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Original article

Links between rational and irrational beliefs, trait anxiety and fear of COVID 19

Liens entre croyances rationnelles et irrationnelles ainsi que l'anxiété trait et la peur de la Covid 19

C. De Landsheer, V. Walburg*

CERES (Culture, Ethique, Religion et Société), Faculté Libre des Sciences Humaines et des Lettres, Institut Catholique de Toulouse (ICT), 3 Rue de la Fonderie, BP 7012, 31068 Toulouse Cedex 7, France



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ABSTRACT

Introduction. – Our beliefs and knowledge influence the way we act, react, or adapt to an aversive situation such as the current COVID-19 pandemic. The purpose of this study is to explore factors that may influence perceived fear of COVID-19.

Methodology. – Three hundred and forty-two people from the general population participated in this study. The participants completed an online anamnestic questionnaire that included questions regarding feelings of vulnerability to illness, fear of COVID-19, rational and irrational beliefs about COVID-19, and trait anxiety.

Results. – A stepwise regression analysis showed that trait anxiety, irrational and rational beliefs, and having comorbidities linked to severe forms of the disease were associated with perceived vulnerability concerning health and fear of COVID-19.

Discussion. – This study seems to underline the importance of pre-existing vulnerabilities that were exacerbated during the pandemic.

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* Corresponding author. Faculté libre des lettres et des Sciences Humaines Institut Catholique de Toulouse (ICT), 31 rue de la Fonderie, BP 7012, 31068 Toulouse Cedex 7, France.

E-mail address: vera.walburg@ict-toulouse.fr (V. Walburg).

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Introduction. – Nos croyances et nos connaissances influent sur nos manières d'agir, de réagir ou encore de s'adapter face à une situation aversive tels que la pandémie de la COVID-19 actuelle. Des facteurs intrinsèques tels que, la propension à l'anxiété trait (Spielberger et al., 1993) des croyances rationnelles ou irrationnelles (Ellis et al., 2007) pourraient influencer sur la peur de la maladie en général et la peur de la Covid-19 plus spécifiquement. L'objectif de la présente étude est d'explorer ces facteurs susceptibles d'influer l'inquiétude vis-à-vis de la santé et la peur perçue de la Covid-19.

Méthodologie. – Trois cent quarante-deux personnes issues de la population tout venant ont participé à cette étude. Ces participants avaient en moyenne 34 ans ($SD = 13.6$) dont un tiers d'étudiants et la moitié avec une activité professionnelle. Les participants ont complété en ligne un questionnaire anamnétique, des questionnaires concernant le sentiment de vulnérabilité face à la maladie, la peur perçue de la Covid-19, les croyances rationnelles et irrationnelles face à la Covid-19 et l'anxiété trait. Le lien a été posté sur une plateforme sécurisée (Sphinx Campus) et l'étude a reçu un avis favorable du comité d'éthique de l'université fédérale de Toulouse.

Résultats. – Une analyse de régression pas à pas indique dans le dernier modèle que le fait de présenter des comorbidités associés à des formes sévères de la maladie ($\beta = 2.25$; $p = 0.006$), l'anxiété trait ($\beta = 0.22$; $p < 0.001$), des croyances irrationnelles ($\beta = 0.41$; $p < 0.001$) augmentent la probabilité d'une perception de vulnérabilité par rapport à la santé, tandis que les croyances rationnelles ($\beta = -0.41$; $p < 0.001$) diminuent cette probabilité. Le modèle ($F(7.334) = 36.4$; $p < 0.001$) explique 36.4 % de la variance. De plus, le statut marital, plus précisément le fait d'être en couple ($\beta = 1.8$; $p = 0.003$), le fait d'avoir des comorbidités connus comme associés à des formes sévères de la maladie ($\beta = 1.73$; $p = 0.04$), l'anxiété trait ($\beta = 0.12$; $p < 0.001$) les croyances irrationnelles ($\beta = 0.53$; $p < 0.001$) est augmentent la probabilité de la peur du Covid-19. Le modèle ($F(5.336) = 21.0$; $p < 0.001$) ; explique 22.6 % de la variance.

Discussion. – Ces résultats suggèrent qu'il soit possible d'associer les inquiétudes ou symptômes anxieux ayant émergés durant cette pandémie à la fois à des causes rationnelles tels que des comorbidités connus comme associés avec des formes graves, mais également à des vulnérabilités antérieures à la pandémie tels que des traits d'anxiété ou une manière particulièrement rigide et intransigeante de voir le monde.

