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RESEARCH PAPER

THE RELATIONSHIP BETWEEN COVID-19 RISK PERCEPTION AND VACCINE HESITANCY IN CANCER PATIENTS: THE MODERATING ROLE OF EXTERNALIZING TRAITS

Simone Cheli, Maria Simona Pino, Gil Goldzweig, Silvia Scoccianti, Valentina Fabbroni, Clara Giordano, Veronica Cavalletti, Andrea Bassetti and Luisa Fioretto

Abstract

Objective: This mixed-methods study aimed to explore the role of externalizing traits in moderating the relationship between COVID-19 risk perception and vaccine hesitancy in patients diagnosed with cancer. A community-based participatory approach – comprising a preliminary qualitative inquiry and a subsequent cross-sectional research – was used to promote effective vaccination campaigns.

Method: 12 people diagnosed with cancer and 7 cancer professionals were recruited for the qualitative inquiry, 356 people either under cancer treatment or in follow-up care for the cross-sectional research.

A phenomenological analysis explored the transcripts of two focus groups. The cross-sectional research tested the hypothesis emerged during the previous qualitative inquiry through self-reported questionnaires and moderated regression.

Results: Phenomenological analysis suggested a pivotal role of externalizing traits in vaccine hesitancy. Moderated regression revealed how the association between risk perception and vaccine hesitancy is moderated by externalizing traits, even when controlled for treatment adherence.

Conclusions: In the present study we found a stronger relationship between risk perception and vaccine hesitancy for patients with higher levels of externalizing traits. We suggest that vaccination campaigns should be personality-informed to offer individualized and effective solutions. Patients with externalizing traits may cope dysfunctionally with vaccination campaigns.

Key words: cancer, COVID-19, HiTOP, risk perception, externalizing, vaccine hesitancy

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Vaccine hesitancy, reflected as either a refusal or a delay in the acceptance of vaccination (MacDonald & SAGE Working Group on Vaccine Hesitancy, 2015), represents a priority health challenge in supporting patients diagnosed with cancer during the COVID-19 pandemic (Corti & Curigliano, 2021; Dooling et al., 2020). Indeed, persons with cancer are considered to be an at-risk population for severe manifestations of SARS-CoV-2 (Seth et al., 2020). While evidence of the safety and effectiveness of vaccines in patients diagnosed with cancer remains limited (So et al., 2021), all major cancer societies recommend that patients be vaccinated (e.g., American Society of Clinical Oncology, 2021; European Society for Medical Oncology, 2021).

The scientific literature recognizes that vaccine hesitancy is a significant threat to public health, and various explanatory theories have been formulated that integrate factors both internal (e.g., attitudes or norms) and external (e.g., public health policies or health professionals' recommendations) to the person (Dubé et al., 2013; Xiao & Wong, 2020). More specifically, the unexpected breakthrough of the COVID-19 pandemic has fostered an understanding of this complex phenomenon through varying data with respect to specific populations and phases of the pandemic (Robinson et al., 2021; Salomoni et al., 2021).

Recently published studies indicate that vaccine refusal rates in cancer patients range from 14.4% to 28.3%, with a full acceptance rate of never below 50% (Mejiri et al., 2021; Moujaess et al., 2021; Villarreal-Garza et al., 2021). Vaccine hesitancy rates in cancer patients do not seem to differ much from those of the

general population, with an absolute majority of people tending to be in favor of vaccination and a minority group strongly opposed to vaccination. The same studies suggest that a low level of vaccine hesitancy among cancer patients is associated with a high level of confidence in the health system, while the opposition groups were found to have a low level of confidence in the health system as well as recurring misconceptions about the effects of vaccines and COVID-19.

The role of personality in vaccine hesitancy

While extensive research on vaccine hesitancy has focused on beliefs about the vaccine or on socio-demographic data, little is known about the role of personality traits and spectra. Evidence supports the role of personality traits assessed through the Five Factor Model (FFM) in predicting health behaviors and adjustment to physical illnesses (Hajek, Bock, & König, 2017; Jerram & Coleman, 1999; Joyner, Rhodes, & Loprinzi, 2018). Nevertheless, the relationship between FFM and vaccination has not been explored well and remains poorly understood. It has been suggested that agreeableness, conscientiousness, and emotional stability are associated with a higher acceptance, even when controlled for attitudes and beliefs (Lin & Wang, 2020). On the other hand, factors such as extraversion, agreeableness, and conscientiousness are associated with greater acceptance of COVID-19 containment measures (Al-Omiri et al., 2021). Similarly, in a study on cancer patients, it was previously shown that the three super-spectra of the Hierarchical Taxonomy of Psychopathology (HiTOP; Ringwald, Forbes, & Wright, 2021) moderate the relationship between COVID-19 risk perception and psychological distress or adherence to treatment (Cheli et al., 2021). The meta-analytic model of HiTOP empirically supports a hierarchical and dimensional look at psychopathology in which there is a convergence of the FFM and the five dimensions of the DSM-5 Alternative Model of Personality Disorders (AMPD; APA, 2013), and a variety of potential clinical benefits that connect research to practice and treatment planning (Hopwood, 2018; Kotov et al., 20217; Ruggero et al., 2019; Widiger & McCabe, 2020).

