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Association Between Childhood Adversities and Mental Well-Being in Young Adults: The Mediational Role of Negative Metacognitive Beliefs

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Abstract

Adverse childhood experiences (ACEs) have long been known to convey cumulative risks for poor mental outcomes in later years. The evidence on association between ACEs, mental well-being (MWB) and their interaction process in young adults is scarce. We sought to adapt the mediational role of metacognitive beliefs within the psychopathological framework to perceived mental health conception. Participants were college students ($N=144$, mean age 21.13 (SD = 3.30), 119 females) who completed online questionnaire battery evaluating sociodemographic features, ACEs, pathologic worrying, state anxiety, metacognitive beliefs, and mental well-being. Significant associations were found among ACEs, MWB, worry, anxiety, and metacognitive beliefs. When MWB was regressed on all predictors (ACEs, worry, anxiety, and metacognitive beliefs), uncontrollability and danger (UD) remained the only significant metacognitive belief alongside these variables. In the subsequent analyses, the role of UD was evident in the more parsimonious models; however, the additional indirect associations was not significant once both worry and state anxiety were incorporated in the structural equation. Our results suggest that metacognitions may represent an important correlate of the associations between ACEs and MWB in early adulthood. Negative beliefs might be a interventional target to promote MWB before developing anxiety symptoms for college students at risk for ACEs.

Keywords Mental well-being · Adverse childhood experiences · Worry · Anxiety · Negative beliefs · Metacognitions

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Introduction

Mental health is one of the fundamental indicators of quality of life. As emphasized by the World Health Organization, it is defined not merely as the absence of mental illness, but as a state of well-being in which individuals are able to realize their potential, cope with normal stresses, and work productively (Herrman et al., 2004). Perceived MWB reflects a broader sense of life quality that extends beyond the clinical manifestations of psychiatric disorders. Nevertheless, converging evidence indicates that psychopathology exerts a robust negative association with MWB. For instance, large twin studies have reported strong negative genetic and environmental correlations between subjective well-being and symptoms of psychopathology, with effect sizes in the moderate-to-strong range (Bartels et al., 2013). Similarly, previous studies consistently report that impairments in mental well-being are related to high levels of psychological distress, emotion dysregulation, anxiety and depression(Kraiss et al., 2020; Malone & Wachholtz, 2018; Winefield et al., 2012). On the other hand, research has provided strong support for the dual-continua model of mental health, which views well-being and psychopathology as related but distinct constructs. Studies indicate that students with greater well-being cope better academically and socially despite some symptoms, whereas those with low well-being may still be at risk even without a formal diagnosis (Eklund et al., 2010; Suldo & Shaffer, 2008). More recent longitudinal and intensive experience-sampling studies provide additional evidence that the negative relationship between distress and well-being holds both between and within individuals, suggesting that momentary increases in distress correspond to decreases in well-being, although the two constructs remain partially independent (Kraiss et al., 2023). Thus, reducing psychopathology and enhancing MWB can be regarded as interrelated yet distinct intervention targets, each contributing uniquely to the promotion of student mental health.

Metacognitive beliefs about worry and rumination are central components of the Cognitive Attentional Syndrome (CAS), which is conceptualized within the Self-Regulatory Executive Function (S-REF) model (Wells, 2009). CAS comprises a set of maladaptive responses such as excessive worry, rumination, heightened self-focus, and maladaptive coping strategies like suppression or threat monitoring, which prolong and intensify emotional distress (Wells, 2009). Recent research has highlighted that the CAS operates as a transdiagnostic phenomenon across a wide range of disorders, in line with the generic metacognitive model (Wells, 2009, 2019). Empirical findings show that dysfunctional metacognitive beliefs are strongly associated with symptoms of depression, generalized anxiety, and social anxiety, and collectively account for a substantial proportion of the shared variance among these disorders. (Nordahl et al., 2019). Similarly, longitudinal evidence indicates that metacognitive beliefs are prospectively associated with maladaptive CAS strategies such as worry and rumination, which in turn mediate increases in anxiety symptoms over time (Nordahl et al., 2023). These findings align with the S-REF model in suggesting that metacognitive beliefs may play a role in the onset and maintenance of psychopathology. Within this framework, beliefs about the uncontrollability and danger of worry (UDs) constitute a well-documented dimension of metacognition. Negative appraisals of worry (meta-worry/Type 2) are related to heightened anxiety and a self-

reinforcing cycle in which attempts to control or suppress thoughts paradoxically increase intrusions and UDs. (Wells, 1999, 2010). Empirical studies have generally indicated that UDs relate more strongly to pathological worry than the frequency or content of worry per se (Wells, 1999, 2010). Importantly, studies in clinical and medical samples have found that UDs are strong correlates of anxiety and depression, and network analyses further show that negative metacognitive beliefs are prominently associated to repetitive negative thinking and these symptoms (Anderson et al., 2019; Anyan et al., 2023; Nordahl et al., 2019). Consequently, these negative metacognitions appear to be not merely correlates but salient factors in anxiety and worry, suggesting their potential clinical relevance.

From a transdiagnostic standpoint, it is relevant to consider the role of early adversity. Landmark analyses from the WHO World Mental Health Surveys linked multiple childhood adversities to the first onset of 20 DSM-IV disorders in 21 countries, underscoring elevated and additive risk (Kessler et al., 2010). Meta-analytic evidence further indicates a dose–response pattern between cumulative ACEs and mental health outcomes (Hughes et al., 2017), and more recent genetically-informed cohort work shows these associations remain observable even after adjusting for familial confounding (Daníelsdóttir et al., 2024). Notably, the burden of these adversities is particularly evident in young adulthood, a developmental window when psychopathology frequently onsets and stabilizes. ACEs have been consistently linked to poorer mental health in young adults (Badr et al., 2018; Husky et al., 2023; Karatekin, 2018; Knipschild et al., 2024; Schilling et al., 2007, 2008; Watt et al., 2022).

