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

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Original Research

Effect of ontological insecurity on vaccination behavior against COVID-19: a hospital-based cross-sectional study

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ABSTRACT

Objective: Coronavirus disease 2019 (COVID-19) has brought great uncertainty to our society and it may have disrupted people's ontological security. Consequently, this hospital-based study concerns the impact of ontological insecurity on vaccination behavior against COVID-19.
Study design: This cross-sectional study was conducted among hospital inpatients.
Methods: A questionnaire survey addressing inpatient ontological insecurity and vaccination behavior against COVID-19 was administered in Taizhou, China. A total of 1223 questionnaires were collected; specifically, 1185 of them were credible, for a validity rate of 96.9%.
Results: The score of ontological insecurity was 13.27 ± 7.84, which was higher in participants who did not recommend vaccination for others than those who did (12.95 ± 8.25 vs 14.00 ± 6.78, $P = 0.022$). There was no difference between the vaccinated and unvaccinated groups (13.22 ± 7.96 vs 13.35 ± 7.67, $P = 0.779$). Lower ontological insecurity (odds ratio [OR] = 1.40, 95% confidence interval [CI]: 1.08–1.81) and being inoculated with COVID-19 vaccines (OR = 2.17, 95% CI: 1.67–2.82) were significantly associated with recommendation of COVID-19 vaccines to others after adjusting for sex, age, education, and occupation. Associations between low ontological insecurity and recommendations for COVID-19 vaccines were observed in men, adults aged 18–59 years, non-farmers, and vaccine recipients.
Conclusions: This study suggests that the ontological insecurity of participants affects their behavior of recommending the COVID-19 vaccination to others rather than getting vaccinated themselves. This promotion of vaccination can be considered from the perspective of improving ontological security in China.

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has caused thousands of deaths and severely affected the global economy and healthcare systems. Many countries have adopted social distancing and lockdown policies to control the disease's spread. In China, a high-intensity 'joint prevention and control' strategy has played an important role in containing epidemics; nevertheless, people's social and living conditions are affected by this approach. In several countries, discrimination and violence broke out after limiting social distancing for long periods.[1,2] These results indicate that people's sense of ontological security is disrupted by changes in social and living environments.[3] The concept of ontological security

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proposed by Anthony Giddens,[4] following psychologist Robert Laing (1960),[5] was described as the 'confidence that most human beings have in the continuity of their self-identity and in the constancy of the surrounding social and material environments.' Once a positive COVID-19 case is identified, a series of tightened measures for the prevention and control of COVID-19 such as taking body temperature, wearing face masks, social distancing, checking health codes, and enforcing travel codes would heighten people's concerns about the situation and increase their sense of insecurity.

Recent research has suggested serious illness potentially threatens people's sense of ontological security.[6] Hospitalized patients often experience more complex diseases, resulting in a sense of insecurity. In addition, hospitals are high-risk places for the spread of the epidemic, which may further reduce people's sense of security. Illness narratives relying on perceptions of emotional and ontological security can in turn elicit adaptive responses to threats.[7,8] A systematic review found positive changes in health-promoting behaviors through narrative interventions.[9] However, few studies have focused on the influence of perceived scarcity of ontological security on the possible behavioral changes of individuals.

To date, vaccination against COVID-19 has been the primary preventive measure. Nonetheless, our previous study found that a significant proportion of people are still reluctant to receive vaccinations.[10] In the present study, we further examine the relationship between ontological insecurity and health-promoting behaviors in hospitalized patients, including self-vaccination and recommendations for vaccination against COVID-19.

