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The role of identity in the development of depressive, anxiety and psychosis symptoms in adolescents exposed to childhood adversity: a process-oriented approach

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Abstract

Background Childhood adversity is known to predispose to a wide array of psychopathology in adolescence and early adulthood. Identity development, being a crucial developmental task during adolescence, has been suggested to affect this association. Nonetheless, research on the role of identity processes is scarce. The current study aims to investigate how identity processes of exploration and commitment may impact the association between childhood adversity and psychopathology.

Methods We cross-sectionally investigated the association between childhood adversity, identity processes (i.e., exploration in breadth and depth, commitment making, identification with commitment and ruminative exploration) and depressive, anxiety and psychosis symptoms in 869 Flemish adolescents between 14 and 20 years old (mean = 15.52, SD = 1.28).

Results Childhood adversity was associated with increased ruminative exploration, which itself was associated with increased psychopathology. On the other hand, commitment making, identification with commitment and exploration in breadth were associated with decreased psychopathology. Processes of exploration in breadth and commitment making attenuated the association between childhood adversity and psychopathology. Moreover, identification with commitment and ruminative exploration potentially mediated this association.

Conclusion These findings underscore the importance of healthy identity processes in adolescents, with and without exposure to childhood adversity. Measures of identity structure and identity processes should be combined to fully capture identity.

Keywords Childhood adversity, Identity processes, Adolescence

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Background

Childhood adversity (CA), including experiences of neglect, abuse, or peer victimization, is well known to predispose to a wide array of mental disorders in adolescence and adulthood. Both retrospective and prospective studies have revealed increased rates for depression, anxiety and psychosis in individuals who experienced early adversity [1–5], and symptoms typically develop earlier and with higher comorbidity, crossing traditional diagnostic borders [2, 4, 6–8]. Still, the pathways from CA to psychopathology remain largely undiscovered, though understanding the psychological consequences of early adversity can provide new tools for intervention [9–11]. Identity development, a crucial developmental task in adolescence and early adulthood, is an essential focus in this regard [12, 13].

During identity development, adolescents aim to find a balance between exploring different options and making stable commitments across different domains, including education, work, relationships, religion and gender [14]. Luyckx and colleagues proposed five identity dimensions that describe this dynamic process on two interrelated domains: exploration and commitment [15–17]. Exploration in breadth and commitment making refer to the period in which an individual explores and chooses between meaningful alternatives and eventually commits to one of these alternatives [18]. Additionally, during exploration in depth and identification with commitment, these existing commitments are continuously re-evaluated to further strengthen them. Identification with commitment can then be described as the degree to which adolescents feel certain about, can identify with, and internalize their choices. Moreover, these dimensions often develop reciprocally: if one is unsatisfied with one's commitments, the process may cycle back to a new round of exploration in breadth [15, 17]. Ruminative exploration on the other hand refers to a more dysfunctional type of exploration: whereas exploration in breadth is an intentional process characterized by goal-oriented exploration of different identity options, ruminative exploration is characterized by distress, passivity, and self-doubt and may interfere with the formation of and identification with commitments (Supplementary Table 1).

Identity development may be disrupted by early adversity because of multiple factors: the cognitive and emotional reactions to adversity may be difficult to integrate into a coherent self-narrative, experiences of abuse may invalidate the individual's sense of self, and individuals may be deprived of experiences (such as positive interactions with caregivers) that support identity development [9, 19]. In psychoanalytic literature, Sandor Ferenczi was the first to describe the intrapsychic effects of early trauma, such as identification with the aggressor and splitting of the self, both impairing the development of a coherent sense of self [20]. Later concepts, such as the 'alien self' and epistemic distrust, also emphasize the negative impact of a neglecting or actively traumatizing early environment on forming a stable, integrated identity [21, 22]. The identity disruption model states that early adversity disrupts typical identity development, which subsequently increases one's vulnerability to psychopathology [23, 24], a hypothesis that has been supported in a range of mental disorders (e.g., eating disorders, anxiety, depression and psychosis) [9, 23, 25, 26]. Indeed, in a previous study, we reported a significant association between CA, a more vulnerable identity structure (i.e., synthesis and confusion) and psychopathology. Moreover, a path analysis pointed to identity structure as a potential mediator in the association between CA and psychopathology, though identity structure did not moderate this association [27].

