Big Five traits predict stress and loneliness during the COVID-19 pandemic: Evidence for the role of neuroticism

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ABSTRACT

The rapid outbreak of the coronavirus disease (COVID-19) has affected citizens' daily lives in an unprecedented way. To curb the spread of the pandemic, governments have taken numerous measures such as social distancing and quarantine, which may be associated with psychological consequences, namely stress and loneliness globally. To understand differential associations of personality traits with psychological consequences of COVID-19, we utilize data from a sample of 99,217 individuals from 41 countries collected as part of the COVIDiSTRESS Global Survey. Data were analyzed using multigroup confirmatory factor analysis and multilevel regression models. Findings showed that while some of the associations were rather weak, Big Five personality traits were significantly associated with perceived stress and loneliness during the pandemic. Our study illustrates that neuroticism especially can be a vulnerability factor for stress and loneliness in times of crisis and can contribute to detection of at-risk individuals and optimization of psychological treatments during or after the COVID-19 pandemic.

1. Introduction

As a global and threatening stressor by itself, the current COVID-19 pandemic has set the ground for an unprecedented crisis in the social, emotional, psychological, and economical sphere. COVID-related stress and negative mental health outcomes are found to be widespread

indiscriminately across different groups of people (e.g., Bao et al., 2020; Brooks et al., 2020; Minahan et al., 2021). Moreover, as a result of lockdown and social distancing measures, an alarming increase in the levels of loneliness also exists according to recent studies (Horigian et al., 2020; Van der Velden et al., 2021). As can be expected, loneliness was found to be closely associated with worry, depression, and anxiety during the COVID-19 pandemic (Hoffart et al., 2020; Palgi et al., 2020; Tso & Park, 2020).

A remarkable factor associated with stress and loneliness during COVID-19 pandemic might be personality traits of individuals (Taylor, 2019). One of the key taxonomies that has been used to classify and operationalize personality traits is the five-factor model (or Big Five), which describes personality as a system with *Neuroticism, Extraversion, Openness to experience, Agreeableness,* and *Conscientiousness* as higher-order domains (Mccrae & Costa, 1999). The Big Five Model is a very often used approach to conceptualize personality, and the five-dimensional structure of this model was found to show high replicability across all the major regions of the world (Rolland, 2002; Schmitt et al., 2007).

The link between personality traits and mental health has been extensively studied under normal circumstances outside a pandemic. However, when considering this relationship, contextual or situational factors, such as the COVID-19 pandemic, should also be considered. Personality is one of the factors which may explain individual differences in response to challenging situations (Han et al., 2021). As Modersitzki et al. (2020) have underlined, psychological consequences of the COVID-19 pandemic have strong associations with person-level variables such as personality characteristics. Especially individuals' mood in extremely stressful situations are suggested to be driven more by personality compared to the pandemic experience (Anglim & Horwood, 2021). Besser et al. (2020) argue that some personality factors could act as a risk factor during the pandemic, whereas others could play a protective role in terms of adaptability to the current situation and coping with it.

Previous studies during the pandemic have studied personality factors in relation to engagement in preventive behaviors and compliance to measures (e.g., Carvalho et al., 2020; Han, 2021; Zajenkowski et al., 2021), subjective well-being (Anglim & Horwood, 2021; Modersitzki et al., 2020), depressive and anxiety symptoms and suicide risk (Han et al., 2021), stress-related (Zacher & Rudolph, 2021) and global pandemic-related appraisals (Modersitzki et al., 2020), COVID-19 anxiety (Nikčević et al., 2021), and behavioral and emotional responses including relaxation and emotional improvement or negative emotional response (Kohút et al., 2021). Therefore, although there are several studies investigating the implications of personality for mental health outcomes during the pandemic, to the best of our best knowledge, no studies have examined the link between personality, pandemic-related stress levels, and loneliness simultaneously during the pandemic. In the current study, we aimed to understand whether personality traits explain a degree of between-subject variance in pandemic-related stress and loneliness during the COVID-19 situation. Understanding these associations would help to design targeted interventions for undesirable psychological outcomes.

2. Method

2.1. Participants and procedure

We used an open dataset available online gathered via the COVIDi-STRESS Global Survey (Yamada et al., 2021). The full dataset contains 173,426 responses from 179 countries and the cleaned dataset contains 125,306 participants (see https://osf.io/f8h9w for the cleaning procedures). The data were gathered during the beginning of the COVID-19 pandemic, between March 30th, 2020 and May 30th, 2020. The project received a waiver to proceed from Aarhus University's Board of Research Ethics Office. In compliance with General Data Protection Regulation

standards, all data were anonymous. An organic snowballing recruitment strategy was adopted for sampling. Participation in the study was voluntary. Participants received information on the aims of the study, confidentiality, and right to withdraw at any phase of the survey.

