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Empirical Article

Autistic traits predict social avoidance and distress: The chain mediating role of perceived stress and interpersonal alienation

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Social avoidance and distress are the primary aspects of social anxiety. Nonautistic people with high levels of autistic traits are more likely to exhibit social avoidance and distress. However, research has yet to reveal how autistic traits induce social avoidance and distress. To fill this gap, the present study recruited 708 participants to complete the 25-item Autism Spectrum Quotient, Social Avoidance and Distress Scale, Chinese Perceived Stress Scale, and Interpersonal Alienation Subscale. The results indicated that autistic traits significantly predicted social avoidance and distress in nonautistic people. In addition, autistic traits induced social avoidance and distress through perceived stress and interpersonal alienation, respectively. Importantly, perceived stress and interpersonal alienation (including the subdimensions of interpersonal alienation: sense of loneliness, sense of social isolation, and alienation between family members) partially mediated the relationships between autistic traits and social avoidance and distress. Overall, autistic traits predict social avoidance and distress via perceived stress and interpersonal alienation. This finding extends the hypothetical model of clinical anxiety in autism spectrum disorders. Furthermore, reducing perceived stress and interpersonal alienation in nonautistic people with high levels of autistic traits may be a valid intervention method to prevent and eliminate their social avoidance and distress.

Key words: Autistic traits, perceived stress, interpersonal alienation, social avoidance, social distress, social anxiety.

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INTRODUCTION

Autism spectrum disorder (ASD) is a pervasive developmental disorder that is characterized by difficulties in social communication (Sucksmith, Roth & Hoekstra, 2011). The typical behaviors, thought patterns, and predominant symptoms of autistic people are called autistic traits (Abu-Akel, Allison, Baron-Cohen & Heinke, 2019). Autistic traits are distributed along a continuum in nonautistic people (Constantino & Charman, 2016; Haraguchi, Stickley, Saito, Takahashi & Kamio, 2019). The levels of autistic traits in nonautistic people are lower than those in autistic people (Constantino, Lajonchere, Lutz *et al*., 2006). As autistic traits are widespread in nonautistic people and have a significant influence on people's behavior and thinking, autistic traits have been viewed as the sixth personality trait (in addition to the Big Five personality traits) in humans (Wakabayashi, Baron-Cohen & Wheelwright, 2006).

Many studies have shown that nonautistic people with high levels of autistic traits face similar challenges in social communication and interpersonal relationships as autistic people, such as social avoidance and distress (Constantino *et al*., 2006). Social avoidance and distress refer to people's tendency to avoid social interactions and experience distress in social situations, which are primary aspects of social anxiety (Watson & Friend, 1969). The prevalence of social anxiety in autistic people is 50%, which is much higher than that in nonautistic people (7%–13%) (Bellini, 2004; Maddox & White, 2015). The main symptoms of social anxiety are physiological arousal, social avoidance, and negative thoughts or worries (Maddox & White, 2015; Spain, Sin, Linder, McMahon & Happé, 2018). Furthermore, among nonautistic people, Freeth, Bullock and Milne (2013) found that students with high levels of autistic traits reported more social anxiety problems, such as negative evaluation anxiety, social avoidance, and social distress, than students with medium or low levels of autistic traits. These research findings suggest that autistic people and nonautistic people with high levels of autistic traits both struggle with social avoidance and distress.

However, the generation of social avoidance and distress in autistic people and nonautistic people with high levels of autistic traits may be due to different mechanisms. Specifically, social avoidance and distress in autistic people are derived from severe autism-specific deficits in social competence. Autism-specific deficits refer to interaction deficits and deficits in inferring others' intentions (Espelöer, Hellmich, Vogeley & Falter-Wagner, 2021). These deficits increase the probability of social failure during social interaction for autistic people, which in turn leads to social avoidance and distress (Bejerot, Eriksson & Mörtberg, 2014; Bejerot & Humble, 2013; Cappadocia, Weiss & Pepler, 2012). In contrast, although the social abilities of nonautistic people with high levels of autistic traits are slightly disrupted, their social and communication abilities are basically intact (Guan & Zhao, 2015). Hence, previous findings that social deficits generate social avoidance and distress in autistic people cannot be fully generalized to nonautistic people with high levels of autistic traits. In other words, in addition to deficits in social competence, other critical factors may induce social avoidance and distress in nonautistic people with high levels of autistic traits. Therefore, the present study examined these potential factors, starting with a review previous relevant findings.