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1. Introduction

The information at our disposal in the face of a threat such as a disease impacts what we do to reduce the danger or to adjust. In the face of the current SARS-CoV-2 pandemic, our knowledge and beliefs have or may still influence our behavior and our experience of the situation. Indeed, feeling concerned or threatened by this disease allows better adherence to health recommendations (Czeisler et al., 2020); on the other hand, young people do not always perceive themselves as being at risk for COVID-19, although this does not necessarily prevent them from understanding and adhering to certain current health constraints (Commodari & La Rosa, 2020). It can be assumed that better sci-

entific knowledge about the situation will help in the understanding of, and therefore the adherence to health recommendations. However according to Čavojević et al. (2020), reasoning based on scientific facts rather than on intuition does not prevent adherence to false health beliefs and sometimes even to conspiracy beliefs. In the same way, the study of Earnshaw et al. (2020) indicates that adherence to conspiratorial theories decreases respect for COVID-19 measures; nevertheless, the source of information considered the most reliable is the physician.

Inappropriate health beliefs concerning COVID-19 may be associated with higher anxiety levels (McCaffery et al., 2020). Anxiety can be defined as the organic response to a potential danger or uncertain situation (Leal et al., 2017). Anxiety has two facets, namely state and trait anxiety, as described by Spielberg (2012). Trait and state anxiety do not activate the same neuronal areas (Saviola et al., 2020). State anxiety corresponds to an anxious state related to an event or situation, while trait anxiety is related to personality traits and is independent of events or context. In the present study, we chose to focus on trait anxiety because it seemed appropriate to focus on the intrinsic traits that may or may not facilitate the experience of the current pandemic (Saviola et al., 2020). Indeed, it seemed relevant to focus on a stable anxiety trait that is part of the personality and may constitute an intrinsic factor of greater vulnerability during this time. Several European studies have looked at the impact of the pandemic on the mental health of populations. For example, an Italian study (Lucchini et al., 2021) on the effects of the pandemic underlined a deterioration of mental health, by aggravating already existing difficulties concerning mental health, particularly in people over 70 years old and young children. Another study conducted in the United Kingdom (Serrano-Alarcón et al., 2021) indicates that the measures taken to curb the virus seem to have caused more deterioration in mental health than the pandemic itself, particularly in populations with fragile socio-economic situations. A longitudinal study conducted in France by Laham et al. (2021) between May 2020 and April 2021 examined anxiety and depressive symptoms associated with feelings of loneliness and social support. The results indicate that depressive and anxiety symptoms were related to strong feelings of loneliness. However, the anxiety assessed in these studies is not necessarily the same as that examined in the present study, mainly because they do not necessarily use the same measurement tools. An Irish study by Hyland et al. (2020) indicates that the prevalence of anxiety disorders during lockdown was around 20%, and was associated with older age, being female and a perceived fear of COVID-19. The same results were also found in a Polish study by Malesza & Kaczmarek (2021). At the same time, a study explored the perceived fear of COVID 19 feelings. In this study Fitzpatrick et al. (2020) indicated that these fears were more prevalent among female individuals, families with children as well as socially vulnerable individuals. Moreover, perceived fear of COVID-19 was associated with poorer mental health (Ornell et al., 2020; Satici et al., 2020). In the same line the longitudinal study conducted in China by Chi et al. (2021) indicates that some adolescents who are particularly vulnerable due to a history of trauma or family financial insecurity have persistent post-traumatic symptoms due to the pandemic. In addition to an anxious tendency being part of the personality, cognitions and beliefs (i.e., rational and irrational beliefs) can also represent a vulnerable factor influencing the way one faces the current situation.

The rational and irrational beliefs described by Ellis et al. (2007) influence the way we perceive our environment and our emotional state. These beliefs can be described as a model of responses or consequences to situations of emotional distress caused by the internal state of mind or the external environment and which results from our evaluation and beliefs (Hyland et al., 2020). Rational beliefs are assumed to lead to functional consequences while irrational beliefs lead to dysfunctional consequences (David et al., 2005). To put it another way, rational thinking is supposed to be flexible and able to adapt to the situation, as in the idea “it would be good if I succeeded in this action”, whereas irrational beliefs would be rigid and inflexible in the face of a situation, as in the idea “I absolutely must succeed in this action”. These rational and irrational beliefs are based on four pillars of belief: high personal standards, intolerance of frustration, catastrophism, and a global devaluation of self and others (Walburg et al., 2014). For each pillar we can add irrational beliefs or in contrast, rational and more balanced beliefs. Indeed, rational thoughts would be more associated with less emotional distress than irrational thoughts (Cramer & Kupshik, 1993). Recent studies have shown that rational beliefs are more associated with the adoption of health behaviors such as social distancing, and respect for lockdown or vaccination (Stanković et al., 2021; Teovanović et al., 2021). In addition, the study of Hyland et al. (2019) showed that irrational beliefs could be associated with a feeling of loneliness.

