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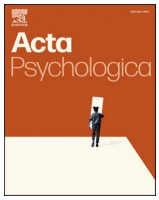

Personality dimensions, resilience, and depression during COVID-19 pandemic: A one-year longitudinal study

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ABSTRACT

Background: The onset of the COVID-19 pandemic has brought to light a significant surge in depression across diverse populations. While a considerable body of research has linked this upswing to lockdowns and restrictive measures, it is crucial to recognize that lockdowns alone cannot fully elucidate the observed increase in mental health disorders, given the vast array of individual psychological responses.

Objective: This study aims to test e whether personality dimensions (Extroversion, Neuroticism, and Psychoticism) and resilience play a role in shielding individuals from developing depression during the COVID-19 pandemic, as observed in a sample of Brazilian adults.

Methods: This research employed a one-year longitudinal naturalistic study involving the general population. It utilized a web-based questionnaire administered in three waves during the COVID-19 pandemic: April 2020, September 2020, and May 2021. The research protocol contains the Patient Health Questionnaire-9 – PHQ-9, the Connor-Davidson Resilience Scale – CD-RISC, and the Eysenck Personality Questionnaire Revised-Abbreviated - EPQR-A.

Results: Our study encompassed 455 participants, of which 35.6 % met the criteria for depression in the first wave, and this figure decreased to 18.5 % in the second and third waves ($p = 0.001$). Resilience levels in the non-depressed group (consistently exhibited higher means across all three waves when compared to the depressed group (first wave: $\overline{x} = 27.98$; second wave: $\overline{x} = 37.26$; third wave: $\overline{x} = 36.67$; $p = 0.001$). Furthermore, resilience exhibited an overall protective effect against depression in all waves (PR = 0.93, $p = 0.000$). Neuroticism and Psychoticism emerged as predictors of depression across all waves (PR = 1.346; $p = 0.0001$ and PR = 1.157; $p = 0.030$), while the Extroversion dimension showed no significant effect.

Conclusion: The decline in depression rates during the first year of the COVID-19 pandemic was influenced by levels of resilience, which acted as a protective factor against the development of depressive symptoms. Notably, Neuroticism and Psychoticism predicted the risk of developing depressive symptoms. Implications for practical intervention in future crisis scenarios suggest the need for public health policy programs featuring personalized interventions that prioritize enhancing resilience.

1. Background

The emergence of the COVID-19 pandemic in 2019 created a high potential for mental disorder risk (Shrira et al., 2020; Tham et al., 2021; Xiang et al., 2020). The effect on the mental health of exposure to risk and fear of contracting the disease, as well as the magnitude of changes to one's routine and the need to adapt individual and collective behaviors to prevent the spread of the infection, have been widely studied worldwide (Grover et al., 2020; Marroquín et al., 2020; Padmanabhanunni & Pretorius, 2021; Violant-Holz et al., 2020).

During the initial stages of the COVID-19 pandemic, cross-sectional studies conducted across the globe revealed a noteworthy rise in the incidence of depressive symptoms among diverse populations (Barros et al., 2020; Braun-Lewensohn et al., 2021; Bryant-Genevier et al., 2021; Burton et al., 2021; Gallagher et al., 2021; Hajek et al., 2021; Idzik et al., 2021; Nwafor et al., 2021; Passos et al., 2020; Schmitt et al., 2021; Stylianou et al., 2020). It was observed that the increase in prevalence occurred with an average increase of 27.6 % in the prevalence of major

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depressive disorder compared to pre-pandemic data (Santomauro et al., 2021).

The restrictions adopted, such as lockdowns, cannot justify the reported increase in disorders, such as anxiety and depression, because the lockdowns seem to generate a minor psychological effect with heterogeneous results so far (Humer et al., 2020; Prati & Mancini, 2021; Saunders et al., 2021). Recently, a review and meta-analysis conducted by Prati and Mancini (2021) showed that lockdown measures had no effect on increasing feelings of loneliness and perceived social support. Since this is a global virus and lockdown estimates vary, we must carefully interpret these results. As the authors state, socio-contextual and individual factors must be considered (Prati & Mancini, 2021).

Several studies have attempted to understand the role of individual characteristics such as personality dimensions (Bellingtier et al., 2021; Holt-Gosselin et al., 2021; López-Núñez et al., 2021; Myerson et al., 2021; Rutland-Lawes et al., 2021; Sahni et al., 2021) and resilience (Lau et al., 2021; Thartori et al., 2021; Zhang et al., 2020) to understand the risk and protective factors for mental disorders in a pandemic context. Personality dimensions can be defined as relatively stable, consistent, and enduring internal characteristics inferred from a pattern of behaviors, attitudes, feelings, and habits within an individual (APA American Psychological Association, 2022). Specific personality dimensions, especially Neuroticism, are consistently described as vulnerable to developing mental disorders (Hakulinen et al., 2015; Jeronimus et al., 2016; Nikčević et al., 2021; Taylor, 2019). During the COVID-19 pandemic, these results have mostly been confirmed (Árbol et al., 2022; Sahni et al., 2021). However, most studies that seek to establish the relationship between personality dimensions and vulnerability to the development of depression in this context are cross-sectional, representing a vital shortcoming (Leguizamo et al., 2021; López-Núñez et al., 2021; Pauly et al., 2021).

