

# Neuroticism, stress, and rumination in anxiety and depression of people with Vitiligo: An explanatory model

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## ABSTRACT

Psychological impacts of Vitiligo have been demonstrated, and associations of the skin disease with anxiety and depression disorders have already been shown. However, it is still unclear the role of individuals' personality factors, such as neuroticism, stress, and rumination, as well as sociodemographic characteristics of people with Vitiligo in such disorders. We conducted a study in a community sample of individuals with Vitiligo ( $N = 324$ ) aiming to test the hypothesis that neuroticism, stress, and rumination are subjacent to these individuals' anxiety and depression symptomatology. We also explored whether individuals' gender might favor the onset or worsening of the psychological consequences of such disorders. Results showed that the relationship between neuroticism, anxiety and depression was mediated by stress and rumination (brooding), being this effect moderated by the participants' gender. Specifically, women's reflection and stress seemed to be important mechanisms to predict their anxiety and depression symptoms, whereas brooding predicts such disorders' symptomatology in men with Vitiligo. These findings may guide future research and clinical interventions for this population, for which it is necessary to consider the psychological consequences of the disease and not just its physiological aspects.

## 1. Introduction

Vitiligo is a chronic condition characterized by a loss of skin pigmentation. In the world, its prevalence varies from 0.06% to 2.28%, and it affects both genders (Bergqvist & Ezzedine, 2020). Scientists in the field have accepted the autoimmune assumption as the most likely etiology. However, psychological impacts of Vitiligo have been demonstrated, and associations of the disease with generalized anxiety disorders, depressive disorder, social phobia, obsessive symptoms, and hypochondria have been pointed out (Dabas et al., 2020; Hamidizadeh et al., 2020; Iannella et al., 2016; Kussainova et al., 2020; Lai et al., 2017; Osinubi et al., 2018). The relationship between Vitiligo and stress has also been investigated, which not only confirms the potential stress of having Vitiligo but also indicates that stress may be connected to the condition's triggering and progression (Silverberg & Silverberg, 2015). Among the relationships mentioned, the potential connection between

rumination and Vitiligo is also indicated but it has not been empirically tested (Erfan et al., 2014). This relationship is hypothesized by the fact that rumination is an underlying mechanism for psychiatric disorders, and these, in turn, are linked to this skin disease (Nolen-Hoeksema et al., 2008; Trapnell & Campbell, 1999). Still, elements like gender and skin color have been connected to the low quality of life of people with Vitiligo (Bonotis et al., 2016; Do Bú et al., 2021; Karelson et al., 2013; Simons et al., 2020), which, in turn, may boost psychiatric disorders such as anxiety and depression.

Notwithstanding these studies, it is still unknown how psychosocial factors might lead to higher or lower levels of anxiety and depression in people with Vitiligo. Specifically, it is yet not known how neuroticism, stress, and rumination together can contribute to depression and anxiety in these individuals. Furthermore, considering that the disease's negative impacts seem to be experienced by men and women differently (Bergqvist & Ezzedine, 2020), it is not clear how gender can operate in

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such relationships. Thus, we aimed to test the role played by neuroticism, stress, and rumination in the levels of anxiety and depression of people with Vitiligo, also exploring how this process occurs for men and women.

