RESEARCH LUXEMBOURG CoVaLux

CoVaLux Research Question 3:

Which Demographic and Socio-economic Factors are Associated with Vaccination Willingness and Beliefs Towards Vaccination?

Rapid report with first results

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Deliverable of:

CoVaLux WP 4: Socio-economic determinants of long COVID and vaccination, and economic consequences with focus on labour market and health care

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General description of the CoVaLux WP4

In the framework of the newly granted CoVaLux project on vaccination and long COVID, our project "*Socio-economic determinants of long COVID and vaccination, and economic consequences with focus on labour market and health care*" aims to triangulate evidence from different data sources such as social security and general population data, the national cohort CON-VINCE as well as national health surveys. We seek to arrive at robust assessments of how socio-economic determinants shape vaccination willingness, occurrence, severity and persistence of long COVID, and economic consequences of long COVID in Luxembourg.

As a first project objective (**PO1**), we will quantify the socio-economic patterning of long COVID and will address the following questions:

- What is the long COVID prevalence along socio-economic gradients in asymptomatic, mild and moderate COVID-19 patients?
- Can we identify socio-economic profiles of vulnerable persons to offer them treatment options as soon as they are available?

We will focus on adults at large, adults aged 75+ years, adolescents (12-17 years of age), and children (5-11 years). Possibly over the course of the project younger children will also be put in focus.

As a second project objective (**PO2**), we will investigate the impact of long COVID on work ability, healthcare, and long-term care costs and will address the following questions:

- What are the immediate economic and healthcare costs associated with long COVID, with a focus on labour market and healthcare costs?
- What are the economic consequences for long COVID patients, with focus on foregone working time and possibly earnings as well as healthcare-related costs?

As a third project objective (**PO3**, so-called RQ3 in the CoVaLux), we will analyse the demographic and socio-economic determinants associated with the COVID-19 vaccination:

> *Which demographic and socio-economic factors are associated with vaccination willingness and beliefs towards vaccination?*

We will investigate vaccination willingness and beliefs towards vaccination both in the general population (Part 1). For this report, we have focused on CON-VINCE data, which is representative of adults 18-79 years, with particularly good coverage of the native population born in Luxembourg (Snoeck et al., 2020). Over the course of the project, we will also investigate patterns in adults aged 75+ years, adolescents (12-17 years of age), children (5-11 years) and different migrant groups with registry (IGSS) data.

Further, we will investigate vaccination willingness and beliefs in different migrant communities living in Luxembourg, which make up a considerable amount (47.2 %) of the Luxembourg population (Statec, 2021; Part 2). Some migrant communities living in Luxembourg have been found to show different, in some cases less favourable, socioeconomic and health profiles compared to the native population. For this rapid report, we have started the exploration of migrant communities' beliefs towards vaccination in members of the ex-Yugoslavian community living in

Luxembourg (Part 2a). To gain insights specific to this aim, we conducted a qualitative analysis of interviews and social media content.

This rapid report with first intermediate results will address

- Socio-demographic and socio-economic determinants of vaccination willingness and beliefs towards vaccination with data from CON-VINCE (Part 1), and
- Vaccination willingness and beliefs towards vaccination in members from the ex-Yugoslavian community living in Luxembourg (Part 2a).

Part 1: Vaccination willingness of the general population

Background

There is still a substantial risk of another wave of COVID-19 infections during the upcoming winter months, which may lead to hospitals being at full capacity, not to mention the significant short- and long-term health burden and possible mortality with or from COVID-19. While COVID-19 vaccination uptake in many European countries has been rather satisfying, the rates of vaccination uptake in Luxembourg are not yet at a point where the pandemic seems fully under control, and does not yet allow to fully return back to 'normal'.

At the time of writing (2021-11-08), statistics from the European Centre for Disease Prevention and Control (ECDC, November 2021) show that **64.9%** of the Luxembourg population are **fully vaccinated**. Older adults (80+ years) are the age groups with the highest vaccination rates (**88.9%**), followed by the 70-79 years, 60-69 years and 50-59 years old population (86.0%, 85.1% respectively 82.7%). In the younger age groups from 25-49 years and 18-24 years, the vaccination rates are lower (70.0% respectively 62.1%). Children (age group <18 years) have the lowest vaccination rate with only 20.2%.

At the time of writing (2021-11-08), statistics from the European Centre for Disease Prevention and Control (ECDC, November 2021) show that only **67.8%** of the Luxembourg population **have at least one vaccine dose**, a percentage still below the EU/EEA average (69.2%). Older adults (80+ years) are the age group with the highest partial vaccination rates (90.6%), followed by the 70-79 years, 60-69 years and 50-59 years old population (87.3%, 86.4% respectively 84.5%). In the younger age groups from 25-49 years and 18-24 years, the partial vaccination rates are lower (73.4% respectively 67.0%). Children (age group <18 years) have the lowest vaccination rate with only 23.9%.

The existing surveys on the topic suggested a higher vaccination uptake – the 'COME-HERE' study mentions a rate of 14.5% of vaccine reluctant participants in their Luxembourg sample ("Are you vaccinated yet?" "No, and I don't plan to") and 22% who were not vaccinated yet ("Not yet, but I plan to") in June 2021 (D'Ambrosio et al., 2021).

Reported vaccination willingness of these surveys and the actual vaccination uptake indeed differ. By now, everyone who wanted to be vaccinated had the chance to do so through a number of different measures. It is thus advised to further investigate the determinants of vaccination and vaccination willingness, and the reasons for vaccination reluctance. Our focus is, over the course

of the project, on the population groups with higher rates of vaccination reluctance and their beliefs towards vaccination.

It is recommended to also look into the reported reasons for vaccination, as they may help in targeting and tailoring outreach efforts to those population groups that are still hesitant or reluctant, and framing public health communication in a way that encourages vaccination hesitant or reluctant individuals to reconsider.

As a general framework, the ECDC recommends adopting the '5Cs' model – Confidence, Constraints, Complacency, Calculation, and Collective responsibility – to understand vaccination willingness and vaccination reluctance (ECDC, 2021). Confidence relates to trust, constraints summarizes different aspects related to (in)convenience like affordability, geographical accessibility etc., complacency relates to individual perceptions of the risk of the disease, calculation summarizes the "individual risk-benefit analysis about whether or not to be vaccinated", and collective responsibility relates to prosocial or altruistic motivations to get vaccinated out of concerns of others' physical health and well-being (ECDC, 2021).

In this report of first intermediate results, we will present evidence based on the CON-VINCE visits (follow-ups) 5 and 6 where data linked to the vaccine willingness and hesitancy was collected in March and from April to June 2021, respectively (exact questions asked to the CON-VINCE participants can be found in the annex of this report).

Method

Data

For this report, we analysed COVID-19 vaccination reluctance and the beliefs towards vaccination with a population-representative national sample, the CON-VINCE cohort (currently transitioning into the H2020-funded international ORCHESTRA project). Here we have a representative coverage of Luxembourg citizens in working age and a wide age range (18-79 years), with a lower share of migrants than in the full population though. For more details on the very high quality of this sample, see Snoeck et al. (2020).

As soon as data are available mid-December 2021, we will complement the analyses based on CON-VINCE with the mid-2021 wave of the national Youth Survey (YAC+) that samples individuals in adolescence and young adulthood. This is a sample with a younger age range and may bring new insights to vaccination reluctance of the age group with currently lowest vaccination uptake.

In the future, we will also rely on data from the national repeated health survey and further waves of CON-VINCE/ORCHESTRA to understand vaccination uptake in more detail. At time of writing, a total of 1237 participants from CON-VINCE have already agreed to continue their participation within ORCHESTRA Luxembourg. ORCHESTRA will ask vaccination reluctant individuals which incentives could increase vaccination uptake. Furthermore, the uptake of and reasons for reluctance towards booster shots to increase immunity levels will be monitored as well.