By contrast, relatively few studies have examined the ACEs–MWB association with explicit attention to intermediate transdiagnostic variables that may represent potential points of focus for intervention. Recent evidence suggests ACEs are related to lower emotional well-being, life satisfaction, and social well-being in adults (Mosley-Johnson et al., 2019), and a recent meta-analysis reports negative associations between abuse/neglect/household dysfunction and experiential and reflective facets of emotional well-being (Yeo et al., 2023). Similar findings have been reported in university samples, where specific ACE profiles were associated with lower MWB (Bartolomé-Valenzuela et al., 2024). Overall, the findings provide preliminary support for an ACEs–MWB relationship, but this association remains less thoroughly studied compared to the ACE–psychopathology association.

Research directly addressing the association between ACEs and metacognitive beliefs is still limited. Existing studies suggest that early emotional abuse is related with stronger negative metacognitive beliefs (e.g., uncontrollability/danger), which were found to mediate associations with depressive, anxiety, and even positive psychotic symptoms. (Ostefjells et al., 2017). Complementary work indicates that aversive childhood experiences are associated with later distress via metacognitions(Myers & Wells, 2015),with similar mediation patterns documented in specific domains such as disordered eating(Martin & Strodl, 2023) and post-traumatic stress disorder (Darnell et al., 2024; Hosseini Ramaghani et al., 2019). Cumulatively, the evidence points toward a mediational account whereby ACEs are linked to dysfunctional metacognitive beliefs, which in turn relate to CAS and elevated psychopathology, ultimately associated with reduced MWB. In line with this perspective, the present study tests this account.

Emerging adulthood is a transitional period characterized by increased vulnerability to nonspecific anxiety, and therefore a useful context for studying how early adversity relates to cognitive and affective vulnerabilities relevant to MWB (Ahmed et al., 2023). In this group, early intervention for subthreshold anxiety was reported to be more cost effective than wait and treat approaches (Kanuri et al., 2015). In this context, we focus on dysfunctional metacognitive beliefs, particularly the UDs, as proximal correlates of perceived MWB in emerging adults. Prior work shows that metacognitive beliefs are associated with psychological vulnerability beyond demographics and diagnostic status, and UDs show the strongest associations (Nordahl & Wells, 2017). Accordingly, we conceptualized them as salient transdiagnostic construcs for analysis. Targeting metacognitive beliefs may offer a transdiagnostic opportunity to mitigate emotional distress in young adults. Although components of this proposed linkage have been examined in prior studies, to our knowledge, no research has yet tested this model in an integrated and comprehensive framework.

Within this hierarchical framework, we aimed to examine interrelationships among adverse childhood experiences, metacognitive beliefs, worry, state anxiety, and perceived mental well being in a university sample. Our hypotheses were: (1)- ACEs, worry, state anxiety, all types of metacognition will be correlated with mental health, (2)- Metacognitions will make an additional contribution to mental health beyond ACEs, state anxiety, and worry, (3)- Among metacognitive domains, UDs will have the strongest associations with MWB as an independent variable, (4)- UDs will have a significant part in the indirect association between ACEs and MWB via metacognition, worry, and anxiety.

Method and Materials

Participants and Procedure

The study sample was recruited from Kent University, Master Program of Clinical Psychology and Department of Psychology in Istanbul, Turkey. Participants were eligible if they consented voluntarily and were within the age range of 18 to 30 years. Individuals who reported a diagnosis of a decompensated major psychiatric disorder (e.g., schizophrenia, organic brain syndrome) were excluded from the study. A total of 144 under-graduate and post-graduate students gave an informed consent and completed a number of scales online. The participants comprised 25 males (17.4%) and 119 females (82.6%), mean age was 21.13 years (SD = 3.30) ranging from 18 to 29. The majority of participants were single (95.8%), non-employee (93.7%), not being previously diagnosed with any psychiatric disorder (94.4%), having no psychiatric family history (96.5%), no prior suicidal attempt (99.3%). The present study, a cross-sectional design in a healthy young adult sample, was conducted in accordance with Helsinki Declaration and ethical approval was granted by Marmara University Medical School Ethics Review Board. Descriptive data of participants was shown in Table 1.

Table 1 Demographic and clinical profiles of participants

Variable	*n*	%
Age	21.13 (Mean)	3.30 (SD)
Gender		
Male	25	17.4
Female	119	82.6
Marital status		
Married	6	4.2
Single	138	95.8
Education		
University	47	32.6
High school	97	67.4
Occupation		
Employee	9	6.3
Non-employee	135	93.7
Income		
Low	35	24.3
Moderate	57	39.6
High	52	36.1
Previous psychiatric diognosis		
None	136	94.4
Major depressive disorder	5	3.5
Anxiety disorders	3	2.1
Other	0	0
Previous suicidal attempts		
None	143	99.3
Present	1	0.7
Psychiatric family history		
None	139	96.5
Major depressive disorder	4	2.8
Psychotic disorders	1	0.7
Other	0	0
Smoking		
None	113	78.5
Present	31	21.5
Alcohol use		
None	119	82.6
Present	25	17.4
Substance use		
None	141	97.9
Present	3	2.1

Measurements

The questionnaire battery consisted of (1)- Sociodemographic data form, (2)- Metacognition Questionnare-30, (3)- Penn State Worry Scale (4)- The Adverse Childhood Experiences Questionnaire (5)- Beck Anxiety Inventory (6)- Short Form Health Survey-36. Sociodemographic and clinical variables (age, gender, marital status, education, occupation, income, psychiatric and family history, suicidal attempts, smoking,

alcohol, and substance use) were assessed using a self-report demographic questionnaire prepared for the study. The internal consistency of the measures were reported in Table 2.

