



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Willingness to get vaccinated against Covid-19 and attitudes toward vaccination in general



Roselinde Kessels^{a,b}, Jeroen Luyten^c, Sandy Tubeuf^{d,*}

^a Maastricht University, Department of Data Analytics and Digitalization, PO Box 616, 6200 MD Maastricht, the Netherlands

^b University of Antwerp, Department of Economics, City Campus, Prinsstraat 13, 2000 Antwerp, Belgium

^c KU Leuven, Leuven Institute for Healthcare Policy, Kapucijnenvoer 35, 3000 Leuven, Belgium

^d UCLouvain, IRSS (Institute for Health and Society) & IRES (Institute of Economic and Social Research), Université catholique de Louvain - Clos Chapelle-aux-Champs, 30, Box B1.30.01, B-1200 Brussels, Belgium

ARTICLE INFO

Article history:

Received 5 January 2021

Received in revised form 10 May 2021

Accepted 22 May 2021

Available online 26 May 2021

Keywords:

Belgium
Covid-19
Hesitancy
Immunisation
Vaccination

ABSTRACT

Background: High uptake of Covid-19 vaccination is required to reach herd immunity.

Methods: A representative sample of 2,060 Belgians were surveyed in October 2020. Regression analyses identified the predictors associated with willingness to get vaccinated against Covid-19, and attitudes toward vaccination in general.

Results: 34% of the participants reported that they will definitely get vaccinated against Covid-19 and 39% that they would “probably”. Intended uptake was strongly associated with age, opinion on the government’s dealing with the Covid-19 pandemic, medical risk, spoken language, gender, and to a lesser extent with having known someone who was hospitalised because of Covid-19. Similar predictors were identified for attitudes to vaccination in general. Covid-19 vaccine hesitancy was more marked in age groups below 54 years old. We further analysed a sample of 17% (N = 349) found favourable to vaccination in general but not willing to be vaccinated against Covid-19. They were mainly female, young, French speaking, slightly less educated, working, and did not belong to a Covid-19 risk group. They were very dissatisfied with the government’s dealing with the pandemic, and did not know someone who was hospitalised because of Covid-19.

Conclusions: Vaccine hesitancy was higher for Covid-19 vaccines than for other vaccines. The part of the population being convinced of the utility of vaccination in general but hesitant about the Covid-19 vaccine is a primary interest group for tailored communication campaigns in order to reach the vaccine coverage needed for herd immunity.

© 2021 Elsevier Ltd. All rights reserved.

1. Introduction

After months of a global public health crisis that has paralysed our societies, safe and effective vaccines that protect against Covid-19 are becoming available [1,2]. The next crucial challenge will be to deploy these vaccines with sufficiently high vaccination coverage rates in the population so that thresholds required for herd immunity can be reached. For vaccine efficacies of approximately 80%, it has been estimated that herd immunity requires that minimally 60% but possibly up to 90% of the population become vaccinated [3,4]. Herd immunity will not just be a bonus that comes on top of individual vaccine protection; it will be an essential layer of Covid-19 prevention on which many people will depend as it

remains to be seen whether Covid-19 vaccines will be equally effective in all individuals and whether some population subgroups won’t be able to receive vaccination for medical reasons.

To rapidly achieve herd immunity, mass vaccination will be required. However, apart from the logistic challenge of reaching sufficient numbers of individuals, there is an even bigger challenge in convincing vaccine hesitant individuals to become vaccinated [5]. Vaccination has always been controversial and throughout history a part of the population has always resisted it [6]. Over the past years, researchers have observed substantial and increasing levels of vaccine hesitancy in the population, often linked to the fact that infectious diseases and their consequences are fading from public memory but also in part through misinformation propagated on the internet [7,8]. The World Health Organization (WHO) labelled vaccine hesitancy one of the top ten threats to global health in 2019, next to e.g. antimicrobial resistance or air pollution

* Corresponding author.

E-mail address: sandy.tubeuf@uclouvain.be (S. Tubeuf).

and climate change [9]. In the context of the Covid-19 vaccine, policy makers dealing with vaccine hesitancy and scepticism will be a critical success factor. Therefore, it is important that policy makers have a good view on the people profiles who are likely to refuse or delay vaccination. This will enable them to target communication campaigns and to devise vaccination strategies that take into account the clustering of susceptibility in profiles that are likely to refuse. Several population surveys have identified predictors associated with Covid-19 vaccine hesitancy. It is more likely to occur in individuals of younger age, women as well as people with lower income, lower education, lower perceived severity of Covid-19, lower Covid-19 exposure, lower trust in government, living in more disadvantaged areas or people adhering to more right-wing political views [10–14].