Methods

Study design and data collection

A face-to-face hospital-based cross-sectional questionnaire survey was administered in Taizhou, China, by uniformly well-trained and qualified nurses using the WeChat-Inc Wen-Juan-Xing platform. The target population were inpatients admitted to Taizhou Hospital during routine COVID-19 epidemic prevention and control. The inpatients were invited to answer the questionnaire voluntarily by scanning the quick response (i.e. 'QR') code on WeChat when they first arrived between July 11 and August 9, 2021. A total of 1223 questionnaires were collected. Redundant questionnaires identified by duplicate identity numbers were removed and only those submitted for the first time were retained. The questionnaires that contained unreasonable information or were answered too quickly were excluded. Finally, 1185 interviewees with valid data were included, thus corresponding to an eligibility rate of 96.9% (1185/1223). The present study was exempted from the requirement for written informed consent and was approved by the Ethics Committee of Taizhou Hospital of Zhejiang Province (approval number: K20210521) in China. All procedures were performed in accordance with the guidelines of the institutional ethics committee of the authors and adhered to the tenets of the Declaration of Helsinki.

Structured questionnaires and measurement

A structured questionnaire comprising several parts was constructed. Its preface described the background and purpose of the survey; also, it would be answered anonymously and voluntarily following informed consent. Demographic information included age, sex, residence, educational level, and occupation. The questionnaire's content also included patients' knowledge about COVID-19 and its prevention and control measures, individual behaviors of prevention and control both before and after admission, and evaluation of the implementation of prevention and control measures in the hospital. The major topics were ontology insecurity and health behaviors, including self-vaccination and recommendations of others for COVID-19 vaccines. The underlying condition of primary ontological insecurity was measured using the first subscale of the newly developed Ontological Insecurity Scale (OIS) with 34 items (OIS-34 scale).[11] The primary ontological insecurity subscale comprises nine items. Responses were scored on the following 5-point Likert scale:0 = *Not at all like me*; 1 = *A little like me*; 2 = *Moderately like me*; 3 = *Very much like me*; or 4 = *Completely like me*. The total score ranges from 0 to 36, where the higher the score, the stronger the ontology insecurity, indicating the lack of a secure sense is more severe. Vaccination behaviors were measured by the following two questions: 'Have you been vaccinated against COVID-19?' (response options: 'yes' or 'no') and 'Have you recommended anyone for the COVID-19 vaccines?' (response options: 'yes' or 'no'). All questions were close-ended, with boxes provided for checked responses.

Statistical analysis

We performed a logical check of the data, excluding those who were under 18 years of age and those who answered within 120 s. Categorical variables regarding basic demographic characteristics and vaccination behaviors were expressed as counts and percentages. The mean and standard deviation were calculated for ontological insecurity. The relationship between vaccination behaviors and ontological insecurity was tested using the Chi-squared test. After classifying high and low ontological insecurity according to the mean score, binary logistic regression models were used to analyze the impact of ontological insecurity on vaccination behavior and the behavior of recommending vaccination to anyone, and the odds ratios (ORs) and corresponding 95% confidence intervals (CIs) were calculated. All data were analyzed using IBM's SPSS version 22.0 and the differences were considered statistically significant at $P < 0.05$.

Results

Of the 1223 collected questionnaires, 27 were excluded due to patients' ages being under 18 years old; notably, one was excluded because of too short a time (less than 120 s) to complete the questionnaire. In addition, 10 redundant questionnaires were excluded owing to duplicate submissions. Finally, 1185 qualified questionnaires were analyzed in this study. The mean (±SD) age was 51.7 ± 16.6 years with 54.3% being female.

Distribution of two vaccination behaviors including vaccination for themselves and recommendations to anyone for COVID-19 vaccination

Overall, 707 participants (59.7%) had been vaccinated against COVID-19 and 819 (69.1%) reported they recommended others for COVID-19 vaccines. The percentage of those who recommended anyone for COVID-19 vaccination was significantly higher in vaccinated patients than in unvaccinated ones (75.2% vs 60.0%, $\chi^2 = 30.89$, $P < 0.001$). The rate of COVID-19 vaccination was higher in men (63.7% vs 56.3%, $\chi^2 = 6.61$, $P = 0.01$) and workers (73.7% vs 58.4%, $\chi^2 = 8.892$, $P = 0.003$) than in their counterparts. The behavior of recommending COVID-19 vaccines to anyone was

Table 1
The relationship between sociodemographic characteristics, ontological insecurity and COVID-19 vaccination behavior.