We used the cleaned dataset and further applied additional cleaning procedures (see Data Analysis section). These steps resulted in the final sample used in this study consisting of 99,217 respondents from 41 countries. In the sample, 72.6% of participants reported to be female, 26.3% are male, while 1.1% responded "other/would rather not say". The mean age was 39.23 (SD = 13.95), ranging from 18 to 110 years. Sociodemographic characteristics of the sample per country are presented in Table S1.

2.2. Measures

2.2.1. Sociodemographic variables

Participants were asked about age, gender, education level, marital status, and country of residence.

2.2.2. Personality traits

Personality traits were assessed using the shortened version of Big-Five Inventory (BFI-S; Lang et al., 2011). It is a 15-item 6-point Likert-type self-report inventory, ranging from 1 (strongly disagree) to 6 (strongly agree). Responses within each personality subdomain were averaged. According to Hahn et al. (2012), the scale has internal consistency with mostly acceptable Cronbach alpha coefficients ranging between 0.44 and 0.76, convergent (correlations average = 0.60) and discriminant validity (coefficients ranging between −0.01 and 0.35), and a significant test-retest stability within 18 months (Neuroticism = 0.74, Extraversion = 0.80, Openness to experience = 0.72, Agreeableness = 0.57, Conscientiousness = 0.67). We obtained similar Cronbach's alpha coefficients for the whole dataset across the five personality traits measured by BFI-S (Neuroticism = 0.69, Extraversion = 0.75, Openness to experience = 0.66, Agreeableness = 0.54, Conscientiousness = 0.59).

2.2.3. Perceived stress

Participants' perceived stress level for the past week was assessed using the Perceived Stress Scale (Cohen et al., 1983), 10-item version (PPS-10; Cohen & Williamson, 1988), with a 5-point Likert scale (ranging from 1 - "never" to 5 - "very often"). Reliability of the scale is reported as 0.84 (Taylor, 2015), and mean scores were used with higher scores indicating higher stress levels. In this study, the PSS-10 had an acceptable internal consistency (α = 0.88).

2.2.4. Loneliness

Loneliness was assessed with a three-item version of the UCLA Loneliness Scale (Hughes et al., 2004; Russell, 1996). Participants reported how often they feel left out, isolated from others, and lack companionship in the last week on a 5-point Likert scale, ranging from 1 - "never" to 5 - "very often". We obtained Cronbach's alpha coefficient of 0.77, similar to previous studies (e.g., Hughes et al., 2004).

2.3. Data analysis

Statistical analyses were conducted using *Jamovi* (Version 1.6.11; The jamovi project, 2021) and *R* (Version 4.0.3; R Core Team, 2021). In the first step of data cleaning, we retained only complete cases on the variables of interest (N = 101,558). Then, we excluded countries with less than 200 respondents (N = 99,217). We transformed gender by coding the responses "Other/would rather not say" as missing values.

Next, we assessed internal consistency (using Cronbach's alpha) and then proceeded with testing the cross-cultural equivalence via the measurement invariance analysis of the study instruments. Since the aim of our study was the meaningful comparisons of factor variances and covariances, we only focused on the metric level of measurement invariance (Lacko et al., 2021; Millsap, 2011). The scalar level that

allows meaningful comparisons of latent means across countries was, therefore, not reported. In multi-group confirmatory factor analyses, we compared the models across 41 countries (configural invariance), with a model with factor loadings constrained to be equal (metric invariance). We evaluated the configural models fit relying on the usually recommended criteria (Hu & Bentler, 1999). As these models are characterized by a growing complexity (each subsequent model is nested within the previous one), while assessing models' superiority we relied on the cut-off criteria recommended by Chen et al. (2008) and Cheung and Rensvold (2002) for testing measurement invariance. We then proceeded with testing multilevel regression models, in which participants were nested within countries, and continuous variables were centered. We regressed mean scores of stress and loneliness on participants' gender, age, and mean scores of Big Five traits. In these models, we set random intercepts on a country level.

3. Results

Descriptive statistics of the sample per country and mean scores of study instruments across countries are given as supplementary information (Table S1 and S2). Table 1 shows the Pearson correlation coefficients for each pair of variables of interest.

