individuals of lower education in general, and among HCWs specifically, in order to reduce the educational gap in influenza vaccination.

CRedit authorship contribution statement

Birgitte Klüwer: . **Rebecca Gleditsch:** Writing – original draft, Writing – review & editing. **Kjersti Margrethe Rydland:** Funding acquisition, Project administration, Supervision, Writing – original draft, Writing – review & editing. **Svenn-Erik Mamelund:** Funding acquisition, Project administration, Writing – original draft, Writing – review & editing. **Ida Laake:** .

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 7

Multivariable poisson regression analyses on **whether influenza vaccines are compatible with respondents’ basic values**. Dependent variable agreement to statement “Influenza vaccines are compatible with my basic values”. Results given as risk difference (RD) for all study years combined and for each year separately. Data from Statistics Norway, T&V-survey Q2 & Q3, influenza seasons 2016/17 & 2019/20–2021/22.

Variables	16/17—21/22 N = 8 436		2016/17 N = 2 127		2019/20 N = 2 363		2020/21 N = 2 039		2021/22 N = 1 907	
	RD (%)	95 % CI	RD (%)	95 % CI	RD (%)	95 % CI	RD	95 % CI	RD	95 % CI
Sex										
Men (ref.)	0		0		0		0		0	
Women	-2.1	-3.9- -0.3	0.2	-3.8-4.2	-3.1	-6.3-0.1	-0.9	-4.1-2.4	-5.2	-8.9- -1.5
Age group (years)										
18-44 (ref.)	0		0		0		0		0	
45-64	-1.5	-3.6-0.5	-1.9	-6.4-2.6	-3.6	-7.2-0.0	2.4	-1.2-6.0	-2.5	-6.8-1.9
65-79	5.1	2.7-7.5	4.8	-0.9-10.5	5.2	1.2-9.3	5.0	0.8-9.3	4.6	-0.3-9.4
Educational attainment										
Compulsory	-18.4	-21.4- -15.5	-17.3	-24.2- -10.4	-18.3	-23.4- -13.3	-22.1	-27.3- -16.8	-16.4	-22.8- -10.0
Intermediate	-12.8	-15.2- -10.3	-15.0	-21.1- -8.9	-13.8	-18.0- -9.6	-9.9	-13.7- -6.1	-12.0	-17.0- -7.0
Higher (undergraduate)	-5.2	-7.7- -2.7	-5.8	-12.0-0.5	-3.7	-7.8-0.5	-5.3	-9.0- -1.5	-6.8	-11.9- -1.7
Higher (graduate; ref.)	0		0		0		0		0	
Medical risk factors										
Yes	1.8	-0.5-4.0	2.9	-2.2-8.0	0.2	-3.7-4.2	-2.1	-6.3-2.0	6.1	1.9-10.4
No (ref.)	0		0		0		0		0	
Health care worker										
Yes	-0.6	-3.5-2.2	-1.4	-7.6-4.8	-1.0	-6.0-4.0	-5.2	-10.6-0.3	5.5	-0.2-11.3
No (ref.)	0		0		0		0		0	
Influenza season										
2016/17 (ref.)	0									
2019/20	12.9	10.4-15.4								
2020/21	15.9	13.4-18.4								
2021/22	9.6	6.9-12.3								

Data availability

The data sets from the Travel and Vacation Surveys (Omnibus) may be ordered from the Norwegian Agency for Shared Services in Education and Research.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.vaccine.2024.03.049>.

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