A model for understanding personality dimensions is the Three Super Factor Model (PEN), proposed by Eysenck, which aims to study personality from temperament traits (Eysenck, 1963, 1967; Eysenck & Eysenck, 1985) The PEN model consists of Psychoticism, Extroversion, and Neuroticism, and according to this theoretical model, high scores in psychoticism indicate low impulse control, greater aggressiveness, impersonality, and antisocial behavior. In contrast, subjects with low psychoticism scores exhibit opposite characteristics and are defined by better impulse control. In neuroticism, high scores are characterized by excessive worry, potentially depressed mood, tension, irrationality, and high emotionality; conversely, low scores indicate emotional stability. Regarding extroversion, high scores describe the subject as sociable, lively, active, assertive, carefree, dominant, cordial, and adventurous, while low scores are associated with introversion (Eysenck & Eysenck, 1985).

Resilience can be defined as the ability to overcome difficult situations and the capacity to withstand pressure or stress (Criss et al., 2002; Picó-Pérez et al., 2021), and is related to adaptive psychophysiological responses to acute stress (Charney, 2004). Resilience is a complex construct and can be defined differently for individuals, families, organizations, societies, and cultures (Southwick et al., 2014). Despite adversity and sustained competence under stress, good adaptation outcomes are the critical resilience constructs (Luthar & Cushing, 2002). As a result, having a higher level of resilience leads to better mental health and decreased stress (Holt-Gosselin et al., 2021; Kermott et al., 2019; Manchia et al., 2022), and can be studied based on the cognitive emotion regulation ability model proposed by Troy & Mauss (Troy & Mauss, 2011). Although psychological resilience has been conceptualized as a personality trait, it has also been conceived as a process that changes over time (Fletcher & Sarkar, 2013). Some authors, such as Luthar et al. (Luthar et al., 2000), referred to this as a dynamic process involving positive adaptation in adversity.

During the pandemic of COVID-19, several studies associated high levels of resilience as a protective factor for depression (Ouanes et al., 2021; Schmitt et al., 2021; Song et al., 2021; Zach et al., 2021; Zhang et al., 2020). However, these studies were cross-sectional in the early stages of the pandemic, which is a significant limitation. A recent review with a meta-analysis of cross-sectional studies that examined the association between resilience and mental disorders in healthcare workers, the general population, and patients during the COVID-19 pandemic showed a negative relationship between resilience and mental illness in all individuals studied (Jeamjitvibool et al., 2022).

Thus, this research is a one-year longitudinal naturalistic study with the general population to investigate if personality dimensions and resilience contributed to depression in a Brazilian adult sample during the COVID-19 pandemic and to verify if resilience and depression varied over time. To our knowledge, this is the first study to evaluate the personality dimensions and resilience in relation to depression in a longitudinal sample.

2. Methods

2.1. Participants

The inclusion of participants in the study was based on sharing the research protocol via the snowball method (first wave – initial recruitment); the leading social network platforms used were Facebook and WhatsApp (Facebook Inc., Menlo Park, California, USA). For the second and third waves, all participants were recruited based on the email list of those from the first wave who provided their email addresses to participate in future surveys.

In the first wave, all questions were organized in Google Forms (Google, Mountain View, California, USA), and the second and third waves were collected in the SurveyMonkey questionnaire. All answers were extracted into an Excel file. All participants declared themselves older than 18 years, and no age limit existed. Each participant authorized the use of their data through a form of informed consent. Participation was anonymous and optional, and the participants were allowed to stop at any point.

2.2. Setting

Data collection occurred at various stages of the COVID-19 pandemic in Brazil (Fig. 1), from the early stages (low death rate) to its peak (the highest death rate) the month before the last wave of data was collected (Ascom SE/UNA-SUS, 2020; Reuters Agency, 2021). The web-based questionnaire was conducted in three waves: the first wave, from April 14, 2020, to April 23, 2020; the second wave, from September 7 to September 28, 2020; and the third wave, from May 2 to May 28, 2021 (Chart 1). The questionnaire design was shared via social networks and

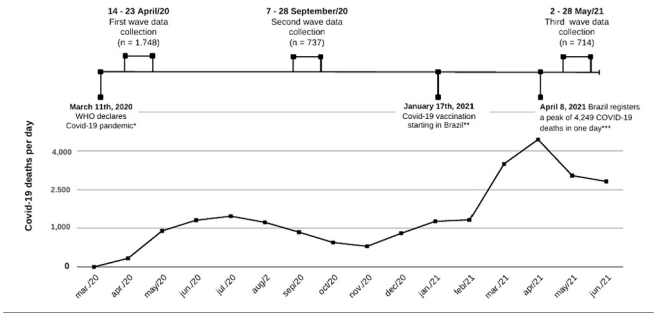

Fig. 1. Timelines for data collection, notable events, and the number of monthly deaths in Brazil during the COVID-19 pandemic until June 30, 2021. *Mortality data:* https://www.worldometers.info/coronavirus/country/brazil/#graph-deaths-daily.*(Ascom SE/UNA-SUS, 2020). **(Agence France Presse, 2021). ***(Reuters Agency, 2021).
Illustration caption: Graph showing monthly COVID-19 mortality in Brazil between March 2020 and June 2021. It illustrates the increase in the number of daily deaths with a peak on April 8, 2021, with 4400 deaths/day.

targeted the general Brazilian population, particularly Southern Brazil.