Multi-group confirmatory factor analyses revealed that the overall single-factor models fit the data well in case of configural invariance in all personality subscales, PSS-10, and Three-Item Loneliness Scale, but only openness and PSS-10 models met the usually applied criteria for metric invariance. In the next step, we tested for partial metric invariance in case of neuroticism, extraversion, agreeableness, conscientiousness, and loneliness (Byrne et al., 1989; Steenkamp & Baumgartner, 1998). Summary of the invariance measurement results is presented as supplementary (see Table S3). After establishing the (partial) metric measurement invariance, we proceeded with multilevel models.

As shown in Table 2 (left side), individuals with higher levels of neuroticism, openness, extraversion, agreeableness, and lower levels of conscientiousness perceived higher levels of stress during the pandemic. Moreover, women and younger individuals had higher stress scores. Right side of Table 2 presents results of the analysis on loneliness. Similarly, as in the case of stress levels, loneliness during the COVID-19 pandemic was positively related to higher levels of neuroticism, extraversion, agreeableness, and lower levels of conscientiousness. Women and younger individuals reported higher loneliness scores. However, unlike the model with stress levels, openness was unrelated to levels of loneliness.

In summary, neuroticism and gender were the strongest predictors of both higher loneliness and stress scores, while the rest of associations were rather weak or even negligible despite their statistical significance.

4. Discussion

Using data from one of the largest available surveys on the psychological impact of COVID-19, the current study explores the association of

personality traits with perceived stress and loneliness during the COVID-19 pandemic. Our findings show that higher neuroticism is associated with higher stress and loneliness scores. This is in line with previous findings (e.g., Buecker et al., 2020; Saleh et al., 2017). Given that neuroticism is related to emotion dysregulation (Gross, 1998), individuals with this personality trait are more likely to announce unpleasant feelings of loneliness. Likewise, loneliness is conceptualized as a subjective experience that evokes feelings of unsafety and subsequent hypervigilance to social threat (Hawkley & Cacioppo, 2010). The vulnerability during a global pandemic for individuals with high neuroticism might be due to their emotion regulation strategies such as avoidance, suppression, rumination, and worry (Barańczuk, 2019), which maintain the inability to tolerate the distressing emotions that arise with the uncertainty about the threats related to pandemic.

Our findings also suggest that while all estimates for these associations of other four Big Five personality traits with stress and loneliness in multilevel models were statistically significant, some of the observed effect sizes were too small to carry reliable meaning and significance, and therefore, should be interpreted with caution. Firstly, our findings showed that higher extraversion accounted for explaining higher stress and loneliness scores. A recent meta-analysis by Buecker et al. (2020) provided evidence for a strong negative link between extraversion and loneliness, which highlights the fact that - in normal conditions - those high in extraversion feel less lonely, possibly due to their frequent engagement in various activities (Lai & Qin, 2020). However, beneficial effects of extraversion on subjective well-being may be particularly attenuated during the pandemic (Anglim & Horwood, 2021). Hence, this finding further provides evidence that this finding may be due to the uniqueness of the current pandemic and the impact of preventive measures.

Moreover, higher levels of openness were related to the higher levels of stress during the pandemic. Openness has been previously shown to be associated with depressive and anxiety symptoms and suicide risk (Blüml et al., 2013; Han et al., 2021), and less fear of infection in the context of COVID-19 (Martin, 2020). Hence, openness to experience as a personality trait can be taken as a vulnerability factor during the COVID-19 pandemic as it can possibly increase the involvement into various types of risk behaviors, which in turn can be related with experiencing higher levels of stress.

Agreeableness is found to be positively associated with stress and loneliness in the current study. Buecker et al. (2020) reported a negative relation with loneliness in normal circumstances. In general, agreeable people care about others and are prosocial in nature (Wilkowski et al., 2006). However, due to pandemic related restrictions, they might bze facing certain stress and loneliness as those limit their ability to carry out helping behaviors and protect others (Mccrae & Costa, 1999; Penner et al., 2005).

Conscientiousness, in our study, comes out to be negatively associated with stress and loneliness. Studies have depicted that conscientiousness is related to increased positive affect (Bartley & Roesch, 2011), use of active problem-solving strategies (Connor-Smith & Flachsbart,

Table 1
Correlations between study variables.

Variable	1	2	3	4	5	6	7	8
Age (1)	–							
Gender (2)	<0.001	–						
Neuroticism (3)	−0.213***	0.077***	–					
Extraversion (4)	−0.011***	0.111***	0.11***	–				
Openness (5)	0.038***	0.063***	0.111***	0.267***	–			
Agreeableness (6)	−0.054***	0.023***	0.088***	0.219***	0.21***	–		
Conscientiousness (7)	−0.097***	0.064***	0.163***	0.15***	0.181***	0.147***	–	
Stress (8)	−0.145***	0.152***	0.292***	0.15***	0.157***	0.089***	0.096***	–
Loneliness (9)	−0.17***	0.099***	0.191***	0.081***	0.036***	0.051***	0.044***	0.403***

0 = male, 1 = female
*** $p < .001$.