Further data to be used over the course of the project

Population data currently requested from IGSS will be analysed to understand the 'status quo' of vaccination (partial and full) of different socioeconomic groups as an indicator of vaccination

willingness in Luxembourg. This may bring new insights as population-based surveys (such as CON-VINCE and YAC+) are usually not able to reflect attitudes and behaviours of the hard-to-reach population groups, such as migrants and individuals with highly disadvantaged socioeconomic background. With IGSS data, we will focus on (a) **migrant groups' vaccination status**, investigating different migrant communities, and (b) **vaccination of vulnerable groups** (individuals treated for chronic conditions, at advanced older ages) and (c) **professional groups** more likely to be involved in multiple social contacts carrying out their job (teachers, service personnel).

Over the course of the project, IGSS data will further be used in the CoVaLux WP4 to (1) assess vaccination uptake of 12- to 17-years-olds, and as soon as vaccination for younger kids is approved, vaccination uptake of 5- to 11-year-olds, (2) determine socioeconomic profiles of individuals who had tested positive for COVID-19 and who are treated for a condition related to long COVID, (3) determine extent and duration of work absences or reduced working hours, forgone wages, healthcare costs of (a) individuals with confirmed diagnosis linked to COVID-19, and (b) of individuals who had tested positive for COVID-19 compared to individuals who had not tested positive for COVID-19, to estimate economic consequences of possibly undiagnosed/undetected long COVID.

Variables

Outcome measures

Question on vaccination willingness: Respondents received the question "Will you agree to get vaccinated against COVID-19 when it is your turn?" We categorized the responses "rather likely" or "very likely" to indicate vaccination willingness, the response "I don't know yet" to indicate undecidedness, and the responses "rather unlikely" or "very unlikely" to indicate vaccination reluctance.

Beliefs towards vaccination were assessed with questions developed in the Research Luxembourg team[1], and a questionnaire we adopted based on insights from a qualitative study by Dodd et al. (2021). CON-VINCE assessed both beliefs towards vaccination of individuals willing to receive the COVID-19 vaccine and reasons for vaccination reluctance. Both will be important to shape public health efforts.

Sociodemographic and socio-economic determinants

To assess <u>educational status</u>, we asked for the years of schooling that have been successfully accomplished. Furthermore, the respondents received the question: "What is your educational degree? Please choose the highest degree achieved". The responses were categorized to "no formal degree", "fundamental education", "secondary education - classical system", "secondary education - technical system", "university degree: Bachelor", "university degree: Master or above", "other type of degree".

<u>Income</u> was assessed in brackets as household gross annual income, with the categories less than 50,000 EUR, 50,000 to 100,000 EUR, 100,000 to 150,00 EUR and more than 150,000 EUR.

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[1] Thanks to Sabine Schmitz and Jhemp Bertemes who participated in this exercise.

Furthermore, the respondents were asked to indicate the type of their household and if they own the home they live in.

What is your household gross annual income?

Normal

1	0 - 25 000 Euros
2	25 001 - 50 000 Euros
3	50 001 - 75 000 Euros
4	75 001 - 100 000 Euros
5	100 001 - 150 000 Euros
6	More than 150 000 Euros
7	No answer

Age was used as continuous variable in logistic regressions and, in the analyses on beliefs towards vaccination, regrouped into 10-year categories summarising participants above the age of 60 into one group, first because of a small number of respondents in this age range, and second due to a very high vaccination uptake of this sample at the time of the CON-VINCE follow-ups.

Strategy of data analysis

For this report, we used descriptive statistics to show frequencies and percentages, and logistic regressions to identify important determinants of vaccination willingness and the variance explained by these determinants.

A word on the general strategy of data analysis. Socio-economic determinants of health (education, occupation, income, home ownership, wealth) are intertwined and, through multiple pathways, influencing living conditions, lifestyle, and (directly or ultimately) health outcomes. When investigating the role of education or occupation, there is little sense in controlling out 'confounders' such as treatment for chronic conditions, unhealthy lifestyle (smoking, alcohol consumption etc.), housing conditions or family structure, since these factors are themselves influenced by the socio-economic determinants of interest. Indeed, this thinking reflects wide scientific consensus in the research field on the social determinants of health (to mention just a few researchers: Sir Michael Marmot, Clare Bambra, Thomas Abel, Bruce Link, Sandro Galea, Johan Mackenbach, and Maria Glymour). We aim at unravelling those determinants of vaccination uptake that are most clearly pointing to possible public health interventions towards certain social groups. These interventions could mean providing incentives, reaching individuals directly in their neighbourhoods and work environments, or other measures.

Results

Vaccination status and vaccination willingness/reluctance

A total of 1,714 CON-VINCE respondents participated in follow-up 5 (March 2021) and 1,589 respondents participated in follow-up 6 (April-June 2021).

At the most recent follow-up 6, a total of 555 (34.9%) of the participants were partially, and a further 271 (17.1%) were fully vaccinated, summing up to half of the respondents having received at least partial vaccination at time of assessment.

Strength of vaccination reluctance

To maximize sample size that allows sub-analyses by socioeconomic indicators, participants were assessed regarding vaccination willingness at a time they were not vaccinated yet, or at the time they were last assessed. This resulted in 800 respondents at visit 5 and 760 respondents at visit 6. Other research foci may result in a different setting up of the data.

In this sample of not yet vaccinated participants at both follow-ups, vaccination willingness was rather high (*rather likely* or *very likely*: N=1,354, 86.8%). A total of 105 (6.7%) participants *did not know yet* if they would get vaccinated when it was their turn. A total of 38 (2.4%) reported that it was *rather unlikely*, and a total of 63 (4.0%) reported it to be *very unlikely* for them to get vaccinated when it was their turn.

Sex/gender differences

While at follow-up 5, there was a slightly higher rate of women (4.7%) vaccinated fully compared to men (2.6%), at follow-up 6 a significantly higher share of men (38.1%) had already been vaccinated with the first shot compared to women (31.7%). There were no sex/gender differences in full vaccination at follow-up 6. Through visual inspection of the agreement rates, men and women reported similar reasons for willingness to get vaccinated. In those undecided or reluctant, a slightly higher share of women reported beliefs related to anxiety (e.g., 'afraid of possible side effects'), while a higher share of men reported they felt not well enough informed. Due to the absence of strong sex/gender differences, we pooled men and women in the analyses on beliefs towards vaccination.

Differences by educational level

There was no educational gradient in the rate of those who had received full vaccination although, in tertiary education, partial vaccination rates were lower compared to upper secondary education. For those not vaccinated yet however, vaccination reluctance was determined by educational status. At the follow-up 6, of those not vaccinated yet, particularly those with upper secondary educational levels were most likely to be vaccination hesitant or reluctant, especially in the age groups below 50 (30-39 years: 18.0%, 40-49: 13.1%, 50-59: 10.7%, 60-69: 10.2%).

Education	18-29	30-39	40-49	50-59	60-69
up to lower secondary	3 (1.5 %)	5 (2.4 %)	5 (2.4 %)	1 (0.5 %)	NA
upper secondary	20 (9.7 %)	37 (18.0 %)	27 (13.1 %)	22 (10.7 %)	21 (10.2 %)
tertiary	3 (1.5 %)	21 (10.2 %)	24 (11.7 %)	11 (5.3 %)	6 (2.9 %)

Table 1. Total number and percentage of participants undecided or reluctant regarding vaccination by educational status and age group. Hesitancy/reluctance was operationalized as willingness to get vaccinated reported as very unlikely, rather unlikely or not known yet.