2.3. Research protocol

The research protocol had four sessions containing: (1) Seven questions for demographic data, (2) The Patient Health Questionnaire-9 – PHQ-9 (Kroenke et al., 2001), (3) The Connor-Davidson Resilience Scale – CD-RISC (Connor & Davidson, 2003), and (4) The Eysenck Personality Questionnaire Revised-Abbreviated - EPQR-A (Francis et al., 1992). In the demographic data, we establish a category termed "Risk group" for participants who indicated the presence of one or more conditions such as: being a health professional, having a chronic disease (such as diabetes, cardiovascular issues, immunosuppression, or respiratory problems), and being over 60 years old.

The PHQ-9 consists of nine questions that assess the presence of each of the symptoms for major depression episodes, as described in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). Each item has four answers (not at all, several days, more than half the days, nearly every day), ranging from zero to three points. This sample was divided into two groups: the Non-depressed group and the Depressed group. Allocation to these groups took into account the score obtained on the first two items of the PHQ-9, which is used as a screening measure indicative of the presence of depressive disorder (Depressed group), with a cutoff point of ≥ 3 on the sum of the first two items (Kroenke et al., 2003). For this study, the internal consistency of the PHQ-9 was calculated according to Cronbach's alpha value (first wave $\alpha = 0.8722$, second wave $\alpha = 0.9065$, third wave $\alpha = 0.9027$). The Brazilian version was adapted by Santos et al. (Santos et al., 2013).

The CD-RISC is a self-report questionnaire with 10 items that measure levels of positive psychosocial adaptation in the face of significant life events. Each item is answered on a 5-point Likert scale based on their own judgments about how well the item described them, from 1 "not true at all" to 5 "true nearly all the time". Example items in CD-RISC are "I can deal with whatever comes" and "When things look hopeless, I don't give up" The total score was calculated. A higher score indicated a higher level of resilience. For this study, the internal consistency of the RISC-10 was calculated according to Cronbach's alpha value (first wave $\alpha = 0.8840$, second wave $\alpha = 0.8959$, third wave $\alpha = 0.8837$). The Brazilian version was adapted by Solano et al. (2016).

The EPQR-A is a self-applied questionnaire with 24 items for assessing the three fundamental personality dimensions (Psychoticism, extraversion, and Neuroticism) and a validity scale (lie scale). In the questionnaire, in which each factor is evaluated via six items, the participant is asked to answer each item with Yes (1) or No (0). The Brazilian version was adapted by Scheibe et al. (Scheibe et al., 2021).

2.4. Sample selection

From the total of 3274 participants in the first wave, 1329 provided their email addresses to participate in the 6- and 12-month follow-up. In total, 737 subjects participated in the second and 714 in the third wave (Fig. 2). After the data were collected in all three waves, the participants were matched using their email addresses as ID, resulting in 455 subjects with a minimum age of 18 and no age limit. For internal validity control in this study, participants were included if they responded to the questionnaires at all three waves and if the Patient Health Questionnaire (PHQ-9) was answered entirely.

2.5. Ethics statement

This research was approved by the Research Ethics Committee of the Hospital de Clínicas de Porto Alegre, Porto Alegre, Southern Brazil, as well as the Brazilian National Research Ethics Committee under CAAE 30487620.7.0000.5327. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. All participants were aged 18 years or older and agreed to participate in the study after signing the consent form.