It is then possible that during the restrictions linked to the pandemic the feeling of loneliness was exacerbated in people with particularly strong irrational beliefs, and that this was anxiety-provoking. Finally, the experimental study conducted by [Harris et al. \(2006\)](#) has highlighted that in a stressful situation, people with irrational beliefs also had higher anxiety levels.

Moreover, as indicated by [Rogers and Walker \(2016\)](#) the self-perception of fragility or vulnerability concerning health is associated with the idea of uncertainty. Therefore, the uncertainties associated with the period of the pandemic particularly exacerbate this feeling of vulnerability or fragility in health. Indeed, the study by [Szabo et al. \(2020\)](#) shows that the perception of oneself as a person at risk for COVID increases the stress experienced during the illness. It is therefore possible that anxious traits and a rather rigid way of seeing the situation, increase the perception of vulnerability to the disease in general and the fear of COVID-19 more specifically. One previous study ([Broche-Pérez et al., 2020](#)) indicated that this fear of COVID-19 may be influenced by sociodemographic variables such as gender.

It seems relevant to study the vulnerability factors involved in the experience and the way of coping with the current pandemic as well as the more or less worrying perception of SARS-CoV-2. Therefore, the purpose of the present study was to explore the relationship among rational and irrational beliefs, anxiety traits, and feelings of vulnerability concerning illness and fear of COVID-19. The first hypothesis states that feelings of vulnerability to illness and fear of COVID-19 are influenced by sociodemographic characteristics, as well as experiences such as whether one has been exposed to COVID-19 or not. The second hypothesis assumes that a high score for irrational beliefs and trait anxiety increases the likelihood of a high score for vulnerability to illness and fear of COVID-19. Finally, the third and last hypothesis assumes that a high rational belief score decreases the likelihood of a high disease vulnerability score and fear of COVID-19.

2. Method

2.1. Participants

For the choice of the sample size, the rule of about five multiplied by the number of items was applied. This gave a range between 250 and 350 participants ([Samuels, 2015](#)). An a posteriori statistical power analysis concerning hierarchical regressions was performed using an online software “free Statistic calculator” version 4.0. This analysis indicates 0.98 for the dependent variable of disease vulnerability and 0.95 for fear of COVID-19.

Three hundred and forty-two individuals participated in this study, of which 290 (84.8%) were women and 52 (15.2%) were men. The mean age of the participants was 34 years ($SD = 13.6$) with a range of 18 to 72 years. Inclusion criteria were informed consent, ability to understand the French language, and being at least 18 years old.

The detailed sociodemographic data is shown in [Table 1](#) below. Three hundred and forty-two individuals participated in this study, of which 290 (84.8%) were women and 52 (15.2%) were men. The mean age of the participants was 34 years ($SD = 13.6$) with a range of 18 to 72 years. Inclusion criteria were informed consent, ability to understand the French language, and being at least 18 years old.

Half of the participants were professionally active and more than a third were students. Most of the participants had a university education, were in a relationship or were single. In addition, the majority of participants had not been personally affected by COVID-19, did not feel particularly vulnerable, and did not suffer from chronic diseases.

2.2. Measures

Sociodemographic data such as age, sex, education level, occupation and marital status were collected with an anamnestic questionnaire. Questions concerning possible COVID-19 infection history were added, namely, if the participant had suffered from COVID-19 himself or herself, or whether the participant perceived himself or herself as being particularly at risk or as suffering from a chronic disease or comorbidities.

Table 1
Sociodemographic data.