Characteristics	Classification	*N* (%)	Have you been vaccinated against COVID-19?			Do you recommend anyone for the COVID-19 vaccines?		
			Yes	No	*P*	Yes	No	*P*
			(*n* = 707, 59.7%)	(*n* = 478, 40.3%)		(*n* = 819, 69.1%)	(*n* = 366, 30.9%)	
Sex					**0.010**			**0.026**
	Men	542 (45.7)	345 (63.7)	197 (36.3)		357 (65.9)	185 (34.1)	
	Women	643 (54.3)	362 (56.3)	281 (43.7)		462 (71.9)	181 (28.1)	
Age (years)					0.657			**<0.001**
	18−59	787 (66.3)	466 (59.2)	321 (40.8)		584 (74.2)	203 (25.8)	
	≥60	398 (33.6)	241 (60.6)	157 (39.4)		235 (59.0)	163 (41.0)	
Residence					0.416			0.108
	Urban	253 (21.4)	143 (56.5)	110 (43.5)		183 (72.3)	70 (27.7)	
	Town	303 (25.6)	188 (62.0)	115 (38.0)		218 (71.9)	85 (28.1)	
	Rural	629 (53.1)	376 (59.8)	253 (40.2)		418 (66.5)	211 (33.5)	
Education					0.087			**<0.001**
	Primary and below	487 (41.1)	301 (61.8)	186 (38.2)		296 (60.8)	191 (39.2)	
	Junior Secondary	343 (28.9)	201 (58.6)	142 (41.4)		239 (69.7)	104 (30.3)	
	Senior Secondary	171 (14.4)	109 (63.7)	62 (36.3)		136 (79.5)	35 (20.5)	
	College and above	184 (15.5)	96 (52.2)	88 (47.8)		148 (80.4)	36 (19.6)	
Occupation					**0.014**			**<0.001**
	Civil servants, staff or professionals	158 (13.3)	87 (55.1)	71 (44.9)		129 (81.6)	29 (18.4)	
	Workers	99 (8.4)	73 (73.7)	26 (26.3)		68 (68.7)	31 (31.3)	
	Farmers	465 (39.2)	267 (57.4)	198 (42.6)		273 (58.7)	192 (41.3)	
	Others	463 (39.1)	280 (60.5)	183 (39.5)		349 (75.4)	114 (24.6)	
Ontological insecurity score					0.781			**0.008**
	≤13	609 (51.4)	361 (59.3)	248 (40.7)		442 (72.6)	167 (27.4)	
	>13	576 (48.6)	346 (60.1)	230 (39.9)		377 (65.5)	199 (34.5)	
Have you been inoculated with the COVID-19 vaccine					–			**<0.001**
	Yes	707 (59.7)	–	–		532 (75.2)	175 (24.8)	
	No	478 (40.3)	–	–		287 (60.0)	191 (40.0)	
Do you recommend anyone for the COVID-19 vaccine					**<0.001**			–
	Yes	819 (69.1)	532 (65.0)	287 (35.0)		–	–	
	No	366 (30.9)	175 (47.8)	191 (52.2)		–	–	

The bold values indicate that $P < 0.05$, which is statistically significant.

Table 2
Factors associated with the behavior of recommending anyone for COVID-19 vaccines.

Variables	Categories	*P*	OR	95% CI
Ontological insecurity score				
	<13 vs ≥13	**0.011**	1.40	1.08–1.81
Have you been inoculated with the COVID-19 vaccine				
	Yes vs no	**<0.001**	2.17	1.67–2.82
Sex	Women vs men	0.197	1.19	0.91–1.56
Age	≥60 vs 18–59 years	**0.048**	0.73	0.53–0.99
Education	Primary and below	–	1.00	–
	Junior Secondary	0.277	1.21	0.86–1.70
	Senior Secondary	0.053	1.60	0.99–2.59
	College and above	0.132	1.51	0.88–2.59
Occupation	Civil servants, staff or professionals	–	1.00	–
	Workers	0.095	0.57	0.29–1.10
	Farmers	**0.020**	0.51	0.29–0.90
	Others	0.383	0.80	0.48–1.33

The bold values indicate that $P < 0.05$, which is statistically significant.