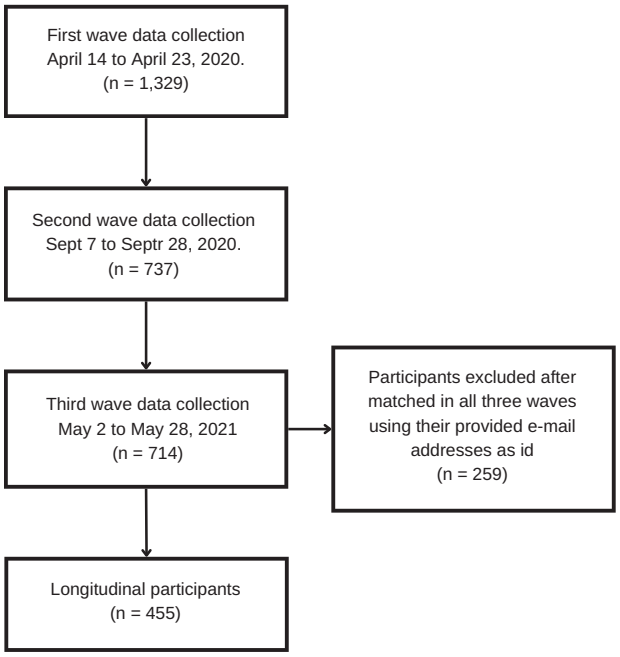

Fig. 2. Flowchart participants
Illustration caption: Flowchart illustrating the sample selection process. First wave $n = 1329$, second wave $n = 737$, and third wave $n = 714$. Arrow indicated the exclusion of $n = 259$ because they did not provide their e-mail address to follow the survey. Participants included $n = 455$.

2.6. Statistical analyses

The subject's sociodemographic data were described using frequency and percentual proportion. To compare the original sample ($n = 1329$) with the model used in this longitudinal study ($n = 455$), a Chi-square goodness-of-fit analysis was performed to ensure its representativeness about the original sample. To investigate the variation in the prevalence of depression in all three waves, the depressive symptoms measured by the PHQ-9 at the three waves were measured using Cochran's Q test.

A univariate descriptive analysis was conducted to investigate the variation in the means of the resilience scores and prevalence of depression in the three waves. To explore the impact of independent variables such as time, resilience, and personality dimensions on the dependent variable of prevalence risk (categorized into non-depressed and depressed groups), the data underwent analysis using Generalized Estimating Equations (GEE). A Bonferroni correction was applied to adjust the personality factor analysis model, incorporating the resilience factor and sociodemographic data as covariates.

Generalized Estimating Equations is a method for modeling longitudinal or clustered data, usually used with non-normal data such as binary or count data. The data was non-parametric and was analyzed using the Shapiro-Wilk test. In all analyses, the significance test was performed with a 95 % confidence interval, and the Alpha error was previously set at 5 % for rejection of the null hypothesis. Statistical analyses were performed using the software SPSS version 27.0 (IBM Corp. Released 2020, n.d.).

3. Results

The results are organized as follows: In paragraph 4.1, we delineate sociodemographic data and representativeness of longitudinal sample. Paragraph 4.2 shows the prevalence of depression across the three

waves. Paragraph 4.3 provides a comparative analysis of resilience variation across the three waves among both depressed and non-depressed subjects. In paragraph 4.4, we expound upon the time, resilience, and personality effects on depression prevalence. Lastly, paragraph 4.5 outlines the effects of personality dimensions on depression prevalence.

3.1. Sociodemographic data and representativeness of longitudinal sample

A total of 455 subjects were included from an original sample of 1329 participants who agreed to participate in this study. Table 1 shows the sociodemographic data and prevalence of depression in the first wave and longitudinal samples. Most subjects were from the risk group (72.9/73.8 %), female (80.0/83.1 %), aged 31–40 years (25.6/26.9), white (90.0/91.6 %), married or had a steady partner (61.8/65.6 %), had paid employment (66.5/68.6 %), and had post-graduation (52.0/58.4 %).

Depressed subjects ($\chi^2 = 3.784$, $p = 0.052$), Age group ($\chi^2 = 15.430$, $p = 0.009$), Occupation ($\chi^2 = 17.201$, $p = 0.016$), and Education level ($\chi^2 = 14.102$, $p = 0.007$) was statistically different between the entire sample and the sample used in the longitudinal analyses. Risk group ($\chi^2 = 0.171$, $p = 0.679$), Sex ($\chi^2 = 2.085$, $p = 0.149$), Ethnic group ($\chi^2 = 1.002$, $p = 0.317$), and Marital status ($\chi^2 = 2.293$, $p = 0.514$) were not significantly different.

Table 1
Sociodemographic data and prevalence of depression and their correlations in the first wave and longitudinal samples during COVID-19 pandemic ($n = 1329$ and $n = 455$).

	Subjects in First Wave (n = 1329)	Longitudinal subjects in First Wave (n = 455)	*p*
	n (%)	n (%)	
Depressed subjects			
Yes	537 (40.8)	162 (35.6)	*0.052*
*Risk group**			
Yes	966 (72.9)	336 (73.8)	0.679
Sex			
Female	1059 (80.0)	378 (83.1)	*0.149*
Age group			
Up to 20 years	26 (2.0)	3 (0.7)	
21–30 years	234 (17.7)	53 (11.7)	
31–40 years	339 (25.6)	122 (26.9)	*0.009*
41–50 years	320 (24.2)	109 (24.1)	
51–60 years	261 (19.7)	111 (24.5)	
61 years or more	143 (10.8)	55 (12.1)	
Ethnic group			
White	1186 (90.0)	414 (91.6)	*0.317*
Marital Status			
Married or had a steady partner	810 (61.8)	296 (65.6)	
Divorced	157 (12.0)	49 (10.9)	*0.514*
Single	319 (24.3)	97 (21.5)	
Widowed	25 (1.9)	9 (2.0)	
Occupation			
Invalidity pensioner	6 (0.5)	4 (0.9)	
Long-service pensioner	143 (10.8)	71 (15.7)	
Sickness benefit	12 (0.9)	3 (0.7)	
Paid employment	878 (66.5)	310 (68.6)	*0.016*
Housewife	57 (4.3)	13 (2.9)	
Student	137 (10.4)	31 (6.9)	
Not able to answer	27 (2.0)	5 (1.1)	
No occupation (not pensioned)	60 (4.5)	15 (3.3)	
Education level			
Incomplete high school	19 (1.4)	2 (0.4)	
Complete high school	91 (6.9)	23 (5.1)	
Incomplete bachelor's or equivalent	214 (16.2)	49 (10.8)	*0.007*
Complete bachelor's or equivalent	310 (23.5)	114 (25.2)	
Post-graduation	686 (52.0)	264 (58.4)	

