

Impact of Psycho-Social Factors, E-health Literacy and Information Access on COVID-19 Vaccination Perceptions and Intentions: Online Survey

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Abstract

The COVID-19 pandemic has been associated with an infodemic which impacts on vaccination perceptions and intentions. E-health literacy seems to be the key to searching health information on the web. Age and income level impact vaccine hesitancy and resistance. It is important to know more about the population who are hesitant to get vaccinated in order to develop appropriate and accessible information. We focused on four factors that impact vaccination perceptions and intentions: socio-demographic characteristics (age and education level), e-health literacy and sources of information about COVID-19. An anonymous online survey was completed by 368 participants, who reported their age, level of education, F-eHEALS (the level of e-health literacy), preferred sources of COVID-19 information, and their vaccination perceptions and intentions (vaccine score). The vaccine score is measured by a combination of two preview questionnaires adapted to COVID-19. We first assessed our questionnaire construct on intentions and perceptions of COVID-19 vaccination. We obtained a unidimensional scale that we correlated with other factors and related to clusters (k-means). The results then showed that age, education level, and sources of COVID-19 information (radio, internet and “no channel”) impact vaccination perceptions and intentions. E-health literacy appears to be a co-variant without direct link with vaccination perceptions and intentions but linked to age and sources of COVID-19 information. This study shows how age, education level, sources of COVID-19 information and e-health literacy can impact COVID-19 vaccination perceptions and intentions.

Keywords: COVID-19, e-Health literacy, socio-demographic characteristics, information access, sources of COVID-19 information, online survey

1. Introduction

Vaccination is a major societal challenge to ending the COVID-19 crisis that has plagued the world for the past year. It is therefore crucial to understand how to vaccinate as many people as possible. However, some people seem to be resistant to the idea. The main reasons that have been identified for non-vaccination are well known in the scientific literature and focus on: beliefs about the ineffectiveness of the vaccine (Black et al., 2018); fear of side effects (Gil et al., 2006); suspicion about the composition of the vaccine (Ernsting et al., 2013); being healthy and unconcerned about vaccination (Boyeau et al., 2011); lack of knowledge about the virus and the vaccine (Falomir - Pichastor et al., 2009); ongoing anti-vaccine social media messages (Smith, 2017). Another factor, which was particularly highlighted during this COVID-19 pandemic, was the dissemination of misinformation about the benefits and risks of vaccines (Broadbent, 2019; Donzelli et al., 2018; Marco-Franco et al., 2021; McKee & Middleton, 2019; Montagni et al., 2021). This last point is probably the most worrying for COVID-19 vaccination.

Several researchers (e.g., Brennen et al., 2020; Brørs et al., 2020; Chong et al., 2020; Murphy et al., 2021) say that the COVID-19 pandemic is associated with an “infodemic” (Zarocostas, 2020). This term is defined as “*over-abundance of information – some accurate and some not – that occurs during an epidemic.*” (World Health Organization, 2020). Even reliable communication channels and information sources can lead to misinformation (Brennen et al., 2020). Several researchers have shown the poor quality of health information (Eysenbach et al., 2002; Zhang et al., 2015). The spread of this misinformation can lead people to act inappropriately and undermine the efforts of governments and health authorities to manage the COVID-19 pandemic. The channels for spreading this false information can come from several sources but converge and centralize on social media (Brennen et al., 2020). Murphy et al. (2021) showed that vaccine-refractory individuals consumed significantly less information about COVID-19 from newspapers, television, radio, government agencies and significantly more information from social media. It would be interesting to better

understand which information channels have an impact on the perception and intentions of COVID-19 vaccination.

Many researchers highlight the importance of taking into account the level of e-health literacy to address this misinformation (Brørs et al., 2020; Chong et al., 2020; Do et al., 2020). E-health literacy seems to be the key to searching health information on the web. According to the *Institute of Medicine (IoM)*, e-health literacy refers to a person's skills "to search for, find, understand and evaluate health information from electronic sources and to apply the knowledge gained to treat or solve a health problem" (Institute of Medicine, 2009). This definition highlights the importance of contextual factors, including the media through which health information is disseminated and of the level of health literacy in relation to these media (Norman & Skinner, 2006a). Currently, few studies have shown an empirical link between e-health literacy and COVID-19 vaccination perception and intentions (e.g., Nath et al., 2021).