A hypothetical model of clinical anxiety in autism spectrum disorders, proposed by Wood and Gadow (2010), suggests that ASD-related stressors induce negative emotions that further exacerbate autistic symptoms, behavioral problems, and personal distress but do not affect social avoidance. However, according to Maslow's hierarchy of needs theory, people with long durations of negative emotions tend to exhibit social avoidance (Maslow, 1943; Yang, Bai, Yu, Wang, Lv & Cao, 2022). This prediction is partially supported by previous studies. For example, Aurora and Coifman (2021) found that negative emotions increased the frequency of social avoidance behaviors. Therefore, the hypothetical model of clinical anxiety in autism spectrum disorders cannot explain why negative emotions induce social avoidance. The present study aimed to expand upon this model.

Specifically, the present study extended the hypothetical model of clinical anxiety in autism spectrum disorders, assuming that autistic people and nonautistic people with high levels of autistic traits may experience stressors. These perceived stresses may further elicit negative emotions and thereby induce social avoidance and distress. Furthermore, many studies have reported more interpersonal alienation (a typical negative emotion experienced in social interaction) in nonautistic people with high levels of autistic traits than in those with low levels of autistic traits (Stice & Lavner, 2019). Importantly, interpersonal alienation may interfere with social interaction and exacerbate social avoidance and distress (Griffiths, Mitchison, Murray, Mond & Bastian, 2018; Ritsher, Otilingam & Grajales, 2003). Hence, we hypothesized that perceived stress and interpersonal alienation may mediate the relationships of autistic traits and social avoidance and distress in nonautistic people.

Perceived stress is defined as the sense of tension and loss of control when an individual perceives external threats (Liu, Lithopoulos, Zhang, Garcia-Barrera & Rhodes, 2021). The primary sensory over-responsivity model suggests that autistic people are more likely to experience discomfort from daily noise, resulting in strong stress responses and anxiety (Green & Ben-Sasson, 2010). Amos, Byrne, Chouinard and Godber (2019) examined whether the sensory over-responsivity model applied to nonautistic people. They also found that sensory over-responsivity and stress were mediators of the relationship between autistic traits and anxiety. In addition, the relationship between stress and anxiety has been generalized to the relationship between stress and social anxiety, known as stress-induced social avoidance (Haller & Bakos, 2002). Specifically, rodents' desire to engage in social communication was significantly reduced when they experienced social or nonsocial stress. daSilva, Huckins, Wang, Wang, Campbell and Meyer (2021) further extended this finding to human participants. The naturalistic mobile sensing study found that a higher level of perceived stress predicted fewer social interactions in the following days. Overall, nonautistic people with high levels of autistic traits are more likely to perceive stress, leading to social avoidance and distress.

Interpersonal alienation is defined as the negative emotional experience of individuals who have been forgotten or isolated by relatives, friends, classmates, or other interpersonal networks in interpersonal interaction (Yang & Wu, 2002; Zeng, Xiao, Ye *et al*., 2022). Empirical studies have shown that autistic people or nonautistic people with high levels of autistic traits struggle to maintain and develop relationships (Pugliese, Fritz & White, 2015; Sosnowy, Silverman, Shattuck & Garfield, 2019; Toseeb, McChesney, Oldfield & Wolke, 2020). These challenges may induce interpersonal alienation, including sense of loneliness, sense of social isolation, and alienation between family members (Pugliese, Fritz & White, 2015; Schiltz, McVey, Dolan Wozniak *et al*., 2021). Furthermore, numerous studies have also found that interpersonal alienation, such as sense of loneliness, sense of social isolation, and alienation between family members, leads individuals to avoid normal social communication (Bosacki, Dane, Marini & Ylc-Cura, 2007; Huan, Ang & Chye, 2014; Lim, Rodebaugh, Zyphur & Gleeson, 2016). In this manner, a higher level of autistic traits may induce more severe interpersonal alienation, which then leads to social avoidance and distress.