		N	%
Professional status	Without professional activity	41	12.0
	Professionally active	173	50.6
	Students	128	37.4
Education level	Less than High School degree	28	8.2
	High school degree	40	11.7
	University degree	274	80.1
Marital status	Single	119	34.8
	In a relationship	195	57
	Separated	26	7.6
	Widow	2	0.6
Have you been affected COVID-19 in the last few months?	No	297	86.8
	Yes	45	13.2
Do you have relatives who have been affected by COVID-19?	No	202	59.1
	Yes	140	40.9
Do you currently suffer from any chronic diseases?	No	270	78.9
	Yes	72	21.1
Do you think you are particularly vulnerable to COVID-19 (age, diabetes, overweight, heart disease)?	No	282	82.5
	Yes	60	17.5

The feeling of vulnerability to disease was evaluated using the Disease Worry Scale (Robbins & Kirmayer, 1996) adapted into French by Langlois et al. (2007). This questionnaire assesses people’s worries about getting sick. Examples of items are: “I think I worry more about my health than most people” or “I get sick easily” can be mentioned. This is a five-point Likert-type questionnaire, with nine items, that explores concerns and feelings of vulnerability to illness and the ratings range from “Not at all matching” which is rated 1, to “Fully matching” rated 5. The score varied between 9 and 45 and the Cronbach’s alpha is 0.86 and omega coefficients is 0.86.

Fear of COVID-19 was assessed using the fear of COVID-19 scale (FCV-19S) devised by Ahorsu et al. (2020) and validated in French by Mailliez et al. (2021). This questionnaire assesses the fear that COVID-19 evokes in people, and examples of items are: “thinking about Covid-19 makes me uncomfortable” and “I am afraid of dying of Covid-19” or “I can’t sleep because I’m worried about having Covid-19”. This is a Likert-type questionnaire with seven items and ratings range from 1 “Strongly disagree” to 7 “Strongly agree”. The score varied between 7 and 49, and the Cronbach’s alpha is 0.85 and omega coefficients was 0.87.

Rational and irrational beliefs were assessed using the Rational and Irrational Beliefs Scale - RIBS (Ellis et al., 2007) used in the French language by several previous studies (Callahan & Denis, 2013; Walburg et al., 2013, 2014). It is a 12-item Likert-type scale with five points ranging from 1 “Really disagree” to 5 “Completely agree”. The items have been adapted to the situation about being infected by the COVID-19 virus during a pandemic. Among the items, five concern rational beliefs, five concern irrational beliefs and two are buffer items. For rational items we can mention “I don’t want to be infected by this virus, but I realize and accept that things don’t always happen as I expect” or “It is unpleasant to be sick but it does not have to be terrible” and “I can handle the idea of being infected with this virus even if it is difficult for me to accept it” as an example; and “I absolutely must not be infected by this virus” or “If I am infected with this virus it means that I am a weak person” and “I would tend to blame others and the world if I were infected with this virus” for irrational items. The items are constructed based on four pillars. Cronbach’s alpha is 0.61 for rational items and 0.73 for irrational items, and the omega coefficients were 0.63 and 0.75 respectively. A confirmatory factorial analysis was carried out with two indicators out of three whose values are a little far from the expected norms, namely, the RMSEA at 0.09 whereas the expected norm is lower than 0.06, the SRMR at 0.07 with

an expected norm < 0.08 and the CFI at 0.83 instead of > 0.9 . This indicates rather weak psychometric properties which must lead to relativize without invalidating the obtained results.

Trait anxiety was assessed using the Y-B form of the State Trait Anxiety Inventory (Spielberger et al., 1993) validated in French. It is a four-point Likert-type scale with response modalities ranging from 1 “almost never” to 4 “almost always”. Items 2,4,5,8,9,11,12,15,17,18,20 are scored in reverse order, the score varied between 20 and 80, Cronbach’s alpha was 0.94 and omega coefficients is 0.95. Examples of such items are “I feel incompetent, not up to the task” or “I have thoughts that disturb me”.

2.3. Procedure

The study received a favorable advice from the ethics committee of the Federal Universities of Toulouse with the reference 020-307. The data were collected on the Internet using a secure platform (Sphinx Campus). The link to the questionnaire was posted on various social media pages (Facebook, Twitter, Instagram) respondents were invited to participate in a survey regarding their experiences with the COVID-19 pandemic. The data was collected between January and March 2021. All participants gave their informed consent and were informed of their right to refuse or withdraw their participation. Participants responded first to the anxiety scale, followed by the rational and irrational beliefs scale, then the vulnerability perception scale, the fear of COVID-19 scale and finally the anamnestic questions. It was decided to present the sociodemographic and COVID experience questions last to avoid overly influencing the answer choices for the other questionnaires. The data was collected in a totally anonymous manner and is being stored in a secure location until it is published, after which it will be destroyed.

