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Maladaptive Beliefs as a Mediator Between Trauma and Anxiety in Adult Survivors

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A B S T R A C T

Objective: This study aimed to examine the mediating role of maladaptive beliefs in the relationship between trauma exposure and anxiety symptoms in adult survivors.

Methods and Materials: A descriptive correlational design was employed with a sample of 430 adult participants from Taiwan, selected based on Krejcie and Morgan's sample size table. Participants completed the Life Events Checklist for DSM-5 (LEC-5) to assess trauma exposure, the Posttraumatic Cognitions Inventory (PTCI) to measure maladaptive beliefs, and the Beck Anxiety Inventory (BAI) to evaluate anxiety symptoms. Descriptive statistics and Pearson correlation analyses were performed using SPSS-27 to examine bivariate relationships, while Structural Equation Modeling (SEM) was conducted in AMOS-21 to assess the direct, indirect, and total effects among the study variables and to test the model's fit.

Findings: The results showed significant positive correlations between trauma and maladaptive beliefs ($r = .51$, $p < .001$), trauma and anxiety ($r = .46$, $p < .001$), and maladaptive beliefs and anxiety ($r = .62$, $p < .001$). SEM analysis indicated that maladaptive beliefs significantly mediated the relationship between trauma and anxiety. The direct path from trauma to anxiety ($\beta = .26$, $p < .001$), the path from trauma to maladaptive beliefs ($\beta = .51$, $p < .001$), and the path from maladaptive beliefs to anxiety ($\beta = .48$, $p < .001$) were all statistically significant. The indirect effect of trauma on anxiety through maladaptive beliefs ($\beta = .25$, $p < .001$) confirmed partial mediation. Model fit indices indicated a good fit ($\chi^2/df = 2.41$, CFI = 0.98, RMSEA = 0.057).

Conclusion: Addressing these dysfunctional cognitions may be essential for reducing anxiety symptoms and improving trauma recovery outcomes.

Keywords: *Trauma, Anxiety, Maladaptive Beliefs.*

1. Introduction

Trauma, defined as exposure to an event involving actual or threatened death, serious injury, or sexual violence, can lead to a cascade of psychological disturbances, particularly when the traumatic experience disrupts core beliefs about safety, control, and self-worth (Scher et al., 2017). Anxiety is a prevalent response to trauma, characterized by hypervigilance, intrusive thoughts, physiological arousal, and avoidance behaviors. However, not all trauma survivors develop anxiety, suggesting that other psychological factors—especially cognitive appraisals—play a central role in determining mental health outcomes (Stein et al., 2024). Theoretical frameworks such as cognitive models of posttraumatic stress posit that individuals' beliefs about themselves, the world, and the meaning of the trauma are central to the development and persistence of anxiety symptoms (Karatzias et al., 2016). Indeed, negative trauma-related beliefs about one's own worth, safety in the world, and the predictability of future events can create a sense of helplessness and perceived vulnerability, intensifying anxiety in survivors (Jaffe et al., 2019).

Maladaptive beliefs are often characterized by internalized cognitions such as "I am permanently damaged," "The world is unsafe," or "I cannot trust anyone," which can serve as cognitive lenses through which subsequent experiences are interpreted (Georgina Gómez de La et al., 2019). These beliefs not only increase the likelihood of reexperiencing trauma-related emotions but also mediate the link between past trauma and present psychological functioning. A recent meta-analysis confirmed the strong association between maladaptive appraisals and the severity of posttraumatic stress and anxiety symptoms (Georgina Gómez de La et al., 2019). This aligns with longitudinal evidence indicating that trauma-related cognitive distortions are significant predictors of persistent anxiety and depressive symptoms in youth and adults alike (Davis et al., 2022; Hansford & Jobson, 2021). Furthermore, maladaptive beliefs may solidify over time, particularly in the absence of corrective interpersonal experiences or therapeutic intervention (Read et al., 2018).