Assessment of Metacognitive Beliefs

Metacognition Questionnare-30 (MCQ-30), a Turkish version of self-report scale (Tosun & Irak, 2008), was used to determine metacognitive beliefs composed of 6-item five subscales: a)- lack of cognitive confidence (LoCC), b)-positive beliefs about worry (PB), c)- cognitive self-consciousness (CSC), d)- negative beliefs about uncontrollability of thoughts and danger (UDs), e)- beliefs about the need to control thoughts (NCT). Items of each subscale are rated on a 4-point Likert scale from 1 to 4, yielding total score 6 to 24. The higher score represents the greater level of dysfunctional beliefs. Sample items from the negative beliefs subscale include: "My worrying could make me go mad" and "When I start worrying, I cannot stop." It was shown a good reliability and internal consistency for all subscales (Wells & Cartwright-Hatton, 2004). Internal consistency (Cronbach's α) for subscales was ranging from $\alpha = 0.68$ to $\alpha = 0.81$ in the present study.

Assessment of Worry

Penn State Worry Scale (PSWQ) was employed to assess excessive worry of participants. A single factor was extracted from 16 items in final analysis of original study (Meyer et al., 1990). The questionnaire is self-report and 5-point Likert scale and generates total score ranging from 16 to 80 with summation of each item score. The higher score indicates the greater level of trait worrying. Example items include: "My worries overwhelm me" and "I worry all the time." Turkish adaptation of the scale yielded a good reliability and validity with $\alpha = 0.91$ (Yılmaz et al., 2008). Cronbach's alpha of the scale was 0.68 suggesting satisfactory level in the present study.

Assessment of Adverse Childhood Experiences

Childhood adversities were measured with The Adverse Childhood Experiences Questionnaire (ACE-Q) which was first used as a seven-category measurement to predict overall health risks in a population-based setting (Felitti et al., 1998). The questionnaire has reached to present 10-item structure with inclusion of new items over time: abuse (emotional, physical, sexual), neglect (emotional and physical), and household dysfunction (growing up with domestic violence, parental marital discord, substance abuse, mental illness and criminal household member). The score of ACE-Q was obtained by summing the number of categories of exposed childhood events, ranging from 0 (unexposed) to 10 (exposed to all categories). 10-item ACE-Q was found to have good validity and reliability in Turkish (Gündüz et al., 2018). Example items include: "Did a parent or other adult in the household often swear at you, insult you, or put you down or hmiliate you?" and "Did you live with anyone who was a problem drinker or alcoholic or who used street drugs?". Internal consistency of the questionnaire was calculated as $\alpha = 0.61$ in present study.

Table 2 Bivariate correlations of study scales

Scales	α	M	SD	1	2	3	4	5	6	7	8
1. ACE-Q	0.61	1.06	0.74	–							
2. BAI	0.88	26.36	6.28	0.118	–						
3. PSWQ	0.68	50.11	4.46	0.132	0.227**	–					
4. MCQ-LoCC	0.74	8.82	3.09	0.173*	0.347**	0.133	–				
5. MCQ-CSC	0.81	15.03	3.69	0.127	0.234**	0.014	0.121	–			
6. MCQ-PB	0.81	10.48	3.39	0.114	0.154	0.015	0.114	0.476**	–		
7. MCQ-UD	0.82	10.81	4.01	0.230**	0.453**	0.241**	0.346**	0.432**	0.323**	–	
8. MCQ-NCT	0.68	12.06	3.39	0.197*	0.281**	0.031	0.288**	0.571**	0.297**	0.465**	–
9. MHCS	-	60.77	25.48	−0.382**	−0.413**	−0.356**	−0.325**	−0.109	−0.185*	−0.473**	−0.256**

*$p<.01$ **$p<.001$ ACE-Q: Adverse Childhood Experiences Questionnaire, BAI: Beck Anxiety Inventory, PSWQ: Penn State Worry Questionnaire, MCQ-LoCC: Loss of cognitive confidence, MCQ-CSC: Cognitive self-consciousness, MCQ-PB: Positive beliefs, MCQ-UD: Negative beliefs about uncontrollability and danger, MCQ-NCT: Beliefs about the need to control thoughts, MHCS: Mental Health Component Score of SF-36

Assessment of Anxiety Level

Beck Anxiety Inventory (BAI) was applied to participants to measure the level of state anxiety. BAI is a 21-item self-report inventory of which each item is rated on a 4-point Likert scale for evaluating the severity of anxiety in psychiatric population (Beck et al., 1988). The items extracted to a single solution were summed to attain a total score ranging from 0 to 63. Example items include: "Numbness or tingling" and "Fear of losing control." Excellent reliability was achieved at the level of $\alpha = 0.93$ in Turkish adaptation study (Ulusoy et al., 1998). The internal consistency was $\alpha = 0.88$ in present sample.