So far, research has thus shown that identity structure plays an important role in the association between CA and psychopathology. Previous research however underscored the importance of identity processes in addition to identity structure, in order to more adequately grasp the dynamic nature of identity development [13, 28]. To date, it remains unclear how these identity processes might influence the association between CA and psychopathology. The current study uses data from a community sample of Flemish adolescents (14 to 20 years old) [29] to investigate the moderating and mediating role of identity processes in the link between CA and development of symptoms of depression, anxiety and psychosis.

More specifically, we aim to answer three main research questions: (1) Is CA associated with identity processes during adolescence? (2) Are identity processes during adolescence associated with depressive, anxiety and psychosis symptoms? and (3) Do identity processes moderate the relation between CA and psychopathology? In line with [27], we additionally explored the potentially mediating effect of identity processes upon this association. We hypothesize that adolescents with a higher exposure to CA show less commitment making, identification with commitment, exploration in breadth and exploration in depth and more ruminative exploration compared to peers without adverse childhood experiences. Secondly, we hypothesize that, in line with previous research, ruminative exploration is associated with increased depressive, anxiety and psychosis symptoms. Finally, we hypothesize that ruminative exploration moderates, i.e., exacerbates, the association between CA and depressive, anxiety and psychosis symptoms.

Methods

Sample

In the current study, we included 869 adolescents aged 14 years and over from the 1913 adolescents who participated in the first wave of the SIGMA study between January 2018 and May 2019. 586 participants were female, 279 were male and 3 identified as 'Other'. Participants had a mean age of 15.52 years (SD = 1.28, range = 14–20). Participants were recruited through 22 mainstream secondary schools across all five provinces in Flanders, Belgium, and all data was collected at school. Although the SIGMA study consisted of self-report questionnaires, experience sampling methodology, an experimental task and wearables, the current study focuses on the self-report data. Further details of the SIGMA study are described elsewhere [29]. The study received ethical approval from the UZ/KU Leuven Medical Ethics Committee and participants and their parents/caregivers provided informed consent prior to participation.

Measures

Childhood adversity

Participants completed the child version of the self-administered Juvenile Victimization Questionnaire – 2nd Revision (JVQ-R2) [30]. This questionnaire consists of 34 screener questions and assesses exposure to conventional crime, child maltreatment, peer and sibling victimization, sexual victimization, and witnessing and indirect victimization. All questions were translated to Dutch and could be answered with "Yes" or "No". Due to time constraints, the subscale on conventional crime was only completed by a limited number of participants and therefore excluded from analyses. Both subscale scores and a composite score were calculated, with higher scores indicating higher CA exposure. The total composite score showed acceptable internal consistency (α = 0.78), with subscales ranging from 0.52 on witnessing and indirect victimization to 0.67 on sexual victimization.

Identity dimensions

The short version of the Dimensions of Identity Development Scale (DIDS) [15] was used to measure the identity dimensions. This 11-item questionnaire can be answered on a 5-point Likert scale ranging from "Strongly disagree" to "Strongly agree" and is subdivided into five subscales: commitment making (e.g. "I have decided on the direction I am going to follow in my life"), identification with commitment (e.g. "My future plans give me self-confidence"), exploration in breadth (e.g. "I think actively about different directions I might take in my life"), exploration in depth (e.g. "I think about whether the aims I already have for life really suit me"), and ruminative exploration (e.g. "I worry about what I want to do with my future"). The subscales on commitment making, identification with commitment, exploration in breadth and ruminative exploration showed good internal consistency (α ranging from 0.84 to 0.88) in the current sample, while internal consistency for exploration in depth (α = 0.70) was acceptable.

Depressive, anxiety, and psychosis symptoms

Considering that CA has especially been implicated in (comorbidity of) depression, anxiety and psychosis [3, 6–8], we specifically assessed depressive, anxiety and psychosis symptoms using the Dutch version of the 53-item Brief Symptom Inventory (BSI) [31, 32]. This self-report questionnaire covers nine symptom dimensions: somatization, obsession-compulsion, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychoticism with acceptable to good internal consistency (α ranging from 0.74 on psychoticism to 0.88 on depression in the current sample). For each question, participants indicated to which extent they experienced those difficulties in the last week on a 5-point Likert scale ranging from "Not at all" to "Extremely". We combined responses on the depression, anxiety, phobic anxiety, paranoid ideation and psychoticism dimensions into a composite score of depressive, anxiety and psychosis symptoms, as every symptom dimension can be considered separately to examine specific areas of psychopathology [33]. Nevertheless, sensitivity analyses were conducted to ensure that results would not differ considerably if we used another composite score, i.e., the Global Severity Index. Results from these sensitivity analyses, as well as a correlation matrix for all BSI symptom dimensions, can be found in the Supplementary Material (Supplementary Tables 7–9). We will adopt the term psychopathology to refer to the composite score of depression, anxiety, and psychosis to improve readability throughout this paper.