The role of maladaptive beliefs in posttraumatic symptomatology has also been explored in clinical and subclinical samples. For example, among adult survivors of childhood maltreatment, maladaptive cognitions related to shame and alienation have been strongly linked to emotional dysregulation and long-term psychological distress (Fenerci & DePrince, 2018). Similarly, maladaptive beliefs related to self-blame, guilt, and social rejection are often seen in individuals with PTSD and comorbid anxiety disorders, contributing to functional impairment and difficulties in interpersonal relationships (Glad et al., 2024). These beliefs are not only reactive but can also perpetuate a negative feedback loop wherein anxiety reinforces distorted beliefs about the self and others, making recovery more difficult (Ullman et al., 2014).

Trauma does not exert its full psychological effect in a vacuum. Cultural, social, and developmental factors significantly shape how individuals interpret and respond to adverse events. In Taiwanese culture, for instance, stigma associated with mental health issues and a cultural emphasis on emotional restraint may lead individuals to internalize distress, potentially amplifying maladaptive beliefs and anxiety symptoms (Pan et al., 2023). The influence of culture is also relevant when considering the generalizability of findings from Western samples to Eastern populations, highlighting the importance of culturally sensitive research. Studies from Asian and Middle Eastern populations have illustrated how trauma appraisals and cognitive schemas vary depending on cultural values, social expectations, and support systems (Maeda et al., 2017; Shabahang et al., 2021). Such findings stress the importance of examining cognitive mediators within specific cultural contexts to better understand their universal and culturally unique functions.

Several theoretical models support the mediating role of maladaptive beliefs between trauma and anxiety. Cognitive theories propose that trauma activates core schemas, which subsequently give rise to negative automatic thoughts and maladaptive interpretations (Artime & Peterson, 2015; Karatzias et al., 2016). These schemas may relate to themes of worthlessness, danger, betrayal, and control, and they distort subsequent experiences, reinforcing anxiety responses (Mitchell et al., 2018). Empirical support for this model comes from studies demonstrating that changes in trauma-related beliefs mediate the effects of trauma-focused therapy on psychological outcomes in both children and adults (Jensen et al., 2018). Similarly, recent work has shown that alienation appraisals—beliefs that one is fundamentally disconnected or rejected by others—serve as a cognitive bridge linking trauma exposure to anxiety and depression in diverse populations (McIlveen et al., 2022; Mitchell et al., 2018).

The durability of maladaptive beliefs over time is another important consideration. Longitudinal studies have shown

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that even years after a traumatic event, dysfunctional appraisals can continue to fuel emotional distress if left unaddressed (Scher et al., 2017). In a study on trauma-exposed parents, early maladaptive cognitions were found to predict long-term anxiety and avoidance behaviors, underscoring the lasting influence of these beliefs (Hiller et al., 2015). The persistence of these beliefs may explain why some trauma survivors continue to struggle despite the absence of ongoing stressors. In such cases, interventions that focus on cognitive restructuring—such as trauma-focused CBT or schema therapy—have demonstrated effectiveness in reducing maladaptive beliefs and alleviating anxiety (Stein et al., 2024).

Notably, certain types of trauma may produce more entrenched cognitive distortions than others. For example, interpersonal traumas such as sexual abuse, domestic violence, and betrayal trauma are strongly associated with the development of maladaptive beliefs around trust, powerlessness, and identity (Boska & Capron, 2021; Stensvehagen et al., 2020). These traumas are often relational in nature, leading to profound disruptions in individuals' belief systems and a heightened vulnerability to anxiety disorders (Contractor et al., 2022; Moradi et al., 2021). Research has also suggested that cognitive flexibility—the ability to revise maladaptive interpretations and adaptively reframe experiences—may moderate the relationship between trauma and psychological outcomes, offering a potential target for therapeutic intervention (Moradi et al., 2021).

There is also emerging evidence that maladaptive beliefs not only mediate the relationship between trauma and anxiety but are bidirectionally related to emotional symptoms. For instance, a study on adults with ADHD found that negative cognitions increased emotional distress, which in turn reinforced maladaptive thought patterns, forming a cyclical interaction between beliefs and emotions (Pan et al., 2023). This dynamic suggests that addressing maladaptive beliefs may not only alleviate current symptoms but also disrupt long-standing psychological cycles that maintain distress.