Assessment of Mental Health

Mental Health Component score (MHCS) was computed to evaluate mental health using algorithm described in manual prepared by developers of Short Form Health Survey-36 (SF-36) (Ware et al., 1994). Two separate measurement results are obtained from SF-36: physical health component score and MHCS. However, we used only one of them in this study. SF-36 is well-established scale that can discriminate well-being in eight health conditions: physical functioning, social functioning, role limitation due to physical problems, mental health, energy and vitality, pain and general health. Example items from the mental health subscale include: "Have you felt so down in the dumps that nothing could cheer you up during the past four weeks?" and "Have you felt downhearted and blue during the past four weeks?" and " How much bodily pain have you had during the past 4 weeks". The score of each domain was computed first by summing the raw score of items and then weighting on the scale from 0 to100 (Ware et al., 1993).We produced two separate scores, nation-weighted (NW) and sample-weighted (SW). The principal component analysis was run to obtain factor loads of mental health component in the present sample. SW was calculated by multiplying z-score of each subscale by the respective factor loads. The nation-based mean and standard deviation (Demiral et al., 2006) for generating z-score and factor loads were used to calculate NW. Both scores were ultimately standardized to T-score in which mean and standard deviation were determined as 50 and 10, respectively. NW ($M = 60.77$, $SD = 25.48$) and SW ($M = 50.00$, $SD = 24.28$) were strongly correlated ($r = .96$). Subsequent analyses were proceeded with SW.

Data Analysis

Sample Size

G*Power 3.1 was used to determine required sample size. We assumed the inter-correlation coefficient of all variables ranging from 0.3 to 0.6 in accordance with pairwise associations in existing literature. We constructed a theoretical equation as following: $Y_{MHCS} = \beta_0 + \beta_1 * (X_{ACEs}) + \beta_2 * (X_{BAI}) + \beta_3 * (X_{PSWQ}) + \beta_4 * (X_{MCQ-UD}) + \beta_5 * (X_{MCQ-NCT}) + \beta_6 * (X_{MCQ-LoCC}) + \beta_7 * (X_{MCQ-CSC}) + \beta_8 * (X_{MCQ-PB}) + \varepsilon$. We calculated effect size of final model as $f^2 = 0.13$, using theoretical correlation matrix. The required sample size was found 124, when power was set to 0.8 and determined the

significance level of α = 0.05. The required sample size for mediational models was determined by the suggestions of Fritz and McKinnon(2007). The estimated coefficient of paths was between 0.20 and 0.40, accordingly the sample size was considered to be between 126 and 162.

Hypotheses Testing

The analyses were conducted with SPSS 25 and AMOS 23.0. All scales were screened for violation from normality. Absolute value of skewness and kurtosis with their standard errors, Kolmogorov-Smirnov/Shapiro-Wilk tests and histograms were used all together to explore distribution of normality. Logarithmic or square root transformation was applied if the variables violated the normality. Distribution was reexamined after replacing the univariate outliers with mean values corresponding to absolute z-score of 2.68. The study variables were entirely decided to be normally distributed at univariate level. Pearson's product-moment correlation coefficient was calculated to assess the strengths of univariate associations. The effect of predictors of mental health was analysed with hierarchical multiple linear regression. Interaction terms was produced by multiplying the centered mean values of respective variables. Bootstrap resampling method was employed to determine indirect effects of putative mediators using Hayes SPSS PROCESS 4.1 in 5000-iterated data (Hayes, 2022). The upper level of significance (α) at which null hypotheses were rejected was set to 0.05.

We evaluated mediation models using hierarchical regression and structural equation modeling (SEM). For regression, we report the multiple correlation coefficient (R), the coefficient of determination (R^2), the adjusted coefficient of determination (adjusted R^2), the standard error of the estimate (SE[e]), and stepwise change indices: the change in explained variance (ΔR^2) and the F-change statistic (ΔF) with corresponding degrees of freedom (df) and p-values (p). SEMs were estimated via maximum likelihood estimation (MLE) and summarized with the chi-square to degrees-of-freedom ratio (χ^2/df), the Comparative Fit Index (CFI), the Tucker–Lewis Index (TLI), the Root Mean Square Error of Approximation (RMSEA) (with confidence intervals where applicable), and the Standardized Root Mean Square Residual (SRMR); the Goodness-of-Fit Index (GFI) is additionally provided descriptively. To compare non-nested specifications while penalizing complexity, we report the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), and the Expected Cross-Validation Index (ECVI). For readability, standardized path coefficients are presented. Indirect (mediation) effects are accompanied by percentile bootstrap 95% confidence intervals (5,000 resamples), and results are interpreted in associational (non-causal) terms.

Results

Bivariate Correlations

Pairwise associations were examined for all study measures. The strongest correlation with MHCS was found to be with UD ($r(142) = -0.473$, $p < .001$), CSC was the

only subtypes of MCQ which had non-significant relation to MHCS. ACE-Q was associated with MHCS (r (142) =−0.382, p<.001). Other notable significant associations of ACE-Q were those with UD (r (142)=0.230, p=.006), NCT (r (142)=0.197, p=.018), and LoCC(r (142)=0.173, p=.038). The only significant correlation of PSWQ within MCQ subscales was with UD (r (142)=0.241, p=.004). UD and MHCS were the two prominent variables that had strongest association with BAI (r (142)=0.453, p<.001; r (142) =−0.356, p<.001, respectively). Correlation matrix at the bivariate level were presented in Table 2.

Hierarchical Multiple Regression Analysis with Interaction Terms

Five-step hierarchical regression analysis was employed to examine whether metacognitive beliefs were associated with MHCS beyond ACE-Q, BAI, PSWQ which were sequentially added to model. All subscales of MCQ were forward-entered in Step 4 to select the strongest contributors and include them into equation, which was akin to a previous approach (Bailey & Wells, 2015). In addition to the planned steps, a final stepwise regression model was constructed to explore potential moderation effects. In this step, centered interaction terms between all prior variables (ACEs, worry, anxiety) and the remaining MCQ subscales were entered into the model. Although no specific hypotheses were formulated regarding these interactions, the analysis was conducted on an exploratory basis to examine whether the associations between metacognitive beliefs and mental well-being varied as a function of other psychological variables. This approach aimed to identify any potential conditional effects that could inform future hypothesis generation.