3.2. Depression prevalence in all three waves

According to PHQ-9, 162 (35.6 %) individuals met the criteria for a depressive episode in the first wave, 84 (18.5 %) in the second and third waves ($\chi^2 = 76.050$; $p = 0.000$) (Fig. 3). Subsequent pairwise comparisons showed significant differences only between the first and second/third waves ($\chi^2 = 0.171$; SE = 0.023; $p = 0.000$).

3.3. Resilience variation in the three waves comparing depressed and non-depressed individuals

The univariate effects analysis (Fig. 4) showed that the Non-depressed group had higher mean resilience values in all three waves (first wave: $\bar{x} = 27.98$; SE = 0.30; second wave: $\bar{x} = 37.26$; SE = 0.31; third wave: $\bar{x} = 36.67$; SE = 0.31) when compared to the Depressed group (first wave: $\bar{x} = 25.57$; SE = 0.41; second wave: $\bar{x} = 34.27$; SE = 0.47; third wave: $\bar{x} = 35.25$; SE = 0.52). All analyses were significant ($p = 0.001$).

3.4. Effects of time, resilience, and personality dimensions on depression prevalence

The analysis of effects of time, resilience, and personality dimensions on depression prevalence, we found a significant effect of time ($\chi2 = 6.326$; df = 2; $p = 0.042$) but no significant interaction between time and resilience in all three waves. A significant effect of resilience was found in Depressed and Non-depressed subjects (for all waves ($\chi^2 = 38.114$; df = 1; $p = 0.000$). Independent of time, resilience showed a prevalence ratio (PR) = 0.93 (CI = 0.91–0.95; $p = 0.000$) for developing depression (Table 2).

When testing model effects on personality dimension (Table 2), a significant impact of Neuroticism was found in both groups (Depressed or Non-depressed subjects) for the three waves ($\chi2 = 108.823$; df = 1; $p = 0.000$) with an effect of time ($\chi2 = 49.273$; df = 1; $p = 0.000$) and the interaction between both ($\chi2 = 27.851$; df = 1; $p = 0.000$). Regardless of the time, Neuroticism showed PR = 1.696 (CI = 1.536–1.873; $p = 0.000$) for the development of depression.

Regarding Extroversion, a significant effect was found in both groups for all three waves ($\chi2 = 4.292$; df = 1; $p = 0.038$) with an effect of time ($\chi2 = 8.455$; df = 2; $p = 0.015$) and the interaction between groups ($\chi2 = 8.570$; df = 2; $p = 0.014$). Regardless of the time, Extroversion showed a PR = 0.88 (CI = 0.779–0.993; $p = 0.038$) for the development of depression.

In the Psychoticism factor, a significant effect was found in both groups for all three waves ($\chi2 = 17.520$; df = 1; $p = 0.000$) with an effect of time ($\chi2 = 65.482$; df = 2; $p = 0.000$) and the interaction between

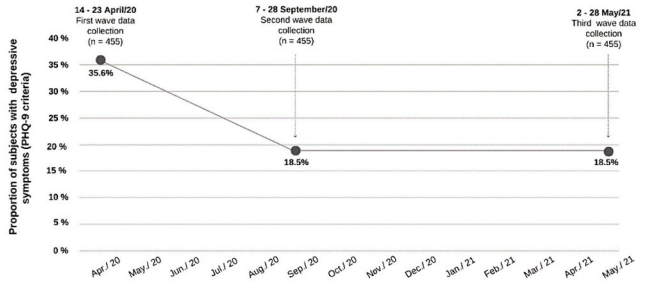

Fig. 3. Prevalence of depression in three waves during COVID-19 pandemic ($n = 455$).
Illustration caption: Line graph illustrating the prevalence of depression in the first wave, second wave, and third wave.