### 1.1. Vitiligo and neuroticism

Previous studies have highlighted that individual characteristics, such as personality traits, seem to be related to the onset and the progression of Vitiligo since they are directly connected to the attitudes that might influence health itself (Erfan et al., 2014; IuN, 1989; López et al., 1995). For instance, Erfan et al. (2014) showed that individuals with Vitiligo scored higher on preoccupation and pessimism scales. The authors associated this result with a rumination tendency but did not analyze this possibility. Also, López et al. (1995) showed that low expressivity, emotional imbalance, insensibility, and aggressiveness characterize people with Vitiligo. Moreover, IuN (1989) investigated 74 people with Vitiligo and found that more than half of the participants had difficulties in social adaptation; furthermore, more than a quarter of the participants demonstrated an accentuation of the characterological personality traits. Similarly, there are studies on the relationship between Vitiligo and Neuroticism, being the latter defined as a trait that denotes an individual predisposition to live more intensively the feelings of anguish, suffering, unsuitability, depression, anxiety, low tolerance to frustration, impulsivity, self-criticism, among others. Regarding this aspect, Bonotis et al. (2016) observed a negative association between neuroticism and the perception of quality of life of people with Vitiligo. The authors verified that the higher the participants scored on the neuroticism scale, the fewer people with Vitiligo expressed a good quality of life concerning the ailment. In other words, the higher the neuroticism level, the greater the propensity of people that consider Vitiligo as a harmful factor for their quality of life. Accordingly, Simons et al. (2020) discuss that people with Vitiligo bearing a high degree of neuroticism are more likely to develop stress, anxiety, and depression symptoms. Besides Sachs-Ericsson et al. (2014) point out an association between neuroticism and rumination, so that the greater the neuroticism, the greater the likelihood of developing rumination. Thus, we reasoned that it is probable that individuals with Vitiligo who are stronger in the neuroticism trait would be more vulnerable to negative reactions (e.g., rumination, stress) that may impact their mental health (e.g., anxiety and depression disorders). Hence, we expect to observe neuroticism as the main predictive variable of anxiety and depression in people with Vitiligo.

### 1.2. Vitiligo and stress

Studies have demonstrated that having Vitiligo is characterized as a stressing factor to people with this condition (Do Bú et al., 2018; Silverberg & Silverberg, 2015). Not only that, but it has been shown that this relationship is not unidirectional, i.e., stress itself may trigger the disease or its exacerbation (Simons et al., 2020). When it comes to the physiological explanations on the role that stress has to cause Vitiligo, starting from the hypothesis that the accumulation of hydrogen peroxide - which is originated due to oxidative stress - leads to melanocyte damage in the epidermal layer of the skin, Gürpınar et al. (2019) analyzed the proportions of cortisol/dehydroepiandrosterone sulfate (DHEAS) among people with Vitiligo. It was observed that DHEAS, the hormone known for its antioxidant properties, was significantly lower than cortisol, a hormone that is elevated during stress. Also, a work carried out by Silverberg and Silverberg (2015) with 1541 adults with Vitiligo, aiming to identify factors that commonly are associated with the triggering of the disorder, showed that 56.6% of the participants indicated that they had experienced stressful situations in their lives and they believed it could be a factor for the disease development. Even with the scarcity of longitudinal studies that explain psychosocial factors as a cause for Vitiligo's onset, these studies help us understand how stress

may be implicated in this skin disorder, either as a harmful element to the quality of life or to the self-image of those who have it. Therefore, considering stress as a phenomenon experienced by people with Vitiligo, given, among other aspects, their skin condition; and the literature that indicates stress as a mediating mechanism between neuroticism, depression, and anxiety (Mineka et al., 2020; Uliaszek et al., 2010), we hypothesize that stress may be a predictor of anxiety and depressive symptomatology of people with Vitiligo.