Despite the robust literature supporting the mediating role of maladaptive beliefs, few studies have systematically examined this pathway in large, non-Western community samples. Most existing research relies on clinical populations, small sample sizes, or Western contexts, limiting generalizability. The current study addresses this gap by focusing on adult survivors in Taiwan and employing both Pearson correlation and Structural Equation Modeling (SEM) to test the mediating role of maladaptive beliefs between trauma exposure and anxiety symptoms.

2. Methodology

2.1. Study Design and Participants

This study employed a descriptive correlational research design to examine the mediating role of maladaptive beliefs in the relationship between trauma exposure and anxiety symptoms among adult survivors. The target population included adults residing in Taiwan who had experienced at least one traumatic event. Using the sample size determination table developed by Krejcie and Morgan (1970), a sample of 430 participants was recruited to ensure sufficient statistical power for both correlation and structural equation modeling analyses. Participants were selected through convenience sampling from urban and semi-urban areas, including mental health clinics, community centers, and online support forums. Inclusion criteria required participants to be over 18 years old, able to read and write in Mandarin, and to have experienced a traumatic event as defined by DSM-5 criteria. Individuals with a current diagnosis of psychosis or cognitive impairment were excluded.

2.2. Measures

2.2.1. Anxiety

The Beck Anxiety Inventory (BAI), developed by Aaron T. Beck, Norman Epstein, Gary Brown, and Robert A. Steer in 1988, is a widely used self-report inventory designed to measure the severity of anxiety symptoms in adults. The BAI consists of 21 items, each describing a common symptom of anxiety (e.g., numbness, fear of the worst happening, nervousness), and respondents rate the extent to which they have been bothered by each symptom during the past week on a 4-point Likert scale ranging from 0 (not at all) to 3 (severely). The total score ranges from 0 to 63, with higher scores indicating greater levels of anxiety. The BAI has demonstrated strong psychometric properties, including high internal consistency (Cronbach's alpha typically above .90) and test-retest reliability. Its construct validity and discriminant validity have been confirmed in clinical and non-clinical populations.

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2.2.2. *Maladaptive Beliefs*

The Posttraumatic Cognitions Inventory (PTCI), developed by Patricia A. Foa, Gail E. Ehlers, David M. Clark, and Edna B. Foa in 1999, is a standardized self-report tool used to assess maladaptive beliefs related to trauma. The PTCI contains 33 items across three subscales: negative cognitions about self, negative cognitions about the world, and self-blame. Respondents rate their agreement with each statement on a 7-point Likert scale ranging from 1 (totally disagree) to 7 (totally agree), with higher scores reflecting stronger maladaptive beliefs. The PTCI has been extensively validated across different populations and trauma types, showing excellent internal consistency (with Cronbach's alpha ranging from .86 to .97 across subscales), as well as strong convergent and discriminant validity. It is widely used in trauma-related research to explore the cognitive dimensions of post-traumatic psychological responses (Kong, 2024; Zhang, 2025).

2.2.3. *Trauma*

The Life Events Checklist for DSM-5 (LEC-5), developed by the National Center for PTSD in 2013, is a widely recognized screening instrument used to assess exposure to potentially traumatic events. The LEC-5 includes 17 items covering a range of traumatic experiences such as natural disasters, physical assault, sexual abuse, combat exposure, and serious accidents. Respondents indicate the extent of their exposure to each event using categories such as "happened to me," "witnessed it," or "learned about it." While the LEC-5 does not provide a severity score, it helps identify relevant trauma exposures that may be linked to psychological symptoms. The LEC-5 has demonstrated strong content validity and good test-retest reliability, and it is commonly used in both clinical assessment and trauma research. Studies have confirmed its applicability across diverse adult populations and its utility in identifying trauma histories for diagnostic or therapeutic purposes (Katrinli et al., 2020; Kracker Imthon et al., 2020; Magwai & Xulu, 2022).