Importantly, we also propose that increased perceived stress may predict increased interpersonal alienation. Campagne's (2019) meta-analysis showed that early medical therapy should be combined with psychological stress therapy to treat early loneliness, social isolation, and alienation between family members; in other words, that perceived stress plays a prodromal role in interpersonal alienation. This hypothesis also aligns with the transactional theory of stress. This theory holds that humans evaluate their own ability to handle stressful events. When people believe that they cannot cope with stressful situations, they experience subjective feelings of stress and related mental stress responses, such as interpersonal alienation (Lazarus & Folkman, 1987). Hence, perceived stress may lead to interpersonal alienation.

As autistic traits are widely distributed in nonautistic people and may threaten people's mental health, it is necessary to elucidate how autistic traits induce social avoidance and distress in nonautistic people. Therefore, the present study examined the relationships between autistic traits and social avoidance and distress in nonautistic people, extending the hypothetical model of clinical anxiety in autism spectrum disorders. The hypotheses of the present study are as follows: (1) autistic traits predict social avoidance and distress; (2) autistic traits induce social avoidance and distress through perceived stress and interpersonal alienation, respectively; and (3) perceived stress and interpersonal alienation play a chain mediating role in the relationships between autistic traits and social avoidance and distress.

METHOD

Participants

Participants were recruited through an online advertisement. They were ethnically Chinese and native speakers of Mandarin Chinese. After all participants completed the questionnaires, we discarded the participants who provided incorrect answers to the attention check questions and whose response duration was shorter than 420 s. Finally, data from 708 participants (296 males and 412 females) with a mean age of 20.98 years (range = 18–29 years; *SD* = 2.08 years) were included in further analyses. This study was approved by the local ethics committee and each participant signed an online informed consent form before the survey.

Materials

The 25-item Autism Spectrum Quotient (AQ25) was used to measure students' autistic traits (Li & Tamaoka, 2019). The AQ25 has 25 items that measure five dimensions of autistic traits, that is, communication, social skill, imagination, attention to detail, and attention switching. Items are scored on a scale from 0 = "strongly disagree" to 3 = "strongly agree." Seventeen

questions are scored in a reverse manner before calculating the overall score. A higher overall AQ25 score indicates higher levels of autistic traits. The Cronbach's alpha coefficient of the scale was 0.76 in the present study.

The Social Avoidance and Distress Scale (SAD) was used to measure the social avoidance and distress of students (Peng, Fan & Li, 2003). The SAD comprises 28 items that measure two dimensions (social avoidance and social distress). Items are scored on a scale from 1 = "completely agree" to 5 = "completely disagree." Fourteen questions are scored in a reverse manner. A higher overall SAD score indicates a higher level of social avoidance and distress. The Cronbach's alpha coefficient of the scale was 0.96 in the present study.

The Chinese Perceived Stress Scale (CPSS) was used to measure the perceived stress of students (Yang & Huang, 2003). The CPSS includes 14 items that measure two dimensions of perceived stress, namely, feeling of tension and sense of being out of control. Items are scored on a scale from 1 = "seldom" to 5 = "always." Seven questions are scored in a reverse manner. A higher overall CPSS score indicates higher perceived stress. The Cronbach's alpha coefficient of the scale was 0.87 in the present study.

The Interpersonal Alienation Subscale of the Adolescent Students' Alienation Scale (ASAS) was used to measure the interpersonal alienation of students (Yang, Zhang & Huang, 2002). The Interpersonal Alienation Subscale has 15 items that measure three dimensions of interpersonal alienation, that is, sense of loneliness, sense of social isolation, and alienation between family members. Items are scored on a scale from 1 = "completely disagree" to 7 = "completely agree." Three questions are scored in a reverse manner. A higher overall Interpersonal Alienation Subscale score indicates higher interpersonal alienation. The Cronbach's alpha coefficient of the scale was 0.94 in the present study. In addition, the Cronbach's alpha coefficients of the subscales (sense of loneliness, sense of social isolation, and alienation between family members) were 0.89, 0.82, and 0.82, respectively.

Data analysis

All data were analyzed by R 4.3.0 (R Core Team, 2020) and SPSS 24. First, common method bias was examined by Harman's single factor test. Second, descriptive statistics were conducted. Third, correlations among autistic traits, social avoidance and social distress, perceived stress, interpersonal alienation, sense of loneliness, sense of social isolation, and alienation between family members were examined with Pearson product–moment correlation. Finally, the PROCESS function of the bruceR package in R 4.3.0 was used to examine the chain mediating role of perceived stress and interpersonal alienation in the relationships between autistic traits and social avoidance and distress.