In this study, we hypothesized that the externalizing super-spectrum moderates the relationship between COVID-19 risk perception and vaccine hesitancy in cancer patients. More specifically, we suppose that at higher levels of externalizing traits, the association between risk perception and vaccine hesitancy is stronger. The externalizing super-spectrum ranges from non-pathological levels of impulse control to maladaptive disinhibition and antagonism, and even severe personality psychopathology (Kotov et al., 2020). An extensive set of previous work has demonstrated in children and adolescents (Beauchaine & McNulty, 2013), as well as adults (Krueger et al., 2005), that externalizing traits are associated with difficulty in regulating one's impulses and adhering to norms and requests from the outside. Moreover, in facing this difficulty, dysregulated and antagonistic behaviors, emotions, and thoughts may emerge. We can hypothesize that these effects increase the risk of a hesitant attitude toward health authorities and policies such as vaccination campaigns. Thus, an increased perception of risk as a source of psychological distress could lead cancer patients with high externalizing traits to paradoxically react to vaccination in a spiteful or oppositional manner.

We formulated and then tested our hypothesis in two consecutive phases. In the first phase of the study (Qualitative Inquiry), we conducted focus groups with cancer patients (N= 12) and professionals (N= 7) to qualitatively formulate a leading hypothesis. In the second phase (Cross-sectional Research), we completed a survey (N= 356) of cancer patients to confirm the hypothesis that emerged. This mixed-methods research was grounded on a community-based participatory approach aimed at promoting a participatory and diversity-focused methodology in outlining clinical research and practice in cancer care (Raber et al., 2019; Treml et al., 2009). Rather than using an expert-driven, top-down approach in defining research goals and objectives, the community-based participatory approach suggests involving healthcare users in the early phases of a research project. Indeed, one of the most common methods comprises initial qualitative research through focus groups or interviews with both patients and professionals, and then subsequent quantitative phases aimed at confirming the hypotheses that emerged during the previous phase.

Methods

Participants

The study included two samples of consecutive adult participants (age≥ 18 years). The first sample (N= 19) was recruited for Qualitative Inquiry and consisted of 12 patients under treatment for a cancer diagnosis (1:3 male to female ratio; age ranging between 56 and 71 years; mean age= 62) and 7 female professionals (2 nurses; 4 psycho-oncologists; 1 oncologist; ages ranging between 31 and 58 years; mean age= 42.7). Inclusion criteria were (a) being a cancer patient (either under treatment or in follow-up care) or (b) being a

Table 1. *Socio-demographic and medical data*

Age (years) mean ± SD	63.17 ± 11.932
Education (years) mean ± SD	11.86 ± 4.640
Gender n (%)	
Male	123 (34.6%)
Female	233 (65.4%)
Cancer n (%)	
Breast	
Stomach/Bowel	145 (40.7%)
Prostate	30 (8.4%)
Lung	32 (9%)
Hematological (Leukemia,	22 (6.2%)
Lymphoma)	17 (4.8%)
Gynecological	26 (7.3%)
Testicles	3 (0.8%)
Other	81 (22.8%)
Diagnosis n (%)	
Recurrence	84 (23.6%)
New diagnosis	229 (72.8%)
Missing	13 (3.7%)
Treatment n (%)	
Under treatment	250 (70.2%)
Follow-up	91 (25.6%)
Missing	15 (4.2%)

Note. Missing data is reported only for the two variables where it was scored.

cancer professional (either an oncologist or a cancer nurse) working in the field of cancer for at least 5 years. The second sample (N= 356; Cross-sectional Research) included only patients who were either under treatment (70.2%) or in follow-up, with a mean age of 63.17 years (see **table 1**) who completed the survey anonymously. The inclusion criterion was being a cancer patient, either under treatment or in follow-up care. All the participants were recruited through a convenience sampling at the Department of Oncology, USL Toscana Centro, Italy. The study was approved by the Ethical Committee and written informed consent was obtained from all participants.