### 1.3. Vitiligo and rumination

Rumination is associated with several psychiatric disorders in youths and adults, including depression, anxiety, and self-harmful behavior. There are also signs that rumination is predicted by the personality trait neuroticism (Nolen-Hoeksema et al., 2008; Roelofs et al., 2008; Trapnell & Campbell, 1999). Accordingly, recognizing Vitiligo as an ailment that affects the self-image of the diagnosed person (Do Bú & Coutinho, 2019), it is possible to consider the relationship between rumination and Vitiligo, since rumination is characterized as a tendency to focus and maintain attention on feelings or events considered unpleasant or threatening to one's self (Trapnell & Campbell, 1999). Therefore, given the adaptive process with the disease, it is likely that people in the first years since their diagnosis present higher rumination indices than those who have had the disease for a more extended period (Sansone & Sansone, 2012). Besides, although the potential connection between rumination and Vitiligo is indicated but not yet confirmed (Erfan et al., 2014), it is still unknown how rumination is related to people with Vitiligo and, also, with their symptoms of anxiety and depression. Nevertheless, given that rumination plays a mediating role between neuroticism and psychological disorders (Roelofs et al., 2008), and considering the potential amplification of rumination due to Vitiligo and its psychosocial impact in individuals with the disease, we hypothesize that rumination is a mediator of the relationship between neuroticism, anxiety, and depression in individuals with Vitiligo.

### 1.4. Sociodemographic characteristics and Vitiligo

Characteristics such as gender, skin color, religion, and nationality of people with Vitiligo are accounted for in the variations of discrimination perception for having the ailment, as well as in their quality of life, such that women with black skin have the worst indices (Bonotis et al., 2016; Do Bú et al., 2021; Do Bú et al., 2022; Karelson et al., 2013; Morales-Sánchez et al., 2017; Simons et al., 2020). In addition, previous studies have shown that women with Vitiligo show higher symptomatology of anxiety and depression compared to men and healthy group controls (Dabas et al., 2020; Hamidzadeh et al., 2020; Iannella et al., 2016; Kussainova et al., 2020; Lai et al., 2017). Thus, knowing that Vitiligo affects men's and women's lives differently in several ways (Do Bú & Coutinho, 2019; Simons et al., 2020), and given previous findings showing differences in anxiety and depression expression between men and women with Vitiligo, we aimed to investigate whether gender moderates the relationship between neuroticism, anxiety, and depression as these relationships are mediated by stress and rumination.

### 1.5. Overview of the research

We tested the hypothesis that the personality trait neuroticism, rumination, and stress are related to anxiety and depression in individuals with Vitiligo. We also explored whether individuals' gender might favor the onset or worsening of the psychological consequences of such disorders. Specifically, we expected that the greater the participants' levels of neuroticism, the higher their anxiety and depression symptoms. Based on the aforementioned studies showing the existence of an association between neuroticism, stress, and rumination as psychological outcomes, we aimed to verify how both stress and rumination would affect the relationship between neuroticism, anxiety, and

depression symptoms. Our reasoning is that the higher the levels of stress and rumination in a person with Vitiligo, the higher their levels of anxiety and depression. Moreover, we sought to test if the participants' gender could function as a moderator in these relationships, proposing moderated mediation hypotheses. Procedures used in this study were approved by a Research Ethics Committee and complied with all expected ethical principles, and datasets used can be accessed at the OSF repository platform: [osf.io/hjwdk](https://osf.io/hjwdk)

## 2. Method

### 2.1. Participants

Three hundred and twenty-four people with Vitiligo (82.2% female, Age:  $M = 32.2$ ,  $SD = 11.78$ ) participated in this study. They were mostly brown-skinned (46.5%) and had higher education degrees (37.5%). It is a convenience sample (non-probabilistic), with the participation of those who voluntarily agreed to collaborate with the research and digitally signed the Informed Consent Form. A sensitive analysis using Webpower (Zhang & Yuan, 2018) showed that this sample size has the power of 0.80 to detect an effect size of  $d = 0.25$  or higher with  $p = .05$ .