Beliefs towards vaccination in those not vaccinated yet

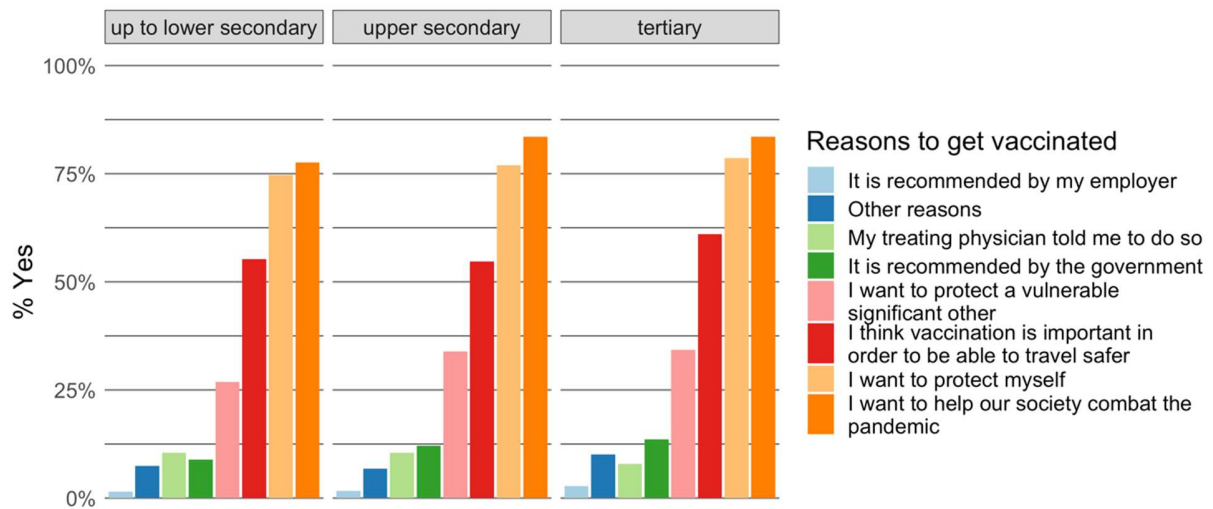### Beliefs towards vaccination of those willing to be vaccinated

To remind the reader, a large majority of participants reported that it was *rather likely* or *very likely* for them to get vaccinated when it was their turn. In the following analyses, those participants who

participated in both follow-ups (visit 5 and 6) were sorted in descending order, and the first response (in most cases thus the response at visit 6) was analysed to maximize sample size.

Figure 1. Reasons for vaccination of those willing to be vaccinated

    a. overall

    b. by age group

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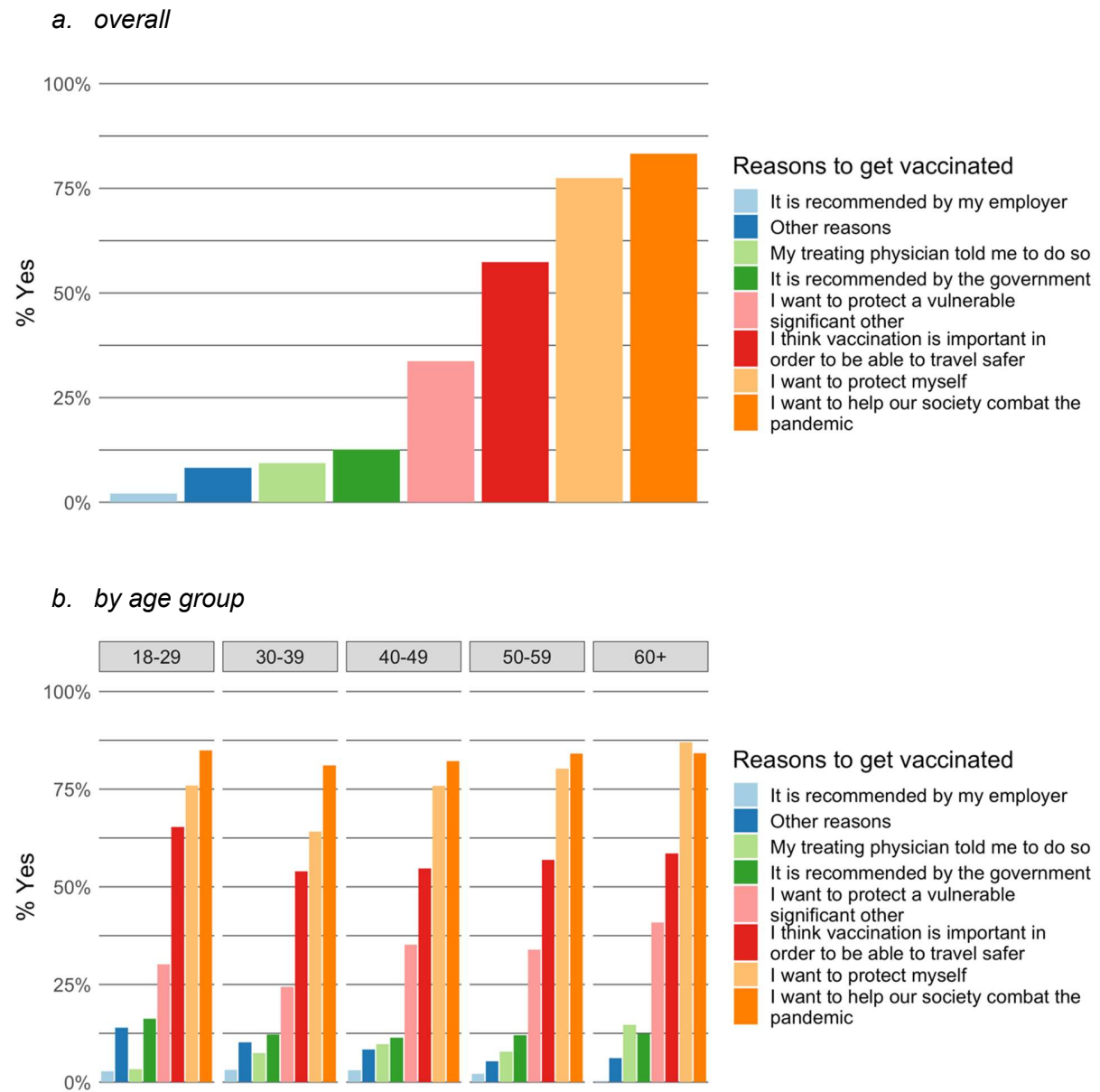
c. by educational level

Of those willing to be vaccinated, a total of 1,172 (85.6%) of participants reported to get vaccinated either to protect a vulnerable family member (n=473 [34.6%]), or to help society combat the pandemic (1121 [81.9%]).

In higher age groups, vaccination reluctance was increasingly unlikely, and all respondents belonging to the age group 80+ (*n*=12) were vaccinated.

Investigating parental status in more detail, a total of 39 (9.2%) respondents with under-age children (0-14 years of age) in the household did not know if they would get vaccinated when it was their turn, a total of 11 (2.6%) reported it was *rather unlikely*, and a total of 20 (4.7%) reported it to be *very unlikely* to be vaccinated.

To see the importance of the different socioeconomic determinants in context, we carried out two logistic regressions, first only considering sex, age, and follow up visit, then also education, income, country of origin and presence of children (0-14 years of age) and adults (70 years and older) in the household.

Table 2. Socioeconomic determinants of low vaccination willingness (hesitancy or reluctance).

a. Total explained variance

Model	McFadden's pseudo r-squared	Cragg & Uhler's pseudo r-squared
1	0.04	0.06
2	0.09	0.13

b. Results from logistic regressions on combined vaccination hesitancy ("don't know") and reluctance ("rather unlikely" or "very unlikely")

Model	Variable	OR	P Value	Lower CI	Upper CI
1	(Intercept)	0.13	0.00	0.06	0.27
	Age	0.99	0.09	0.98	1.00
	Sex				
	Male	Reference			
	Female	1.39	0.03	1.03	1.89
	Follow-up				
	Visit 5	Reference			
	Visit 6	2.27	0.00	1.59	3.28
2	(Intercept)	0.05	0.00	0.01	0.19
	Age	0.98	0.03	0.96	1.00
	Sex				
	Male	Reference			
	Female	1.18	0.36	0.83	1.67
	Follow-up				
	Visit 5	Reference			
	Visit 6	2.43	0.00	1.61	3.72
	Education				
	Up to Lower Secondary	Reference			
	Upper Secondary	1.47	0.38	0.66	3.76
	Tertiary	0.93	0.87	0.39	2.47
	Income				
	Greater 150,000	Reference			
	Up to 50,000	3.95	0.00	1.77	9.42
	50,000 to 100,000	3.18	0.00	1.62	6.85
	100,000 to 150,000	2.91	0.00	1.47	6.32
	Country of Origin				
	Luxembourg	Reference			
	Other	1.43	0.07	0.96	2.10
	Marital Status				
	Married/Partnership	Reference			
	Single	0.92	0.74	0.54	1.52
	Divorced/Widowed/other	2.24	0.00	1.38	3.60
	Living with Child (0-14)				
	No	Reference			
	Yes	1.10	0.65	0.73	1.65
	Living with Adults (70+)				
	No	Reference			
	Yes	0.49	0.50	0.03	2.50

From the logistic regressions (Table 2), gender differences from the bivariate analyses were no more significant. Participants interviewed at follow-up visit 6 were at higher odds for vaccination hesitancy or reluctance. Only in model 2, younger participants were more likely to be vaccination hesitant or reluctant.