Measures

The **Cancer Treatment Non-Adherence during COVID-19 (CTNA)** total score is an 8-item, 5-point Likert, multilingual, single scale assessing treatment non-adherence in cancer patients during COVID-19 (Cheli et al., 2021). The Italian version of CTNA reports acceptable reliability in the present study (Cronbach's alpha= .703).

The **COVID-19 Vaccine Risk Perception in Cancer Patients (CVRC)** total score is a 7-item, 5-point Likert, single scale assessing anti-COVID-19 vaccine hesitancy in cancer patients (Cheli et al., 2022) reporting a high reliability in the normative sample and in the present research (Cronbach's alpha= .806). The CRVC is available only in Italian.

The **Depression, Anxiety, and Stress Scales – 21 (DASS-21)** total score is a 21-item, 4-point Likert scale assessing the level of psychosocial distress (Antony et al., 1998). It comprises three subscales (depression, anxiety, and depression) plus a total score. The Italian total score (see Bottesi et al., 2015) showed very high reliability in the present study (Cronbach's alpha= .951).

The **Perceived Risk of Coronavirus Risk Scale (PRCRS)** total score is an 8-item, 5-point Likert, multilingual, single scale assessing the risk perception related to COVID-19 (Kanovsky & Halamová, 2020) and reported acceptable reliability in the present research (Cronbach's alpha= .787).

The **Personality Inventory for the DSM-5 – Brief Form (PID-5-BF)** is a brief screening tool aimed at assessing the five pathological personality traits (negative affectivity, detachment, antagonism, disinhibition, and psychoticism) as defined by the DSM-5 AMPD (Anderson et al., 2018). In the present sample, Italian PID-5-BF scales and total score (see Somma et al., 2019) showed high reliability (Cronbach's alpha ranging between .801 and .908). We used an aggregated score of antagonism and disinhibition (Cronbach's alpha= .815) to assess the externalizing super-spectrum (see Statistical Analysis).

Procedure

After signing the informed consent form, the participants (N= 19) of Sample 1 (Qualitative Inquiry) accessed the focus groups at the Department of Oncology, USL Toscana Centro, Italy. Consistent with a com community-based participatory approach, the researchers analyzed the transcripts of the focus groups to operationalize the hypotheses that emerged and transform them into validated variables to include in the subsequent Cross-sectional Study. Then, the referral oncologists disseminated the Cross-sectional Research. Patients who showed interest and then signed the informed consent (N= 356) received the paper questionnaire of this second phase of the study. The questionnaire was completed in the cancer unit and then returned to the referral oncologist.

Qualitative Analysis

Qualitative Inquiry (first phase) consisted of two focus groups of patients (N= 6 + 6) and one focus group of professionals (N= 7). During the focus groups (each lasting about 60-90 minutes), two researchers (each with at least 10 years of experience in qualitative research) led an open discussion initiated by two questions: (i) How do people with cancer diagnosis perceive COVID-19 vaccination?; (ii) What can make it difficult or undesirable to accept vaccination? Subsequently, the research team analyzed the transcripts of the focus groups using a phenomenological approach (Neubauer, Witkop, & Varpio, 2019) aimed at understanding how participants describe the phenomenon (i.e., vaccine hesitancy). We opted for an interpretative phenomenological approach aimed at providing a detailed examination of the lived experience of the investigated phenomena as experienced by the participants themselves. In this approach, researchers play an active role in the interpretative process. If from one side this may channelize the results, it was considered necessary in order to transform the patients' narratives into a consistent set of psychological variables to explore in the second phase of the study (i.e., through validated self-reports). The results were then used to ground a hypothesis for subsequent Cross-sectional Research using the HiTOP spectra and super-spectra as a reference framework (Kotov et al., 2017; Ringwald et al., 2021). All the qualitative analyses were performed by hand and pencil without any software.

Statistical Analysis

We inspected all study variables (CTNA; CVRC; DASS-21; PRCRS; PID-5-BF; Diagnosis; Treatment) of the Cross-sectional Research (second phase) for missing values. Only two variables reported missing data: diagnosis (3.7%) and treatment (4.2%). Little's Missing Completely at Random (MCAR) test indicated the data could be considered as MCAR, $\chi 2= 5.477$, $p= .140$. Then, to test for background variables as possible confounders, a multiple regression analysis was calculated to predict vaccine hesitancy based on sex, diagnosis, treatment, adherence, and distress. This preliminary analysis was also aimed at possibly suggesting covariates to include in the moderated regression model.