This paper aims to identify among a representative sample of the Belgian population the predictors associated with the willingness to become vaccinated against Covid-19 and investigate whether these coincide with predictors of attitudes toward vaccination in general.

2. Methods

2.1. Survey

We used a nationally representative panel of the market research agency Dynata to complete a survey between 6 and 16 October 2020[‡]. A sample of 2,698 respondents drawn from a panel of 5,500 selected members who mirror the Belgian population (aged 18–80 years) as well as possible[§], were invited to participate in the survey. Of these, 494 did not complete the survey and 144 were excluded because they did not meet the company's internal quality controls (e.g., they completed the survey unreasonably fast (below a third of the median time to completion)). This left us with a sample of 2,060 responses, which fulfilled pre-determined Belgium quota for age, gender and province (Appendix A). The main objective of the survey was to carry out an experiment to elicit individual preferences on who should get vaccinated first in the population; the results of the experiment are reported elsewhere [15]. In this paper we focus on two specific questions about attitudes toward vaccination. Before participants took the experiment, we asked them to answer the question “Would you say that vaccination for infectious disease is... very useful, rather useful, rather useless, very useless”. Then, at the end of the experiment, we asked the question “Once there is a safe and effective Covid-19 vaccine, will you get vaccinated?” and the four response items were “definitely”, “probably”, “probably not”, “definitely not”. The survey started by asking respondents for a range of sociodemographic characteristics along with their attitudes toward the government's dealing with the corona crisis, whether they had had Covid-19, whether someone they knew had had it, was hospitalised because of it and had died because of it. Respondents were also asked whether their profession was among the “essential professions” (i.e., those that were obliged to keep working during the first “lockdown” in March/April 2020)

[‡] Our survey was carried out almost one month before the press release from Pfizer-BioNTech successfully completing their phase III trials for a Covid-19 vaccine (9 November, 2020).

[§] The research company has a pool of 252,597 volunteers, from which it selected a standard panel of 5,500 individuals who resemble the Belgian citizens as well as possible. The company evaluates their pool of participants continuously, systematically eliminates low-quality responders and participation is rewarded with bonus points that lead to vouchers to buy certain products or make donations. Online panels are second-best in comparison with population surveys with randomly drawn participants from a census. However, we checked how our survey sample compared to national Belgium data (see Appendix A) and found that our sample was representative of Belgians for most comparable characteristics but higher educated respondents were overrepresented.

and whether they considered themselves to be part of a risk group for Covid-19 and if so, which group they belonged to (old age, chronic illness, obesity, or other). Finally, respondents were asked about whom should decide who gets the Covid-19 vaccine first (government, scientists or the population) and whether they would choose to be vaccinated themselves once a vaccine becomes available.

2.2. Data analysis

We considered willingness to get Covid-19 vaccinated as a binary variable grouping the answers “definitely” against “probably”, “probably not” and “definitely not”. We determined the factors significantly associated to this response using a multivariate logistic regression model with as dependent variable whether an individual intends to become vaccinated or still doubts or refuses to become vaccinated. We estimated adjusted and unadjusted odds ratios of willingness to be Covid-19 vaccinated using all the variables that showed significance ($p < 0.05$) in a univariate analysis. We repeated the same analysis for attitudes toward infectious disease vaccination grouping “very useful” against “rather useful”, “rather useless” and “very useless”.

We then studied the sub-sample of people who exhibited a seemingly inconsistent opinion of being pro-vaccination in general but being unwilling to take the Covid-19 vaccine once available. We used basic descriptive statistics and frequencies to describe all variables, comparing the full sample of survey data with the smaller sample of inconsistent individuals. We used chi-square tests to indicate significant differences in proportions between the two samples. We performed all analyses using the JMP Pro 16 statistical software.

3. Results

A total of $N = 2,060$ surveys were completed and checked for quality based on respondents' answers to several comment boxes. None were excluded. Overall, 34% ($N = 651$) indicated that they would “definitely” become vaccinated with a Covid-19 vaccine and 39% ($N = 742$) stated that they would “probably” become vaccinated with a Covid-19 vaccine, 18% ($N = 346$) said “probably not” and 9% ($N = 165$) said “definitely not”. The numbers of sceptical answers to Covid-19 vaccination were substantially higher than the sceptical answers to the usefulness of vaccination in general. Whereas 73% stated to be willing to become vaccinated with the Covid-19 vaccine, 90% stated to think that vaccination is useful to protect against infectious diseases. 49% ($N = 1,002$) stated that vaccination is “very useful” and 41% ($N = 848$) stated it to be “rather useful”. 7% ($N = 153$) said “rather useless” and 3% ($N = 57$) said “very useless”.