Moreover, there is currently no consensus between the level of ehealth literacy and the socio-demographic characteristics of a population (Atmann et al., 2019; Del Giudice et al., 2018; Valizadeh-Haghi & Rahmatizadeh, 2018; Wångdahl et al., 2020). In contrast, many socio-demographic characteristics also showed an impact on vaccination perceptions and intentions. Being over 40 years old and having a high level of education are factors that can lead to a higher take-up rate of vaccination (Black et al., 2018; Kelly et al., 2008). Murphy et al. (2021) showed that age and income level were socio-demographic factors that impact vaccine hesitancy and resistance. Younger age and lower income were related to vaccine hesitancy and resistance. Schwarzingler et al. (2021) showed, from a French sample, that outright vaccine refusal and vaccine hesitancy were both significantly inversely associated with age and lower educational level. It is important to know more about the population who are hesitant to get vaccinated in order to develop appropriate and accessible information (e.g., Aw et al., 2021; Biswas et al., 2021; Nehal et al., 2021; Sallam, 2021).

The scientific literature shows that a significant proportion of the population has a poor perception of the COVID-19 vaccine and is hesitant to get vaccinated (e.g., Callaghan et al., 2020; Grech & Gauci, 2020; Kwok et al., 2021; Neumann-Böhme et al., 2020). It is necessary to understand this problem in order to come to terms with the pandemic (Dror et al., 2020; Murphy et al., 2021). It is therefore imperative to understand the roles of socio-demographic characteristics, e-health literacy and sources of COVID-19 information with the COVID-19 vaccination perceptions and intentions. The aim of the study is to better understand how these dimensions impact COVID-19 vaccination perceptions and intentions. To achieve this goal, we developed four hypotheses:

H1: According to Murphy et al. (2021), older participants will be more favorable to COVID-19 vaccination perceptions and intentions than younger participants.

H2: According to Schwarzingler et al. (2021), participants with a high level of education will be more favorable to COVID-19 vaccination perceptions and intentions than participants with a lower level of education.

H3: According to Chong et al. (2020), Brørs et al. (2020) and Do et al. (2020), participants with a high level of e-health literacy will have higher COVID-19 vaccination perceptions and intentions than participants with a low level of e-health literacy.

H4: According to Murphy et al. (2021) and Brennen et al. (2020), respondents consuming getting their information from unreliable less reliable sources (social networks, internet media, family and friends, or no channels) will be less favorable to COVID-19 vaccination perceptions and intentions than those who do not use this type of information source. Respondents getting their information from more reliable sources (newspapers, television, radio, scientific literature, professional health) will be less favorable to COVID-19 vaccination perceptions and intentions than those who do not get information from such sources.

2. Method

2.1 Participants

Our online questionnaire attracted 369 responses from people aged 16 to 82 years (mean = 39,47 years, SD = 15,57). We excluded one participant who did not consent to the study. The only one inclusion criterion for this study was that the participants are native French speakers. All the participants signed a consent form after being informed of the study's progress and they were given no compensation.

2.2 Procedure

Participants were invited to complete an anonymous online survey. Each participant had to consent to the study by means of electronic validation in order to be able to access the questionnaires. The instructions given to the participants explained the main objective of the study regarding COVID-19 vaccination perceptions and intentions. The questionnaire was split into four parts. Firstly, the participants completed information about their age and level of education. Secondly, they completed the vaccine questionnaire (Bertin et al., 2020; Biasio et al., 2020). Thirdly, they

completed an ehealth literacy questionnaire (F-eHEALS - Chaniaud et al., in press). Finally, they identified their sources of COVID-19 information. The survey was prepared, distributed, and collected by “LimeSurvey” and had been shared online through various social networks. For its distribution, a convenient, non-probability sampling method was adopted. It took about 5 min to complete. Responses were collected from February 13 to March 19, 2020. The study was in line with the ethical recommendations of the Declaration of Helsinki and the questionnaire was approved by the CNIL (French protection authority).

2.3 Questionnaires

2.3.1 Socio-demographic Measurement

This questionnaire included personal details: age and educational level.