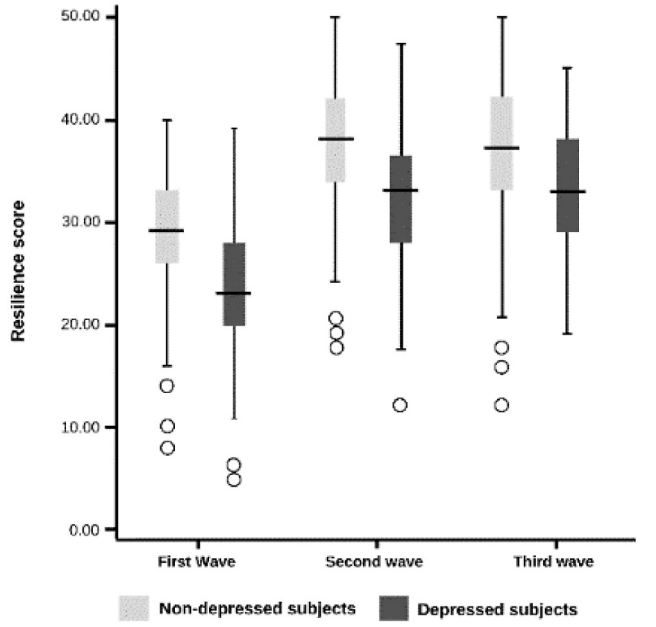

Fig. 4. Three-wave Resilience mean scores in depressed and non-depressed individuals during COVID-19 pandemic (n = 455).
Illustration caption: Boxplot of average resilience scores in depressed and non-depressed people at each wave.

both ($\chi 2 = 8.074$; df = 2; $p = 0.018$). Regardless of the time, Psychoticism showed a PR = 1.53 (CI = 1.253–1.865; $p = 0.000$) for the development of depression.

3.5. Effects of personality dimensions on depression prevalence

In the personality dimension analysis model (Table 3), including covariates resilience and socio-demographic data (gender, age, ethnicity, marital status, occupation, level of education, and risk group), we found that there was a significant interaction Neuroticism (PR = 1.394; $p = 0.000$) and Psychoticism (PR = 1.122; $p = 0.023$) on depression prevalence in all waves, and no significant interaction in Extroversion (PR = 1.019; $p = 0.590$).

When we analyze the personality dimensions and their interaction with depression prevalence in each wave, a significant interaction is observed for Neuroticism in all three waves (first wave: PR = 1.193; $p = 0.000$; second wave: PR = 1.566; $p = 0.000$; and third wave: PR = 1.716; $p = 0.000$) while in Psychoticism this interaction was only significant in the second and third waves (first wave: PR = 1.027; $p = 0.732$; second wave: PR = 1.284; $p = 0.034$; and third wave: PR = 1.400; $p = 0.001$). Extroversion showed no significant interaction in any of the three waves (first wave: PR = 0.976; $p = 0.150$; second wave: PR = 0.903; $p = 0.119$; and third wave: PR = 0.976; $p = 0.681$).

The covariates exhibiting a significant association in the model's effect include resilience, sex, age, and educational levels. Resilience and female sex are associated with Neuroticism ($X^2 = 24.073$, $p = 0.001$; $X^2 = 8.368$; $p = 0.004$); resilience, female sex, and aged between 31 and 40 years are associated with Extroversion ($X^2 = 71.407$, $p = 0.001$; $X^2 = 11.826$, $p = 0.004$; $X^2 = 11.881$, $p = 0.001$); resilience, sex female, educational level Incomplete bachelor's or equivalent and age between 41 and 50 years are associated with Psychoticism ($X^2 = 75.214$, $p = 0.001$; $X^2 = 14.228$, $p = 0.001$; $X^2 = 6.207$, $p = 0.045$; $X^2 = 12.188$, $p = 0.001$).

4. Discussion

To our knowledge, this is the first study to assess the effect of personality dimensions and resilience in adult depression in a longitudinal sample during the COVID-19 pandemic. Our study demonstrated that depressive symptoms found at the beginning of the COVID-19 pandemic decreased in all subjects during the one-year follow-up. On the other hand, resilience increased compared to the initial pandemic phase for subjects with and without depression, and resilience was a protective factor for developing these symptoms. The personality dimensions Neuroticism and Psychoticism were shown to be risk factors, increasing the probability of depression in subjects with a predominance of these dimensions.

4.1. Depression prevalence variations in one year of follow-up during COVID-19 pandemic

The prevalence of depression in our sample was 35.6 % in the first wave, 18.5 % in the second wave, and 18.5 % in the third wave. These findings suggest that the presence of depression in our sample was similar to other studies worldwide (Oryan et al., 2021; Pappa et al.,

Table 2
Effects of time, resilience, and personality dimensions in depression prevalence during the first year of the COVID-19 pandemic (n = 455).