When carrying out univariate analyses, we found larger discrepancies in different age groups' willingness to be Covid-19 vaccinated compared to their attitude toward vaccination in general. While at most 12.7% of the population across all age groups found vaccination rather or very useless (See Fig. 1), Covid-19 vaccine scepticism represented between 30% and 36% among people younger than 54 years old with the largest share of sceptics in the 25–34 and 35–44 age groups (See Fig. 2). While there were fewer Covid-19 vaccine sceptics in the older age groups (20% in 55–64 and 13.3% in people above 65), these shares were still larger than the shares of people reporting vaccination in general to be useless across any age groups.

The multivariate logistic regression analyses (Table 1) revealed that factors predicting willingness to vaccinate against Covid-19 were being male (Odds Ratio (OR) = 1.53, (95% confidence interval 1.25–1.89), $p < 0.0001$), being Dutch-speaker (OR = 2.37 (1.89–

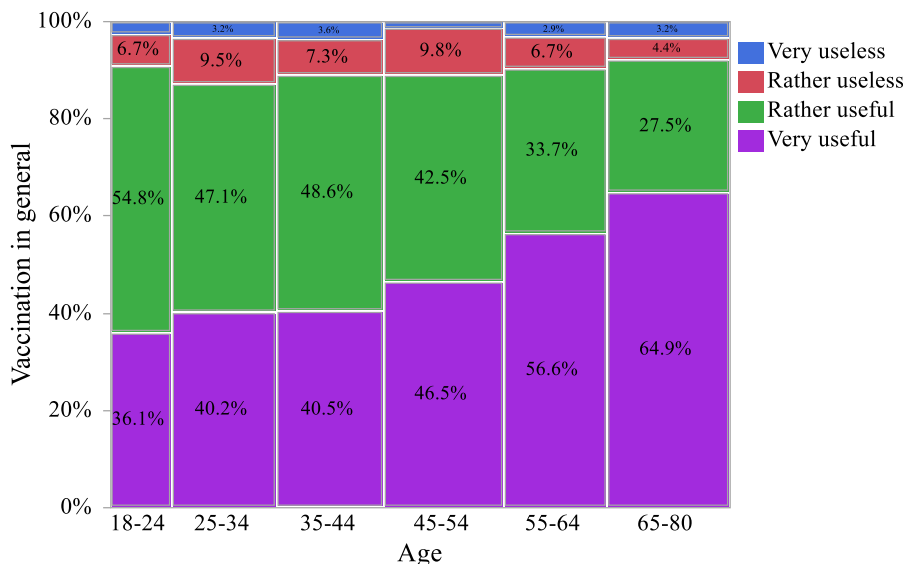


Fig. 1. Distribution of the attitudes toward the usefulness of infectious disease vaccination according to age groups.

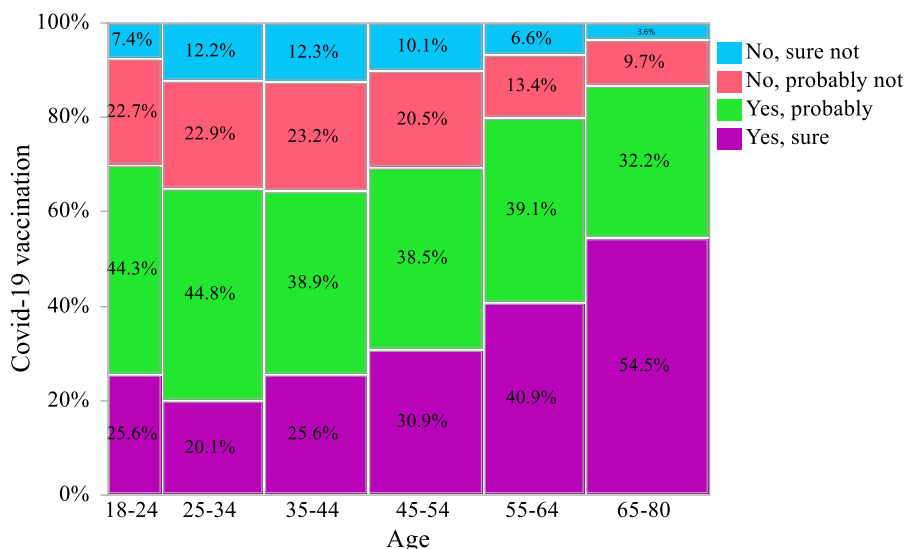


Fig. 2. Distribution of the willingness to be Covid-19 vaccinated according to age groups.