2.3.2 E-Health Literacy

E-Health literacy was measured with the F-eHEALTH Literacy Scale (F-eHEALS). The French version of F-eHEALS translated by Chaniaud et al. (in press), like the original version of Norman and Skinner’s eHEALS (Norman & Skinner, 2006b), consists of 8 items measuring ehealth literacy on a 5-point Likert scale (ranging from 1 = strongly disagree to 5 = strongly agree). The scoring of the eHEALS score depends on the points obtained for each of the items (“strongly disagree” scores 1 point and “strongly agree” score 5 points). The eHEALS score ranges from 8 to 40 points. The higher the score, the higher the level of ehealth literacy.

2.3.3 Sources of COVID-19 Information

We used the same sources of COVID-19 vaccine information as Murphy et al. (2021): newspaper, television, radio, internet, social media, health professional, family or friends. We added “no channel” for people who do not follow the news of the pandemic as well as “scientific literature”. The respondent answered ‘yes’ or ‘no’ to each of the information sources presented.

2.3.4 Perception and Intention to Get Vaccinated Against COVID-19

The perception and the intention to get vaccinated against COVID-19 were measured with a combination of two validated questionnaires : 1) the full 5-item on a 5-point Likert scale (e.g., “*Vaccinations are one of the most significant contributions to public health*” ranging from 1 = *strongly disagree* to 5 = *strongly agree*) developed by Lewandowsky et al. (2013) and translated by Bertin et al. (2020), and 2) the dichotomic scale developed by Biasio et al. (2020) applied to COVID-19 vaccines (e.g., “*Will you get vaccinated, if possible?*”) that we adapt through a full 5-item on a 5-point Likert scale (ranging from 1 = *strongly disagree* to 5 = *strongly agree*).

We computed a score associated with these two questionnaires. The global score is calculated to take into account inverted items and to obtain a total score of between 0 and 40. To do this, it is calculated through two steps: first, one point is subtracted from the score ticked by the respondent for items 1, 2, 3, 4, 6, 8, 9 and 10, while the calculation is 5 minus the score ticked by the respondent for items 5 and 7; secondly, the 10 new recalculated scores are added together.

2.4 Data Analysis

Data were analyzed using SPSS 22 (IBM Corporation, 2013). We tested the association between each of the independent variables (age, level of education, ehealth literacy, source of COVID-19 information) and the vaccine score (vaccination perceptions and intentions), then between each other. We established three vaccine score clusters (pro-vaccine, undecided, anti-vaccine) using k-means. Bivariate correlations (Pearson), ANOVAs and Student t-tests were performed when the sample met the homoscedasticity criteria, while non-parametric tests (Kruskal-Wallis and Mann-Whitney) were performed when the sample did not meet these criteria. The fidelity assessment for the F-eHEALS and the vaccine score was performed by analyzing the internal consistency of the tool as assessed by Cronbach’s alpha. Construct validity was measured by an exploratory factor analysis (Principal Component Analysis). According to Comrey and Lee (2013), factor scores above 0.71 were considered excellent, those above 0.63 very good, and those above 0.55 good. The fidelity assessment was performed by analyzing the internal consistency of the tool as assessed by Cronbach’s alpha (Nunnally, 1978).

3. Results

Data, materials in French (with English translation) and analyses are available on the OSF repository at the following address: <https://osf.io/rwne9/>

3.1 Score Vaccine

3.1.1 Assessment of Construct

The Bartlett sphericity test is significant ($\text{Chi}^2 (n = 368) = 1766.56, \text{ddl} = 28, P < .000$) and the Kaiser-Meyer-Olkin index (KMO) is 0.9. The first factor alone explains 63.11% of the total variance of the 10 items analyzed. Examination

of the factor structure reveals a unidimensional scale. The principal component factor analysis is presented in table 1. Cronbach's alpha was 0.753.

Table 1. Principal component factor analysis of the vaccine score

| Component 1 | |
|-------------|-------|
| item 1 | .807 |
| item 2 | .597 |
| item 3 | .783 |
| item 4 | .888 |
| item 5 | -.813 |
| item 6 | .875 |
| item 7 | -.575 |
| item 8 | .836 |
| item 9 | .917 |
| item 10 | .778 |

3.1.2 K-means

Three vaccine score clusters were performed using k-means: pro-vaccine (N=184), undecided (N = 109) and anti-vaccine (N = 75) (see detail in table 2).