There was no statistically significant relation found for education. With income greater than 150,000€ set as reference, ordered income categories showed strongly increasing odds for vaccination reluctance or undecidedness with decreasing income, indicating 4 times higher odds

of vaccination hesitancy and reluctance for incomes below 50,000€. Respondents with a country of origin other than Luxembourg were more likely to be vaccination reluctant or undecided, however distributions in this highly heterogeneous and selective group of migrants from EU- and non-EU countries varied significantly. For marital status there were no higher odds found for singles, but for divorced, widowed or participants with other marital status compared to married participants or participants living in a registered relationship. Living with an underage child (0-14 years of age) did not reach significance anymore contrary to the bivariate findings. Similarly, living with adults (70 years and older) was associated with lower odds for vaccination hesitancy or reluctance.

Pseudo R squared estimates following McFadden's and Cragg & Uhler's approaches indicated greater predictive abilities for model 2 which included the socioeconomic indicators (model 1 just included sociodemographic indicators). These increases in explained variance mean that income was able to explain the variation in vaccination hesitancy and reluctance. Income thus was a strong social determinant of vaccination hesitancy and reluctance.

Beliefs towards vaccination of those undecided or reluctant to be vaccinated

Reasons against vaccination for those undecided to be vaccinated were determined to some extent by age group and by educational group (Figure 2).

Figure 2. Reasons against vaccination for those undecided to be vaccinated
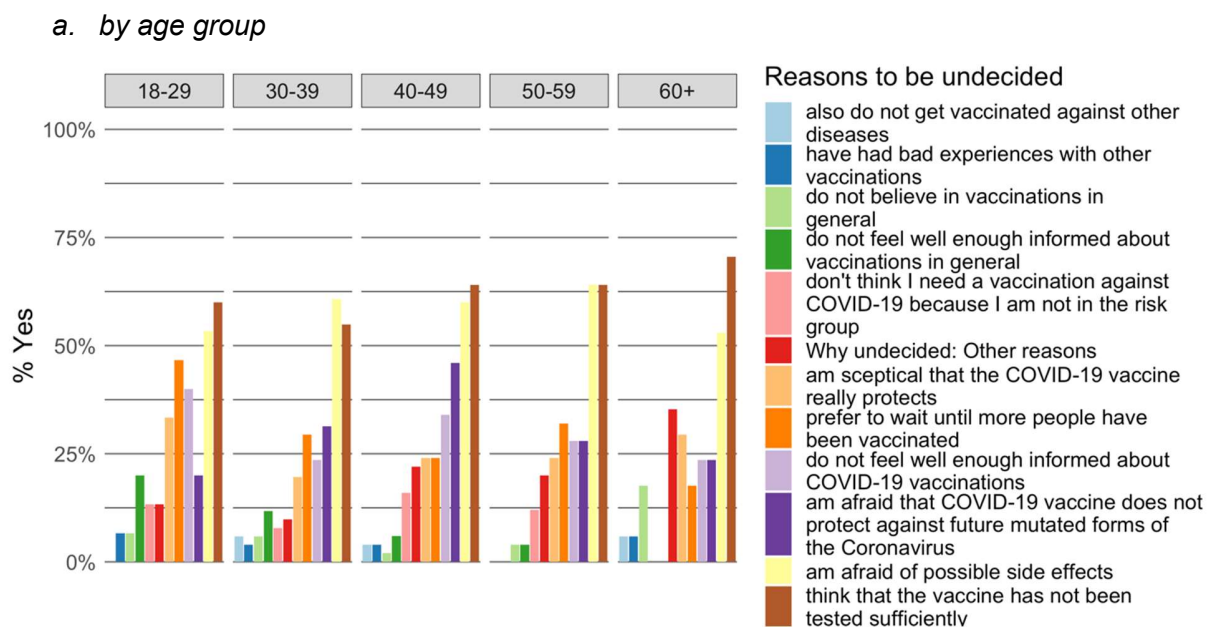
   a. by age group

Note. Due to few cases in the age groups 60-69 and 70-79, these numbers should be looked at with caution.
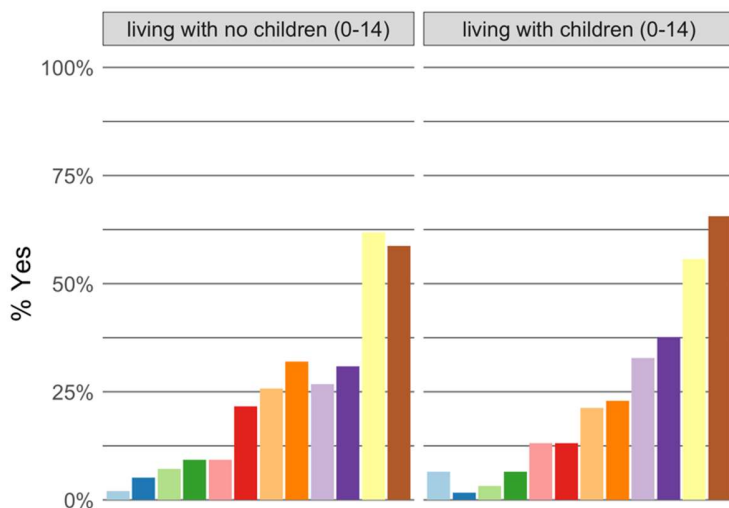
*b. by educational level*

Reasons to be undecided
- also do not get vaccinated against other diseases
- have had bad experiences with other vaccinations
- do not believe in vaccinations in general
- do not feel well enough informed about vaccinations in general
- don't think I need a vaccination against COVID-19 because I am not in the risk group
- Why undecided: Other reasons
- am sceptical that the COVID-19 vaccine really protects
- prefer to wait until more people have been vaccinated
- do not feel well enough informed about COVID-19 vaccinations
- am afraid that COVID-19 vaccine does not protect against future mutated forms of the Coronavirus
- am afraid of possible side effects
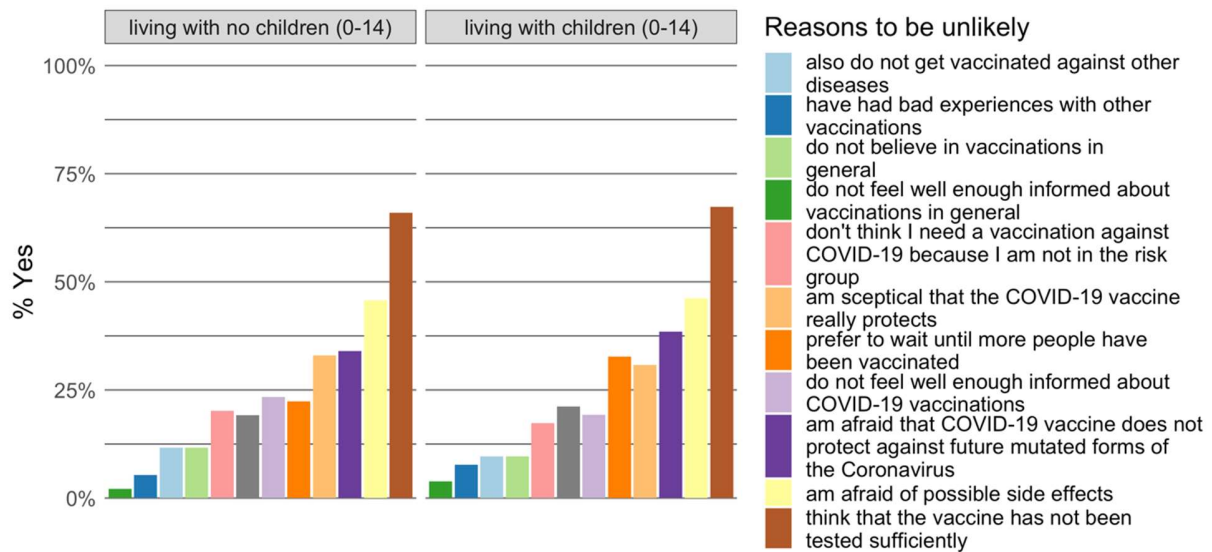- think that the vaccine has not been tested sufficiently