Then, we used moderated regression to test the hypothesis that the association between risk perception and vaccine hesitancy would depend on levels of externalizing super-spectra. The reliability of using a composite variable for assessing externalizing traits (the sum of PID-5-BF antagonism and disinhibition scores; see Cheli et al., 2021; Ringwald et al., 2021) was tested using McDonald's Omega (see **table 2**). In the Supplementary Materials, we report moderated regression models that include either antagonism or disinhibition as a moderator.

All analyses were performed using SPSS 25. McDonald's Omega was computed using the Omega macro and moderated regression analysis with the PROCESS macro (Hayes, 2018). A single plot for each of several simple slopes of moderated regression was created using the Interactive application (McCabe et al., 2018).

Table 2. *Intercorrelations among measures*

	M	SD	Ω	Vaccine Hesitancy	Risk Percep-tion	Non-ad-herence	Dsitress	Exter-naliz-ing	Diag-nosis	Treat-ment
Vaccine Hesitancy	12.321	5.136	.810	1						
Risk Perception	21.79	6.182	.720	,168**	1					
Non-adherence	17.12	6.274	.732	,410**	,107*	1				
Distress	9.772	10.68	.955	,022	,172**	,153**	1			
Externalizing	14.859	4.459	.818	,144**	,069	,083	,318**	1		
Diagnosis	***	***	***	-,090	,021	-,064	,033	,070	1	
Treatment	***	***	***	,092	-,004	,094	,112	,112*	-,110*	1

Note. * Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed). *** M, SD, and Ω are not computed for categorical variables.

Results

Qualitative Research

The focus groups revealed numerous reflections and perspectives from both patients and professionals. The answers to the first question (i.e., vaccine risk perception) showed a convergence of all the participants on a theme: high perception of risk considering the oncological diagnosis as a concurrent risky condition. All the professionals and about half of the patients (N= 5) also underlined a perception of limited comprehensibility of information relating to vaccination and COVID-19 spread provided by authorities.

The second question (i.e., vaccine hesitancy) revealed more clear-cut positions from some participants. Two patients expressed that their hesitancy is due to an unreliable health and political system and a fear of information being withheld. Two professionals provided a causal explanation linked to the patients' low level of education. The other narratives were interpreted as converging more on some characteristics of those patients with a greater propensity to refuse the vaccine. In patients' focus groups, these characteristics referred to a tendency to experience greater anger, mistrust, and fear of the healthcare system. Professionals seemed to converge on oppositional attitudes described as contemptuous or haughty, or with a general inability to relate to norms or prescriptions. Finally, most participants (6 patients and 6 professionals) pointed out that hesitancy was related to a limited interest in the health of others.

The research team attempted to bring these narratives back to recurring dimensions linked to personality models, converging on antagonism and disinhibition. Indeed, the participants recurrently placed their attention on difficulties in regulating impulses and emotions and on manifestations of having little interest in others and the non-modifiable nature of one's beliefs. In conclusion, the researchers hypothesized that the most recurrent HiTOP super-spectrum in patients with higher vaccine hesitancy was the externalizing one.

Cross-sectional research

First, a preliminary multiple linear regression was calculated to predict vaccine hesitancy based on background variables. A significant regression equation was found ($F(5,255) = 10.276$, $p < .001$) with a R^2 of .168. As reported in **table 3**, only non-adherence results were determined to be significant, whereas sex, diagnosis, treatment, and distress were not. These results prompted us to include non-adherence as a covariant in the moderated regression model.

Second, we used a combined variable for assessing externalizing traits by adding PID-5-BF antagonism and disinhibition and by confirming aggerated score reliability through McDonald's Omega (Ω= .818; see **table 2**). Finally, we tested the moderating role of externalizing traits (W) in the relationship between risk perception (X) and vaccine hesitancy (Y), with non-adherence as a covariate (because the latter was the only significant predictor in the multiple regression model). We found a significant moderation effect (R^2= .2817; **table 4**). The results indicate that there is a stronger relationship between risk perception and vaccine hesitancy for individuals with higher levels of externalizing traits, even when controlled for non-adherence.

This pattern of results is presented in **figure 1** and shows that at low levels of externalizing traits, there is a negative or null correlation between risk perception and vaccine hesitancy (left panels). At moderate levels

Table 3. *Regression analysis summary for background variables predicting vaccine hesitancy*

Variable	*B*	95% CI	β	*t*	*p*
Sex	-.073	[-1.286, 1.119]	-.007	-.120	.904
Treatment	.555	[-.727, 1.836]	.050	.852	.395
Diagnosis	-.574	[-1.439, .292]	-.075	-1.305	.193
Non-adherence	.302	[.212, .392]	.388	6.616	.000
Distress	-.020	[-.072, .032]	-.044	-.755	.451

Note. R2 = .168 (N = 356, p < .001). CI = confidence interval for *B*.