2.4. Statistics

The data was analyzed with Jamovi[®] software. First, descriptive frequencies of the participants’ characteristics were calculated. Then comparisons of means according to the experience with COVID-19 of the participants as well as some sociodemographic characteristics were performed. These comparisons of means were performed with a non-parametric Mann-Whitney U test because the distribution of the scores did not follow a normal distribution. Finally, two stepwise regression analyses in relation to factors explaining vulnerability perception concerning health as well as fear of COVID-19 were conducted. Given the statistical analyses envisaged and the number of variables, the minimum sample size was estimated at 130 participants.

3. Results

Table 2 below shows the results of comparisons of means concerning vulnerability perception concerning health and fear of COVID-19 according to sociodemographic variables and life experience concerning COVID-19.

Results regarding perceived health vulnerability indicated an influence of educational level with significantly lower perceived vulnerability among individuals with higher education ($m = 15.6$; $SD = 6.07$) compared to participants with a high school graduate level (21.3 ; $SD = 9.07$) or lower ($m = 18.5$; 8.07); $X^2(2) = 16.24$; $p < 0.001$. In addition, having a chronic illness ($m = 18.2$; $SD = 6.88$) induced a significantly greater perception of vulnerability than not having this type of pathology ($m = 16.1$; $SD = 6.85$); $U = 7454$; $p = 0.002$. Likewise, people who perceive themselves as particularly vulnerable to COVID-19 ($m = 19.7$; $SD = 8.02$) compared to people who do not perceive themselves as vulnerable ($m = 15.8$; $SD = 6.46$); $U = 5788$; $p < 0.001$.

However, occupational status ($X^2(2) = 2.46$; $p = 0.29$), marital status ($X^2(2) = 1.93$; $p = 0.38$), gender ($U = 6223$; $p = 0.04$), or having or not having children ($U = 12936$; $p = 0.26$) did not affect the perception of this vulnerability when the Bonferroni correction was taken into account. The same was true for having been infected with COVID-19 ($U = 6329$; $p = 0.56$) or having relatives infected ($U = 13266$; $p = 0.33$).

Table 2

Mean comparison with a Man-Witney and Kruskal Wallis test concerning perception of vulnerability regarding health, fear of COVID-19 according to sociodemographic data and life experience with COVID-19.

		Vulnerability perception concerning health			Fear of COVID-19		
		Mean	SD	p/Effect Size	Mean	SD	p/Effect Size
Professional status	Without professional activity n = 41	17.5	7.76	0.29/0.01	16.3	8.57	0.53/0.01
	Professionally active n = 173	16.3	7.27		15.1	6.60	
	Students n = 128	16.5	6.08		14.3	5.63	
Marital status	Single n = 120	16.2	6.73	0.38/0.01	13.3**	5.51	0.002/0.04
	In a relationship n = 195	16.8	6.94		15.9**	6.92	
	Separated n = 26	15.8	7.51		15.5	6.89	
Education level	University degree n = 274	15.6***	6.07	<0.001/0.01	14.7	5.91	0.39/0.04
	High school degree n = 40	21.3***	9.07		17.00	9.62	
	Less than High School degree n = 28	18.5	8.07		14.1	6.75	
Having children	No n = 208	16.6	6.63	0.26/0.07	14.5	6.45	0.12/0.10
	Yes n = 134	16.4	7.34		15.5	6.66	
Gender	Men n = 52	15.2	6.65	0.04/0.17	13.7	5.77	0.21/0.11
	Women n = 290	16.8	6.93		15.2	6.65	
Have you been affected COVID-19 in the last few months?	No n = 297	15.9	6.45	0.56/0.05	14.9	6.46	0.75/0.02
	Yes n = 45	15.9	6.45		15.3	7.3	
Do you have relatives who have been affected by COVID-19?	No n = 202	16.4	7.12	0.33/0.06	14.7	6.61	0.29/0.06
	Yes n = 140	16.7	6.6		15.2	6.45	
Do you currently suffer from any chronic diseases?	No n = 270	16.1	6.85	0.002/0.23	14.6	6.51	0.04/0.15
	Yes n = 72	18.2	6.88		16.0	6.59	
Do you think you are particularly vulnerable to COVID-19 (age, diabetes, overweight, heart disease)?	No n = 282	15.8	6.46	<0.001/0.31	14.4	5.94	0.003/0.25
	Yes n = 60	19.7	8.02		17.6	8.40	
Age		Rho -0.17		p 0.003	Rho 0.10		p 0.85

Post-hoc Dwass-Steel-Critchlow-Fligner pairwise comparison. Bonferroni correction 0.05/10 = 0.005. Post-hoc analysis: * p < 0.05; ** p < 0.01; *** p < 0.001.