Statistical analyses

Given the nested nature of our data (i.e., participants nested within schools), we tested our hypotheses using linear mixed-effects models. The first research question was tested using 10 linear mixed-effects models with the five identity dimensions (commitment making, identification with commitment, exploration in breadth, exploration in depth or ruminative exploration) as dependent variable, and CA (adversity sum score or sum scores on the individual subscales) as independent variable. 10 models were fitted for the second research question with psychopathology as a dependent variable and each of the identity dimensions as independent variable. For the third research question, we included psychopathology as a dependent variable and the identity dimensions and CA (adversity sum score) as independent variables, resulting in a total of 10 models, of which five models included an

interaction term between the independent variables. Age and sex were added as covariates in all models, and p-values were adjusted for multiple comparisons using Holm's correction. Finally, in line with [27] within the SIGMA study, we included a path analysis with CA as predictor of the five identity processes and of psychopathology to evaluate the potential mediation effect of identity processes on the association between CA and psychopathology. Although all included analyses are similar to [27], the current study was not preregistered. In order to ensure a meaningful comparison between boys and girls, we assessed measurement invariance for both dependent variables, i.e., identity dimensions and psychopathology. Identity showed good metric (absolute: CFI = 0.997, TLI = 0.996, RMSEA = 0.025; relative: χ^2 = 5.17, df = 6, p = .52) and scalar measurement invariance (absolute: CFI = 0.997, TLI = 0.997, RMSEA = 0.022; relative: χ^2 = 10.09, df = 6, p = .12), indicating that both the factor loadings and the intercepts can be assumed to be equal across the sexes. Psychopathology showed good metric measurement invariance (absolute: CFI = 0.993, TLI = 0.992, RMSEA = 0.025; relative: χ^2 = 30.288, df = 24, p = .18), but not scalar invariance (absolute: CFI = 0.991, TLI = 0.991, RMSEA = 0.028; relative: χ^2 = 131.11, df = 24, p < .001).

For all research questions, we looked at a linear mixed-effects model with random intercept and slope for school as well as a linear mixed-effects model with a random intercept for school. We only included the models with a random intercept in our final analyses, as models with both random slope and random intercept were overfitted.

Table 1 Descriptive statistics for all variables included in the current study (N = 869)

Variable	Mean	SD	Observed range	Theoretical range	Available N
Age	15.52	1.28	14–20		869
Sex (% girls)*	67.43				868
Identity					
Commitment making	6.65	2.24	2–10	2–10	785
Identification with commitment	5.94	2.32	2–10	2–10	776
Exploration in breadth	7.38	2.00	2–10	2–10	783
Exploration in depth	6.14	2.08	2–10	2–10	757
Ruminative exploration	8.41	3.41	3–15	3–15	780
Psychopathology					
Anxious, depressive and psychotic symptoms	25.85	18.92	0–87	0–108	684
Childhood adversity					
Adversity sum score	4.70	3.69	0–25	0–25	627
Indirect victimization	1.39	1.38	0–8	0–8	702
Peer victimization	1.62	1.26	0–6	0–6	734
Sexual victimization	0.90	1.32	0–7	0–7	706
Maltreatment	0.82	1.00	0–4	0–4	735

* 3 participants identified as 'Other'

Furthermore, as some linear mixed-effects models were singular, we fitted a linear regression accounting for the clustered school level by adding clustered standard errors. Because of violations in model assumptions, we transformed the composite score for depressive, anxiety and psychosis symptoms using a boxcox transformation with λ equal to 0.2828. This transformation improved skewness from 1.0791 to -0.0129.

All analyses were performed using RStudio [34]. The major R packages that we used were tidyr (1.2.0) [35] and tidyverse (1.3.1) [36] for data manipulation, and lme4 (1.1.28) [37] and lmerTest (3.1.3) [38] for analyses. Internal consistency for all questionnaire subscales was calculated using the DescTools package [39].