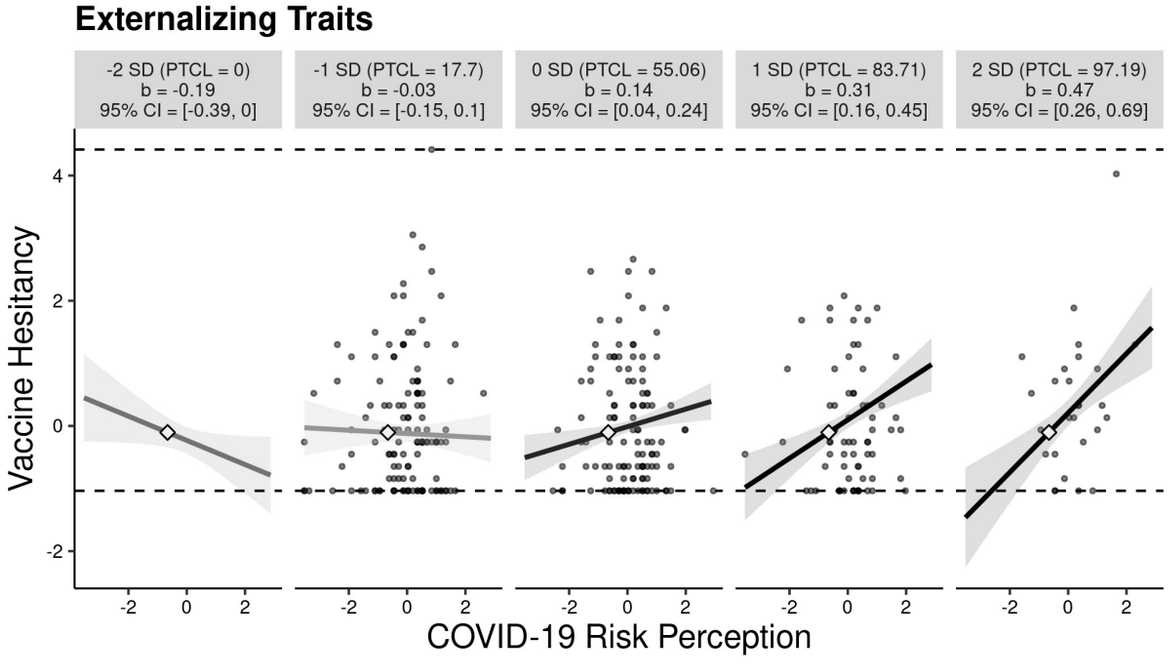
Table 4. *Moderated regression model*

Model Coefficients Summary	Beta	b	SE	t	*p*
(Intercept)		-1.07	0.142	-7.545	.000
Non-adherence	0.383	0.962	0.008	7.890	.000
Risk perception	0.138	0.14	0.050	2.822	.005
Externalizing	0.111	0.11	0.048	2.290	.023
Risk perception x Externalizing	0.176	0.167	0.046	3.621	.000

Conditional Effects	**Externalizing**	**Effect**	**SE**	**t**	***p***
	10.3952	.0098	.0567	.1725	.863
	14.8889	.1566	.0447	3.5055	.000
	19.3825	.3033	.0655	4.6338	.000

Note. The moderated regression model was found significant (R2= .2817; F= 9.7129; p= .0000) as well as the test of interaction (R2 change= .0334; F= 12.2704; p= .0005). We report in **table 1** the Model Coefficients Summary and the Conditional Effects at levels of moderator (Externalizing) for the relationship between Risk perception (focal antecedent) and Vaccine hesitancy (outcome). Non-adherence was included in the model as covariate..

Figure 1. *Association of Perception Risk and Vaccine Hesitancy across Levels of Externalizing Traits*



Note: Simple slopes are provided for levels of the moderator (externalizing traits) 1 SD and 2 SD below the mean, at the mean, and 1 SD and 2 SD above the mean. Each panel shows the computed 95% confidence region (shaded area), the observed data (gray circles), and the maximum and minimum values of the outcome (dashed horizontal lines). CI = confidence interval; PTCL = percentile.

of externalizing traits, the correlation between risk perception and vaccine hesitancy is positive, although this correlation is relatively modest (middle panel). At high levels of externalizing traits, the association between risk perception and vaccine hesitancy is positive and strong (right panels).

Of note, moderated regression models that include either antagonism or disinhibition as moderator were significant even if with a smaller R^2 than in the model with externalizing traits as moderator (see Supplementary Materials).