### 2.2. Instruments and procedures

Participants were invited on social media platforms, such as Facebook, Twitter, and WhatsApp, to answer an online questionnaire. For eligibility, participants should be older than 18 years; be Brazilian citizens, and be diagnosed with Vitiligo by a dermatologist. On average, participants spent 15 min completing the following scales:

#### 2.2.1. Ruminative Response Scale (RRS-VR)

This instrument measures two factors of rumination: brooding (encompasses the more harmful rumination aspects) and reflection (a more positive dimension of the construct, where the individual tends to find through this mechanism adaptive alternatives to reduce their suffering) (Zanon et al., 2018). Participants were instructed to answer the 10-item scale focusing on their thoughts and actions when they feel sad or depressed (ranging from 1 = totally disagree to 4 = totally agree). The RRS-VR showed for this study satisfactory fit indices: CFI = 0.93, RMSEA = 0.08 (IC 90% = 0.06–0.10), and SRMR = 0.04. Alphas of Cronbach for its two factors were: brooding ( $\alpha = 0.83$ ) and reflection ( $\alpha = 0.74$ ).

#### 2.2.2. Big Five Personality Factors Inventory

This measure is answered on a 5-point scale (1 = Totally Disagree to 5 = Totally Agree), and assesses the Personality Traits according to the Theory of the Big Five Factors throughout 20 items (Andrade, 2008). Its dimensions are Neuroticism, Conscientiousness, Openness, Amiability, and Extroversion. Regarding its psychometric quality, the measurement model showed the following goodness-of-fit indices: CFI = 0.86, TLI = 0.83, RMSEA = 0.07 (IC 90% = 0.06–0.08), and SRMR = 0.07. The scale's internal consistency for the neuroticism factor was  $\alpha = 0.76$ .

#### 2.2.3. Depression, Anxiety, and Stress Scale (DASS)

It was validated in Brazil by Vignola and Tucci (2014) and has three subscales with seven items each, answered from 0 = Completely Disagree to 4 = Completely Agree. Each subscale measures the emotional states of depression, anxiety, and stress. Participants were instructed to answer it thinking of how they felt during the previous week. The individuals' scores for each emotional state were grouped according to their severity of stress, anxiety, and depression. The threshold marks proposed by Vignola and Tucci (2014) were followed to compute the prevalence of these conditions with a confidence interval of 95%. DASS's measurement model fitted this study's data satisfactorily: CFI = 0.92, TLI = 0.91, RMSEA = 0.07 (IC 90% = 0.01–0.087), and SRMR = 0.04. Its subscales had high internal consistency: depression ( $\alpha$

= 0.91), anxiety ( $\alpha = 0.88$ ), and stress ( $\alpha = 0.87$ ).

### 2.2.4. Sociodemographic questionnaire

Questions were utilized to access the participants' age, gender, income, education, and time since Vitiligo diagnosis.

### 2.3. Data analysis

To characterize the sample, descriptive statistics were utilized, such as measures of central tendency, variability, and percentages, as well as the estimation of confidence intervals of 95%. To test the hypothesis, variance analyses were carried out, as well as the bivariate Pearson correlation, and hierarchical linear regression. Moreover, the predictive processes were tested by mediations and moderated mediations through the macro Process version 3.5 (Hayes, 2013). Missing values were considered not extreme MCAR ( $<1\%$ ;  $p > .05$ ), and Listwise deletion was applied given their tiny expression (Lodder, 2014).

## 3. Results

Initially, we investigated the prevalence of stress, anxiety, and depression among people with Vitiligo. The majority of the population with Vitiligo was classified as "normal" either in regards to stress, anxiety, or depression. However, 13.2%, 11.0%, and 11.4% of the participants displayed, respectively, stress, anxiety, and depression scores that ranged from moderate to extremely severe (see Table 1). Also, we explored sociodemographic differences between participants by gender (male vs. female), income (low vs. high), skin color (white vs. non-white), and time with Vitiligo ( $>12$  years vs.  $<12$  years), regarding neuroticism, rumination (reflection and brooding), stress, anxiety and depression indices.