RESULTS

Common method bias

Harman's single factor test was used to conduct an exploratory factor analysis of all items of autistic traits, social avoidance and distress, perceived stress, and interpersonal alienation. This test extracted 13 common factors with eigenvalues higher than 1. The explanation rate of the first factor was 31.75%. This proportion was lower than the cut-off value of 40%. Therefore, the results of the present study were not significantly affected by common method bias.

Correlation analysis

Autistic traits were significantly positively correlated with perceived stress ($r = 0.553$, $p < 0.001$), social avoidance and distress ($r = 0.775$, $p < 0.001$), interpersonal alienation ($r = 0.623$, $p < 0.001$), sense of loneliness ($r = 0.643$, $p < 0.001$), sense of social isolation ($r = 0.521$, $p < 0.001$), and alienation between family members ($r = 0.505$, $p < 0.001$). Perceived stress was significantly positively correlated with social avoidance and distress ($r = 0.623$, $p < 0.001$), interpersonal alienation ($r = 0.650$, $p < 0.001$), sense of loneliness ($r = 0.658$, $p < 0.001$), sense of social isolation ($r = 0.580$, $p < 0.001$), and alienation between family members ($r = 0.512$, $p < 0.001$). Interpersonal alienation ($r = 0.660$, $p < 0.001$), sense of loneliness ($r = 0.687$, $p < 0.001$), sense of social isolation ($r = 0.564$, $p < 0.001$), and alienation between family members ($r = 0.513$, $p < 0.001$) were significantly positively correlated with social avoidance and distress (see Table 1).

Chain mediating effect analysis

The chain mediating effect of perceived stress and interpersonal alienation in the relationships between autistic traits and social avoidance and distress was examined. Autistic traits significantly positively predicted perceived stress ($\beta = 0.644$, $p < 0.001$) and interpersonal alienation ($\beta = 0.424$, $p < 0.001$). Perceived stress significantly positively predicted social avoidance and distress ($\beta = 0.213$, $p < 0.001$) and interpersonal alienation ($\beta = 0.421$, $p < 0.001$). Interpersonal alienation also significantly positively predicted social avoidance and distress ($\beta = 0.218$, $p < 0.001$) (see Fig. 1a).

Importantly, the chain mediating effect was further verified by the PROCESS function of the bruceR package in R 4.3.0. Specifically, 5,000 samples from 708 data points were extracted by random repeated sampling to calculate the average path coefficient. The results showed that the 95% confidence interval (95% CI) of the mediating effect of perceived stress, the mediating effect of interpersonal alienation, and the chain

Table 1. *Correlation analysis results of autistic traits, social avoidance and distress, perceived stress, and interpersonal alienation*

	AT	PS	SAD	IA	SL	SSI	AFM
1. AT	1						
2. PS	0.553***	1					
3. SAD	0.775***	0.623***	1				
4. IA	0.623***	0.650***	0.660***	1			
5. SL	0.643***	0.658***	0.687***	0.956***	1		
6. SSI	0.521***	0.580***	0.564***	0.903***	0.815***	1	
7. AFM	0.505***	0.512***	0.513***	0.868***	0.739***	0.680***	1

Notes: AFM = Alienation between Family Members; AT = Autistic traits; IA = Interpersonal Alienation; PS = Perceived Stress; SAD = Social Avoidance and Distress; SL = Sense of Loneliness; SSI = Sense of Social Isolation.
***Indicates $p < 0.001$.