c. by presence of children in the household

Reasons to be undecided
- also do not get vaccinated against other diseases
- have had bad experiences with other vaccinations
- do not believe in vaccinations in general
- do not feel well enough informed about vaccinations in general
- don't think I need a vaccination against COVID-19 because I am not in the risk group
- Why undecided: Other reasons
- am sceptical that the COVID-19 vaccine really protects
- prefer to wait until more people have been vaccinated
- do not feel well enough informed about COVID-19 vaccinations
- am afraid that COVID-19 vaccine does not protect against future mutated forms of the Coronavirus
- am afraid of possible side effects
- think that the vaccine has not been tested sufficiently

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Figure 3. Reasons for respondents with vaccination reluctance.
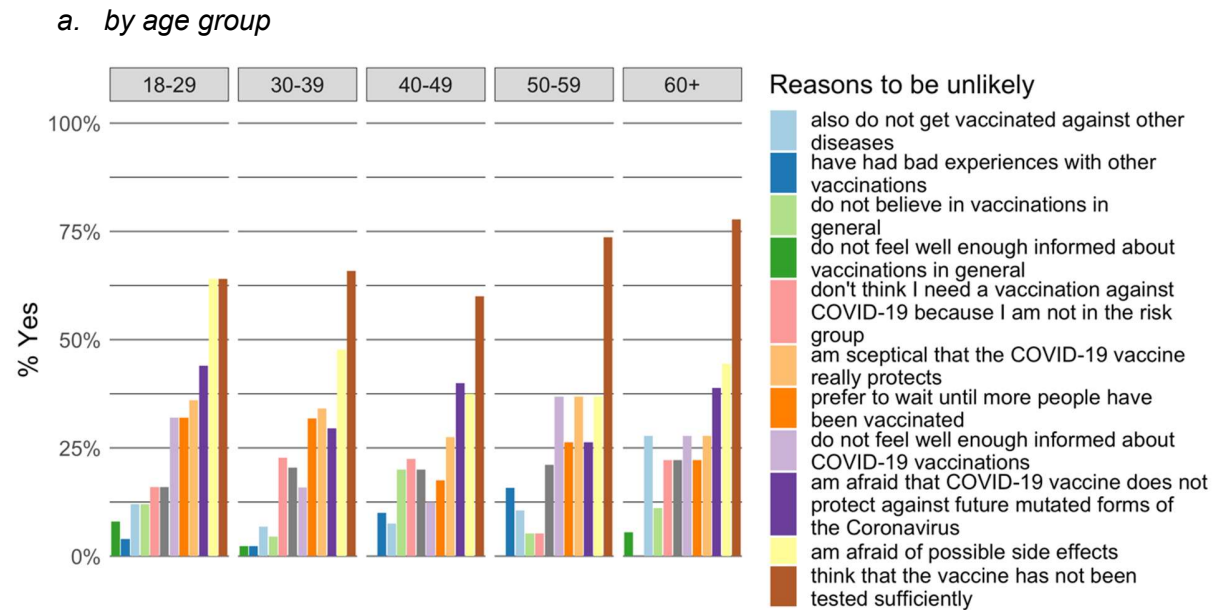
  a. *by age group*

Note. Due to few cases in the age groups 60-69 and 70-79, these numbers should be looked at with caution.

  b. *by educational level*

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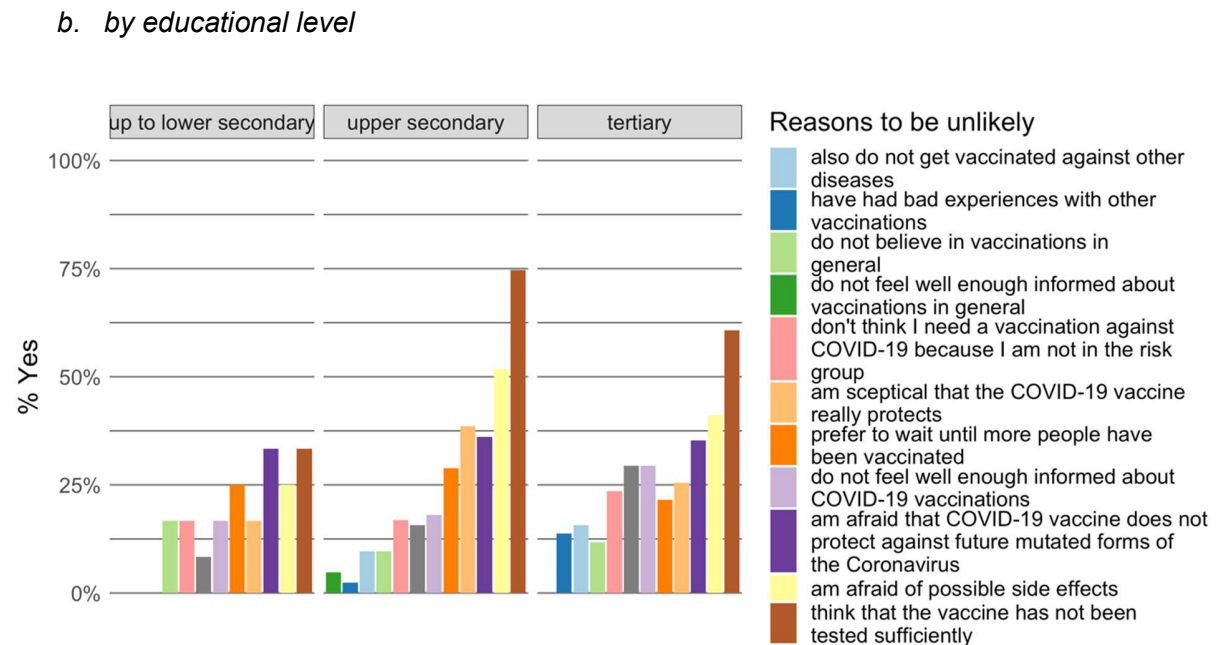
c. by presence of children in the household

Discussion

Vaccination status and vaccination willingness/reluctance

The CON-VINCE study assessed vaccination willingness in spring 2021, at a time when vaccines were still prioritized to certain professional groups and people at older ages. The sample, while at follow-up 6 close to half of the participants had received at least partial vaccination, showed high vaccination willingness (86.8%), comparable with vaccination willingness of other surveys conducted at the time.

Indeed, only 13.1% were *hesitant* or *reluctant to be vaccinated*. At the time of writing, virtually everyone willing and able to be vaccinated with one of the approved vaccines has been given the opportunity by the Luxembourg Government (Luxembourg Government, 2021), however, vaccination uptake is lower than what the CON-VINCE and other surveys at the time suggested. This discrepancy of the population-based figures with actual vaccination uptake at the time of writing may partly be due to the sample composition, with a higher share of respondents in the healthcare sector, and partly due to selective enrolment, a phenomenon which is ubiquitous in population-based surveys. By triangulating these findings with evidence from registry (IGSS) data, we will be able to draw conclusions about the population shares less well represented in population-based surveys, which is why we will analyse the sociodemographic and socioeconomic determinants of vaccination uptake of the full population with registry (IGSS) data.