2.3. *Data Analysis*

Data were analyzed using SPSS version 27 and AMOS version 21. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize demographic characteristics. Pearson correlation coefficients were calculated to examine the bivariate relationships between the dependent variable (anxiety) and the independent variables (trauma and maladaptive beliefs). Prior to advanced analysis, assumptions for normality, linearity, and multicollinearity were checked and confirmed. Subsequently, Structural Equation Modeling (SEM) using AMOS-21 was conducted to test the hypothesized mediation model, with trauma as the exogenous variable, maladaptive beliefs as the mediating variable, and anxiety as the endogenous variable. Model fit was evaluated using several indices (Beck et al., 2015; Contractor et al., 2022; Ito et al., 2021; McLean et al., 2019).

3. Findings and Results

Of the 430 participants, 243 (56.5%) identified as female and 187 (43.5%) as male. The age of participants ranged from 19 to 64 years, with a mean age of 36.47 years (SD = 10.32). Regarding marital status, 211 participants (49.1%) were single, 179 (41.6%) were married, and 40 (9.3%) were divorced or widowed. In terms of educational attainment, 94 individuals (21.9%) had completed high school or less, 218 (50.7%) held a bachelor's degree, and 118 (27.4%) had completed graduate or professional education. Employment status showed that 267 participants (62.1%) were employed full-time, 79 (18.4%) part-time, 56 (13.0%) unemployed, and 28 (6.5%) were students or retired.

Table 1

Descriptive Statistics for Study Variables (N = 430)

Variable	M	SD
Trauma Exposure	9.47	3.26
Maladaptive Beliefs	148.22	24.39
Anxiety	26.85	11.14

The descriptive statistics in Table 1 show that the participants had a mean trauma exposure score of 9.47 (SD = 3.26), indicating moderate levels of exposure to traumatic events. The mean score for maladaptive beliefs was 148.22 (SD = 24.39), suggesting relatively elevated levels of dysfunctional cognitions. The mean anxiety score was 26.85

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(SD = 11.14), reflecting mild to moderate anxiety symptoms among participants.

All statistical assumptions required for correlation and structural equation modeling were evaluated and met. The Shapiro-Wilk test indicated that the distribution of scores for anxiety (W = .984, p = .073), trauma exposure (W = .981, p = .091), and maladaptive beliefs (W = .986, p = .082) did not significantly deviate from normality. Scatterplots confirmed linearity, and variance inflation factors (VIFs) for trauma and maladaptive beliefs were 1.42 and 1.36 respectively, indicating no multicollinearity. Homoscedasticity was visually confirmed through residual plots. These results justified proceeding with both Pearson correlation and SEM analyses.

Table 2

Pearson Correlation Coefficients and p-values Between Study Variables

Variables	1	2	3
1. Trauma Exposure	—		
2. Maladaptive Beliefs	.51** (p < .001)	—	
3. Anxiety	.46** (p < .001)	.62** (p < .001)	—

As shown in Table 2, trauma exposure was significantly positively correlated with maladaptive beliefs (r = .51, p < .001) and anxiety (r = .46, p < .001). Additionally, maladaptive beliefs were strongly correlated with anxiety (r = .62, p < .001). These results support the hypothesis that trauma and maladaptive beliefs are associated with higher levels of anxiety symptoms.

Table 3

Fit Indices for the Structural Equation Model

Fit Index	Value
χ^2	4.82
df	2
χ^2/df	2.41
GFI	0.97
AGFI	0.94
CFI	0.98
TLI	0.96
RMSEA	0.057

The model fit indices in Table 3 indicate a good fit between the hypothesized model and the observed data. The chi-square value (χ^2 = 4.82, df = 2, χ^2/df = 2.41) is within acceptable limits. The Goodness-of-Fit Index (GFI = 0.97), Adjusted GFI (AGFI = 0.94), Comparative Fit Index (CFI = 0.98), and Tucker-Lewis Index (TLI = 0.96) all exceeded the conventional cutoff of 0.90. The Root Mean Square Error of Approximation (RMSEA = 0.057) was below the 0.08 threshold, indicating a satisfactory model fit.