2.95), $p < 0.0001$), knowing someone who was hospitalised for Covid-19 (OR = 1.78 (1.16–2.71), $p = 0.0083$), and belonging to a medically vulnerable group (OR = 1.71 (1.35–2.17), $p < 0.0001$). The willingness to get Covid-19 vaccinated also gradually increased with age groups from age 45 when compared to the younger age category of 18–24 (45–54 OR = 1.16 (0.75–1.77), 55–64 OR = 1.72 (1.11–2.66), 65 and above OR = 2.26 (1.45–3.53), $p < 0.0001$) and with satisfaction toward the government’s response to the health crisis (satisfied OR = 2.94 (1.61–5.37), rather satisfied OR = 1.55 (1.15–2.10), rather dissatisfied OR = 1.17 (0.87–1.58), $p = 0.0003$). When asked about who should decide about priority access to the Covid-19 vaccine, people willing to get vaccinated were more likely to reply government or scientists (respectively OR = 1.58 (1.00–2.51), OR = 2.14 (1.50–3.06), $p < 0.0001$) versus the population.

The predicting factors of the willingness to get vaccinated against Covid-19 were mostly similar to the predicting factors of reporting that infectious disease vaccination is very useful as illustrated by the strong correlation with the very high odds ratio of

being both willing to take the Covid-19 vaccine and finding infectious disease vaccination very useful (OR = 16.44 (12.72–21.24)). While socioeconomic characteristics were not identified as predictors of the willingness to vaccinate against Covid-19, educational attainment is significantly and increasingly associated with positive opinion about vaccination in general (compared to basic education, secondary school OR = 1.35 (1.04–1.75), higher education OR = 1.71 (1.32–2.22), $p = 0.0002$).

While most respondents finding vaccination very or rather useful were favourable to Covid-19 vaccination (71.3%), a sample of $N = 349$ individuals (18.3%) exhibited a remarkable opinion toward vaccination (Fig. 3). They considered vaccination against infectious diseases very useful (15%, $N = 52$) or rather useful (85%, $N = 297$), but reported they would definitely not (24%, $N = 85$) or rather not (76%, $N = 264$) vaccinate against Covid-19. As these are likely to be the people in which communication campaigns about safety and effectiveness of Covid-19 vaccines are most effective, we investigated further who those people were (Table 2). Compared to the main sample, they were more likely to be women

Table 1
Unadjusted and adjusted odds ratios of willingness to get Covid-19 vaccinated and of having a non-hesitant attitude toward vaccination in general.