Discussion

The aim of this study was to explore the moderating role of externalizing traits in the association between COVID-19 risk perception and vaccine hesitancy. Our main conclusion is that as antagonistic and disinhibited traits increase, risk perception becomes more strongly linked to vaccine hesitancy. These findings have several implications for outlining tailored vaccination campaigns and psycho-oncology services.

First, the source of our main hypothesis was a community-based participatory approach that started with two focus groups of cancer patients and professionals. The results of this qualitative inquiry underscored the significance of diverse stakeholders as active participants in all stages of research to improve healthcare research, education, and policies (Tremblay et al., 2018). This collaborative and community-oriented approach is extremely relevant in the context of a pandemic in which the capacity to involve institutions and citizens in the vaccination process is pivotal for the bio-psycho-social well-being of all humanity (Sallam, 2021). In the current study, such an approach brought into focus the importance of personality traits (not only external factors) as affecting vaccine hesitancy. These traits should be considered in the design of future studies and while making policy decisions.

Second, our study supports the cost-effectiveness of screening tools based on dimensional models (Hopwood, 2018; Ruggero et al., 2019) when conceptualizing complex forms of adjustment such as the adjustments of individuals diagnosed with cancer during COVID-19 (Cheli et al., 2021). A brief questionnaire (i.e., PID-5-BF) would help to identify those with a higher risk of refusing the vaccine, bridging research into practice. Our results, if confirmed, suggest that only 10 items (antagonism and disinhibition scales) will identify people with high internalizing traits and potentially dysfunctional coping strategies. We recommend that resources be allocated to explore internal personality factors, rather than just to administer advertising campaigns related to external environmental factors.

Third, the increasing evidence supporting the safeness and effectiveness of a vaccine booster (third or fourth dose) for both the general population and vulnerable sub-groups fosters the need for tailored vaccination campaigns (Bar-On et al., 2021). Health systems and local authorities need strategies to develop interventions for those who exhibit greater vaccine hesitancy. If we can hypothesize that externalizing traits are among the recurring variables of hesitant patients, then we can develop communicative interventions capable of targeting these traits. Given the specificity of the antagonistic and disinhibited traits (i.e., impulsiveness, disagreeableness, irresponsibility, etc.), specific attention must be paid to the development of communication that does not exacerbate oppositional attitudes. We suggest an approach based (as is usual in psycho-oncology) on stepped-care, in which the goal is to obtain the maximum clinical improvement with the minimum impact on the patient (Bower & Gilbody, 2005). Communication strategies should therefore promote emotional validation rather than dispute incorrect contents so as to deepen the patients' awareness of their own (and others') experiences and to progressively propose more articulated behavioral interventions aimed at reducing distress (Hopwood, 2018). Of note, we outlined at our Department (i.e. the recruitment center) a communication strategy that was consistent with reported results. Patients with hesitant or even oppositive attitude were emotionally validated and contacted several times – so as to be involved in the vaccination campaigns – rather than disputed about content of their beliefs, and this possibly resulted in a very low refusal rate of 4.5% (Pino et al., 2022).

Finally, the transferability of our results must be discussed in terms of their limitations. Several biases might have affected our findings, reflecting the variety of cancer types, treatments, and side effects. On the other hand, multiple linear regression suggests that sex, diagnosis, treatment, and psychosocial distress did not affect vaccine hesitancy. Moreover, a moderation model was specifically used to control for non-adherence. Thus, the exclusion of that hesitancy was the effect of a low level of compliance caused by other variables.

Future research should work to confirm our results on larger samples stratified for tumor site and cancer stage. It would also be appropriate to investigate possible differences between various health systems and cultures, given that our sample was exclusively Italian. Furthermore, although our moderation model was found to be significant with increasing conditional effects of the moderator, the percentage of variance explained in the model was 28%. We hypothesize the existence of several variables that affect the relationship between risk perception and vaccine hesitancy.

Conclusion

In this study, we found that externalizing traits involving antagonism and disinhibition enhanced the connection between COVID-19 risk perception and vaccine hesitancy in cancer patients. This finding suggests the usefulness of a personality-informed perspective in outlining an effective vaccination campaign. Specifically, antagonistic and disinhibited traits are supposed to expose patients to paradoxical responses in which the perception of risk seems to expose them to potentially dysfunctional coping strategies (that is a hesitant or even oppositive attitude toward vaccination campaigns). Future research should confirm these findings and test specific communication and psychosocial strategies for people with high externalizing traits.