Table 4

Total, Direct, and Indirect Path Coefficients Between Variables in the SEM Model

Path	b	SE	β	p
Trauma → Maladaptive Beliefs	3.61	0.41	.51	<.001
Maladaptive Beliefs → Anxiety	0.23	0.03	.48	<.001
Trauma → Anxiety (Direct)	0.61	0.14	.26	<.001
Trauma → Anxiety (Indirect via MB)	0.83	0.12	.25	<.001
Trauma → Anxiety (Total Effect)	1.44	0.18	.51	<.001

Table 4 presents the structural path coefficients within the mediation model. Trauma significantly predicted maladaptive beliefs (b = 3.61, β = .51, p < .001), and maladaptive beliefs significantly predicted anxiety (b = 0.23,

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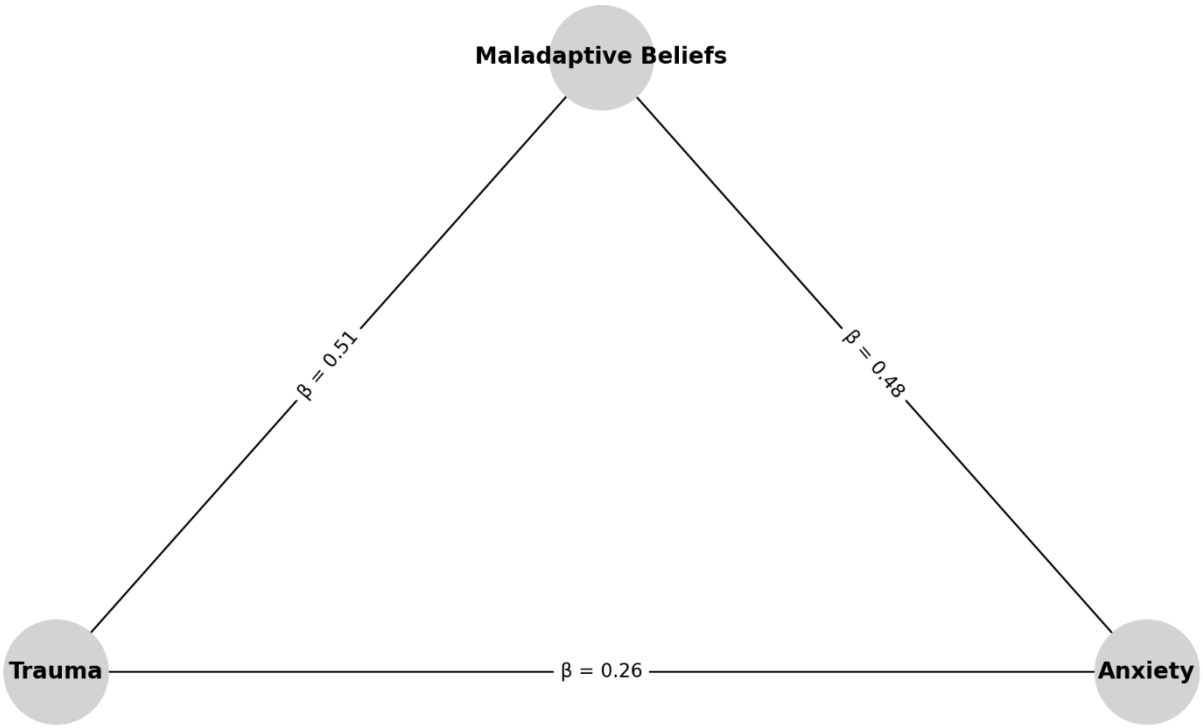
β = .48, p < .001). The direct path from trauma to anxiety was also significant (b = 0.61, β = .26, p < .001). Importantly, the indirect path from trauma to anxiety via maladaptive beliefs was significant (b = 0.83, β = .25, p < .001), confirming the mediating role of maladaptive beliefs. The total effect of trauma on anxiety (b = 1.44, β = .51, p < .001) underscores the combined impact of both direct and indirect pathways.