Characteristic	Covid-19 vaccine acceptance			General vaccine acceptance		
	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)	P-value (adjusted)	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)	P-value (adjusted)
Gender						
Male	1.55 (1.28–1.87)	1.53 (1.25–1.89)	<0.0001	1.26 (1.06–1.50)	1.32 (1.08–1.61)	0.0058
Language						
Dutch	2.33 (1.90–2.85)	2.37 (1.89–2.95)	<0.0001	1.68 (1.41–2.00)	1.54 (1.25–1.90)	<0.0001
Age						
18–24	1.00 (reference)	1.00 (reference)	<0.0001	1.00 (reference)	1.00 (reference)	<0.0001
25–34	0.73 (0.47–1.13)	0.69 (0.44–1.09)		1.19 (0.83–1.70)	1.28 (0.86–1.91)	
35–44	1.00 (0.66–1.52)	0.95 (0.61–1.47)		1.21 (0.85–1.72)	1.29 (0.86–1.93)	
45–54	1.30 (0.87–1.95)	1.16 (0.75–1.77)		1.54 (1.09–2.18)	1.59 (1.07–2.36)	
55–64	2.02 (1.35–3.03)	1.72 (1.11–2.66)		2.31 (1.62–3.30)	2.31 (1.53–3.49)	
65–80	3.48 (2.35–5.16)	2.26 (1.45–3.53)		3.27 (2.31–4.64)	2.45 (1.59–3.76)	
Education						
Basic	1.00 (reference)	1.00 (reference)	0.1705	1.00 (reference)	1.00 (reference)	0.0002
Third degree sec school	1.18 (0.93–1.51)	1.11 (0.84–1.45)		1.31 (1.05–1.64)	1.35 (1.04–1.75)	
Higher	1.09 (0.85–1.38)	1.28 (0.98–1.68)		1.52 (1.22–1.90)	1.71 (1.32–2.22)	
Have children						
Yes	1.22 (1.00–1.49)		NS	1.30 (1.09–1.56)		NS
Profession						
Working	1.00 (reference)		NS	1.00 (reference)		NS
Homemaker	0.97 (0.58–1.62)			1.05 (0.68–1.63)		
Student	0.98 (0.66–1.46)			0.76 (0.54–1.06)		
Unemployed	1.02 (0.68–1.54)			1.01 (0.70–1.44)		
Disabled	1.87 (1.27–2.76)			1.04 (0.72–1.50)		
Retired	2.93 (2.33–3.69)			2.06 (1.66–2.57)		
Profession is not 'essential'						
Yes	1.40 (1.09–1.81)		NS	1.24 (1.00–1.55)		NS
Financial difficulties						
Never	1.41 (1.08–1.86)		NS	1.84 (1.43–2.36)	1.33 (1.00–1.79)	0.1095
Once a year	1.04 (0.77–1.42)			1.27 (0.96–1.69)	1.09 (0.79–1.50)	
Once every three months	0.89 (0.65–1.23)			1.08 (0.81–1.44)	1.01 (0.73–1.39)	
Every month	1.00 (reference)			1.00 (reference)	1.00 (reference)	
Satisfaction with government's approach to Covid-19 pandemic						
Very satisfied	3.69 (2.12–6.43)	2.94 (1.61–5.37)	0.0003	5.28 (2.87–9.71)	4.14 (2.13–8.04)	<0.0001
Rather satisfied	1.66 (1.26–2.19)	1.55 (1.15–2.10)		1.74 (1.36–2.23)	1.53 (1.16–2.04)	
Rather dissatisfied	1.23 (0.94–1.63)	1.17 (0.87–1.58)		1.37 (1.07–1.75)	1.24 (0.94–1.64)	
Very dissatisfied	1.00 (reference)	1.00 (reference)		1.00 (reference)	1.00 (reference)	
Has had a Covid-19 infection						
Yes, confirmed with a test	1.34 (0.70–2.54)		NS	1.60 (0.90–2.86)	1.07 (0.56–2.05)	0.1145
Probably, but not confirmed with a test	1.00 (reference)			1.00 (reference)	1.00 (reference)	
No	1.43 (0.99–2.06)			1.47 (1.07–2.02)	1.45 (1.00–2.12)	
Know personally someone who has had Covid-19						
Yes, confirmed with a test	1.35 (0.90–2.04)		NS	1.31 (0.91–1.88)	1.13 (0.74–1.71)	0.0036
Probably, but not confirmed with a test	1.00 (reference)			1.00 (reference)	1.00 (reference)	
No	1.28 (0.90–1.82)			1.06 (0.78–1.44)	0.71 (0.49–1.04)	
Know personally someone who was hospitalised for Covid-19						
Yes	1.60 (1.09–2.35)	1.78 (1.16–2.71)	0.0083	1.04 (0.73–1.49)		NS
Know personally someone who died of Covid-19						
Yes	1.31 (0.85–2.04)		NS	1.21 (0.80–1.85)		NS
Belong to a medically vulnerable group						
Yes	2.61 (2.15–3.18)	1.71 (1.35–2.17)	<0.0001	2.34 (1.95–2.81)	1.83 (1.45–2.30)	<0.0001
Determination vaccine prioritisation						
Population	1.00 (reference)	1.00 (reference)	<0.0001	1.00 (reference)	1.00 (reference)	<0.0001
Government	2.35 (1.53–3.60)	1.58 (1.00–2.51)		2.84 (1.90–4.23)	1.94 (1.26–2.97)	
Scientists	2.30 (1.64–3.20)	2.14 (1.50–3.06)		2.84 (2.10–3.85)	2.57 (1.86–3.55)	
Covid-19 vaccine acceptance						
Yes, sure				16.44 (12.72–21.24)		
General vaccine acceptance						
Very useful	16.44 (12.72–21.24)					

Note: NS stands for “highly non-significant” (p-value > 0.2).

(p = 0.0067), younger than 54 years old (p < 0.0001), French speaking (p < 0.0001), with first or second degree secondary school (p = 0.0714), and working (p < 0.0001). They were also less likely to belong to a Covid-19 risk group (p < 0.0001), to have known someone who was hospitalised because of Covid-19 (p = 0.0314), and they were rather or very dissatisfied with the government's dealing with the Covid-19 crisis (p < 0.0001). A sample of N = 36

individuals (1.9%) presented however negative attitudes toward vaccination in general but were willing to get vaccinated against Covid-19. They would get the Covid-19 vaccine for sure (0.4%, N = 8) or probably (1.5%, N = 28), but reported they find vaccination against infectious diseases very useless (0.7%, N = 13) or rather useless (1.2%, N = 23). Compared to the main sample, they were more likely to be men (p = 0.0046) who had not had a Covid-19 infection