Results

Descriptive statistics of and pairwise correlations between all variables are shown in Table 1 and Supplementary Table 2, respectively. The majority of our sample (67%) was female. Participants reported on average 14 out of 27 symptoms of depression, anxiety and psychosis. 579 out of 627 participants reported at least one adverse event during childhood (mean = 4.70, SD = 3.69, range = 0–25). There were however marked differences in the reported prevalence of different types of CA: the majority of participants reported at least one event of peer victimization (588 participants or 80%) or indirect victimization (481 participants or 69%), while maltreatment and sexual victimization were reported less frequently (364 participants or 50% and 314 participants or 44%, respectively). There were some differences between participants with complete and incomplete data. Participants that did not have any missing datapoints (n = 531) were on average older (t = -32.818, p < .001) and were more often female (t = -4.2966, p < .001) than participants with at least one missing datapoint. Furthermore, participants with complete data reported more CA (t = -6.6088, p < .001) and more symptoms (t = -5.4673, p < .001).

Hypothesis 1 CA was positively associated with ruminative exploration (p < .001): adolescents exposed to CA reported higher levels of this identity process. CA was not associated with any of the other identity dimensions (Supplementary Table 3). We further examined the association of the individual adversity subscales with the identity processes, yet none of the adversity subscales were significantly associated with identity development.

Hypothesis 2 Higher scores on ruminative exploration (p < .001) were associated with higher scores on psychopathology. In contrast, commitment making (p < .001), identification with commitment (p < .001) and exploration in breadth (p = .0023) were negatively associated with psychopathology: adolescents engaging in these identity