3.2 Age, Education Level, Ehealth Literacy and Sources of COVID-19 Information With Perception and Intention to Get Vaccinated

Table 2. Descriptive analyses of socio-demographic characteristics, vaccine score clusters, and ehealth literacy level with the vaccine score

| Variables | n(%) | Vaccine score means (SD) |
|--|--|--------------------------|
| Socio-demographic characteristics, level of health literacy and source of COVID-19 information | | |
| Age | 39.47 years (15.57) | 368(100) |
| Education level | Middle school | 4(1.1) 16.25(16.38) |
| | Basic technical level (e.g., Youth Training, BTEC First Diploma) | 22(6) 19.27(10.76) |
| | High school level | 37(10,1) 18.51(10.18) |
| | Secondary Higher education 1st cycle - high school diploma | 79(21.5) 23.68(9.22) |
| | Higher education 2nd cycle - Bachelor's degree | 99(26.9) 24.72(10.66) |
| | Higher education 3rd cycle - Master's degree | 99(26.9) 28.03(8.95) |
| | Ph.D | 28(7.6) 29.04(9.59) |
| Ehealth literacy level | 31.53/40 (5.52) | 368(100) |
| Vaccine score clusters | Pro-vaccine | 184(50) 33.31(3.14) |
| | Undecided | 109(29.6) 21.18(3.975) |
| | Anti-vaccine | 75(20.4) 8.56(3.86) |

3.2.1 Age

Age ($M = 39.47$, $SD = 15.57$, range = 16-82 years) is not significantly correlated with the vaccine score ($r = 0.2$, $P = .705$). However, age significantly impacts the vaccine score clusters ($F(2,367) = 3.532$, $P = .03$, $\eta^2 = 0.02$). The pro-vaccine ($M = 40.82$, $SD = 15.17$) and anti-vaccine ($M = 40.95$, $SD = 15.44$) clusters are significantly older than the undecided cluster ($M = 36.17$, $SD = 15.97$).

In contrast, there is a low, negative significant correlation between age and the ehealth literacy level ($r = -.12$, $P = .02$).

3.2.2 Education Level

The education level significantly impacts the vaccine score ($F(6,367) = 6.954$, $P < .000$, $\eta^2 = 0.01$). The higher the education level, the higher the vaccine score.

In contrast, there is no significant difference between education level and ehealth literacy level ($F(6,367) = 6.954$, $P = .08$).

3.2.3 Level of Ehealth Literacy (F-eHEALS) with COVID-19 Vaccination Perceptions and Intentions

The ehealth literacy level (Cronbach's alpha was 0.9) is not correlated with the vaccine score ($r = 0.08$, $P = .15$). eHealth literacy level has no impact on the vaccine score clusters ($F(2,367) = 1.722$, $P = .18$) including the pro-vaccine ($M = 32.05$, $SD = 5.47$), the undecided ($M = 31.09$, $SD = 5.13$) and the anti-vaccine ($M = 30.87$, $SD = 6.11$) groups.

Some sources of COVID-19 information (internet and scientific literature) were significantly impacted by the ehealth literacy level. "Internet" ($F(1,367) = 5.139$, $P = .024$; $M = 31.94$, $SD = 5.24$) and "scientific literature" ($F(1,367) = 14.97$, $p < .000$, $M = 33.14$, $SD = 4.46$) have a positive impact on the vaccine score.

3.2.4 Source of COVID-19 Information

Some sources of COVID-19 information (internet, radio, no channel) significantly impact the vaccine score. On the one hand, "radio" and "internet" have a positive impact on the vaccine score. On the other hand, "no channel" has a negative impact on the vaccine score. All the data are detailed in Table 3 below.