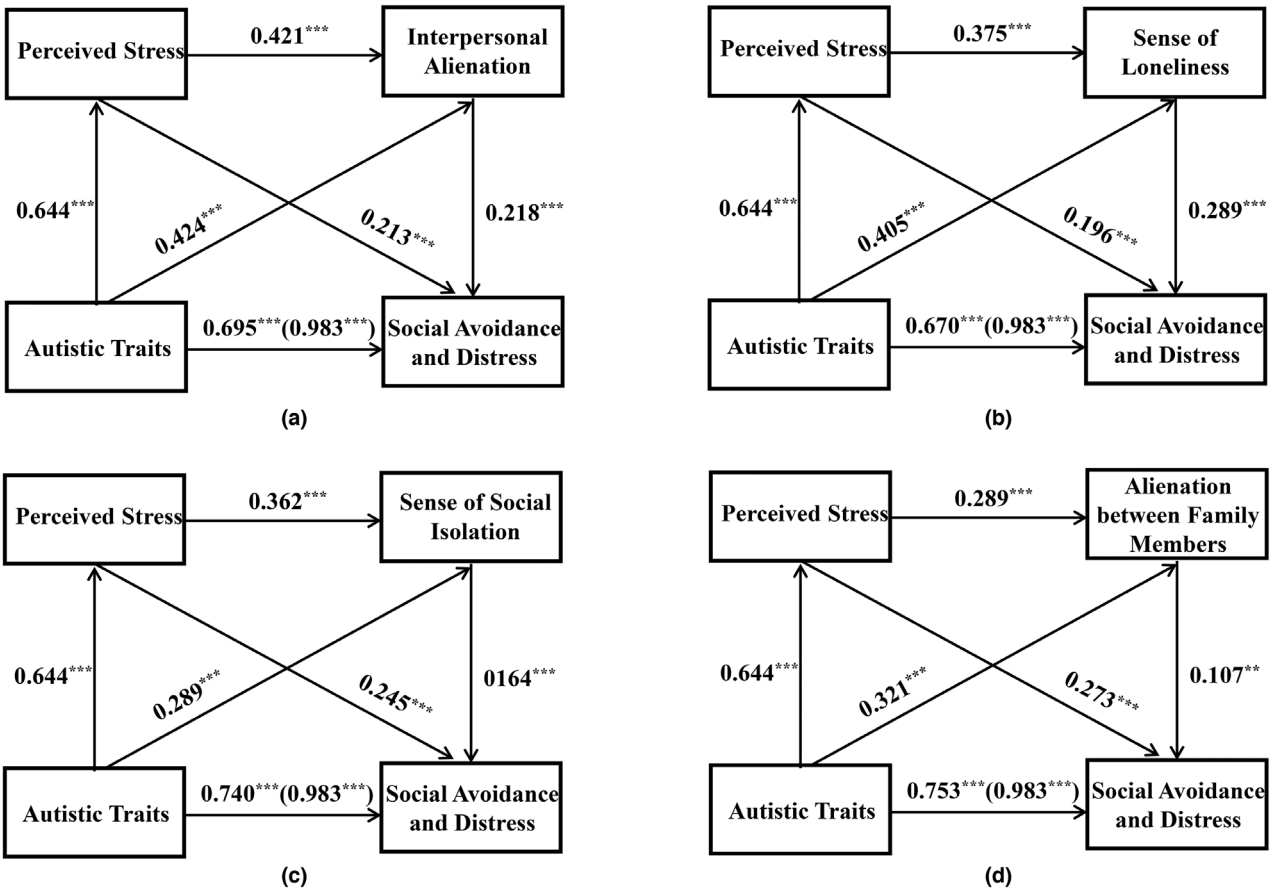

Fig. 1. The model of the relationships among autistic traits, social avoidance and distress, perceived stress, and interpersonal alienation (including three dimensions of interpersonal alienation).*Note*: ** indicates $p < 0.01$; *** indicates $p < 0.001$.

mediating effect were [0.088, 0.190], [0.056, 0.133], [0.036, 0.086], respectively. All 95% CI excluded 0 (see Table 2). The direct effect of autistic traits on social avoidance and distress was still significant (standardized direct effect = 0.695, $p < 0.001$). Therefore, the mediating effects of perceived stress and interpersonal alienation were both significant. Perceived stress and interpersonal alienation played a partial chain mediating role in the relationships between autistic traits and social avoidance and distress. The ratios of the mediating effect of perceived stress, the mediating effect of interpersonal alienation, and the chain mediating effect to the total effect were 0.137/0.983 = 13.937%, 0.092/0.983 = 9.359%, and 0.059/0.983 = 6.002%, respectively.