Substantial differences were found between genders concerning neuroticism [ $F(1,323) = 7.64$ ;  $p = .006$ ,  $d = 0.40$ ]; stress [ $F(1, 323) = 10.28$ ;  $p = .001$ ,  $d = 0.48$ ]; rumination (brooding) [ $F(1, 323) = 7.53$ ;  $p = .006$ ;  $d = 0.41$ ]; anxiety [ $F(1, 323) = 10.18$ ;  $p = .002$ ;  $d = 0.43$ ]; and depression [ $F(1, 323) = 12.72$ ;  $p = .001$ ,  $d = 0.55$ ]; in a way that women showed higher averages for all of the constructs. We also found in regard to income for neuroticism [ $F(1, 323) = 8.78$ ;  $p = .003$ ,  $d = 0.37$ ]; stress [ $F(1, 323) = 13.96$ ;  $p = .001$ ;  $d = 0.46$ ]; reflection [ $F(1, 323) = 7.06$ ;  $p = .008$ ,  $d = 0.32$ ]; brooding [ $F(1, 323) = 14.13$ ;  $p = .001$ ,  $d = 0.45$ ]; anxiety [ $F(1, 323) = 8.79$ ;  $p = .003$ ,  $d = 0.37$ ]; and depression [ $F(1, 323) = 17.63$ ;  $p = .001$ ;  $d = 0.53$ ]; due to people who have an income up to one minimum wage showed averages higher than those who earned more than one salary for all the analyzed constructs. Concerning

**Table 1**

Prevalence of people with Vitiligo grouped according to the severity classifications of depression, anxiety, and stress.

DASS-21 Factor	Classification	Total sample (N = 325)	
		n (%)	CI (95%)
Stress	Normal	256(78.8)	74.2–83.1
	Mild	26(8.0)	5.2–11.1
	Moderate	16(4.9)	2.8–7.4
	Severe	13(4.0)	1.8–6.5
	Extremely Severe	14(4.3)	2.2–6.5
Anxiety	Normal	268(82.5)	78.2–86.5
	Mild	21(6.5)	4.0–9.2
	Moderate	12(3.7)	1.5–5.8
	Severe	12(3.7)	1.8–5.8
Depression	Extremely Severe	12(3.7)	1.8–6.1
	Normal	256(78.8)	74.2–83.1
	Mild	32(9.8)	6.5–13.2
	Moderate	14(4.3)	2.2–6.8
	Severe	10(3.1)	1.2–4.9
	Extremely Severe	13(4.0)	2.2–6.2

Note. CI (95%) – Confidence interval for prevalence of 95%; n – number of participants.

participants' skin color, we divided the sample between those who declared themselves to be white and non-white (black, brown, yellow). No meaningful observations were found. Finally, the quantity of time with Vitiligo diagnosis showed a significant difference only for the rumination (brooding) factor [ $F(1, 323) = 8.49; p = .004, d = 0.33$ ], as people who have had Vitiligo for less than 12 years showed greater brooding when compared to those who have had it for longer.

We further explored the relationships between neuroticism, rumination, stress, anxiety, and depression of the participants in this current study. High and moderate correlations were observed between the neuroticism, depression, anxiety, stress, and rumination factors (reflection and brooding) (Table 2).

Then, we performed a hierarchical regression analysis to predict anxiety and depression; in which the first block contained the participants' gender and neuroticism, whereas the second block was composed of stress and rumination factors (Table 3).

The models of hierarchical multiple regression tested, evinced that participants' gender and neuroticism predict anxiety and depression. When included in block 2, stress and rumination (brooding) meaningfully explain anxiety and depression.

### 3.1. Mediation analysis

To investigate the psychological process that leads to anxiety and depression in people with Vitiligo, two mediation models were constructed through the macro PROCESS Macro version 3.5 (Hayes, 2013) with bootstrapping of 5000 simulations.