Table 3
Step-by-step regression analysis for factors associated with vulnerability perception concerning health.

		β	p	F	df	R ² adj
Step 1	Education Level	-0.78	0.006	12.2	4.337	0.116
	Do you currently suffer from any chronic diseases?	2.01	0.03			
	Do you think you are particularly vulnerable to COVID-19?	3.55	<0.001			
Step 2	Age	-0.12	<0.001	34.9	5.336	0.332
	Education Level	0.37	0.13			
	Do you currently suffer from any chronic diseases?	0.94	0.25			
	Do you think you are particularly vulnerable to COVID-19?	3.15	<0.001			
Step 3	Age	0.01	0.92	38	6.335	0.395
	Anxiety trait	0.28	<0.001			
	Education Level	-0.24	0.31			
	Do you currently suffer from any chronic diseases?	1.32	0.08			
	Do you think you are particularly vulnerable to COVID-19?	2.98	<0.001			
	Age	-0.01	0.21			
	Anxiety trait	0.24	<0.001			
Step 4	Rational believes	-0.63	<0.001	36.4	7.334	0.421
	Education Level	-0.26	0.26			
	Do you currently suffer from any chronic diseases?	1.27	0.09			
	Do you think you are particularly vulnerable to COVID-19?	2.25	0.006			
	Age	-0.05	0.09			
	Anxiety trait	0.22	<0.001			
	Rational believes	-0.41	<0.001			
Irrational believes	0.41	<0.001				

Table 4
Step-by-step regression analysis for factors associated with fear of COVID-19.

		β	p	F	df	R ² adj
Step 1	Marital status	1.67	0.004	10.5	2.339	0.052
	Do you think you are particularly vulnerable to COVID-19?	3.18	<0.001			
Step 2	Marital status	2.15	<0.001	20.6	3.338	0.147
	Do you think you are particularly vulnerable to COVID-19?	3.03	<0.001			
Step 3	Anxiety trait	0.16	<0.001	19.2	4.337	0.176
	Marital status	1.94	<0.001			
	Do you think you are particularly vulnerable to COVID-19?	2.84	<0.001			
	Anxiety trait	0.14	<0.001			
Step 4	Rational believes	-0.41	<0.001	21.0	5.336	0.226
	Marital status	1.6	0.003			
	Do you think you are particularly vulnerable to COVID-19?	1.73	0.04			
	Anxiety trait	0.12	<0.001			
	Rational believes	-0.12	0.36			
	Irrational believes	0.53	<0.001			

In relation to fear of COVID-19, people in couples ($m = 15.9$; $SD = 6.92$) were significantly more afraid than single people ($m = 13.3$; $SD = 5.51$); $X^2(2) = 12.51$; $p = 0.002$. Similarly, individuals who perceived themselves as particularly at risk for COVID-19 had significantly greater fear ($m = 17.6$; $SD = 8.40$) compared to those who did not perceive themselves to be at risk ($m = 14.4$; $SD = 5.94$); $U = 6391$; $p = 0.003$.

However, professional status ($X^2(2) = 1.26$; $p = 0.53$), level of education ($X^2(2) = 1.86$; $p = 0.39$), having children ($U = 12537$; $p = 0.12$), gender ($U = 6715$; $p = 0.21$), having had COVID-19 yourself ($U = 6488$; $p = 0.75$) or loved ones having it ($U = 13190$; $p = 0.29$), or having a chronic illness ($U = 8221$; $p = 0.04$) did not affect fear of COVID-19 when applying the Bonferroni correction.

In addition, a Spearman correlation analysis indicated a negative and significant correlation between age and perceived vulnerability to disease ($\rho = -0.16$; $p = 0.003$) but no significant relationship between age and fear of COVID-19 ($\rho = 0.01$; $p = 0.85$).

Tables 3 and 4 show stepwise regressions including sociodemographic variables which were previously significant at $p < 0.005$ in univariate analyses, also including anxiety trait, rational and irrational beliefs that predict the perception of vulnerability concerning health and fear of COVID-19.

Table 3 below shows the results of a step-by-step regression analyses for factors associated with vulnerability perception concerning health.