We further analyzed the chain mediating effects of perceived stress and three dimensions of interpersonal alienation on the relationships between autistic traits and social avoidance and distress. In the model of autistic traits, social avoidance and distress, perceived stress, and sense of loneliness, autistic traits significantly positively predicted perceived stress ($\beta = 0.644$, $p < 0.001$) and sense of loneliness ($\beta = 0.405$, $p < 0.001$). Perceived stress significantly positively predicted social avoidance and distress ($\beta = 0.196$, $p < 0.001$) and sense of loneliness ($\beta = 0.375$, $p < 0.001$). Sense of loneliness also significantly positively predicted social avoidance and distress ($\beta = 0.289$, $p < 0.001$) (see Fig. 1b). Furthermore, the chain mediating effect analysis showed that the 95% CI of the mediating effect of perceived stress, the mediating effect of sense of loneliness, and the chain mediating effect were [0.078, 0.179], [0.075, 0.162], [0.044, 0.098], respectively. All 95% CI excluded 0 (see Table 2). The direct effect of autistic traits on social avoidance and distress was still significant (standardized direct effect = 0.670, $p < 0.001$). Therefore, the mediating effects of perceived stress and sense of loneliness were both significant. Perceived stress and sense of loneliness played a partial chain mediating role in the relationships between autistic traits and social avoidance and distress. The ratios of the mediating effect of perceived stress, the mediating effect of sense of loneliness, and the chain mediating effect to the total effect were 0.126/0.983 = 12.818%, 0.117/0.983 = 11.902%, and 0.070/0.983 = 7.121%, respectively.

In the model of autistic traits, social avoidance and distress, perceived stress, and sense of social isolation, autistic traits significantly positively predicted perceived stress ($\beta = 0.644$, $p < 0.001$) and sense of social isolation ($\beta = 0.289$, $p < 0.001$). Perceived stress significantly positively predicted social avoidance and distress ($\beta = 0.245$, $p < 0.001$) and sense of social isolation ($\beta = 0.362$, $p < 0.001$). Sense of social isolation also significantly positively predicted social avoidance and distress ($\beta = 0.164$, $p < 0.001$) (see Fig. 1c). In addition, the chain mediating effect analysis showed that the 95% CI of the mediating effect of perceived stress, the mediating effect of sense of social isolation, and the chain mediating effect were [0.108, 0.212], [0.024, 0.076], [0.020, 0.061], respectively. All 95% CI excluded 0 (see Table 2). The direct effect of autistic traits on social avoidance

Table 2. *Standardized indirect effects and 95% confidence interval of chain mediation models*

Pathway	Estimate	95% Confidence interval	
		Lower	Upper
Autistic Traits→Perceived Stress→Interpersonal Alienation→Social Avoidance and Distress			
AT→PS → SAD	0.137	0.088	0.190
AT→IA → SAD	0.092	0.056	0.133
AT→PS → IA → SAD	0.059	0.036	0.086
Autistic Traits→Perceived Stress→Sense of Loneliness→Social Avoidance and Distress			
AT→PS → SAD	0.126	0.078	0.179
AT→SL → SAD	0.117	0.075	0.162
AT→PS → SL → SAD	0.070	0.044	0.098
Autistic Traits→Perceived Stress→Sense of Social Isolation→Social Avoidance and Distress			
AT→PS → SAD	0.158	0.108	0.212
AT→SSI → SAD	0.048	0.024	0.076
AT→PS → SSI → SAD	0.038	0.020	0.061
Autistic Traits→Perceived Stress→Alienation between Family Members→ Social Avoidance and Distress			
AT→PS → SAD	0.176	0.128	0.227
AT→AFB → SAD	0.035	0.012	0.060
AT→PS → AFB → SAD	0.020	0.007	0.035

Note: AFB = Alienation between Family Members; AT = Autistic Traits; IA = Interpersonal Alienation; PS = Perceived Stress; SAD = Social Avoidance and Distress; SL = Sense of Loneliness; SSI = Sense of Social Isolation.

and distress was still significant (standardized direct effect = 0.740, $p < 0.001$). Therefore, the mediating effects of perceived stress and sense of social isolation were both significant. Perceived stress and sense of social isolation played a partial chain mediating role in the relationships between autistic traits and social avoidance and distress. The ratios of the mediating effect of perceived stress, the mediating effect of sense of social isolation, and the chain mediating effect to the total effect were 0.158/0.983 = 16.073%, 0.048/0.983 = 4.883%, and 0.038/0.983 = 3.866%, respectively.