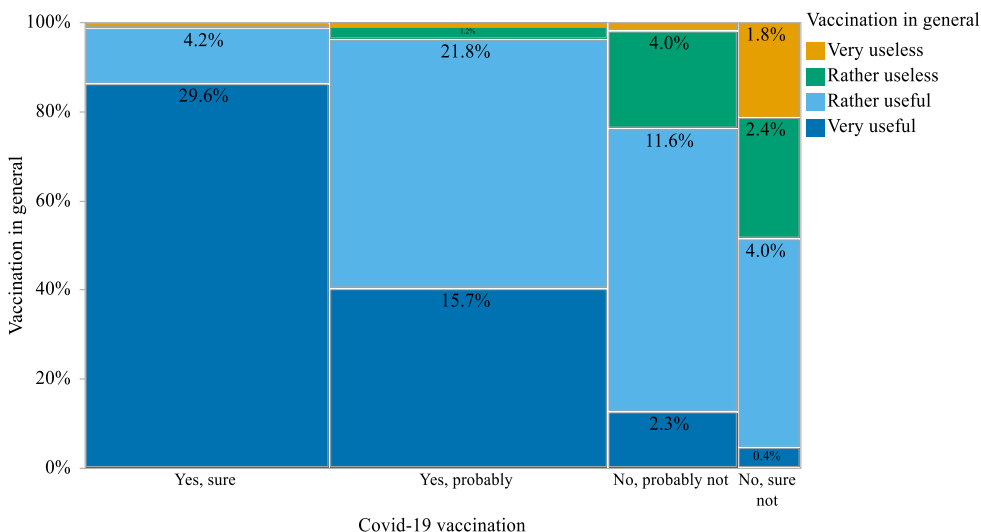


Fig. 3. Attitudes toward the usefulness of infectious disease vaccination and the willingness to be Covid-19 vaccinated.

($p = 0.0546$) or had not known someone with a Covid-19 infection ($p = 0.0463$), neither had they known someone who had been hospitalised ($p = 0.0331$) or had died ($p = 0.0710$) because of Covid-19.

4. Discussion

A majority of Belgians (73%) report that they will definitely or probably get vaccinated against Covid-19, though uptake is predicted to be lower among younger individuals, people at lower risk of severe forms of Covid-19, women, those with lower education, and those with lower trust in authorities. These characteristics have also been identified as predictors of Covid-19 vaccine hesitancy in similar studies in other countries [10–14].

According to Anderson et al. (2020) [3], if a vaccine has approximately 80% efficacy, it is between 70% and 90% of the population who needs to be vaccinated. If this is the case, the observed share of the population willing to get Covid-19 vaccinated in this representative sample may not be sufficient. However, a sample of 17% of the population was found to be in favour of vaccination in general but hesitant toward Covid-19 vaccination and so, this hesitant group may be a key factor in whether herd immunity against the coronavirus can be achieved within the population. Our study suggests that, rather than focussing on vaccine sceptics or antivaxxers who will be harder to convince that Covid-19 vaccination is necessary, communication and educational efforts should be mainly targeted at the group we identified as being pro-vaccines but doubtful about the specific Covid-19 vaccine.

A limitation of this survey is that it did not collect reasons for Covid-19 vaccine hesitancy to study further the sample of contradictory individuals who consider vaccination useful, but do not wish to get vaccinated against Covid-19. Why are people hesitant? Some of the many reasons behind vaccine hesitancy are related to the success of vaccines to eradicate diseases that used to be deadly and as a result, people focus on the perceived risks of vaccination because they are less aware of the consequences of not vaccinating [5,16]. In the context of Covid-19, we show that vaccine hesitancy may also be caused by individuals having no personal experience with people in their proximity having been critically ill or passing away as a result of Covid-19 [17] because the willingness to get vaccinated is almost twice higher when knowing someone who has been hospitalised because of Covid-19. However, there is hesitancy toward the Covid-19 vaccine

beyond a clear support for the usefulness of vaccination against infectious diseases. This Covid-19 hesitant group differs from anti-vax profiles. Their hesitancy might therefore be explained by particular concerns about the Covid-19 vaccine, e.g., that it has been developed too fast, that the full safety profile of the vaccine is not (yet) entirely understood or where it was manufactured as shown in other studies [12–14,18,19].

To conclude, our study found that a larger than usual share of the general public may prefer not to vaccinate against Covid-19 and this suggests that many feel they cannot make a fully informed vaccination decision. This calls for communication campaigns that comfort people on the safety and efficacy of Covid-19 vaccination, particularly in the hesitant subgroup that is nonetheless pro-vaccination in general.