The final model showed that each step significantly increased the variance explained. MCQ-UD was the only metacognitive belief retained in Step 4, accounting for an incremental 4.5% of variance (Adj R^2 = 0.359, F(4,139)=21.065, p<.001), while ACE-Q, BAI, and PSWQ also remained significant. In the last step, interaction terms did not significantly add to the explained variance in MHCS, and all variables remained significantly associated with the outcome: ACE-Q (β = −0.27, t = −3.55, p=.001), BAI (β = −0.29, t = −3.20, p=.002), PSWQ (β = −0.22, t = −3.09, p=.002), and MCQ-UD (β = −0.24, t = −3.04, p=.003). Together, these variables accounted for 36% of the variance (F(7,136)=12.504, p<.001). The sequential analysis indicated that MCQ-UD showed a unique association with MHCS above and beyond the other variables, although no moderation effects were detected. The achieved power of the final model was 0.99. Model results are presented in Table 3.

Serial Multiple Mediation Analysis in Bootstrapped Data

We proceeded to test whether MCQ-UD retained its position as a mediator in relationship between ACE-Q and MHCS. Besides, the inter-correlations among study scales established in prior analyses fulfilled the prerequisites to construct serial mediation models: MCQ-UD was deemed superior to PSWQ and BAI, respectively. The conceptual diagram was illustrated in Figs. 1, 2 and 3. The initial model revealed that ACE-Q had a both significant direct effect (c'= −8.10, S.E.=2.11, CI95% [−13.15, −4.82]) and indirect effect (ab= −2.55, $SE_{bootstrap}$=1.12, $CI95\%_{bootstrap}$ [−5.26, −0.86]),

Table 3 Hierarchical regression model explaining mental well-being from ACEs, anxiety, worry, and metacognitive beliefs

IVs	Step 1		Step 2		Step 3		Step 4		Step 5	
	β	*t*	*β*	*t*	*β*	*t*	*β*	*t*	*β*	*t*
ACE-Q	−0.40**	−5.15	−0.35**	−4.93	−0.33**	−4.71	−0.29**	−4.19	−0.27**	−3.55
BAI			−0.35**	−4.93	−0.30**	−4.27	−0.21*	−2.71	−0.29*	−3.20
PSWQ					−0.23*	−3.28	−0.20*	−2.91	−0.22*	−3.09
MCQ-UD (remainder of stepwise)							−0.24*	−3.16	−0.24*	−3.04
PSWQ X MCQ-UD (centered)									−0.05	−0.54
BAI X MCQ-UD (centered)									0.17	1.74
ACE-Q X MCQ-UD (centered)									<−0.001	−0.003
Method	Enter		Enter		Enter		Forward		Enter	
p	<0.001		<0.001		<0.001		<0.001		<0.001	
F	F(1,142) = 26.515		F(2,141) = 27.591		F(3,140) = 23.260		F(4,139) = 21.065		F(7,136) = 12.504	
Adj.R²	0.151		0.271		0.318		0.359		0.360	
R²Change	0.157		0.124		0.051		0.045		0.014	
p (F Change)	<0.001		<0.001		<0.01		<0.01		0.370	

*p<.01 **p<.001 ivs: independent Variables, ACE-Q: adverse childhood experiences Questionnaire, BAI: Beck anxiety Inventory, PSWQ: Penn state worry Questionnaire, MCQ-UD: Negative beliefs about uncontrollability and danger

partially mediated via MCQ-UD. The direct effect was not remarkably diminished even after PSWQ was added to model as a second consecutive mediator (c' = −8.44, SE = 2.05, CI95% [−12.49, −4.39]), suggesting that PSWQ contributed little incremental indirect effect beyond MCQ-UD. The pathway from ACE-Q to PSWQ was not significant, whereas all remaining paths were significant in Model 2. We then included BAI in model as a third mediator, which minimally altered the total indirect effect in final model (b_{total} = −3.12, $SE_{bootsrap}$=1.26, $CI95\%_{bootstrap}$[−6.08, −1.001]). In Model 3, indirect associations reached significance only for the MCQ-UD pathways ('a_1b_1,' '$a_1d_1b_2$,' and '$a_1d_{1.2}b_3$'), whereas the pathway '$a_1d_1d_2b_3$' was not significant (illustrated in the diagrams). The unstandardized coefficients pertaining to indirect effects of pathways were reported in Table 4.

Comparative Model Fit and Parsimony: Hierarchical Regression and SEM Indices

Hierarchical regression indicated that adding worry and then anxiety was associated with small but statistically significant increases in explained variance in MWB beyond ACE and MCQ-UD (Model 1: R^2=0.302; Model 2: ΔR^2=0.057, $\Delta F(1,140) = 12.354$, p=.001; Model 3: ΔR^2=0.034, $\Delta F(1,139) = 7.762$, p=.006), accompanied by decreases in the standard error of estimate (Table 5).

In the SEM comparisons, Model 1 showed excellent fit ($\chi^2/df = 1.113$, CFI = 0.998, TLI = 0.995, RMSEA = 0.028, SRMR = 0.025) and the lowest parsimony-penalized indices (AIC = 26.45; BIC = 59.12; ECVI = 0.185). Model 2 also fit well ($\chi^2/df = 1.035$, CFI = 0.997, TLI = 0.996, RMSEA = 0.016, SRMR = 0.048) but with higher AIC/BIC/ECVI (67.80/133.13/0.474). Model 3 exhibited comparatively weaker fit ($\chi^2/df = 1.609$, CFI = 0.949, TLI = 0.930, RMSEA = 0.065, SRMR = 0.054) and the largest information criteria (AIC = 161.69; BIC = 265.64; ECVI = 1.131) (Table 6). Taken together, these results suggest that while adding worry and anxiety is associated with negligible incremental improvement in regression models, the more parsimonious Model 1 is preferred by parsimony-adjusted SEM metrics. SEM results largely corroborated the sequential specifications presented above. Full model details of all indirect-effect estimates and standardized path coefficients are provided in the Supplementary Materials (Tables S1–S5 and Figures S1–S3).