Figure 1

Model with Beta Coefficients



4. Discussion and Conclusion

The current study aimed to investigate the mediating role of maladaptive beliefs in the relationship between trauma exposure and anxiety symptoms in a community sample of adult survivors in Taiwan. Using Pearson correlation and Structural Equation Modeling (SEM), the findings revealed significant positive correlations between trauma exposure and anxiety, trauma and maladaptive beliefs, and maladaptive beliefs and anxiety. Most notably, SEM analyses demonstrated that maladaptive beliefs partially mediated the relationship between trauma and anxiety, suggesting that individuals who experience trauma may develop dysfunctional beliefs that, in turn, increase their vulnerability to anxiety symptoms. These findings underscore the cognitive mechanisms that bridge past trauma and current psychopathology, highlighting maladaptive beliefs as a critical psychological construct in trauma recovery.

The strong association between trauma exposure and anxiety is consistent with a substantial body of literature demonstrating that individuals who endure traumatic events often experience heightened levels of anxiety, hyperarousal, and avoidance behaviors (Glad et al., 2024; Stein et al., 2024). These anxiety symptoms are often rooted in perceived threats and loss of control triggered by trauma-related reminders. The current study reaffirms this well-established link and expands upon it by identifying a cognitive mediator—maladaptive beliefs—that partially explains how trauma translates into anxiety. This supports cognitive models of trauma that posit that maladaptive interpretations of traumatic experiences are pivotal in the development of emotional disorders (Georgina Gómez de La et al., 2019; Karatzias et al., 2016).

The finding that maladaptive beliefs mediate the relationship between trauma and anxiety aligns with prior research that has emphasized the role of distorted cognitions in posttraumatic outcomes. For example, negative appraisals

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about the self (e.g., "I am weak") or the world (e.g., "nowhere is safe") have been shown to increase susceptibility to anxiety and depressive symptoms (Jaffe et al., 2019; McIlveen et al., 2022). Studies have consistently found that such beliefs are not only outcomes of trauma but also mechanisms that perpetuate emotional distress. In their meta-analysis, Georgina Gómez de La et al. (2019) confirmed that maladaptive appraisals significantly predicted PTSD and anxiety severity across diverse populations. Our findings are aligned with these conclusions and demonstrate their applicability in a Taiwanese cultural context.

Additionally, the significant correlation between trauma and maladaptive beliefs found in the present study supports earlier findings that traumatic experiences disrupt core beliefs about safety, predictability, and worth, leading to entrenched negative cognitions (Boska & Capron, 2021; Contractor et al., 2022). These beliefs may serve an initial protective function—helping individuals make sense of senseless experiences—but often become rigid and maladaptive over time (Read et al., 2018). The present study observed that these maladaptive beliefs were closely linked to higher anxiety symptoms, reinforcing the view that trauma-related cognitive distortions serve as emotional amplifiers that sustain psychological distress (Fenerci & DePrince, 2018; Hansford & Jobson, 2021).

Importantly, our findings reflect the relevance of these mechanisms in a non-Western, collectivist cultural context. Prior research suggests that in cultures emphasizing emotional control and relational harmony, individuals may be more likely to internalize trauma and suppress distressing emotions, inadvertently reinforcing maladaptive beliefs (Maeda et al., 2017; Shabahang et al., 2021). In Taiwan, cultural values surrounding shame, reputation, and family honor may intensify trauma-related beliefs such as self-blame or unworthiness, thereby heightening anxiety symptoms. This notion is consistent with findings from Glad et al. (2024), who reported that shame and guilt appraisals predicted long-term psychopathology following collective traumatic events. Similarly, Pan et al. (2023) found that maladaptive cognitions and emotional symptoms exhibited bidirectional associations, illustrating a self-reinforcing cycle of belief and affective dysregulation.