5. Ethics committee approval

This study did not fall under the Belgian law on experiments as anonymised data collected by a third party were analysed and therefore the Social and Societal Ethics Committee (SMEC) of KU Leuven decided that no approval was needed.

Role of funding source

No funding sources to declare. Roselinde Kessels acknowledges her Elinor Ostrom research grant from Maastricht University which was used to collect part of the data. Also, she thanks the JMP Division of SAS Institute for further financial support.

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.

Acknowledgement

The authors are grateful to Xan Gregg for providing assistance with the data visualizations in JMP.

Table 2

Descriptive statistics of the full sample and the subsample of contradictory respondents who believe vaccination is useful, but who do not wish to become vaccinated against Covid-19.

Characteristic	Response item	Full sample (N = 2,060)		Subsample (N = 349)		P-value of difference ⁵
		N	%	N	%	
Respondents' general background						
Gender	Female	1055	51%	206	59%	p = 0.0067
	Male	1005	49%	143	41%	
Age	18–24	208	10%	41	12%	p < 0.0001
	25–34	346	17%	76	22%	
	35–44	358	17%	83	24%	
	45–54	400	19%	79	22%	
	55–64	341	17%	38	11%	
	65–80	407	20%	32	9%	
Language	Dutch	1174	57%	156	45%	p < 0.0001
	French	886	43%	193	55%	
Education	None	8	0%	0	0%	p = 0.0714
	Primary school	65	3%	6	2%	
	First degree secondary school	208	10%	43	12%	
	Second degree secondary school	262	13%	53	15%	
	Third degree secondary school	715	35%	120	35%	
	Higher education (non-university)	495	24%	81	23%	
	University or post-university education	278	14%	45	13%	
	PhD	21	1%	0	0%	
	Other	8	0%	1	0%	
	Have children	Yes	1283	62%	208	
No		777	38%	141	40%	
Profession	Working	1039	51%	216	62%	p < 0.0001
	Homemaker	87	4%	14	4%	
	Student	168	8%	28	8%	
	Unemployed	138	7%	30	8%	
	Disabled	131	6%	20	6%	
	Retired	497	24%	41	12%	
	Difficulties with monthly expenses	Never	847	41%	124	
Once a year	447	22%	79	23%		
Once every three months	413	20%	77	22%		
Every month	353	17%	69	20%		
Respondents' Covid-19 related background						
Self-reported membership of a Covid-19 risk group	No	1261	61%	265	76%	p < 0.0001
	Yes, elderly	384	19%	28	8%	
	Yes, chronically ill	424	21%	52	15%	
	Yes, severe obesity	133	6%	14	4%	
	Yes, other	69	3%	6	2%	
Self-reported profession is labelled as 'essential'	Yes	393	19%	74	21%	p = 0.3575
Has had a Covid-19 infection	No	1667	81%	275	79%	p = 0.4110
	Yes, confirmed with a test	64	3%	8	2%	
	Probably, but not confirmed with a test	173	8%	24	7%	
Know personally someone who has had Covid-19	No	1823	89%	317	91%	p = 0.7480
	Yes, confirmed with a test	314	15%	49	14%	
	Probably, but not confirmed with a test	187	9%	35	10%	
Know personally someone who was hospitalised for Covid-19	No	1559	76%	265	76%	p = 0.0314
	Yes	127	6%	12	3%	
Know personally someone who died of Covid-19	No	1933	94%	337	97%	p = 0.5222
	Yes	92	4%	13	4%	
	No	1968	96%	336	96%	
	Very satisfied	66	3%	2	1%	
Satisfaction with government's approach to Covid-19 pandemic	Rather satisfied	774	38%	92	26%	p < 0.0001
	Rather dissatisfied	827	40%	158	45%	
	Very dissatisfied	393	19%	97	28%	
	Determination of the vaccine prioritization strategy	Population	242	13%	58	
Government	196	10%	29	8%		
Scientists	1466	77%	262	75%		

⁵ Chi-square test to indicate significant differences in proportions between the two samples.