Results indicated that the relationship between neuroticism and anxiety (Fig. 1) was mediated by stress (indirect effect:  $b = 0.47; SE = 0.04; CI\ 95\% = 0.39; 0.55$ ), non-mediated by reflection (indirect effect:  $b = 0.01; SE = 0.01; CI\ 95\% = -0.01; 0.04$ ), and mediated by brooding (indirect effect:  $b = 0.05; SE = 0.02; CI\ 95\% = 0.01; 0.08$ ). Concerning depression, another mediation analysis showed that the relationship between neuroticism and the construct (Fig. 2) was also completely mediated by stress (indirect effect:  $b = 0.46; SE = 0.04; CI\ 95\% = 0.38; 0.53$ ), non-mediated by reflection (indirect effect:  $b = 0.01; SE = 0.01; CI\ 95\% = -0.01; 0.04$ ), and mediated by brooding (indirect effect:  $b = 0.11; SE = 0.02; CI\ 95\% = 0.06; 0.16$ ).

Next, analyses of moderated mediation of the relationship between neuroticism and anxiety indicated reliable interactions between gender and reflection ( $b = 0.20; SE = 0.08; p = .023$ ), and between gender and brooding ( $b = -0.26; SE = 0.09; p = .004$ ). The decompositions of the interactions evinced that the relationship between neuroticism and anxiety was mediated by reflection for women (indirect effect:  $b = 0.03; SE = 0.01; CI\ 95\% = 0.00; 0.06$ ) and not for men (indirect effect:  $b = -0.05; SE = 0.04; CI\ 95\% = -0.14; 0.02$ ), and that the relationship between neuroticism and anxiety was mediated by brooding for men (indirect effect:  $b = 0.16; SE = 0.05; CI\ 95\% = 0.05; 0.27$ ), but not for women (indirect effect:  $b = 0.01; SE = 0.02; CI\ 95\% = -0.03; 0.05$ ).

Regarding the mediated relationship between neuroticism and depression; analyses of moderated mediation showed significant interactions between gender and stress ( $b = 0.30; SE = 0.14; p = .04$ ), and between gender and brooding ( $b = -0.29; SE = 0.09; p = .001$ ); in such a way that the mediation by stress was stronger for women (indirect effect:  $b = 0.49; SE = 0.04; CI\ 95\% = 0.40; 0.57$ ) than for men (indirect

**Table 2**  
Correlations between constructs.

	1	2	3	4	5	6
1. Neuroticism	–					
2. Depression	0.54	–				
3. Anxiety	0.56	0.76	–			
4. Stress	0.68	0.79	0.81	–		
5. Reflection	0.35	0.40	0.38	0.40	–	
6. Brooding	0.50	0.59	0.52	0.54	0.52	–

Note. All coefficients are reliable at  $p = .001$ .

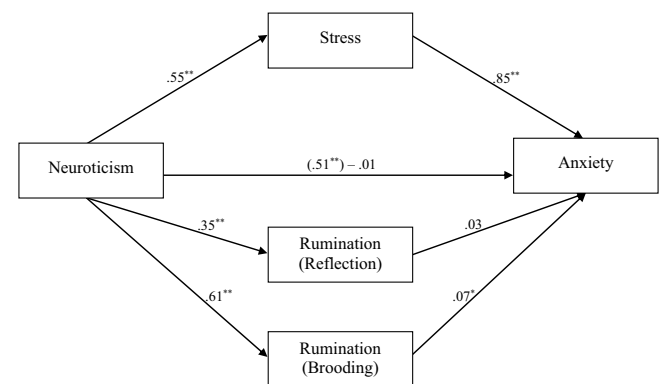
**Table 3**  
Multiple regression to determine predictors of anxiety and depression.

Predictors	Anxiety		Depression	
	Block 1	Block 2	Block 1	Block 2
	$\beta$	$\beta$	$\beta$	$\beta$
Gender (dummy)	0.09*	0.03	0.11*	0.04
Neuroticism	0.56**	–0.01	0.52**	–0.07
Stress		0.75**		0.71**
Rumination (Reflection)		0.04		0.03
Rumination (Brooding)		0.10*		0.22**
Adjusted R <sup>2</sup>	0.32	0.67	0.30	0.67

Note. Gender (0 = male; 1 = female).