Step 1 indicated that education ($\beta = -0.78$; $p = 0.006$) and age ($\beta = -0.12$; $p < 0.001$) are inversely associated with perceived vulnerability while suffering from chronic disease ($\beta = 2.01$; $p = 0.03$) and perceiving oneself as particularly vulnerable to COVID-19 ($\beta = 3.55$; $p < 0.001$) is positively associated. The model ($F(4.337) = 12.2$; $p < 0.001$) explains 11.6% of the variance. In step 2 the score of the anxiety trait is introduced into the model. At this point, only the perception as a particularly vulnerable person to COVID-19 ($\beta = 3.15$; $p < 0.001$) and the trait anxiety ($\beta = 0.28$; $p < 0.001$) are positively associated with vulnerability perception concerning health. The model ($F(5.336) = 34.9$; $p < 0.001$) explains 33.2% of the variance. Step 3 introduces the rational beliefs in the model. Perceiving oneself as particularly vulnerable to COVID-19 ($\beta = 2.98$; $p < 0.001$) as well as trait anxiety ($\beta = 0.24$; $p < 0.001$) is positively associated with perceived vulnerability to health, whereas rational beliefs ($\beta = -0.63$; $p < 0.001$) are inversely associated with it and the model ($F(6.335) = 38$; $p < 0.001$) explains 39.5% of the variance. Finally, in step 4, irrational beliefs were also introduced into the system. In this last model, the perception of vulnerability to health ($\beta = 2.25$; $p = 0.006$), trait anxiety ($\beta = 0.22$; $p < 0.001$) and irrational beliefs ($\beta = 0.41$; $p < 0.001$) are positively associated with the perceptions of vulnerability to the disease. Rational beliefs ($\beta = -0.41$; $p < 0.001$) are inversely associated with the perception of vulnerability to the disease, and the model ($F(7.334) = 36.4$; $p < 0.001$) explains 42.1% of the variance.

Table 4 below shows the results of a step-by-step linear regression for factors associated with COVID-19.

Step 1 included marital status ($\beta = 1.67$; $p = 0.004$) and seeing oneself as particularly vulnerable to COVID-19 ($\beta = 3.18$; $p < 0.001$) both were positively associated with fear of COVID-19, the model ($F(2.339) = 10.5$; $p < 0.001$) explained 5.3% of the variance. In step 2 the trait anxiety score is introduced. All three variables, namely, marital status ($\beta = 2.15$; $p < 0.001$), perception as particularly vulnerable to COVID-19 ($\beta = 3.03$; $p < 0.001$) and trait anxiety ($\beta = 0.16$; $p < 0.001$) are positively associated with fear of COVID-19. The model ($F(3.338) = 20.6$; $p < 0.001$) explained 14.7% of the variance. At step 3, rational beliefs are added to the model. Marital status ($\beta = 1.9$; $p < 0.001$) perceiving oneself as particularly vulnerable to COVID-19 ($\beta = 2.84$; $p < 0.001$) and trait anxiety ($\beta = 0.14$; $p < 0.001$) are positively associated with fear of COVID-19. Rational beliefs ($\beta = -0.41$; $p < 0.001$) were inversely associated with fear of COVID-19 and the model ($F(4.337) = 19.2$; $p < 0.001$) explained 17.6% of the variance. In step 4 irrational beliefs have been added. Marital status ($\beta = 1.6$; $p = 0.003$), perceiving oneself as particularly vulnerable ($\beta = 1.7$; $p = 0.04$), trait anxiety ($\beta = 0.12$; $p < 0.001$) as well as irrational beliefs ($\beta = 0.53$; $p < 0.001$) were positively associated with fear of COVID-19. However, rational beliefs were no longer significantly associated and the model ($F(5.336) = 21.0$; $p < 0.001$) explained 22.5% of the variance.

4. Discussion

The purpose of the present study was to explore factors associated with vulnerability perception regarding health in general and fear of COVID-19 more specifically. The first hypothesis states that a person's perceptions of vulnerability to illness and fear of COVID-19 are influenced by sociodemographic characteristics as well as experiences such as whether they have been exposed to COVID-19 or not. The perception of health vulnerability seems to be influenced mainly by the level of education insofar as people with higher education have a lower level of vulnerability perception, which is in line with the study by De Coninck et al. (2020). It is possible that people with higher levels of education feel more empowered to seek and access information about their health that allows them to feel less vulnerable. However, age seems to have little influence on this perception of vulnerability, which is contrary to a previous study by Hyland et al. (2020). This difference can be explained by the fact that ours was a rather young population that did not really perceive itself as vulnerable (Commodari & La Rosa, 2020). In addition, perceiving oneself as a COVID-19-vulnerable person is quite logically associated with greater perceived health vulnerability. Indeed, people with comorbidities known to be risk factors for severe cases of the disease, such as advanced age, diabetes or heart disease as indicated