Table 3
Associations between low ontological insecurity and the behavior of recommending anyone for COVID-19 vaccines in different models.

Model	Stratification	*P*	OR	95% CI
1	Total	**0.011**	1.40	1.08–1.81
2	Men	**0.018**	1.57	1.08–2.29
	Women	0.202	1.26	0.88–1.81
3	18–59 years	**0.003**	1.65	1.18–2.30
	≥60 years	0.944	1.02	0.67–1.54
4	Farmers	0.931	1.02	0.69–1.49
	Non-farmers	**<0.001**	1.86	1.30–2.65
5	Vaccinated	**0.005**	1.66	1.16–2.37
	Unvaccinated	0.502	1.14	0.78–1.67

Model 1: adjusted for sex, age, education, occupation, and self-vaccination status.
Model 2: adjusted for age, education, occupation, and self-vaccination status.
Model 3: adjusted for sex, education, occupation, and self-vaccination status.
Model 4: adjusted for sex, age, education, and self-vaccination status.
Model 5: adjusted for sex, age, education, and occupation.
The bold values indicate that $P < 0.05$, which is statistically significant.

related to sex, age, education level, occupation, and vaccination (Table 1).

Ontological insecurity and two vaccination behaviors

The mean (±SD) score of ontological insecurity was 13.27 ± 7.84, and was higher in those who did not recommend others for vaccination than in those who did (12.95 ± 8.25 vs 14.00 ± 6.78, $P = 0.022$). The patients were divided into high and low ontological insecurities, with a cutoff of 13. The results of the univariate analysis (Table 1) revealed that patients with a lower score of primary ontological insecurity were significantly more likely to recommend vaccination against COVID-19 than those with higher scores of ontological insecurity (72.6% vs 65.5%, $P = 0.008$).

We further calculated the magnitude of the association between ontological insecurity and the behavior of recommending COVID-19 vaccines to anyone in a binary logistic regression model. As shown in Table 2, ontological insecurity (low vs high: OR = 1.40, 95% CI: 1.08–1.81, $P = 0.011$) and vaccination themselves (yes vs no: OR = 2.17, 95% CI: 1.67–2.82, $P < 0.001$) were significantly associated with the behavior of recommending anyone for COVID-19 vaccines after adjusting for the demographic variables. Moreover, the elderly and farmers were not likely to recommend vaccination against COVID-19.

Contrariwise, there was no difference in the score of ontological insecurity between the vaccinated and unvaccinated groups (13.22 ± 7.96 vs 13.35 ± 7.67, $P = 0.779$). Therefore, vaccination behavior was not associated with ontological insecurity ($P = 0.781$; Table 1).

Associations between ontological insecurity and behavior of recommending vaccination in different subgroups

We further performed multiple logistic regression models with different stratifications according to sex, age, occupation, and vaccination status. As displayed in Table 3, overall low ontological insecurity increased the likelihood of recommending COVID-19 vaccination behavior (OR = 1.40, 95% CI: 1.08–1.81, $P = 0.011$). Specifically, the associations were only observed in men (OR = 1.57, 95% CI: 1.08–2.29, $P = 0.018$), adults aged 18–59 years (OR = 1.65, 95% CI: 1.18–2.30, $P = 0.003$), non-farmers (OR = 1.86, 95% CI: 1.30–2.65, $P < 0.001$), and the vaccinated subgroups (OR = 1.66, 95% CI: 1.16–2.37, $P = 0.003$).