Those willing to be vaccinated reported high agreement with prosocial and altruistic motivations, willingness to get vaccinated out of concern for the health and well-being of others. A very high share of those willing to be vaccinated did this to protect a vulnerable significant other or help society combat the pandemic (85.6% in total agreed with at least one of these reasons). More ego-centric – nonetheless valid – reasons like protecting oneself or getting vaccinated to travel safer also received high rates of agreement (75% and over 50%, respectively). Altruistic

motivations of those willing to be vaccinated could be helpful in public health messages, as it could evoke a sense of collective responsibility to care for each other. According to previous findings, messages targeting altruism can have a positive impact on vaccination intentions (Cucciniello et al., 2021).

Results from logistic regressions indicated that participants were more likely to be vaccine hesitant or reluctant at visit 6 compared to visit 5. While we cannot fully explain this finding to date, it may be the case that news (or fake news) about vaccine side effects which were in the media at the time may have led some participants to reconsider or modify their opinion (those "rather likely" to get vaccinated may have become "undecided" at the next follow-up). Regressions showed further that the likelihood of being vaccination hesitant or reluctant did not vary significantly by age and gender, which is why we would put less emphasis on targeting individuals by age or gender based on these findings. However, due to low vaccination uptake of the younger age groups from vaccine tracker data (ECDC, November 2021), younger individuals should be targeted more directly.

Country of origin other than Luxembourg and being divorced, widowed or having a marital status other than married or living in a registered relationship were associated with higher likelihood of being vaccination hesitant or reluctant. However, the group sizes for these groups were small and need further investigation to consolidate these findings. There were tendencies for living with underage children or adults above the age of 70 to affect vaccination reluctance; these factors were not significant but the explained variance increased. Results suggest higher reluctance when living with children and lower reluctance when living with older adults indicating that members were putting different weight on their own vaccination status based on the (correct) risk perceptions of the severity of COVID-19 for the family members with respect to age. Further, respondents with children in the household reported to be afraid of side effects, and we speculate that side effects were (rightly) considered to be interfering with work and family duties.

On a technical note, higher likelihood of vaccination hesitancy or reluctance were found at the visit (follow-up) 6. One potential explanation might be that participants who wanted to get vaccinated already had received a vaccination before visit 6, which decreased the sample of willing-but-not-yet-vaccinated respondents. Further intra-individual changes may have occurred due to media reports on side effects of different vaccines at the time. Despite trends in beliefs towards vaccination and vaccination rates by education, no such trend was found in vaccination willingness indicating that income might be the main driver of these associations. The income gradient with less income indicating higher likelihood of vaccination hesitancy or reluctance indicates lower socioeconomic standing related with health outcomes – a finding contributing to the classic social determinants of health literature. Indeed, income was found to affect vaccination willingness independently of educational level.

We observed patterning of beliefs towards vaccination by age group and by educational level, which we will outline further below.

Of those vaccination-hesitant or -reluctant, very few reported that they didn't get vaccinations against other diseases or that they did not believe in vaccinations in general. This is encouraging, as the proportion of so-called anti-vaxxers – whose opinion may be hard to change – was low in this sample.

There was a slightly higher vaccination hesitancy or reluctance of those with under-age children in the household, however beliefs towards vaccination were quite similar among the two groups.

Vaccination hesitancy (Undecidedness)

Of those undecided to get vaccinated, the reasons for them being undecided are most interesting to be investigated in more detail, as they can probably be convinced to be vaccinated with increased outreach efforts and possibly incentives.

Further, as currently the youngest age groups in adolescence and early adulthood have lowest shares of vaccination uptake according to ECDC data (November 2021), and lower-educated respondents had higher vaccination undecidedness and reluctance, we will focus the discussion on these two sociodemographic groups.

Role of age

Of those undecided to get vaccinated, all age groups unequivocally reported that they thought that the vaccine had not been tested sufficiently (all age groups above 50%, and 60+ years of age above 60%). To combat this widespread opinion, public health messages could emphasize the large number of administered vaccines and very low risk of severe side effects. This fear also goes into the direction of possible longer-term side effects, which has recently extensively been discussed again in the media of the neighbour country Germany.

Notably half of those who were *undecided* in the youngest age group (18-29 years of age) agreed with the statement they preferred to wait until more people had been vaccinated, much more than in older age groups. The youngest age groups also reported more often they did not feel well enough informed about COVID-19 vaccinations. Younger people who were undecided about getting vaccinated were less often afraid of possible side effects, while rate of agreement was considerably higher in the young- and mid-aged groups (30-39, 40-49, 50-59 years).

Role of education

There was no meaningful *educational gradient* in the rate of those who had actually received their first or their first and second shot at the CON-VINCE follow-up visits 5 and 6. This may be due to healthcare staff being prioritized at the time to be vaccinated, a group which includes also cleaning staff at hospitals etc. who usually have lower levels of education on average. However, we observed educational gradients in the willingness to be vaccinated and the beliefs towards vaccination.

Lower-educated respondents reported higher shares of combined vaccination hesitancy and reluctance, in line with the literature on the social determinants of health. When looking at beliefs towards vaccination, around two thirds of those vaccination-undecided with lower educational status reported they thought that the vaccine had not been tested sufficiently, compared to middle and higher-educated participants.

Over one third of those who were undecided with lower educational status reported that they did not feel well enough informed about COVID-19 vaccinations, and one third reported they did not feel well enough informed about vaccinations in general. Providing more fact-based information – possibly in easy language and adapted to language skills of lower educated individuals – thus seems as a good entry to increase vaccination willingness.

Reluctance

Of those lower-educated respondents who were *reluctant* to get vaccinated, there was noteworthy low agreement with any of the beliefs towards vaccinations. The main reason, which about one third of the respondents (37%) agreed with, was that they were afraid that the COVID-19 vaccine does not protect against future mutated forms of the Coronavirus. For lower-educated vaccine-reluctant, the other reasons with higher agreement (felt the vaccine was not tested sufficiently, afraid of side effects, prefer to wait until more people have been vaccinated, sceptical that the COVID-19 vaccine really protects) were reported by less than one third of them. We conclude that other reasons (e.g., belief in specific conspiracy theories, beliefs about specific side effects like infertility, impotence) may play a role here. The CON-VINCE follow-ups, planned at the time of writing, will include more questions on these beliefs. Further insights will be gained from qualitative interviews.

Of those vaccination *reluctant* in the youngest age group, close to two thirds reported that they were afraid of possible side effects, and a little lower than half of them reported that they were afraid that the COVID-19 vaccine does not protect against future mutated forms of the Coronavirus. Public health messages should stress that so far, no real 'vaccine escape' has been noted and the available vaccines remain effective. Again, this information should be communicated in easy language. Communicating with lower-educated individuals over the last weeks also revealed that seemingly easy-to-understand concepts like 'booster' shots are not understood by individuals less fluent in English language. Adapting the terms to reflect positively connoted concepts, such as translating 'booster' into 'strengthening the power' of the vaccine through a third shot, seems warranted.

More than one third reported that they were sceptical that the COVID-19 vaccine really protects. About one third of the vaccination-reluctant youngest age group also reported that they did not feel well enough informed about COVID-19 vaccinations.

Part 2: Vaccination willingness in different migrant communities living in Luxembourg

Over the course of the CoVaLux project, we aim at understanding the viewpoints and perspectives of members of the different migrant communities in more detail. This will be done through a combination of quantitative analyses of survey data such as from CON-VINCE, and registry data from the IGSS. We will also collect qualitative data where necessary and possible.

Our starting hypothesis is that members of the migrant communities living in Luxembourg may show vaccination profiles similar to the vaccination uptake of the populations of their home countries. Thus, Portuguese migrants living in Luxembourg (14.9% of the total population of 634,000 residents of Luxembourg, Statec 2021) should show high vaccination uptake similar to vaccination uptake in Portugal, and similar patterns should hold also for other large groups of migrant communities (French, Italians, Belgians, Germans) whereas members of the ex-Yugoslavian community living in Luxembourg (around 14,000 individuals) should show less favourable vaccination profiles etc. (see below).