Discussion

We aimed to explore direct and indirect relationship between ACEs and perceived MWB in young adults. The indirect associations were examined within the framework of the metacognitive model. The main findings of the present work were as follows: a)- Metacognitions were associated with MWB above and beyond the contributions of ACEs and other anxiety-related symptoms such as worry and state anxiety, b)- UD was the only independent variable among the MCQ dimensions that showed a significant association with MWB, c)- Across models, MCQ-UD showed consistent associations with the ACE–MWB linkage, including a significant indirect association in the simpler specification, whereas evidence for pathways involving

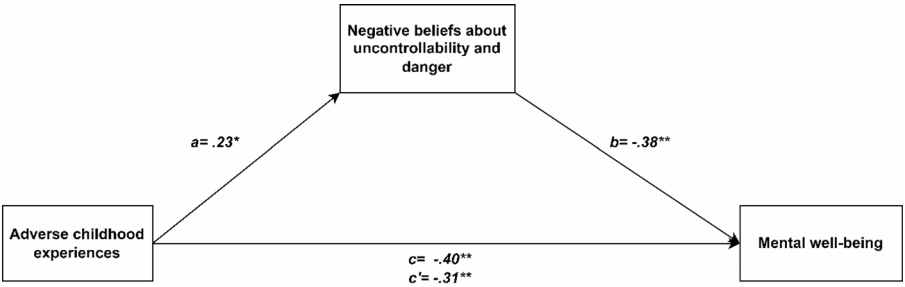

Fig. 1 Model-1 depicts the relationship between adverse childhood events and mental well-being mediated by negative beliefs about uncontrollability and danger. The coefficients are standardized *p<.01 **p<.001

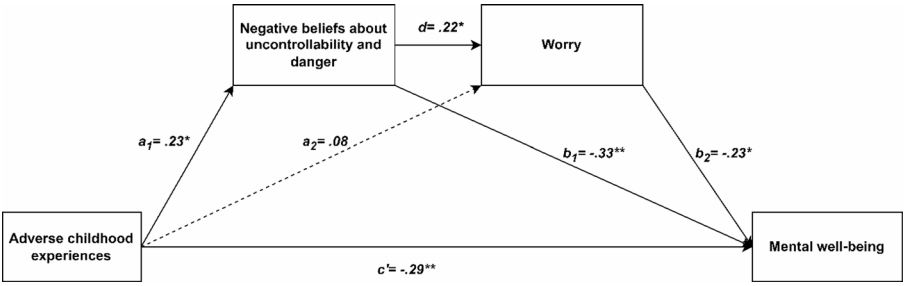

Fig. 2 Model-2 depicts the relationship between adverse childhood events and mental well-being mediated by negative beliefs about uncontrollability and danger and worry, and interrelations thereon. The coefficients are standardized. Dashed line represents non-significant path *p<.01 **p<.001

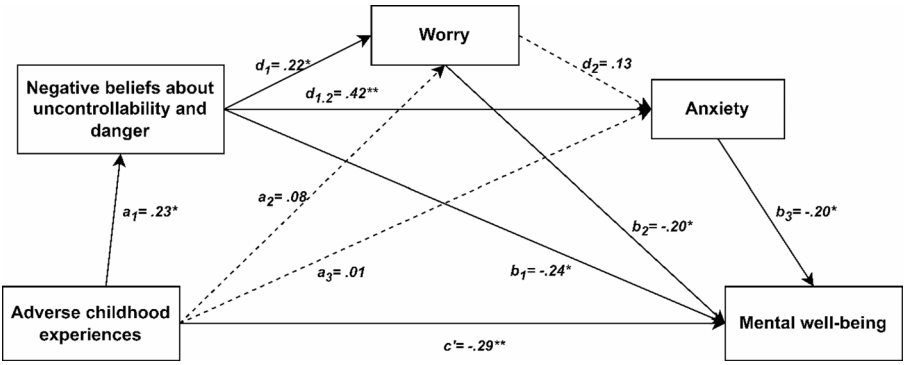

Fig. 3 Model-3 depicts the relationship between adverse childhood events and mental well-being mediated by negative beliefs about uncontrollability and danger, worry, anxiety and interrelations thereon. The coefficients are standardized. Dashed line represents non-significant path *p<.01 **p<.01

Table 4 Coefficients of indirect effects in paths with bootstrap standard error and confidence interval (95% CI)

Paths	Estimates (b)	S.E	Lower Limit of b	Upper Limit of b
Model 1				
ACE→MCQ-UD→MHCS	−2.552*	1.121	−5.263	−0.859
Model 2				
ACE→MCQ-UD→MHCS	−2.213*	0.999	−4.640	−0.735
ACE→PSWQ→MHCS	−0.540	0.577	−1.710	0.638
ACE→MCQ-UD→PSWQ→MHCS	−0.340*	0.207	−0.831	−0.037
Total	−3.092*	1.180	−5.654	−1.012
Model 3				
ACE→MCQ-UD→MHCS	−1.634*	0.886	−3.761	−0.386
ACE→PSWQ→MHCS	−0.479	0.534	−1.574	0.588
ACE→BAI→MHCS	−0.030	0.680	−1.799	0.973
ACE→MCQ-UD→PSWQ→MHCS	−0.302*	0.191	−0.741	−0.025
ACE→MCQ-UD→BAI→MHCS	−0.578*	0.369	−1.523	−0.099
ACE→PSWQ→BAI→MHCS	−0.061	0.091	−0.2785	0.090
ACE→MCQ-UD→PSWQ→BAI→MHCS	−0.038	0.041	−0.140	0.016
Total	−3.121*	1.255	−6.077	−1.002