Discussion

COVID-19 has brought great uncertainty to society and triggered people's ontological insecurity

A model of ontological insecurity constructed from a sociological perspective showed that social uncertainty plays a growing role within a general framework of subjective insecurity.[12] Individuals' ontological security is often integrated unperceived into their daily lives. However, imperceptible concepts become easier to perceive

when the external environment is threatened by drastic changes. The perceived scarcity of ontological security diminishes confidence in the continuity of self-identity and disturbs a sense of trust and stability.[13] COVID-19 has brought great uncertainty to society, broken people's daily life order, and elicited much COVID-19-related stress and mental health problems like sleep shortness, shortness in temper, family discord,[14] and suicide.[15] During the COVID-19 crisis, many households experienced the lockdown in vulnerable situations and their ontological security was severely weakened.[16] Research in Australia also illustrated that the uncertainties created by the COVID-19 pandemic triggered ontological insecurity.[17]

Ontological security influences people's behavior in a crisis

Research suggests that ontological security is a better predictor of the impact of social and environmental changes on personal security during a pandemic; moreover, it is also a better predictor of people's behavioral trends during a crisis.[18] A study on migrant workers found that people who feel insecure are more likely to engage in risk-taking behaviors.[19] Our recently published study also suggested that ontological insecurity mediated the effects of pandemic-induced disruption to inpatients' lives on their prevention behavior—including washing their hands, wearing facial masks, and social distancing.[20] We also found the more ontologically secure people were, the more inclined they were to choose the behavior of recommending vaccination. This was found especially in men, adults aged 18–59 years, non-farmers, and vaccinated groups.

Ontological security is 'not simply a matter of self-preservation or self-interest,' but relies on 'the well-being of others as well.'[21] As ontological security is essentially a form of trust in continuity, the sense of insecurity reflects a lack of trust and poor relationships. Actively encouraging peers, relatives, and friends to get vaccinated is a sign of good social relations. A discrete choice experiment showed that peer influence and social norms are critical in vaccine decision-making.[22] The behavior of recommending vaccination to others is not only beneficial to others but also to oneself. For most patients with contraindications to vaccines, encouraging others to receive vaccines can build up immunity in the vaccinated individuals and provide a benefit to others in the community via herd immunity, which uses the altruistic nature of vaccines to reduce the opportunity of infection. From a public health perspective, one of the effective vaccination strategies relies on altruistic motivations rather than self-interested goals.[23]

Ontological security, individual risk attitudes and vaccination decisions

As discussed earlier, a perceived scarcity of ontological security can drive people to adopt risk-taking behaviors; conversely, perception of ontological security may influence people to choose risk-averse behaviors. Risk aversion may affect a decision to be vaccinated in two opposite ways: some choose vaccination because they fear the consequences of an infectious disease, whereas others choose not to be vaccinated because they worry about the vaccine's side effects.[24] The research involving the econometric model based on bounded rationality shows that risk aversion has a positive effect on the decision to be vaccinated, a finding that implies that the impact of perceived effectiveness of vaccination outweighs the impact of its perceived side effects.[24,25] Another study also found that risk-averse French general practitioners were more inclined to vaccinate against influenza—both for themselves and their patients.[26]

The results of this study showed that ontological security was associated with the behavior of recommending COVID-19 vaccines to others, although the association with self-vaccination behavior was not statistically significant. Participants with higher levels of ontological insecurity were less likely to recommend others for vaccination against COVID-19. As a risk-averse behavior, encouraging others to get vaccinated can both prevent them from suffering from adverse reactions to the vaccine and protect them from infection caused by the altruistic nature of the vaccine. Accordingly, our results are consistent with established theories of ontological security and decision-making under risk. Therefore, the findings suggest that improving people's perception of ontological security is helpful in promoting and encouraging them to receive COVID-19 vaccines.

Public health implication

The prospect theory states that individuals are inclined to make risk-seeking or risk-averse choices based on how a health-related message is presented. Therefore, because of the phenomena of risk aversion, information framing that emphasizes the positive aspects (i.e. gain frames) leads to more risk aversion, whereas that which emphasizes equivalent negative aspects (i.e. loss frames) leads to riskier decisions.[27,28] Consequently, to boost vaccine uptake, the government should vigorously promote the effectiveness of vaccines in a positive way, so that people—especially the elderly and those with underlying diseases—understand the benefits of vaccination and are more likely to make risk-averse choices. Meanwhile, the accessibility and orderliness of vaccination is also critical to increase the perception of ontological security, thereby increasing the tendency of recommending others for COVID-19 vaccines.