Appendix A. Study sample representativeness compared to overall Belgian population

Variables	Categories	Study sample	Belgian population [§]
Gender	Female	51%	51%
	Male	49%	49%
Age	18–24	10%	11%
	25–34	17%	16%
	35–44	17%	17%
	45–54	19%	18%
	55–64	17%	16%
	65–80	20%	22%
Language	Dutch	57%	60%
	French	43%	40%
Province	Vlaams-Brabant	10%	10%
	Waals-Brabant	7%	3%
	Brussels Capital	9%	10%
	Antwerpen	15%	16%
	Limburg	8%	8%
	East Flanders	13%	13%
	West Flanders	10%	11%
	Hainaut	6%	12%
	Liège	10%	10%
	Luxembourg	5%	3%
	Namur	8%	4%
Education	None or primary school	26%	34%
	Secondary school	35%	37%
	Higher education	39%	29%

[§]Source: Statbel

References

- [1] Voysey M, Clemens SAC, Madhi SA, Weckx LY, Folegatti PM, Aley PK, et al. Safety and efficacy of the ChAdOx1 nCoV-19 vaccine (AZD1222) against SARS-

- CoV-2: an interim analysis of four randomised controlled trials in Brazil, South Africa, and the UK. *Lancet* 2020;397(10269):99–111.
- [2] Polack FP, Thomas SJ, Kitchin N, Absalon J, Gurtman A, Lockhart S, et al. Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine. *N Engl J Med* 2020;383(27):2603–15.
- [3] Anderson RM, Vegvari C, Truscott J, Collyer BS. Challenges in creating herd immunity to SARS-CoV-2 infection by mass vaccination. *Lancet* 2020;396(10263):1614–6.
- [4] Altmann DM, Douek DC, Boyton RJ. What policy makers need to know about COVID-19 protective immunity. *Lancet* 2020;395(10236):1527–9.
- [5] McAteer J, Yildirim I, Chahroudi A, for the Society for Pediatric Research Advocacy C. The VACCINES Act: Deciphering Vaccine Hesitancy in the Time of COVID-19. *Clin Infect Dis* 2020;71(15):703–5.
- [6] Marshall GS. Vaccine Hesitancy, History, and Human Nature: The 2018 Stanley A. Plotkin Lecture. *J Pediatric Infect Dis Soc* 2019;8(1):1–8.
- [7] Horne Z, Powell D, Hummel JE, Holyoak KJ. Countering antivaccination attitudes. *Proc Natl Acad Sci* 2015;112(33):10321–4.
- [8] Luyten J, Bruyneel L, van Hoek AJ. Assessing vaccine hesitancy in the UK population using a generalized vaccine hesitancy survey instrument. *Vaccine* 2019;37(18):2494–501.
- [9] WHO. Ten threats to global health in 2019; 2018 [
- [10] Edwards B, Biddle N, Gray M, Sallis K. COVID-19 vaccine hesitancy and resistance: Correlates in a nationally representative longitudinal survey of the Australian population. *PLoS ONE* 2021;16(3):e0248892.
- [11] Freeman D, Loe BS, Chadwick A, Vaccari C, Waite F, Rosebrock L, et al. COVID-19 vaccine hesitancy in the UK: the Oxford coronavirus explanations, attitudes, and narratives survey (Oceans) II. *Psychol Med* 2020;1–15.
- [12] Khubchandani J, Sharma S, Price JH, Wiblishauser MJ, Sharma M, Webb FJ. COVID-19 Vaccination Hesitancy in the United States: A Rapid National Assessment. *J Commun Health* 2021;46(2):270–7.
- [13] McCabe SD, Hammershaimb EA, Cheng D, Shi A, Shyr D, Shen S, et al. Unraveling Attributes of COVID-19 Vaccine Hesitancy in the U.S.: A Large Nationwide Study. *medRxiv* 2021.
- [14] Schwarzing M, Watson V, Arwidson P, Alla F, Luchini S. COVID-19 vaccine hesitancy in a representative working-age population in France: a survey experiment based on vaccine characteristics. *Lancet Public Health* 2021;6(4):e210–21.
- [15] Luyten J, Tubeuf S, Kessels R. Who should get it first? Public preferences for distributing a COVID-19 vaccine. *CEPR Covid Econ* 2020;57:1–19.
- [16] Luyten J, Desmet P, Dorgali V, Hens N, Beutels P. Kicking against the pricks: vaccine sceptics have a different social orientation. *Eur J Public Health* 2014;24(2):310–4.
- [17] Davies C. Imperial Bioscience Review [Internet]. London; 2020. Available from: <https://imperialbiosciencereview.com/2020/11/20/how-do-we-tackle-vaccine-hesitancy-and-effectively-communicate-vaccine-safety-to-the-general-public-in-the-covid-19-era/>
- [18] Neumann-Böhme S, Varghese NE, Sabat I, Barros PP, Brouwer W, van Exel J, et al. Once we have it, will we use it? A European survey on willingness to be vaccinated against COVID-19. *Eur J Health Econ* 2020;21(7):977–82.
- [19] Emanuel EJ, Persad G, Upshur R, Thome B, Parker M, Glickman A, et al. Fair Allocation of Scarce Medical Resources in the Time of Covid-19. *N Engl J Med* 2020;382(21):2049–55.