Table 2
Results of Multilevel Models with Participants Nested within Countries and Areas.

Fixed effects	Perceived stress				Loneliness			
	β	95% CI	SE	p	β	95% CI	SE	p
Gender (Men vs Women)	−0.217	[−0.230, −0.204]	0.007	< 0.001	−0.128	[−0.142, −0.114]	0.007	< 0.001
Age	−0.006	[−0.006, −0.005]	0.000	< 0.001	−0.012	[−0.012, −0.011]	2.35E-04	< 0.001
Neuroticism	0.331	[0.322, 0.339]	0.004	< 0.001	0.255	[0.246, 0.264]	0.004	< 0.001
Extraversion	0.068	[0.059, 0.077]	0.005	< 0.001	0.089	[0.079, 0.099]	0.005	< 0.001
Openness	0.072	[0.066, 0.079]	0.003	< 0.001	−0.002	[−0.009, 0.005]	0.004	0.597
Agreeableness	0.030	[0.020, 0.040]	0.005	< 0.001	0.014	[0.004, 0.025]	0.005	0.008
Conscientiousness	−0.012	[−0.022, −0.002]	0.005	0.019	−0.031	[−0.042, −0.021]	0.005	< 0.001
Random effects	LRT	SD	p		LRT	SD		p
Country	7331.32	0.251	< 0.001		5372.94	0.251		< 0.001

2007), and lessened distress and loneliness (Buecker et al., 2020; Luo & Roberts, 2015) in general. It has been shown that resilience, support seeking, appraisal of self-efficacy, and coping and self-regulation abilities mediate the link between conscientiousness and distress (Hoyle, 2006; Kocjan et al., 2021; Nikčević et al., 2021) and suggested that conscientious individuals are perceived more positively by others and feel less lonely (Schermer & Martin, 2019). Therefore, the possibility that people high in conscientiousness benefit from close relationships, cope better, and feel less stressed and lonely during the pandemic could explain our findings.

Our data also showed that women and younger individuals had higher stress and loneliness scores during the pandemic, as consistent with Kowal et al. (2020), Luchetti et al. (2020), and Luo et al. (2020). In sum, using a worldwide dataset, the Big Five personality traits, especially neuroticism, have been shown to be associated with stress and loneliness during the pandemic. Although the effect sizes for associations of stress and loneliness except for neuroticism were quite small, our findings contribute to the literature of personality traits by exploring their role in shaping responses to feelings of stress and loneliness in a crisis such as the COVID-19 pandemic. In times of crisis, stress and loneliness can have a detrimental effect on the way individuals cope and manage their everyday life and responsibilities. Mapping the personality profiles of those who are more vulnerable to stress and loneliness may be crucial in identifying those at risk and can help prevent severe psychological problems.

However, this study has several limitations. Given the timeframe of our study, we used single source cross-sectional data, raising concerns about prohibiting inferences of causality. Our sample was not nationally representative and hence, the generalizability of our findings is not given across gender or age. In future studies, non-self-report measures such as fine-grained daily diaries and/or experience-sampling designs could be used to better understand the associations between personality and psychological well-being during crises. Future studies would also focus on associations of sociodemographic variables including gender and age with personality and psychological outcomes during the pandemic. Finally, because of the limited length of our survey, future studies should investigate other aspects of personality that could be surveyed to understand the psychological toll of the pandemic in more detail.

CRediT authorship contribution statement

Gözde Ikizer: Conceptualization, Methodology, Investigation, Writing – original draft; Marta Kowal: Conceptualization, Methodology, Software, Formal analysis, Investigation, Writing – original draft; İlknur Dilekler Aldemir: Conceptualization, Investigation, Writing – original draft; Alma Jeftić: Conceptualization, Investigation, Writing – original draft; Aybegum Memisoglu-Sanli: Conceptualization, Writing – original draft; Arooj Najmussaqib: Conceptualization, Writing – original draft; David Lacko: Investigation, Writing – original draft; Kristina Eichel: Writing – original draft; Fidan Turk: Writing – original draft; Stavroula

Chrona: Writing – original draft; Oli Ahmed: Writing – original draft; Jesper Rasmussen: Data collection management, Writing – original draft; Raisa Kumaga: Writing – original draft; Muhammad Kamal Uddin: Writing – original draft; Vicenta Reynoso-Alcántara: Writing – original draft; Daniel Pankowski: Writing – original draft; Tao Coll-Martín: Writing – original draft.

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Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2022.111531.

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