The dramatic threat posed by COVID-19 not only disrupts people's sense of ontological security but also triggers adaptive responses from governments, institutions, and individuals. As an adaptive response, vaccination is an effective measure to control epidemics that many governments are vigorously promoting. Vaccination is viewed not only as self-interested, but more importantly as altruistic because some vaccines are more beneficial to society than to vaccine recipients, who experience related adverse effects.[29] In the present study, 75.2% of the COVID-19 vaccine recipients recommended others for vaccination. Interestingly, 60% of the participants who were not yet vaccinated reported that they would also recommend others to get vaccinated. Most of the unvaccinated participants (70.7%) had contraindications to vaccination. Given this, to promote vaccination among this group, multidisciplinary treatment and integrated disease management are needed to improve their fulfillment of the vaccination requirements. Moreover, unvaccinated participants with vaccine contraindications were more likely to recommend vaccination than those who were not vaccinated for other reasons (65.1% vs 47.9%, $P < 0.001$). We argue that unvaccinated people, because of contraindications, may not be willing to be self-vaccinated. However, further evidence is needed in the future. From the perspective of evolutionary game theory, those who disregard preventive measures, including vaccination, can be seen as free riders[30] and their motivation for free-riding behavior may be dominated by their peers.[31] Finally, it is necessary for policymakers to use altruistic motivations[23] and peer persuasion[32] to encourage and promote vaccination.

Methodological considerations

To the best of our knowledge, this study is the first to explore the influence of ontological insecurity on vaccination behavior against

COVID-19 among hospitalized patients in Taizhou, China. The results demonstrated that the hospitalized patients' sense of ontological security was not too low in the context of the COVID-19 epidemic. Individuals with a high sense of ontological security had greater confidence in the sustainable stability of their environment and a greater sense of self-identity. Their self-vaccination behavior was not influenced, but they were more likely to have good practices in the recommendation of vaccination to others.

Nevertheless, this study has some limitations. First, the study sample was only inpatients at a regional hospital, likely indicating a selection bias. The results of this study may have limited generalizability, but they are useful for promoting vaccination strategies. Second, more poorly educated farmers and workers were included who might not have fully understood the content of the questionnaire. The accuracy of their information may not be guaranteed, although uniformly trained nurses have explained some obscure items of the questionnaire. Third, the bias resulting from unknown factors may have confounded the results. More relevant clinical variables were unavailable owing to the anonymity of the questionnaire. Finally, our data were collected only at one time point and we could not investigate the impact of an outbreak on ontological security. Further longitudinal studies are needed to verify the causal relationship between ontological security and health-promoting behaviors.

Conclusions

In summary, this study presented the level of ontological security of hospitalized patients and found a positive association between their ontological security and behavior of recommending the COVID-19 vaccination to others. The results provided a reasonable theoretical basis for the development of vaccine promotion strategies. Accordingly, people's perceptions of ontological security and vaccination altruism can be used to promote vaccination plans through peer persuasion.

Author statements

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Ethical approval

This study was exempted from the requirement for written informed consent and was approved by the Ethics Committee of Taizhou Hospital of Zhejiang Province (approval number: K20210521) in China. All procedures were performed in accordance with the guidelines of the institutional ethics committee of the authors and adhered to the tenets of the Declaration of Helsinki.

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Competing interests

All authors declare that they have no conflict of interest.

Author contributions

H-X Chen and T-H Tung conceived the study. M-X Zhang, G-F Shi, X–Y Wu and T-H Tung designed the questionnaire. W-Z Wang and F-M Cheng collected the data. M-X Zhang, C Luo and T-H Tung analyzed and interpreted the data. M-X Zhang and G-F Shi wrote the first draft of the paper and interpreted the relevant literature. C Luo, X–Y Wu, W-Z Wang, F-M Cheng, H-X Chen, and T-H Tung edited and approved the final manuscript.