*Significant coefficient ACE-Q: Adverse Childhood Experiences Questionnaire, BAI: Beck Anxiety Inventory, PSWQ: Penn State Worry Questionnaire, MCQ-UD: Negative beliefs about uncontrollability and danger, MHCS: Mental Health Component Score of SF-36

Table 5 Model fit and incremental improvement: a comparison of mediation models

Model	IVs	*R*	R^2	Adj. R^2	SE(e)	ΔR^2	ΔF	df1	df2	*p*(ΔF)
1	ACE, MCQ-UD	0.550	0.302	0.292	21.434	0.302	30.532	2	141	<0.001
2	+ PSWQ	0.599	0.359	0.345	20.620	0.057	12.354	1	140	0.001
3	+ BAI	0.627	0.393	0.375	20.139	0.034	7.762	1	139	0.006

Table 6 SEM fit comparison of the three structural models

MODELS	χ^2/df	GFI	TLI	CFI	RMSEA	SRMR	AIC	BIC	ECVI
MODEL 1	1.113	0.988	0.995	0.998	0.028	0.025	26.450	59.118	0.185
MODEL 2	1.035	0.963	0.996	0.997	0.016	0.048	67.796	133.132	0.474
MODEL 3	1.609	0.949	0.930	0.949	0.065	0.054	161.692	265.635	1.131

worry and state anxiety was weaker or model-dependent; MCQ-UD did not function as a significant moderator.

The first hypothesis was principally supported, as all variables were significantly correlated with mental well-being score except for MCQ-CSC. ACEs, examined as the main independent variable in this study, were found moderately associated with mental well-being score. A substantial body of research has focused on the long-term outcomes of ACEs on psychopathology in young adults (Badr et al., 2018; Daníelsdóttir et al., 2024; Karatekin, 2018; Schilling et al., 2007, 2008; Watt et al., 2022), whereas the specific link between ACEs and MWB has received comparatively less attention (Bartolomé-Valenzuela et al., 2024; Huang et al., 2021; Kelifa et al., 2021).

The present findings contribute to this area by suggesting that ACEs have a measurable relationship with MWB in a college-aged population.

Although MWB can be assessed in different ways, the SF-36 captures both general health and mental health dimensions, allowing for a broader interpretation of subjective mental functioning. Our finding was in line with recent studies in which measures of MWB were obtained with close indices akin to SF-36 in college students(Bartolomé-Valenzuela et al., 2024; Kelifa et al., 2021) and in general population setting (Hughes et al., 2016; Mosley-Johnson et al., 2019; Yeo et al., 2023). Importantly, this raises the issue of whether the link between ACEs and MWB can be understood independently of psychopathology. Only a limited number of studies have addressed this issue by exploring intermediate variables in relationship between ACEs and MWB, such as depression, resilience, or social support (Kelifa et al., 2021), self-report diagnosis of depression and social/emotional support (Bethell et al., 2019). Based on this, we formulated hypotheses to examine an additional psychopathological structure that may link ACEs with MWB.

We proposed a model with two core pathways: (1) a direct relationship between ACEs and MWB, and (2) an indirect relationship through transdiagnostic framework, including metacognitive beliefs, worry, and state anxiety. The emergence of MCQ-UD as the sole metacognitive dimension significantly associated with MWB was in line with our third hypothesis and aligned with the principles of the metacognitive model (Wells, 2009). The MCQ-UD had a significant incremental contribution to the explained variance in MWB, surpassing all other independent variables. This finding supports and extends earlier research conducted in various populations, including parents of children with cancer (Toffalini et al., 2015), in college students (Marino et al., 2018). Given these results, the interpretive focus of the fourth hypothesis required further specification. The analyses highlighted the specific indirect role of MCQ-UD in the association between ACE and MWB, with robust MCQ-UD–involved indirect paths in the simpler specification and a significant total indirect association in the full sequential model. In line with Wells' (2009) framework, state anxiety was included as the terminal emotional state in the sequence; however, evidence for indirect routes that did not involve MCQ-UD (e.g., paths relying only on worry and/or state anxiety) was limited and generally non-significant (see Table 4,Table S3-S6, and Fig. 3, Figure S1-S3).

To our knowledge, no prior study has directly tested metacognitive beliefs as mediators of the relationship between ACEs and mental well-being. However, related evidence highlights the potential relevance of such aspects. For instance, Huang et al.(2021) reported that mindfulness partially mediates the association between ACEs and psychological well-being, underscoring the importance of cognitive-affective processes in this pathway. Moreover, Reina and Kudesia(Reina & Kudesia, 2020) suggested that metacognitive beliefs may serve as precursors to mindfulness, shaping the individual's ability to engage in adaptive self-regulation. Overall, the evidence indirectly supports the notion that metacognitive dimensions are implicated in the association between ACEs and MWB. In accordance with the S-REF model, our results align with the idea that early negative experiences can trigger maladaptive metacognitive processes, which, in turn, contribute to prolonged emotional distress (Myers & Wells, 2015; Ostefjells et al., 2017). In addition, our models highlighted

the relavance of metacognition as a distinct construct potentially underlying the association between ACEs and MWB. This finding can also be interpreted in light of evidence suggesting that early adversities may be associated with difficulties in the development of self-regulation (Blair & Raver, 2012; Lund et al., 2022; Tinajero et al., 2020). This may be due to their indirect association with executive functions that underpin metacognitive abilities.