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Supplementary Materials

Run MATRIX procedure:

********* PROCESS Procedure for SPSS Version 3.5 *********
Written by Andrew F. Hayes, Ph.D. www.afhayes.com
Documentation available in Hayes (2018).
www.guilford.com/p/hayes3
****

Model : 1
Y : VAX_TOT (Vaccine hesitancy)
X : PCRS (Risk perception)
W : PID5_A (Antagonism)

Covariates:
CTA (Treatment Non-adherence)

Sample
Size: 356

****

OUTCOME VARIABLE:
VAX_TOT

Model Summary

R	R-sq	MSE	F	df1	df2	p
,4422	,1956	21,4755	20,4813	4,0000	337,0000	,0000

Model

	coeff	se	t	p	LLCI	ULCI
constant	9,6439	2,8556	3,3773	,0008	4,0270	15,2609
PCRS	-,1557	,1230	-1,2658	,2064	-,3976	,0862
PID5_A	-,7462	,3873	-1,9265	,0549	-1,5081	,0157
Int_1	,0379	,0171	2,2154	,0274	,0043	,0716
CTA	,3216	,0410	7,8449	,0000	,2409	,4022

Product terms key:
Int_1 : PCRS x PID5_A

Test(s) of highest order unconditional interaction(s):

	R2-chng	F	df1	df2	p
X*W	,0117	4,9079	1,0000	337,0000	,0274

Focal predict: PCRS (X)
Mod var: PID5_A (W)

Conditional effects of the focal predictor at values of the moderator(s):

PID5_A	Effect	se	t	p	LLCI	ULCI
4,5391	,0164	,0564	,2913	,7710	-,0945	,1273
6,9795	,1090	,0418	2,6091	,0095	,0268	,1911
9,4199	,2015	,0616	3,2691	,0012	,0803	,3227

Moderator value(s) defining Johnson-Neyman significance region(s):

Value	% below	% above
6,3022	54,3860	45,6140

Conditional effect of focal predictor at values of the moderator:

PID5_A	Effect	se	t	p	LLCI	ULCI
,0000	-,1557	,1230	-1,2658	,2064	-,3976	,0862
1,0000	-,1178	,1070	-1,1002	,2720	-,3283	,0928
2,0000	-,0799	,0915	-,8726	,3835	-,2599	,1002
3,0000	-,0419	,0767	-,5470	,5847	-,1927	,1089
4,0000	-,0040	,0630	-,0638	,9491	-,1279	,1199
5,0000	,0339	,0514	,6597	,5099	-,0672	,1350
6,0000	,0718	,0436	1,6473	,1004	-,0139	,1576
6,3022	,0833	,0423	1,9670	,0500	,0000	,1666
7,0000	,1097	,0418	2,6256	,0090	,0275	,1919
8,0000	,1477	,0467	3,1632	,0017	,0558	,2395
9,0000	,1856	,0565	3,2821	,0011	,0744	,2968
10,0000	,2235	,0693	3,2256	,0014	,0872	,3598
11,0000	,2614	,0836	3,1266	,0019	,0969	,4259
12,0000	,2993	,0988	3,0289	,0026	,1049	,4937
13,0000	,3372	,1146	2,9434	,0035	,1119	,5626
14,0000	,3752	,1307	2,8710	,0044	,1181	,6322
15,0000	,4131	,1470	2,8101	,0052	,1239	,7022
16,0000	,4510	,1635	2,7586	,0061	,1294	,7726
17,0000	,4889	,1801	2,7148	,0070	,1347	,8432
18,0000	,5268	,1968	2,6772	,0078	,1398	,9139
19,0000	,5648	,2135	2,6447	,0086	,1447	,9848
20,0000	,6027	,2304	2,6162	,0093	,1496	1,0558

Data for visualizing the conditional effect of the focal predictor: Paste text below into a SPSS syntax window and execute to produce plot.

```
DATA LIST FREE/
  PCRS     PID5_A    VAX_TOT   .
BEGIN DATA.
   15,8506   4,5391   12,0024
   21,9298   4,5391   12,1023
   28,0090   4,5391   12,2021
   15,8506   6,9795   11,6481
   21,9298   6,9795   12,3105
   28,0090   6,9795   12,9729
   15,8506   9,4199   11,2938
   21,9298   9,4199   12,5187
   28,0090   9,4199   13,7437
END DATA.
GRAPH/SCATTERPLOT=
 PCRS    WITH    VAX_TOT  BY     PID5_A   .
```

********* ANALYSIS NOTES AND ERRORS *********

Level of confidence for all confidence intervals in output:
95,0000

W values in conditional tables are the mean and +/- SD from the mean.