in a French study by [Ouattara et al. \(2021\)](#) will have a greater perception of vulnerability. The fear of COVID-19 seems to affect more people who live in a couple. It is possible to explain this by the fact that these people feel responsible for another person and this increases the level of anxiety felt. Finally, knowing that one is a person with risk factors for severe forms of the disease ([Ouattara et al., 2021](#)) is logically associated with a higher level of fear. The second hypothesis presumes that a high score for irrational beliefs and trait anxiety increases the likelihood of a high score for vulnerability regarding health and fear of COVID-19. In accordance with our expectations, trait anxiety and irrational beliefs increased the probability of a higher level of perceived vulnerability to health as well as fear of COVID-19. Moreover, these two variables were the best predictors in both cases. Thus, having a greater intrinsic tendency toward anxiety or particularly rigid or inflexible beliefs increases the risk of pandemic-related worries or of seeing oneself as particularly vulnerable to the pandemic. This is consistent with previous studies ([Commodari & La Rosa, 2020](#); [Fitzpatrick et al., 2020](#); [Malesza & Kaczmarek, 2021](#)). Lastly, the third hypothesis assumes that a high rational belief score decreases the likelihood of a high disease vulnerability score and fear of COVID-19. Rational beliefs, that is, beliefs that are flexible and adjustable to the demands of the context, decrease the likelihood of perceiving oneself as a vulnerable person with respect to health; however, these beliefs are only modestly related to fear of COVID-19 and only if irrational beliefs are not considered which either indicate an indirect effect or that rational beliefs are not related to fear of COVID-19.

4.1. Limitations

This study has several limitations. First, we considered whether participants and relatives had contracted COVID-19, but we did not specify the severity of the disease if this was the case or if hospitalization was required. The severity of illness or hospitalization may affect the outcome of the study. Even more, so since it is highly likely that most participants who contacted COVID-19 did not develop severe forms of the disease. Secondly, as has already been mentioned several times, the population was predominantly represented by young people, with one third of the participants being students, so it might have been better to target more people in the risk categories. However, the purpose of this study was to explore these variables in a general population without targeting specific categories, which may be the subject of a future study. Also, the difference in population distribution between men and women may have affected the results of the study carried out by [Khan et al. \(2021\)](#), as a previous study highlighted gender differences in the experience of the pandemic. However, in the present study, gender did not appear to influence the outcome. What is more, the questionnaire used to assess rational and irrational beliefs had rather moderate internal cohesion. In addition, the questionnaire as a translated tool that has already been used in French publications, but it has not yet been validated. Finally, irrational beliefs, although particularly inflexible, can perhaps be appropriate when a person has comorbidities associated for severe forms of the disease, which must be considered a limitation of the present study. And presenting the questionnaire in a fixed order may also be a bias, nevertheless this choice also allowed the anamnestic questionnaire to be presented at the end because questions about the personal history with COVID-19 could have influenced responses about illness beliefs. In terms of statistical limitations, the heterogeneity of the numbers involved in the comparisons of means can increase the risk of type I error, this limitation implies that the study should be replicated to confirm or correct the results. Finally, assessing trait anxiety rather than state anxiety was perhaps not particularly appropriate for the purpose of the research. Indeed, the anxiety experienced by individuals and observed in another study ([Hyland et al., 2020](#)) may have been generated directly by the pandemic situation. Especially as most of the studies that have focused on anxiety during this pandemic do not specifically address trait anxiety, which is a limitation to the comparability with other studies that must be taken into consideration.

4.2. Implications

The implications of the results of this study highlight the role of trait anxiety and irrational beliefs in health-related concerns in general and COVID-19 more specifically, observed during this pandemic ([Haider et al., 2020](#); [Khan et al., 2020](#)). This observation is irrespective of whether one has risk factors

for severe forms of the disease or has contracted COVID-19 either personally or has been contracted by other family members. Therefore, it cannot be excluded that the increase in psychological disorders observed since the pandemic is influenced by pre-existing vulnerabilities, such as a trait anxiety or a particularly intransigent and inflexible way of perceiving the world, that have been exacerbated by the pandemic. Future studies are needed to better understand the underlying mechanisms involved.

To conclude, we can retain from this study that anxious traits and a particularly rigid way of considering the world influence the way of experiencing the current pandemic. This may also offer ideas for therapeutic treatment for health professionals working with patients who are particularly concerned by this pandemic.

Disclosure of interest

The authors declare that they have no competing interest.

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