In the model of autistic traits, social avoidance and distress, perceived stress, and alienation between family members, autistic traits significantly positively predicted perceived stress ($\beta = 0.644$, $p < 0.001$) and alienation between family members ($\beta = 0.321$, $p < 0.001$). Perceived stress significantly positively predicted social avoidance and distress ($\beta = 0.273$, $p < 0.001$) and alienation between family members ($\beta = 0.289$, $p < 0.001$). Alienation between family members also significantly positively predicted social avoidance and distress ($\beta = 0.107$, $p < 0.01$) (see Fig. 1d). In addition, the chain mediating effect analysis showed that the 95% CI of the mediating effect of perceived stress, the mediating effect of alienation between family members, and the chain mediating effect were [0.128, 0.227], [0.012, 0.060], [0.007, 0.035], respectively. All 95% CI excluded 0 (see Table 2). The direct effect of autistic traits on social avoidance and distress was still significant (standardized direct effect = 0.753, $p < 0.001$). Therefore, the mediating effects of perceived stress and alienation between family members were both significant. Perceived stress and alienation between family members played a partial chain mediating role in the relationships between autistic traits and social avoidance and distress. The ratios of the mediating effect of perceived stress, the mediating effect of alienation between family members, and the chain mediating effect to the total effect were 0.176/0.983 = 17.904%, 0.035/0.983 = 3.560%, and 0.020/0.983 = 2.035%, respectively.

DISCUSSION

The results showed that autistic traits directly predicted social avoidance and distress in nonautistic people. Furthermore, autistic traits affected social avoidance and distress through perceived stress and interpersonal alienation, respectively. Importantly, autistic traits also affected social avoidance and distress via perceived stress and interpersonal alienation (including subdimensions of interpersonal alienation), namely, there was a chain mediating effect. This study is the first to reveal how autistic traits influence social avoidance and distress in nonautistic people. Specifically, autistic traits induce social avoidance and distress in nonautistic people (who have basically intact social skills) via the mediating effects and chain mediating effect of perceived stress and interpersonal alienation.

Autistic traits induced social avoidance and distress in nonautistic people

We found that autistic traits positively predicted social avoidance and distress. Autistic people exhibit more severe social anxiety than nonautistic people (Bejerot *et al*., 2014). This effect might be due to their limited social skills (American Psychiatric Association, 2013). Autistic people are frequently rejected in social interaction due to their deficits in social skills, which results in social avoidance and distress (Bejerot *et al*., 2014).

However, the social avoidance and distress experienced by nonautistic people are slightly different. Even though nonautistic people may have higher levels of autistic traits, their social abilities are also intact to some extent. Therefore, the social avoidance and distress of nonautistic people with high levels of autistic traits are caused not only by the lack of social ability but also by perceived stress and interpersonal alienation. Nonautistic people with high levels of autistic traits could perceive and hide their deficiencies, which leads to stress, interpersonal alienation, social avoidance, and social distress (Beck, Lundwall, Gabrielsen, Cox & South, 2020). Hence, autistic traits exacerbate social avoidance and distress in nonautistic people.

The mediating effect of perceived stress

Perceived stress was found to mediate the relationships between autistic traits and social avoidance and distress. This finding is basically consistent with previous studies. Autistic people perceive more adverse factors as stressors and take longer to recover from stress (Lytle & Todd, 2009). This phenomenon is also prevalent in nonautistic people. Research by Fietz, Valencia and Silani (2018) showed that nonautistic people with high levels of autistic traits experience more stress. Moreover, being in a stressful situation for a long time will lead to a tendency to avoid social interaction. This view aligns with the diathesis-stress

model. The model suggests that interpersonal stressors from parents or peers can amplify an individual's vulnerability, leading to persistently high levels of social withdrawal (Gazelle & Ladd, 2003; Gazelle & Rubin, 2019). Thus, nonautistic people with high levels of autistic traits treat perceived stress as a threat, which in turn triggers social avoidance and distress.

The mediating effect of interpersonal alienation

Interpersonal alienation and its subdimensions mediated the relationships between autistic traits and social avoidance and distress. These results are similar to those of prior studies. Nonautistic people with high levels of autistic traits report more severe loneliness, social isolation, and alienation between family members (Caruana, White & Remington, 2021; Stice & Lavner, 2019). These negative emotions are triggers for social avoidance and distress. From the perspective of evolutionary psychology, exclusion by social partners increases existential crisis (Leary, 2015). Hence, humans avoid rejection by others, especially from intimate associations. Alienation from intimate associations decreases the frequency of social interaction (Yuan, Jiang, Yan *et al*., 2022). Overall, nonautistic people with high levels of autistic traits are more likely to show interpersonal alienation (i.e., sense of loneliness, sense of social isolation, and alienation between family members), which then leads to social avoidance and distress.