------ END MATRIX -----

Run MATRIX procedure:

********* PROCESS Procedure for SPSS Version 3.5 *********
Written by Andrew F. Hayes, Ph.D. www.afhayes.com
Documentation available in Hayes (2018).
www.guilford.com/p/hayes3
****
Model : 1
Y : VAX_TOT (Vaccine hesitancy)
X : PCRS (Risk perception)
W : PID5_DIS (Disnibhition)

Covariates:
CTA (Treatment Non-adherence)

Sample
Size: 356

****
OUTCOME VARIABLE:
VAX_TOT

Model Summary

R	R-sq	MSE	F	df1	df2	p
,4833	,2336	20,4597	25,6809	4,0000	337,0000	,0000

Model

	coeff	se	t	p	LLCI	ULCI
constant	11,4525	2,5353	4,5173	,0000	6,4656	16,4395
PCRS	-,3057	,1106	-2,7646	,0060	-,5232	-,0882
PID5_DIS	-,9219	,3156	-2,9212	,0037	-1,5426	,3011
Int_1	,0535	,0139	3,8615	,0001	,0263	,0808
CTA	,3220	,0399	8,0642	,0000	,2434	,4005

Product terms key:
Int_1 : PCRS x PID5_DIS

Test(s) of highest order unconditional interaction(s):

	R2-chng	F	df1	df2	p
X*W	,0339	14,9108	1,0000	337,0000	,0001

Focal predict: PCRS (X)
Mod var: PID5_DIS (W)

Conditional effects of the focal predictor at values of the moderator(s):

PID5_DIS	Effect	se	t	p	LLCI	ULCI
5,1522	-,0298	,0514	-,5803	,5621	-,1310	,0713
7,9094	,1178	,0413	2,8497	,0046	,0365	,1991
10,6665	,2654	,0608	4,3658	,0000	,1458	,3850

Moderator value(s) defining Johnson-Neyman significance region(s):

Value	% below	% above
7,2104	51,4620	48,5380

Conditional effect of focal predictor at values of the moderator:

PID5_DIS	Effect	se	t	p	LLCI	ULCI
4,0000	-,0915	,0625	-1,4655	,1437	-,2144	,0313
4,8000	-,0487	,0545	-,8930	,3725	-,1560	,0586
5,6000	-,0059	,0479	-,1225	,9026	-,1001	,0883
6,4000	,0370	,0431	,8576	,3917	-,0478	,1218

7,2000	,0798	,0409	1,9530	,0517	-,0006	,1602
7,2104	,0804	,0409	1,9670	,0500	,0000	,1607
8,0000	,1226	,0416	2,9509	,0034	,0409	,2044
8,8000	,1655	,0451	3,6720	,0003	,0768	,2541
9,6000	,2083	,0508	4,1008	,0001	,1084	,3082
10,4000	,2511	,0581	4,3223	,0000	,1368	,3654
11,2000	,2940	,0665	4,4229	,0000	,1632	,4247
12,0000	,3368	,0755	4,4589	,0000	,1882	,4854
12,8000	,3796	,0851	4,4618	,0000	,2123	,5470
13,6000	,4225	,0950	4,4484	,0000	,2357	,6093
14,4000	,4653	,1051	4,4273	,0000	,2586	,6720
15,2000	,5081	,1154	4,4031	,0000	,2811	,7351
16,0000	,5510	,1258	4,3783	,0000	,3034	,7985
16,8000	,5938	,1364	4,3539	,0000	,3255	,8621
17,6000	,6366	,1470	4,3307	,0000	,3475	,9258
18,4000	,6795	,1577	4,3088	,0000	,3693	,9896
19,2000	,7223	,1684	4,2883	,0000	,3910	1,0536
20,0000	,7651	,1792	4,2693	,0000	,4126	1,1176

Data for visualizing the conditional effect of the focal predictor: Paste text below into a SPSS syntax window and execute to produce plot.

```
DATA LIST FREE/
    PCRS     PID5_DIS  VAX_TOT   .
BEGIN DATA.
   15,8506   5,1522   11,7220
   21,9298   5,1522   11,5406
   28,0090   5,1522   11,3592
   15,8506   7,9094   11,5202
   21,9298   7,9094   12,2362
   28,0090   7,9094   12,9522
   15,8506  10,6665   11,3184
   21,9298  10,6665   12,9318
   28,0090  10,6665   14,5452
END DATA.
GRAPH/SCATTERPLOT=
 PCRS    WITH    VAX_TOT  BY     PID5_DIS .
```

********* ANALYSIS NOTES AND ERRORS *********

Level of confidence for all confidence intervals in output:
 95,0000

W values in conditional tables are the mean and +/- SD from the mean.

------ END MATRIX -----