References

1. Abel T, McQueen D. The COVID-19 pandemic calls for spatial distancing and social closeness: not for social distancing! *Int J Public Health* 2020;**65**(3):231. https://doi.org/10.1007/s00038-020-01366-7.
2. He J, He L, Zhou W, Nie X, He M. Discrimination and social exclusion in the outbreak of COVID-19. *Int J Environ Res Public Health* 2020;**17**(8):2933. https://doi.org/10.3390/ijerph17082933.
3. Campbell MC, Jeffrey Inman J, Kirmani A, Price LL. Times of trouble: a framework for understanding consumers' responses to threats. *J Consum Res* 2020;**47**(3):311–26. https://doi.org/10.1093/jcr/ucaa036.
4. Giddens A. *Modernity and self-identity*. Stanford: Stanford University Press; 1991.
5. Laing RD. *The divided self: an existential study in sanity and madness*. London: Penguin Books; 1960 [reprinted 2010].
6. Pârvan A. Patients' substantialization of disease, the hybrid symptom and metaphysical care. *J Eval Clin Pract* 2015 Jun;**21**(3):380–8. https://doi.org/10.1111/jep.12250.
7. Malcolm D, Orme MW, Morgan MD, Sherar LB. Chronic obstructive pulmonary disease (COPD), illness narratives and Elias's sociology of knowledge. *Soc Sci Med* 2017 Nov;**192**:58–65. https://doi.org/10.1016/j.socscimed.2017.09.022.
8. Crossley ML. 'Let me explain': narrative emplotment and one patient's experience of oral cancer. *Soc Sci Med* 2003 Feb;**56**(3):439–48. https://doi.org/10.1016/s0277-9536(01)00362-8.
9. Perrier MJ, Martin Ginis KA. Changing health-promoting behaviors through narrative interventions: a systematic review. *J Health Psychol* 2018 Sep;**23**(11):1499–517. https://doi.org/10.1177/1359105316656243.
10. Zhang MX, Lin XQ, Chen Y, Tung TH, Zhu JS. Determinants of parental hesitancy to vaccinate their children against COVID-19 in China. *Expert Rev Vaccines* 2021 Oct;**20**(10):1339–49. https://doi.org/10.1080/14760584.2021.1967147.
11. Marlowe NI, Nicholson Perry K, Lee J. Ontological insecurity I: psychometric development of a new measure and relationship to subclinical psychotic-like experiences. *J Clin Psychol* 2020 Mar;**76**(3):423–39. https://doi.org/10.1002/jclp.22849.
12. Valente R, Valera Pertegas S. Ontological insecurity and subjective feelings of unsafety: analysing socially constructed fears in Italy. *Soc Sci Res* 2018 Mar;**71**:160–70. https://doi.org/10.1016/j.ssresearch.2017.11.007.
13. Hawkins RL, Maurer K. 'You fix my community, you have fixed my life': the disruption and rebuilding of ontological security in New Orleans. *Disasters* 2011 Jan;**35**(1):143–59. https://doi.org/10.1111/j.1467-7717.2010.01197.x.
14. Islam SMD, Bodrud-Doza M, Khan RM, Haque MA, Mamun MA. Exploring COVID-19 stress and its factors in Bangladesh: a perception-based study. *Heliyon* 2020;**6**(7):e04399. https://doi.org/10.1016/j.heliyon.2020.e04399.
15. Sher L. The impact of the COVID-19 pandemic on suicide rates. *QJM* 2020 Oct 1;**113**(10):707–12. https://doi.org/10.1093/qjmed/hcaa202.
16. Brown P, Newton D, Armitage R, Monchuk L, Robson B. Locked down: ontological security and the experience of COVID-19 while living in poor-quality housing. *J Community Psychol* 2022 May;**24**. https://doi.org/10.1002/jcop.22883.
17. Pan G, Korolev A. The struggle for certainty: ontological security, the rise of nationalism, and Australia-China tensions after COVID-19. *J Chin Political Sci* 2021;**26**(1):115–38. https://doi.org/10.1007/s11366-020-09710-7.
18. Blake D, Marlowe J, Johnston D. Get prepared: discourse for the privileged? *Int J Disaster Risk Reduct* 2017;**25**:283–8. https://doi.org/10.1016/j.ijdrr.2017.09.012.
19. Yang Q, Huo J, Xi Y. Exploring the risk-taking tendency among migrant workers in the COVID-19 pandemic: the role of ontological security. *Work* 2021;**68**(2):269–83. https://doi.org/10.3233/WOR-205017.
20. Luo C, Wu X, Wang W, Zhang MX, Cheng F, Chen H, et al. Patients' responses to COVID-19 pandemic: the relationship between potential pandemic-induced disruptions, ontological security, and adaptive responses in Taizhou, China. *Front Public Health* 2022;**10**:865046. https://doi.org/10.3389/fpubh.2022.865046.
21. Banham Rebecca. Emotion, vulnerability, ontology: operationalising 'ontological security' for qualitative environmental sociology. *Environ Sociol* 2020;**6**(2):132–42.
22. Verelst F, Kessels R, Delva W, Beutels P, Willem L. Drivers of vaccine decision-making in South Africa: a discrete choice experiment. *Vaccine* 2019 Apr 3;**37**(15):2079–89. https://doi.org/10.1016/j.vaccine.2019.02.056.
23. Vietri JT, Li M, Galvani AP, Chapman GB. Vaccinating to help ourselves and others. *Med Decis Mak* 2012 May-Jun;**32**(3):447–58. https://doi.org/10.1177/0272989X11427762.
24. Tsutsui Y, Benzion U, Shahrabani S, Din GY. A policy to promote influenza vaccination: a behavioral economic approach. *Health Policy* 2010;**97**:238–49.
25. Tsutsui Y, Benzion U, Shahrabani S. Economic and behavioral factors in an individual's decision to take the influenza vaccination in Japan. *J Socio-Econ* 2012;**41**:594–602.