Table 3. Source of COVID-19 information with the vaccine score

| Source of COVID-19 information | N(%) | Vaccine means (SD) | F | P-value | η^2 |
|--------------------------------|-----------|--------------------|-------|---------|----------|
| Newspaper | 54(14.7) | 27.94(9.57) | 0.15 | .7 | - |
| Television | 204(55.4) | 25.33(9.31) | 1.87 | .17 | - |
| Radio | 112(30.4) | 26.88(9.38) | 7.5 | .006** | .001 |
| Internet | 261(70.9) | 25.41(10.12) | 4.56 | .03* | .01 |
| Social media | 164(44.6) | 24.31(10.33) | 2.35 | .13 | - |
| Scientific literature | 116(31.5) | 24.96(11.43) | 0.13 | .72 | - |
| Health professional | 93(25.3) | 26.31(9.38) | 3.15 | .08 | - |
| Family and friends | 104(28.3) | 23.16(9.21) | 3.12 | .08 | - |
| No channel | 21(5.7) | 17.52(11.55) | 10.96 | .001*** | 0.03 |

Note.***. Correlation is significant at the .001 level ; **. Correlation is significant at the .01 level ; *. Correlation is significant at the .05 level.

4. Discussion

The objective of this study was to explore the relationships between socio-demographic characteristics, e-health literacy and sources of COVID-19 information with COVID-19 vaccination perceptions and intentions. To achieve this goal, we used two questionnaires about COVID-19 vaccination intentions and perceptions. Once we had checked the validity of the questionnaire, we formulated four hypotheses.

The internal consistency ($\alpha = 0.753$) was judged as good according to Nunnally's recommendations (Nunnally, 1978). These results are congruent with those of the original study (Bertin et al., 2020 ; $\alpha = 0.84$) which obtained a similar result. For the construct validity, the Bartlett sphericity test is significant, and the Kaiser-Meyer-Olkin (KMO) sampling precision index can be described as excellent. These results indicate that the correlations between the items are of good quality and thus legitimize the factor analysis. Construct validity has highlighted a unidimensional structure. The factor scores ranged from 0.58 to 0.97 which is considered as a good to excellent score (Comrey & Lee, 2013). We decided to keep the ten items.

We made four hypotheses, that age (H1), education level (H2), ehealth literacy (H3) and source of COVID-19 information (H4) would have an impact on COVID-19 vaccination perceptions and intentions.

Our first hypothesis (H1) was that older participants would have better COVID-19 vaccination perceptions and intentions compared to younger participants. We can partially validate this hypothesis. The results show that there is no correlation between age and vaccine score which is not in line with the results of Murphy et al (2021). However, age significantly impacts the vaccine score clusters. The pro-vaccine and the anti-vaccine are significantly older than the undecided cluster which reveals a U-shaped curve as in the results of Schwarzinger et al. (2021).

Our second hypothesis (H2) was that participants with a high level of education will be more favorable to COVID-19 vaccination perceptions and intentions than participants with a lower education level. We can validate this hypothesis. The results show that the education level significantly impacts the vaccine score. The higher the education level, the higher the vaccine score. These results are in line with the results of Murphy et al. (2021) and Schwarzinger et al. (2021).

Our third hypothesis (H3) was that participants with a higher level of ehealth literacy will be more favorable to COVID-19 vaccination perceptions and intentions than participants with a low level of ehealth literacy. Our results cannot validate this hypothesis. We do not observe correlation between ehealth literacy and vaccine score and ehealth literacy level has no impact on the vaccine score clusters. These results are not in line with the idea of Brørs et al. (2020), Chong et al. (2020) and Do et al. (2020). However, ehealth literacy could have a covariant role, indeed ehealth literacy is correlated with age and impacts the sources of COVID-19 information (figure 1).

There are several reasons for this lack of correlation. We observed that the standard deviation of the F-eHEALS was quite low, which may be caused by a population that was too homogeneous or a questionnaire that was not sufficiently discriminating. We can also discuss how to measure ehealth literacy. The F-eHEALS is a self-reporting questionnaire, and some participants may think they are reading reliable sources when actually they are not. However, we also found that participants who reported reading scientific literature had a significantly higher ehealth literacy level than those who reported not reading scientific literature. Scientific literature can be considered a reliable source of health information. However, these same individuals reading the scientific literature may have a negative COVID-19 vaccination perception and intention. It would therefore be interesting in the future to better understand the role of ehealth literacy in relation to information sources in terms of individuals' perceptions and intentions.