Factor study	Effect	Wave	χ2	df	p	Prevalence Ratio (PR)	95 % CI
Time	*Time*	All waves	6.326	2	0.042	–	–
	Time x Resilience	All waves	5.474	2	0.065	–	–
	Resilience		38.114	1	0.000	0.932	0.911–0.953
Resilience		First wave	82.944	1	0.000	0.928	0.913–0.943
	Each wave	Second Wave	75.796	1	0.000	0.906	0.887–0.927
		Third wave	35.338	1	0.000	0.930	0.908–0.953
	Time x Neuroticism	All waves	27.851	1	0.000	–	–
	Neuroticism		108.823	1	0.000	1.696	1.536–1.873
Neuroticism		First wave	71.465	1	0.000	1.339	1.251–1.432
	Each wave	Second Wave	98.681	1	0.000	1.727	1.551–1.924
		Third wave	119.360	1	0.000	1.764	1.593–1.953
	Time x Extroversion	All waves	8.570	2	0.014	–	–
	Extroversion		4.292	1	0.038	0.880	0.779–0.993
Extroversion		First wave	0.610	1	0.435	0.967	0.889–1.052
	Each wave	Second Wave	11.138	1	0.001	0.796	0.696–0.910
		Third wave	4.722	1	0.030	0.867	0.763–0.986
	Time x Psychoticism	All waves	8.074	2	0.018	–	–
	Psychoticism		17.520	1	0.000	1.530	1.253–1.865
Psychoticism		First wave	1.725	1	0.189	1.136	0.939–1.375
	Each wave	Second Wave	9.986	1	0.002	1.506	1.168–1.941
		Third wave	23.280	1	0.000	1.669	1.355–2.054

Note: The analyses were adjusted for the effect of time.

Table 3
Effects of personality dimensions on depression prevalence adjusted for resilience and socio-demographic data during the first year of the pandemic COVID-19 ($n = 455$).

Factor study	Wave	χ2	df	*p*	Prevalence Ratio (PR)	95 % CI
Neuroticism	All waves	27.623	2	0.000	1.394	1.246–1.460
	First wave	17.898	1	0.000	1.193	1.099–1.295
	Second Wave	41.045	1	0.000	1.566	1.365–1.797
	Third wave	81.870	1	0.000	1.716	1.527–1.929
Extroversion	All waves	0.291	1	0.590	1.019	0.933–1.085
	First wave	2.076	1	0.150	0.976	0.867–1.148
	Second Wave	2.425	1	0.119	0.903	0.795–1.027
	Third wave	0.170	1	0.681	0.976	0.979–1.148
Psychoticism	All waves	7.540	2	0.023	1.122	1.014–1.320
	First wave	0.117	1	0.732	1.027	0.882–1.196
	Second Wave	4.474	1	0.034	1.284	1.019–1.619
	Third wave	11.187	1	0.001	1.400	1.149–1.705

Note: For the adjusted model effect, the covariates sex, age, ethnicity, marital status, occupation, educational level, and risk group were included in this analysis.

2021; Ramiz et al., 2021), especially those centered on the early stages of the pandemic, but it was also superior to others (Hajek & König, 2021; Idzik et al., 2021; Kämpfen et al., 2020; Passos et al., 2020; Rohde et al., 2020; Schmitt et al., 2021). The reduction to 18.5 % of depression prevalence found in the second wave (September 2020) was also like that observed in other studies with data collected during the same period (Fancourt et al., 2021; Hajek & König, 2021).

4.2. Effect of resilience on depression in one year of follow-up during COVID-19 pandemic

In our investigation of the fixed effect of resilience on depression, we discovered an increase in resilience levels across both groups (Depressed and Non-depressed). Specifically, for each point increase on the resilience scale, there was a decrease of 7 % in the risk of developing depression. These results align with previous cross-sectional studies that have explored the mediating relationship between resilience and the onset of depressive symptoms in the context of the COVID-19 pandemic (Havnen et al., 2020; Shi et al., 2022).

The low scores of resilience observed in the first wave for both groups (Depressed and Non-depressed subjects), associated with the high prevalence of depression, showed us that the first phase of the pandemic was potentially the most defiant; contextually, it was the phase with the most significant uncertainty and lack of knowledge about the infection. This result can be explained by the conceptualization of resilience as a process (Luthar et al., 2000), which recognizes that the effects of protective and promoting factors vary contextually (from one situation to another) and temporally (throughout a problem and an individual's lifetime) in line with the Lazarus appraisal theory, which has its central point as: "how we appraise an event determines how we react emotionally" (Lazarus, 1999 p.87), or in other words, it is not a particular event that causes a specific emotion—however, rather, the subjective appraisals of the event lead to emotional reaction.

Troy and Mauss' (2011) cognitive emotion regulation model could serve as an explanatory framework for the phenomenon wherein individuals displayed a more negative response during the initial phases of the pandemic compared to stages marked by a substantial surge in infections and fatalities related to the disease. This model is based on the appraisal theory (Lazarus, 1999) with the addition of selective attention control (Folkman & Lazarus, 1985): the higher the attention directed at a particular negative stimulus, the more threatening it may become, and vice versa. Thus, the attention directed at the initial stages of the pandemic may have produced this effect, considering the effect of the pandemic on everyone's routines.