Part 2a: Members of the ex-Yugoslavian community

Lead: Ivana Paccoud

Background

Over the course of the investigation of social determinants of health in Luxembourg, members from communities other than the Luxembourgish native population have been discussed with regard to their health profiles on COVID-19 relevant indicators that are less favourable compared to those of the native population and other migrant communities. For this reason, we aimed to investigate if hesitancy or reluctance to get vaccinated may be more prevalent in some groups, and in particular in those coming from the Ex-Yugoslavian countries. First of all, we would like to acknowledge all members of the ex-Yugoslavian community who are supporting the Public Health efforts in Luxembourg through care work, research, and other activities. This report particularly tries to understand motivations of those members who are vaccine hesitant or reluctant.

Although there is a lack of academic research about vaccine hesitancy among people from Ex-Yugoslavia, a recent report highlighted the influence of conspiracy theories as one of the main reasons behind the anti-vax movements across the Western Balkans (Bieber et al., 2021). Indeed, it is believed that the Balkans are particularly exposed to misinformation on social media. The reasons for the belief in conspiracy theories are mostly associated with the long-standing issue of the mistrust in the government, fuelled by corruption and a lack of transparency.

Methods

To better understand the reasons behind the vaccine hesitancy in the Ex-Yugoslavian population in Luxembourg we undertook a rapid review of the literature, followed by the social media content analysis and telephone interviews with three members of the Ex-Yugoslavian community, expressing the wider views of this group. Quotes are extracted and translated from the content analysis of posts on social media (Facebook).

Results

Some of the main conspiracy theories include: the virus is purposely man-made by powerful people to halve the world population, it is linked to pharmaceutical companies and their desire to make profit, the vaccine will enable large-scale population tracking (by elites such as Bill Gates) through either 5G technology, changes to the DNA or microchipping (Bieber et al., 2021). From our interviews and the social media content analyses, we gained the following statements:

> *"The Government doesn't care about us. There are doctors and even Nobel prize winners who said that the whole issue with COVID19 is just politics, and they are planning to decrease the population."*

From this comment, a division of the society into 'they' and 'us' can be noted, which can reflect a perceived power imbalance between those who are running the country and the rest of the society. Besides the conspiracy theories, there are some – especially the younger population – who are reluctant to be vaccinated against COVID-19 due to the belief that the virus is similar to

the flu. Since they think it has no serious health consequences among the younger part of the population, they would rather have the virus than have a vaccine.

There are also those who worry about the side-effects, and the unknown long-term effects of the vaccines. They argue that the COVID-19 vaccines were made too quickly, and are therefore not safe.

> *"They still haven't got a vaccine for HIV, or cancer, how can they make a COVID-19 vaccine in such a short time… Something is not right"*

> *"For a vaccine to be made, we need more than two or three years to see whether there are no long-term effects. It seems that they are doing experiments on us."*

On the other side, some are concerned about the efficacy of the vaccines.

> *"If the vaccine is so efficient, why do we need to have three doses?"*

Concerns about vaccine safety and efficacy are especially widespread among pregnant women and those who are breastfeeding, mostly because of fears of health consequences for their babies. In addition, there is also a shared concern among young women about the negative impact that the COVID-19 vaccine could have on their fertility. Finally, there are others who follow the advice of influential people, such as the tennis player Novak Djokovic who has stated that he will not get the vaccine (Liew, 2021).

Discussion

In members of the ex-Yugoslavian community living in Luxembourg and vaccine hesitant or reluctant, attitudes toward the COVID-19 vaccines were largely negative. Misinformation and beliefs in conspiracy theories seem to be widespread. These attitudes and beliefs are reflected in the low vaccination rates among some countries in the Western Balkans. Several countries have fully vaccinated rates among the adult population well below the EU average (65%), including Bosnia and Herzegovina (16%), Albania (31%), Kosovo (41%), Serbia (43%), North Macedonia (37%), Montenegro (39%), Croatia (44%), and Slovenia (54%) (Ritchie et al., 2020).

These preliminary results point to complex reasons driving vaccine hesitancy in the ex-Yugoslavian community. These range from believing in conspiracy theories through a widespread misinformation on social media to concerns about the safety and effectiveness of the vaccines. Therefore, it is important to move away from spreading misinformation towards responsible use of social media. Governments should be as transparent as possible about the vaccination programmes in order to increase confidence and gain trust among the population. Better information sharing about the safety and efficiency of vaccines, especially among young women, and positive role models would be crucial in increasing the vaccination uptake among this group. However, before drawing final conclusions, availability of data on different migrant and ethnic communities in Luxembourg should be a key priority in better understanding the determinants of vaccine acceptance and hesitancy.

General recommendations

In discussions over the last weeks, a few best practice examples can be noted for Luxembourg. For example, Dr. René Dondelinger, geriatrician in the South (working at Emile Mayrisch and three care homes) spoke with reluctant persons and reminded them about their social and collective responsibility, and how much better the COVID-19 vaccines were tested compared to e.g. flu vaccines (see also here: Servior). In a personal communication, he also mentioned that the process of getting vaccinated in his team was framed as a collective endeavour.

Moving forward and gaining more knowledge about migrant communities in Luxembourg, targeted messaging in the native languages of these communities may also make sense. Our research experience in other projects shows that, for example, members from the ex-Yugoslavian community may be more responsive to messages in their native languages. Further, since the spread of misinformation and beliefs in conspiracy theories of the adult population of this community is quite high, we suggest increased efforts at schools and in training to reach (all) children and adolescents with educational material based on scientific evidence on COVID-19. The children and adolescents may then bring the new knowledge into their families.

In order to protect vulnerable people with pre-existing conditions and older adults with lower immunity after vaccination, we recommend increased outreach to healthcare workers and doctors, not on the basis of occupation but on the basis of job tasks involving frequent and close contact to vulnerable persons (older people, people with severe medical conditions). Going to workplaces with specific measures should be helpful to reach *frontaliers*.

We also recommend considering the social environment, and considering aiming at increasing vaccination uptake of certain communities and groups – reach out at festivals of certain ethnicities, workplaces of groups with lower vaccination uptake, neighbourhoods, reach communities by finding 'champions' who act as role models and convince their peers.
Luxembourg has driven a fact-based information strategy during the COVID-19 pandemic, which is helpful to counteract misinformation and spread of rumours, for example over social media. For this next phase to convince vaccine hesitant and reluctant citizens and *frontaliers*, we recommend to additionally reach individuals through emotional messages, for example mentioning altruistic motivations of those who were willing to be vaccinated in CON-VINCE.

Please see also the ECDC (October 2021) recommendations with other best-practice examples, for example, targeting outreach to vulnerable populations alongside increased efforts to reach the general population, select places to reach the hard-to-reach members of minority communities, and public places where people shop or take public transport should reach the broad public and possibly people that do not consume traditional news. It would also be important to involve communication experts to develop the best strategies to reach certain hard-to-reach demographics through less traditional formats, for example on social media. Here, important insights could be gained from the Swiss government social media strategy.

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Questions on vaccination in CON-VINCE follow-ups 5 and 6

Q1: Have you already been vaccinated against COVID-19?

1   Yes

2   No

Ask only if Q1 – Answer 1

Q2: When have you been vaccinated (Dose 1)?

[_D_][_D_]/[_M_][_M_]/[_2_][_0_][_Y_][_Y_]

Ask only if Q1 – Answer 1

Q3: Have you already received the second dose?

1   Yes

2   No

Ask only if Q3 – Answer 1

Q4: When have you been vaccinated (Dose 2)?

[_D_][_D_]/[_M_][_M_]/[_2_][_0_][_Y_][_Y_]

Ask only if Q1 – Answer 1

Q5: Do you know the brand of the vaccine?

1   Pfizer-BioNTech Covid Vaccine

2   Moderna Covid Vaccine

3   AstraZeneca Covid Vaccine

4   Johnson & Johnson Covid Vaccine

5   Other

999   Don't know *Fixed *Exclusive

Q6: Please indicate the batch number of your vaccine (if you know this information: is generally found in your vaccination passport or the certificate of vaccination):

1   Batch number: _____

999   Don't know

Q7: Have you experienced an adverse event after vaccination (dose 1)?