The partial mediation observed in this study suggests that while maladaptive beliefs are crucial, other factors likely contribute to the trauma-anxiety relationship. For instance, emotion regulation strategies, attachment styles, and social support networks may also influence posttraumatic responses (Read et al., 2018; Ullman et al., 2014). Nonetheless, maladaptive beliefs appear to be a consistent and significant mechanism, and their influence has been confirmed in both clinical and non-clinical samples. For example, Davis et al. (2022) demonstrated that trauma-related cognitive processes predicted internalizing psychopathology in adolescents over time, and Mitchell et al. (2018) highlighted the role of alienation beliefs in connecting childhood trauma with emotional dysfunction. These findings provide additional empirical support for the mediating role of trauma-related cognitions in long-term psychological outcomes.

The current findings also echo research emphasizing the role of cognitive restructuring in trauma recovery. Therapeutic approaches that specifically target maladaptive beliefs—such as Cognitive Processing Therapy (CPT) and schema-focused therapy—have demonstrated success in reducing trauma-related anxiety (Jensen et al., 2018; Scher et al., 2017). Jensen et al. (2018) found that changes in trauma-related cognitions mediated treatment effects in traumatized youth, suggesting that cognitive change is a mechanism of healing. The consistency of these findings with the present results supports the conceptual and clinical value of targeting maladaptive beliefs as part of evidence-based trauma interventions.

Moreover, our findings contribute to the growing literature exploring how the type and context of trauma influence cognitive outcomes. Interpersonal traumas—such as abuse, betrayal, or emotional neglect—are often associated with deeper and more persistent cognitive disruptions compared to non-interpersonal traumas (Boska & Capron, 2021; Stensvehagen et al., 2020). The present sample included various trauma types, and while trauma specificity was not the central focus, the strength of the association between trauma and maladaptive beliefs may reflect the relational and cumulative nature of participants' experiences. Future research could benefit from distinguishing between trauma types and their differential impact on cognitive and emotional functioning.

Finally, the cultural and regional relevance of this study marks a valuable contribution. Most previous studies on trauma-related cognitions have been conducted in Western populations. The confirmation of similar cognitive-emotional pathways in a Taiwanese sample broadens the cross-cultural validity of these findings and underscores the importance of integrating culturally attuned frameworks in trauma research (Srinivas et al., 2015; Stensvehagen et al., 2022). Such cultural considerations are critical for

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developing interventions that are both evidence-based and context-sensitive.

5. Limitations & Suggestions

Despite its strengths, the present study has several limitations. First, the cross-sectional design limits causal inferences regarding the relationships among trauma, maladaptive beliefs, and anxiety. Although SEM provides insight into directional relationships, longitudinal data would be necessary to confirm the temporal sequence and stability of these associations. Second, all data were collected through self-report measures, which are subject to biases such as social desirability, recall error, and shared method variance. Third, although the sample was culturally specific and relatively large, it was recruited through convenience sampling, limiting the generalizability of findings to other populations. Additionally, while the study utilized validated tools, it did not explore the role of potential moderating variables such as gender, trauma type, coping style, or social support, which could offer a more nuanced understanding of the findings.

Future research should address these limitations through longitudinal and experimental designs that can better establish causality and developmental trajectories of maladaptive beliefs. Incorporating diverse assessment methods—such as clinical interviews, informant reports, or physiological measures—could help mitigate biases associated with self-report. Moreover, future studies should explore the moderating effects of demographic, psychological, and contextual variables such as gender, coping strategies, cultural beliefs, and trauma type. Investigating the role of protective cognitive factors, such as cognitive flexibility or posttraumatic growth, may also help balance the current focus on dysfunction. In addition, comparative cross-cultural studies are needed to explore how cultural norms and values shape the cognitive processing of trauma and its psychological aftermath across different societies.

Given the strong mediating role of maladaptive beliefs, trauma-informed mental health interventions should prioritize cognitive restructuring strategies that challenge and modify dysfunctional appraisals related to the self, others, and the world. Practitioners should be trained to identify trauma-related cognitions in clients and help them develop more balanced and adaptive interpretations of their experiences. Additionally, culturally sensitive adaptations of cognitive-behavioral interventions may enhance treatment effectiveness, especially in collectivist cultures where emotional expression and help-seeking behaviors differ. Community-based education and support programs can also help normalize trauma reactions and reduce stigma, facilitating earlier access to care and improved long-term outcomes.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contributed in this article.

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