Notably, the direct effect of ACEs on MWB remained robust in all models, indicating that the relationship between ACEs and MWB may involve a diverse range of indirect pathways. In support of this, previous work has examined the contributions of genetic vulnerability, environmental adversity, and neural processes in relation to mental health trajectories (Taylor & Stanton, 2007). Extending this perspective, Nurius et al. (2015) highlighted that ACEs are associated with increased risk for subsequent adversities and reduced social connectedness in adulthood, both of which are linked to poorer psychological well-being. An alternative explanation for the strength of these associations may lie in the cumulative scoring method used for the ACE-Q, which has been shown to amplify statistical associations with mental health outcomes (Evans et al., 2013).

Taken together, our findings suggest that a transdiagnostic approach may be more appropriate for capturing the the role of dysfunctional metacognitive beliefs as vulnerability factors linking early adversity to reduced well-being. Given that the Cognitive Attentional Syndrome (CAS) is increasingly viewed as a transdiagnostic factor in ACE-related psychopathology (Dragan & Kowalski, 2020), it represents a notable component underlying persistent emotional distress. Therefore, the absence of symptoms alone may not necessarily coincide with higher levels of well-being when early adversity is linked to maladaptive coping and cognitive patterns. This interpretation is supported by a previous research reporting that UDs accounted for subtantial portion of the mediational variance in the relationship between emotional stability and positive mental health in college students. (Marino et al., 2018).

An important nuance in interpreting our findings concerns the internal composition of the MCQ-UD subscale. Emerging evidence suggests that beliefs about uncontrollability and beliefs about danger, while conceptually related, may function differently in their associations with psychological outcomes. Specifically, uncontrollability beliefs have been shown to be stronger associations with emotional dysregulation and clinical symptomatology (Salguero & Ramos-Cejudo, 2023). Although the present study did not disaggregate these components, this distinction represents a potentially informative direction for future research. This structural limitation of the MCQ-UD was considered when interpreting our findings.

There are several limitations to consider in the present work. Although the sample size was adequate for testing the hypotheses, future studies with larger samples are needed to provide more robust evidence for young adults. Additionally, the study sample lacked sufficient representation of male participants. Another limitation was that the cross-sectional design precludes conclusions about the directionality of associations. Therefore, the findings should be interpreted as correlational rather than causal, despite the statistical strength of the mediation models. The data of ACEs were ascertained by self-report, which may have introduced recall bias. Moreover, categorical distinctions of ACEs may not have been adequately captured due to the

cumulative scoring of the ACE-Q. It should be noted that the internal consistency values for both the PSWQ (α = 0.68) and the ACE-Q (α = 0.61) were relatively low in the present sample. While these values fall slightly below conventional thresholds, they may still be acceptable for psychological research, particularly in studies involving heterogeneous constructs or community samples (Taber, 2018). The psychometric literature suggests that moderate alpha values may be expected in instruments such as the ACE-Q, which consist of dichotomously scored items across broad domains (e.g., abuse, neglect, household dysfunction). Some previous studies have likewise reported moderate internal consistency for this measure, including α = 0.75 in the Turkish validation study by Gündüz et al. (2018), α = 0.70 in Olah et al. (2023), and α = 0.64 in Kovács-Tóth et al. (2023). Likewise, although the PSWQ generally exhibits robust psychometric properties, slightly reduced reliability may occur in non-clinical or culturally diverse samples. Finally, correlations between PSWQ scores and other relevant variables were small in magnitude, in contrast to prior studies that typically reported stronger associations. This discrepancy should be considered when interpreting the limited mediational role of worry in our model. These limitations may have introduced measurement imprecision and should be taken into account when evaluating the strength of the observed associations in the mediation analyses. Beyond these issues, model comparisons showed that adding worry and anxiety yielded only modest ΔR^2 gains and did not consistently improve parsimony-adjusted SEM fit. AIC, BIC, and ECVI specifically favored the more parsimonious Model 1. Accordingly, findings from the extended specifications should be regarded as model-dependent. The sample size of 144 relative to model complexity likely limited power and contributed to wide bootstrap confidence intervals, especially for Model 3 paths. In addition, MWB was modeled as an observed composite and parceling was used for certain constructs; these measurement choices may introduce imprecision and can mask item-level heterogeneity (see Supplementary Materials, Tables S1–S6; Figures S1–S3).

The present study is among the first to examine the statistical mediation of metacognitive beliefs in the association between ACE and MWB within the S-REF framework. At the same time, our modeling did not fully realize the S-REF sequence: the extended specifications that added worry and state anxiety (Models 2 and 3) were not more explanatory than the simpler model and did not consistently improve parsimony-adjusted fit. Accordingly, the strongest and most consistent indirect associations involved MCQ-UD, whereas paths relying solely on worry and/or state anxiety were limited and generally non-significant. These observations suggest that the present evidence supports the relevance of metacognitive beliefs to the ACE–MWB linkage, while indicating the need for larger, preregistered studies that can more fully operationalize S-REF processes. Although a cumulative ACE score was used in line with the original framework, this approach may have obscured the distinct contributions of specific types of adversity. Future studies should consider disaggregating ACE domains to clarify how different forms of childhood adversity relate to mental well-being. Overall, our results may have implications for early intervention and prevention, particularly if replicated in longitudinal clinical studies. Screening for ACEs in mental health services could help identify college students at risk for emotional instability, thereby offering an opportunity to reduce secondary stressors. Metacog-

nitive attention training may also represent a feasible approach to mitigating the emotional consequences of early adversity on subjective MWB in this population; however, it represents only one component of the broader Metacognitive Therapy (MCT) framework. Future research should examine not only accessible, self-directed training methods but also the applicability of structured MCT protocols (Wells, 2009) for promoting MWB among students at elevated risk for ACEs.

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Declarations

Competing Interests The authors declare no competing interests.

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