The chain mediating effect of perceived stress and interpersonal alienation

This study is the first to show that perceived stress and interpersonal alienation play a partial chain mediating role in the relationships between autistic traits and social avoidance and distress. On the one hand, the level of autistic traits directly affects social avoidance and distress. Nonautistic people with high levels of autistic traits are more likely to develop social avoidance tendencies than nonautistic people with low levels of autistic traits (White, Ollendick & Bray, 2011). On the other hand, compared with nonautistic people with low levels of autistic traits, nonautistic people with high levels of autistic traits more frequently perceive unfavorable or adverse events as stressors. High levels of stress consumes energy and results in physical and mental exhaustion. This feeling of exhaustion triggers loneliness, social isolation, and alienation between family members, which then elicit negative social cognition and negative social behavior. This finding is in line with prior studies. Nonautistic people with high levels of autistic traits struggle with complex life events and unexpected changes, thus resulting in stress (Hirvikoski & Blomqvist, 2015). High daily stress levels predict strong interpersonal alienation (Al Rajhi & Alkhalili, 2020). When individuals experience chronic interpersonal alienated, they avoid social interaction (Griffiths, Mitchison, Murray, Mond & Bastian, 2018).

Importantly, this finding also complements the hypothetical model of clinical anxiety in autism spectrum disorders. The model suggests that ASD-related stressors induce negative emotions, which in turn aggravate autistic symptoms, behavioral problems, and personal distress, but not social avoidance (Wood & Gadow, 2010). However, the present results showed that perceived stress and interpersonal alienation are chain mediators of the relationships between autistic traits and social avoidance and distress. This result also extends the hypothetical model of clinical anxiety in autism spectrum disorders. Specifically, negative emotions (e.g., interpersonal alienation) caused by ASD-related stressors not only aggravate autistic symptoms, behavioral problems, and personal distress but also increase social avoidance. Therefore, negative emotions are predictors of social avoidance.

Limitations and future research

Although this study revealed the relationships among autistic traits, social avoidance and distress, perceived stress, and interpersonal alienation, two limitations and future directions should be considered. First, this study used a cross-sectional design. Causal relationships between variables could not be determined. In the future, a longitudinal design should be used to determine the causal relationships among autistic traits, social avoidance and distress, perceived stress, and interpersonal alienation. Second, this study recruited undergraduate students and graduate students as participants to construct the models. Future studies need to verify whether the findings of this study can be extended to children, elderly individuals, and even people with other mental disorders.

In conclusion, these findings highlight two important ways to reduce social avoidance and distress in nonautistic people with high levels of autistic traits. One potential method is to implement interventions to reduce perceived stress. For example, mindfulness-based stress reduction and mindfulness-based cognitive therapy may be effective measures to relieve stress (Querstret, Morison, Dickinson, Cropley & John, 2020). These therapy methods help individuals focus on the experience of the moment, thereby reducing stress and promoting physical and mental health (Huberty, Green, Glissmann, Larkey, Puzia & Lee, 2019). Another potential approach is to increase emotion regulation when facing stressful events to avoid experiencing a sense of interpersonal alienation (Vafa, Azizi & Elhami Athar, 2021). For example, cognitive reappraisal strategies can be used to regulate negative emotions. This strategy encourages individuals to evaluate stressful events from new perspectives, which in turn reduces interpersonal alienation (Dryman & Heimberg, 2018). In short, reducing perceived stress and interpersonal alienation represent useful ways to prevent social avoidance and distress.

CONCLUSION

The present study showed that autistic traits affected social avoidance and distress in nonautistic people. Furthermore, autistic traits increased social avoidance and distress via perceived stress and interpersonal alienation, respectively. Importantly, perceived stress and interpersonal alienation (including the subdimensions of interpersonal alienation, that is, sense of loneliness, sense of social isolation, and alienation between family members) played a partial chain mediating role in the relationships between autistic traits and social avoidance and distress.

The authors have no conflicts of interest to disclose and the data supporting the findings of this study are available at https://osf.io/jfgv7/?view_only=2c84660327e34e96bae9a4e17d058890.

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