\*  $p = .05$ .

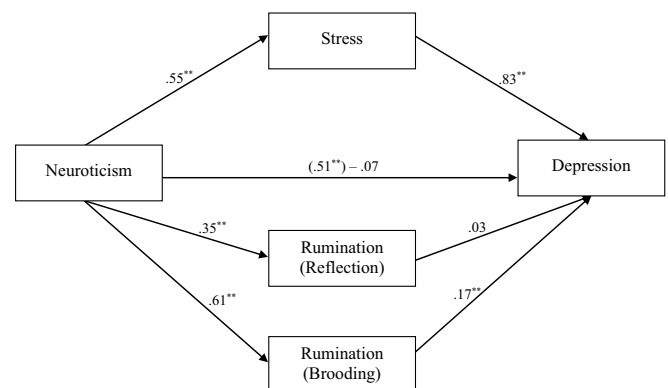
\*\*  $p = .001$ .



Note. \* $p < .05$ , \*\* $p < .001$ .

**Fig. 1.** Mediated relationship between neuroticism and anxiety.

Note. \* $p < .05$ , \*\* $p < .001$ .



Note. \*\* $p = .001$ .

**Fig. 2.** Mediated relationship between neuroticism and depression.

Note. \*\* $p = .001$ .

effect:  $b = 0.28; SE = 0.07; CI\ 95\% = 0.15; 0.45$ ), and the brooding mediation was stronger for men (indirect effect:  $b = 0.23; SE = 0.07; CI\ 95\% = 0.10; 0.38$ ) than for women (indirect effect:  $b = 0.07; SE = 0.02; CI\ 95\% = 0.03; 0.12$ ). Therefore, the individuals' gender seemed to be an important variable in the processes that link neuroticism to anxiety and depression through stress and rumination's dimensions.

## 4. Discussion

Results indicated that the relationship between neuroticism, anxiety, and depression was mediated by stress and brooding, being this effect moderated by the participants' gender. Specifically, women's reflection



and stress seem to be important mechanisms to predict their anxiety and depression symptoms, whereas brooding predicts such disorders' symptomatology in men with Vitiligo. In this regard, we suggested a possible psychological process that culminates in an aggravation of anxiety and depression in people with this skin disease. To date, a psychological process with all of these factors analyzed together has not been proposed by the literature for this population. It is also innovative, since recognizing gender in this process, we raise questions about how social standards of beauty and gender norms may affect more women's mental health with Vitiligo compared to men's. Thus, this study contributes to the literature that points to psychological and emotional factors related to Vitiligo.

The prevalence of stress, anxiety and depression among participants in this study is higher than among Brazilian college students (Martins et al., 2019), Indian high school students (Kumar & Akoijam, 2017), and the elderly population in Iran (Babazadeh et al., 2016). These findings are consistent with the literature showing that people with Vitiligo have higher levels of anxiety, depression, and stress than people who do not have it (i.e., the general population) (Hamidzadeh et al., 2020; Kussainova et al., 2020; Lai et al., 2017).

Significant differences between the genders in the constructs of neuroticism, stress, rumination, anxiety, and depression, with women presenting higher scores in all of them, are also backed up by the literature. In this context, several works point out that women have higher scores in neuroticism scales (Lippa, 2010); are significantly more likely to develop anxiety and depression disorders (World Health Organization [WHO], 2017); display higher chronic stress indices (Matud, 2004); and, present higher reflection and brooding indices when compared to men (Johnson & Whisman, 2013). With respect to studies that specifically examined people with Vitiligo, previous research is reinforced by our findings, as female participants have higher rates of anxiety and depression compared with male participants (Dabas et al., 2020; Hamidzadeh et al., 2020; Iannella et al., 2016; Lai et al., 2017). Although the clinical relevance of these differences should be interpreted with caution (Kussainova et al., 2020; Lai et al., 2017), given societal beauty standards and gender norms, particularly shared through the media, it is critical that further research examine how Vitiligo can intensify and affect more women's (vs. men's) mental health.