1   Yes

2   No

Q8: Please specify the adverse event you experienced after vaccination (dose 1)

	Yes	No	Unknown
Any reaction on the injection site (redness, warmth, pain, itch, haematoma, swelling, induration)	○	○	○
Did you have extensive limb swelling	○	○	○
Have you had fever and/or chills	○	○	○
Have you had headaches and/or suffered from nausea or vertigo	○	○	○
experienced a sudden increase in Fatigue / Malaise	○	○	○
had muscle aches/ joint pain	○	○	○

Q9: On what date did you first experience symptoms after dose 1?

[_D_][_D_]/[_M_][_M_]/[_2_][_0_][_Y_][_Y_]

Q10: Have you experienced an adverse event after vaccination (dose 2)?

1   Yes

2   No

Ask only if Q10 – Answer 1

Q11: On what date did you first experience symptoms after dose 2?

[_D_][_D_]/[_M_][_M_]/[_2_][_0_][_Y_][_Y_]

Ask only if Q10 – Answer 1

Q12: Please specify the adverse event you experienced after vaccination (dose 2)

	Yes	No	Unknown
Any reaction on the injection site (redness, warmth, pain, itch, haematoma, swelling, induration)	○	○	○
Did you have extensive limb swelling	○	○	○
Have you had fever and/or chills	○	○	○
Have you had headaches and/or suffered from nausea or vertigo	○	○	○
experienced a sudden increase in Fatigue / Malaise	○	○	○
had muscle aches/ joint pain	○	○	○

Ask only if Q12 – Answer ROW 1, YES OR Q8 – Answer ROW 1, YES

Q13: You indicated that you experienced a reaction on the injection site. Could you please specify for each of the following for how long you have had this problem?

	Less than 1 day	1 day	2 days	3 days	4 days	5 days	6 days	1 week	2 weeks	1 month	Still unresolved	Not applicable
redness	○	○	○	○	○	○	○	○	○	○	○	○
warmth	○	○	○	○	○	○	○	○	○	○	○	○
pain	○	○	○	○	○	○	○	○	○	○	○	○
itch	○	○	○	○	○	○	○	○	○	○	○	○
haematoma	○	○	○	○	○	○	○	○	○	○	○	○
swelling	○	○	○	○	○	○	○	○	○	○	○	○
induration	○	○	○	○	○	○	○	○	○	○	○	○

Q14: You indicated that you have had extensive limb swelling. Could you please specify for how long you have had this problem?

1   Less than 1 day

2   1 day

3   2 days

4   3 days

5   4 days

6   5 days

7   6 days

9   1 week

10   2 weeks

11   1 month

12   Still unresolved

Q15: You indicated that you have had fever and/or chills. Can you please specify for each interval for how long you have had the given temperatures?

	Less than 1 day	1 day	2 days	3 days	4 days	5 days	6 days	1 week	2 weeks	1 month	Still unresolved	Not applicable
37.5 -37.9 C	O	O	O	O	O	O	O	O	O	O	O	O
38.0 -40.4 C	O	O	O	O	O	O	O	O	O	O	O	O
40.5 – 42.0 C	O	O	O	O	O	O	O	O	O	O	O	O
Higher than 42 C	O	O	O	O	O	O	O	O	O	O	O	O
chills	O	O	O	O	O	O	O	O	O	O	O	O

Q16: You indicated that you have had headaches and/or suffered from nausea or vertigo. Could you please specify for how long you have had these problems?

	Less than 1 day	1 day	2 days	3 days	4 days	5 days	6 days	1 week	2 weeks	1 month	Still unresolved	Not applicable
Headaches	○	○	○	○	○	○	○	○	○	○	○	○
Nausea/vertigo	○	○	○	○	○	○	○	○	○	○	○	○

Q17: You indicated that you experienced a sudden increase in Fatigue / Malaise. Could you please specify for each of the following for how long you have had this problem?

1   Less than 1 day

2   1 day

3   2 days

4   3 days

5   4 days

6   5 days

7   6 days

9   1 week

10   2 weeks

11   1 month

12   Still unresolved

Ask only if Q12 – Answer ROW 6, YES OR Q8 – Answer ROW 6, YES

Q18: You indicated that you have had muscle aches/ joint pain. Could you please specify for how long you have had these problems?

	Less than 1 day	1 day	2 days	3 days	4 days	5 days	6 days	1 week	2 weeks	1 month	Still unresolved	Not applicable
Muscle aches	O	O	O	O	O	O	O	O	O	O	O	O
Joint pain	O	O	O	O	O	O	O	O	O	O	O	O

Q19: Have you had a positive SARS-CoV-2 test since your vaccination?

1   Yes

2   No

Ask only if Q19 – Answer 1

Q20: What kind of test was performed?

1   PCR test (detects the presence of the SARS-CoV-2 virus by detecting the presence of viral RNA)

2   Rapid Antigen test (detects the presence of the SARS-CoV-2 virus by detecting viral proteins)

3   Unknown

Ask only if Q19 – Answer 1

Q21: When have you had your positive SARS-CoV-2 after the vaccination ?

[_D_][_D_]/[_M_][_M_]/[_2_][_0_][_Y_][_Y_]

Ask only if Q19 – Answer 1

Q22: How severe have your symptoms been?

1   asymptomatic (asymptomatic)

2   cold-like symptoms

3   considerable symptoms without hospitalisation

4   hospitalized due to symptoms

Q23: In period between June 2020 until now have you been vaccinated against the influenza virus?

1   Yes

2   No

Q24: In period between June 2020 until now have you received a Pneumococcal vaccine?

1   Yes

2   No

Q25: Have you been vaccinated against Mumps, Measles and Rubella (this information is generally found in your vaccination passport?)

1   Yes

2   No

999   Don't know

Ask only if Q25 – Answer 1

Q26: Please specify when you were vaccinated against Mumps, Measles and Rubella

1   [_D_][_D_]/[_M_][_M_]/[_2_][_0_][_Y_][_Y_]

999   Don't know

Q27: Will you agree to get vaccinated against COVID-19 when it is your turn?

1   Very likely

2   Rather likely

3   Rather unlikely

4   Very unlikely

5   I don't know yet

Ask only if Q27– Answer 1,2

Q28: What are the reasons for you to agree to get vaccinated against COVID-19? Please tick all that apply.

1   I want to protect myself

2   I want to protect a vulnerable significant other

3   I want to help our society combat the pandemic

4   It is recommended by the government

5   My treating physician told me to do so

6   It is recommended by my employer

7   I think vaccination is important in order to be able to travel safer

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8   Other reasons

Q29: Why are you undecided about getting vaccinated against COVID-19? Please tick all that apply.

1   I do not believe in vaccinations in general

2   I also do not get vaccinated against other diseases

3   I have had bad experiences with other vaccinations

4   I do not feel well enough informed about vaccinations in general

5   I do not feel well enough informed about COVID-19 vaccinations

6   I don't think I need a vaccination against COVID-19 because I am not in the risk group

7   I prefer to wait until more people have been vaccinated

8   I am afraid of possible side effects

9   I am skeptical that the COVID-19 vaccine really protects

10   I am afraid that COVID-19 vaccine does not protect against future mutated forms of the coronavirus

11   I think that the vaccine has not been tested sufficiently

12   Other reasons

Why do you think it is unlikely for you to agree to get vaccinated against COVID-19? Please tick all that apply.

1   I do not believe in vaccinations in general

2   I also do not get vaccinated against other diseases

3   I have had bad experiences with other vaccinations

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4   I do not feel well enough informed about vaccinations in general

5   I do not feel well enough informed about COVID-19 vaccinations

6   I don't think I need a vaccination against COVID-19 because I am not in the risk group

7   I prefer to wait until more people have been vaccinated

8   I am afraid of possible side effects

9   I am skeptical that the COVID-19 vaccine really protects

10   I am afraid that COVID-19 vaccine does not protect against future mutated forms of the coronavirus

11   I think that the vaccine has not been tested sufficiently

12   Other reasons