Our fourth hypothesis (H4) was that respondents consuming information from unreliable sources (social networks, internet media, family and friends, or no channels) will have lower COVID-19 vaccination perceptions and intentions than those who do not consume this type of information. Respondents getting their information from more reliable sources (newspapers, television, radio, scientific literature, professional health) will have lower COVID-19 vaccination perceptions and intentions than those who do not get their information from such sources. We can partially validate our hypothesis. The results show that "radio" and "internet" have a positive impact on the vaccine score and "no channel" has a negative impact on the vaccine score. Our results partially agree with those of Murphy et al. (2021) in that respondents with negative perceptions and who didn't want to get vaccinated were also those who didn't get their information from the radio, though we couldn't demonstrate a similar effect for newspaper or TV information. In contrast, our results show that respondents with less hesitancy to get vaccinated were more likely to get their information from the Web, which tends to contradict the results of Murphy et al. (2021).

Furthermore, our results do not seem to support an infodemic effect, since we observed that respondents who were not interested in getting information about vaccination ("no channel") had a significantly negative COVID-19 vaccination perception and intention compared to those who used some form of information source, even social media. Regardless of its quality, if individuals seek out information about the pandemic, they are likely to have a better perception and be more likely to get vaccinated against COVID-19. Thus, the current problem would not be infodemic but the importance of involving all individuals in public health issues. However, these results may be explained by the fact that respondents appear to have a high level of ehealth literacy, or the data collected may have been in a particular cycle where infodemic was at a minimum (Gallotti et al., 2020), or we interviewed very few individuals who tend to accept misinformation in our sample. These people can be very difficult to approach because of their distrust of science.

This study has some limitations. Given the socioeconomic similarity between members of the study sample, it is not possible to generalize the results to other populations. The population usually available in online surveys have a higher-than-average level of education, which does not allow for recommendations for the population with a low level of education. Nevertheless, the methodology employed may be useful for those interested in understanding perception and hesitancy to get vaccinated. We provide open access (<https://osf.io/rwne9/>) to our material and data to allow replication of this study in other populations.

To conclude, this study shows how age, education level, sources of COVID-19 information and ehealth literacy can impact COVID-19 vaccination perceptions and intentions (figure 1). It would be interesting to better understand why some individuals are disinterested in the pandemic. The questions of lassitude, habituation, adaptation to uncertainty, social norms in the new social behaviors and in particular health behaviors, the perception of risk, the individual and collective meaning given to the health situation, the familiarization of the strange in the notion of 'living with' can be evoked. Similarly, we encourage studies to better understand the moderating role of ehealth literacy on vaccination perceptions and intentions. Because ehealth literacy is related to individuals' education levels and social and cultural backgrounds, we encourage rethinking the ways in which studies collect data to gain a comprehensive view of the entire population. This would allow public health messages to be tailored to the psychological and behavioral devices of the population as a whole.

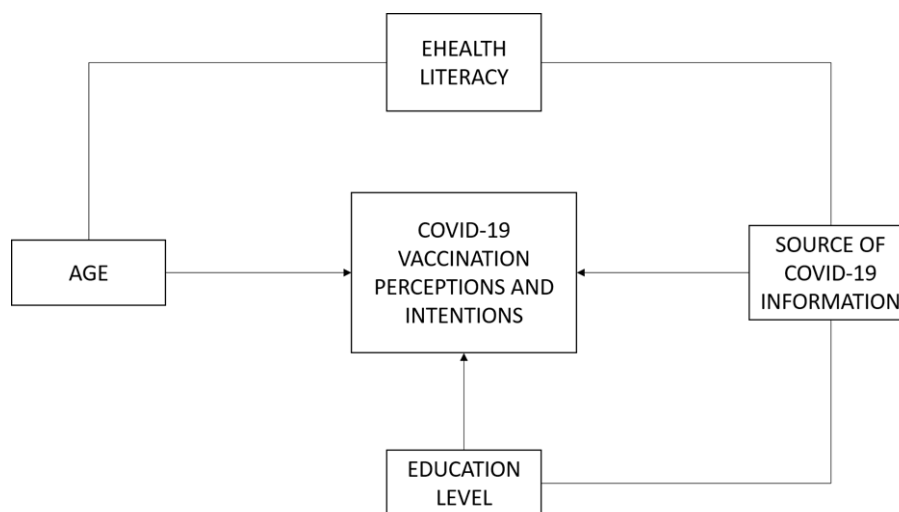


Figure 1. Conceptual model of the relationship between age, education level, ehealth literacy, source of COVID-19 information and vaccination perceptions and intentions

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