When it comes to the differences regarding family income; participants from a lower-income household showed higher averages to the neuroticism, stress, rumination, anxiety, and depression constructs; also confirming the data once demonstrated by the literature. Studies indicate that higher neuroticism indices are connected to a low income (Vittengl, 2017), as well as stress (Allen et al., 2014), rumination (Roelofs et al., 2008), and depression (Patel et al., 2018). Meaningful differences were expected concerning skin color for the scores that refer to the constructs, as the literature points that the negative impacts of Vitiligo are boosted when it comes to non-white people (Bonotis et al., 2016). However, these differences were not observed in this study. This may have occurred due to the low amount of non-white people in the sample of this study. Future studies must attempt to homogenize their samples in a way to verify such a hypothesis.

Having Vitiligo for a shorter time associated with the rumination's brooding factor may indicate that people at the beginning of the disease's development are still processing its discovery. In this way, rumination (i.e., cognitive over-focusing) may unintentionally result in magnifying the disease's perceived symptoms, mainly in the first years with the diagnosis (Sansone & Sansone, 2012). However, this result should be considered with caution once there are no studies that address the relationship between time since the diagnosis of Vitiligo and rumination factors. As a suggestion, future studies might verify the current relationship more broadly and deeply.

Albeit contributing to the literature on Vitiligo's emotional factors, the study carried out bore a few limitations. First of all, we highlight the impossibility of inferring causal relationships, given the study's correlational nature and the ethical impossibility of experimenting with the

mediating variables. Consequently, we suggest that further studies test, practically and longitudinally, how the treatment of anxiety and depression of people with Vitiligo contributes to a likely remission of the Vitiligo's progression. A study of this nature is deemed appropriate because people with Vitiligo associate its triggering and progression to psychological factors, as well as these mental disorders (Do Bú et al., 2018; Silverberg & Silverberg, 2015). Also, this study raises the hypothesis of a process that can occur, in reality, in different directions than the hypothesized/proposed one or even vary depending on the life story of each person. However, the directions followed in this study have already been partially or completely indicated by the literature for other clinical populations (Roelofs et al., 2008; Sachs-Ericsson et al., 2014; Williams et al., 2017). Regardless of that, while we recognize the importance of these factors, other models must be tested in future research.

Despite the limitations, the results presented may guide future research and clinical interventions for this population, for which it is necessary to consider the psychological consequences of the disease and not just its physiological aspects. In this context, dermatologists and psychologists must look into the psychological factors here verified, envisioning the management of therapeutics that includes the mental healthcare of this population. Considering such aspects, healthcare professionals can map out, in an interdisciplinary way, therapeutic possibilities that comprehend the specificities of each individual who has the ailment.

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## Ethics approval

Committee for Ethics in Research on Human Beings, number of registry 2.190.296.

## Consent to participate

Informed consent was obtained from all individual participants included in the study.

## Consent for publication

The authors affirm that human research participants provided informed consent for publication of the data collected.

## Code availability

Not applicable.

## Availability of data and material

Datasets and supplementary material can be accessed at the OSF Platform: [https://osf.io/hjwdk/?view\\_only=51fb75a930514bca97b4b01efad23838](https://osf.io/hjwdk/?view_only=51fb75a930514bca97b4b01efad23838)

## Authors' contributions

**Emerson Do Bú:** conceptualization, methodology, formal analysis, writing - original draft and writing - review and editing; **Vitória Santos:** investigation, methodology, formal analysis and writing - original draft; **Kaline Lima:** methodology and formal analysis; **Cicero Pereira:** Supervision and review and editing; **Edna Alexandre:** writing - review and editing; **Viviane Bezerra:** writing - review and editing.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.actpsy.2022.103613>.

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