26. Massin S, Ventelou B, Nebout A, Verger P, Pulcini C. Cross-sectional survey: risk-averse French general practitioners are more favorable toward influenza vaccination. *Vaccine* 2015 Jan 29;**33**(5):610–4. https://doi.org/10.1016/j.vaccine.2014.12.038.
27. Tversky A, Kahneman D. The framing of decisions and the psychology of choice. *Science* 1981;**211**(4481):453–8. https://doi.org/10.1126/science.7455683.
28. Kühberger A. The influence of framing on risky decisions: a meta-analysis. *Organ Behav Hum Decis Process* 1998;**75**(1):23–55. https://doi.org/10.1006/obhd.1998.2781.
29. Pywell S. Vaccination and other altruistic medical treatments: should autonomy or communitarianism prevail? *Med Law Int* 2000;**4**(3–4):223–43. https://doi.org/10.1177/096853320000400405.
30. Yong JC, Choy BKC. Noncompliance with safety guidelines as a free-riding strategy: an evolutionary game-theoretic approach to cooperation during the COVID-19 pandemic. *Front Psychol* 2021 Mar 16;**12**:646892. https://doi.org/10.3389/fpsyg.2021.646892.
31. Verelst F, Kessels R, Willem L, Beutels P. No such thing as a free-rider? Understanding drivers of childhood and adult vaccination through a multicountry discrete choice experiment. *Vaccines* 2021 Mar 16;**9**(3):264. https://doi.org/10.3390/vaccines9030264.
32. Pennings S, Symons X. Persuasion, not coercion or incentivisation, is the best means of promoting COVID-19 vaccination. *J Med Ethics* 2021;**47**(10):709–11. https://doi.org/10.1136/medethics-2020-107076.