4.3. Personality dimension and risk of depression

The personality dimensions Neuroticism and Psychoticism were found to have a significant interaction with the prevalence risk (PR) of depression. This means that every point increase on the Neuroticism scale raised the risk by 39.4 %, while every point increase on the Psychoticism scale raised it by 12.2 % in all waves. When analyzing the waves separately, the interaction remained significant in both cases, except Psychoticism, which was not significant in the first wave. It is worth noting that in both cases, there was a substantial increase in PR over time, indicating that by the end of the third wave, Neuroticism had increased to 71.6 % and Psychoticism to 40 %.

Most studies examining the link between personality traits and depression focus on the Five-Factor Model (FFM) (Mccrae & Costa, 1997). While the FFM model and the PEN model have distinct theoretical constructs, they have shown factor correlations. Psychoticism in the PEN model combines factors related to Agreeableness vs. Antagonism and Conscientiousness vs. Undependability, while Extroversion and Neuroticism are directly correlated in both models. However, Eysenck (1991) argues that the Openness vs. Closedness to experience aspect in the FFM is a cognitive ability and not a personality trait, and so there is no equivalent or correlated factor in the PEN model (Costa & McCrae, 1995; Larstone et al., 2002). Hence, establishing equivalence between the PEN and FFM models, individuals characterized by elevated levels of Neuroticism, Antagonism, and Undependability demonstrate an increased prevalence risk of depression.

Our findings on Neuroticism are consistent with previous research suggesting that this trait is linked to a heightened vulnerability to psychiatric disorders (Jeronimus et al., 2016; Shi et al., 2022). As for Psychoticism, it is not surprising that it appeared as a prevalence risk factor for depression since it reflects the opposite of the protective factors known in the FFM (Hakulinen et al., 2015).

Surprisingly, Extroversion did not prove to be a potential protector of depression, as shown in other studies (Nikčević et al., 2021). In the separate analysis of Extroversion, a protective effect was observed at all waves, but this was not stable when we adjusted the study to include resilience and sociodemographic data. When analyzed separately and controlled by covariates, the protective role of Extroversion showed us that, somehow, their interaction was controlled by other variables.

4.4. Resilience and personality dimension

According to a range of studies (Pauly et al., 2021), there is growing evidence to suggest that resilience may serve as a crucial factor in moderating the connection between neuroticism and depression, as highlighted in the work of Gong et al. (Gong et al., 2020). Nonetheless, resilience's role in this context remains elusive, with lingering questions about whether it plays a direct, causal mediating role in this complex relationship. Additional controlled studies are necessary to provide a more comprehensive understanding of resilience's involvement in mental health dynamics.

In our study, resilience showed significant fluctuations over time, different from others (Pauly et al., 2021). We observed that the effects of the personality dimensions on depression showed significant covariation with resilience and other sociodemographic characteristics (gender, age, and educational level), which in the Neuroticism and Psychoticism

dimensions did not interfere with the result and remained stable. This highlights the need for further investigation into how these fluctuations may impact the associations between personality dimensions and mental health.

5. Limitations

Our study had some limitations that restrict us from generalizing it to the general population. The high percentage of women (83.1 %), white individuals (90.1 %), married or with a stable partner (65.6 %), employed (68.6 %), and with a high-level education (83.6 %) does not represent the reality of the majority of the Brazilian population.

The low retention of participants in the study and the lack of control for possible confounding variables, such as pandemic-related stressors (like job loss or bereavement), social support, or history of mental health problems, might also have affected the results. In addition, data collection through an online questionnaire could have introduced some bias, as people who choose to participate in such studies might systematically differ from those who don't. Moreover, self-evaluations can also be influenced by bias or the inability to assess one's feelings and behaviors more precisely.

6. Conclusions

In conclusion, our findings indicate that the reduction in depression occurred shortly after the first months of the pandemic, and resilience levels might directly affect this decrease. Based on our study, we observed that the increased resilience scores were a protective factor for the development of depressive symptoms during the COVID-19 pandemic, and the increased resilience occurred in all studied subjects, regardless of previous depressive symptoms.

Neuroticism and Psychoticism were risk factors for depression. However, they were susceptible to interaction with resilience, indicating that regardless of these personality dimensions, mechanisms associated with resilience worked positively in all waves.

Although it is hard to make future predictions, it is plausible to indicate by our study that individuals will respond to new crises possibly influenced by their more stable personality traits. Initially, people might experience higher symptoms but might develop greater resilience if supported correctly.

It is important to note that personality traits are resistant to change. Therefore, the practical implications in future crisis scenarios could be based on public health policy programs with personalized interventions that prioritize enhancing resilience, especially in the short term. We hope that future studies can better elucidate the interaction of resilience with the different dimensions of personality to clarify how the mechanisms work and that we can develop methods to improve resilience.

Thus, we hope the results of our research contribute to a better understanding of individual characteristics and their role in the development of depression during the COVID-19 pandemic to implement preventive and treatment strategies considering personal factors.

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CRediT authorship contribution statement

Igor Londero: Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Data curation, Conceptualization. **Neusa Sica da Rocha:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

Data availability

The raw data supporting the conclusions of this article will be made available by the authors upon request, without undue reservation.

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