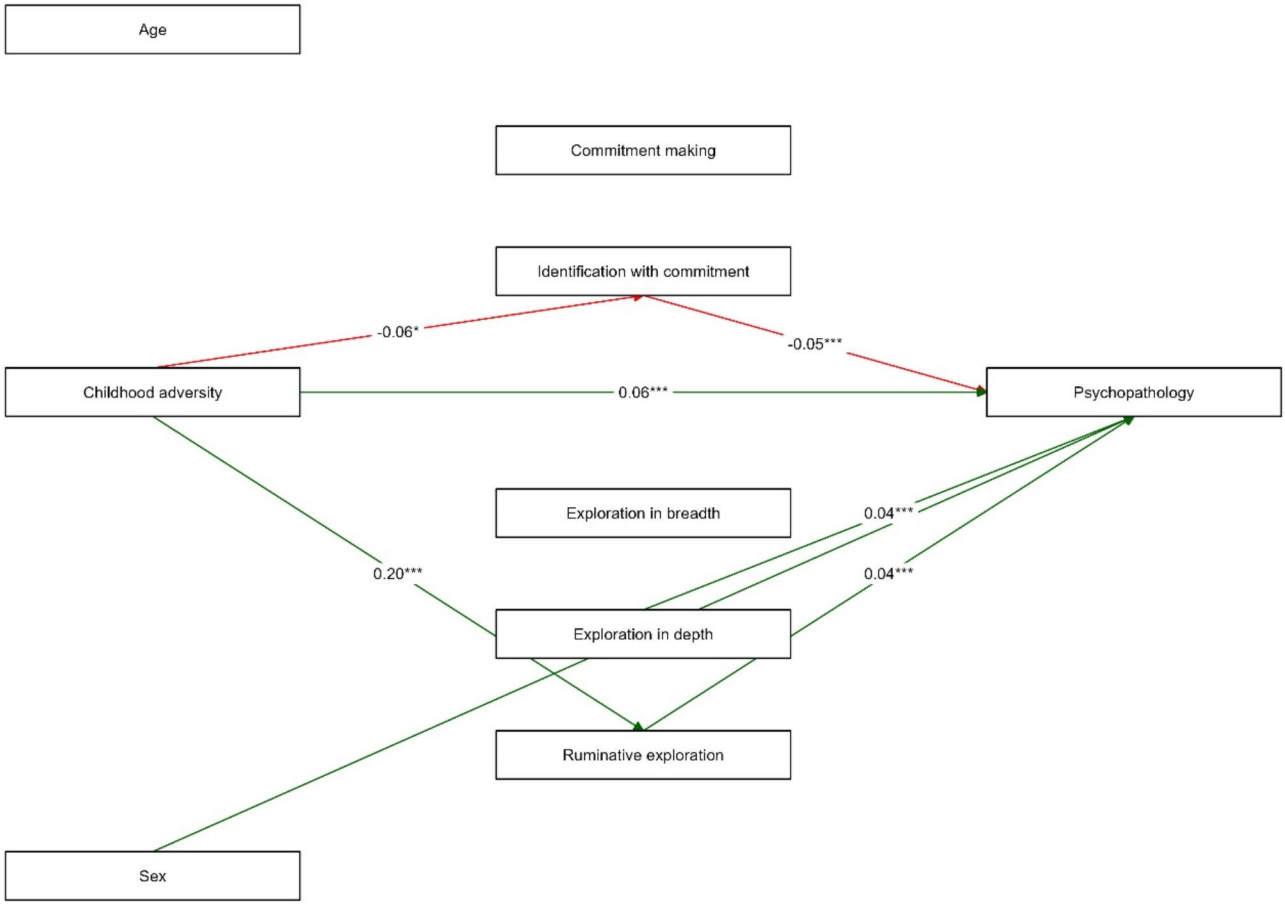

Fig. 1 Visualization of the path model. CA and sex are directly associated with psychopathology. CA is a positive predictor of ruminative exploration, which in turn is positively associated with psychopathology. CA is a negative predictor of identification with commitment, which is also negatively associated with psychopathology. * $p < .05$; *** $p < .001$

processes reported fewer symptoms overall. We found no significant association between exploration in depth and psychopathology (Supplementary Table 4). The interaction term between age and any of the identity processes was not significant.

Hypothesis 3 We found a significant interaction effect between CA and commitment making ($p = .0478$). Post-hoc analyses indicated a positive association between CA and psychopathology, but this association was reduced in adolescents with high levels of commitment making ($est = 0.138$, $p < .001$). The interaction terms between CA and identification with commitment, exploration in breadth, exploration in depth, and ruminative exploration, respectively, were not significant (Supplementary Table 5).

In contrast, a path analysis suggested a potential partial mediating role of identification with commitment and ruminative exploration on the association between CA and psychopathology (Supplementary Table 6). More specifically, CA positively predicted ruminative exploration, which was positively associated with psychopathology. Moreover, CA was a negative predictor of identification with commitment, which was also negatively associated with psychopathology. Finally, the direct paths between CA, sex and psychopathology were significant (Fig. 1). Fit statistics indicate a good relative fit ($\chi^2 = 1234.398$, $p < .001$, CFI = 0.970, TLI = 0.899) and a marginal to good absolute fit (RMSEA 90% CI = [0.060; 0.108], SRMR = 0.044).

Discussion

In our adolescent community sample, CA was associated with increased ruminative exploration. We found no significant association between CA and any of the other identity dimensions. These findings are in line with previous studies, supporting the hypothesis that CA negatively impacts identity development [40–44]. Looking specifically at adversity subscales, we found no evidence for a significant association of the different adversity subscales with identity processes. In line with our second hypothesis, our study shows that ruminative exploration

is associated with symptoms of depression, anxiety and psychosis in Flemish adolescents. Additionally, commitment making, identification with commitment and exploration in breadth, were associated with lower levels of reported psychopathology. Third, we aimed to investigate whether identity processes would moderate and/or mediate the impact of CA on psychopathology. We found that commitment making attenuated the association between CA and psychopathology. Identification with commitment, exploration in breadth, exploration in depth and ruminative exploration did not moderate the association between CA and psychopathology. An exploratory path analysis on the other hand suggested that identification with commitment and ruminative exploration may partially mediate the association between CA and psychopathology: CA positively predicted ruminative exploration, which in turn was positively associated with psychopathology, while the reverse was true for identification with commitment. Thus, in our study, healthy identity processes that are typically associated with positive developmental outcomes, i.e., commitment making and identification with commitment, could potentially protect against the detrimental influence of early adversity on adolescent mental health, although longitudinal data is crucial to further validate this finding. Ruminative exploration in contrast may partially underly the positive link between CA and psychopathology. These findings complement earlier studies indicating an association between CA, identity structure (synthesis vs. confusion) and psychopathology [9, 23, 25–27, 42, 43, 45, 46]. To our knowledge, this study is be the first to focus on the role of identity processes rather than identity structure in the association between CA and psychopathology.

Similar to findings in prior studies involving young adults [42, 43] and adolescents [40, 41, 44, 47], the present study found a significant association between ruminative exploration and increased symptoms of depression, anxiety, and psychosis during adolescence. Ruminative exploration is characterized by continuous, passive and negative reflection on one's identity, aligning with a ruminative cognitive style marked by repetitive negative thinking about one's problems or feelings. This cognitive style has consistently been associated with symptoms of depression and anxiety [48]. As ruminative exploration pertains specifically to a repetitive and passive focus on identity-related uncertainties en questions, it interferes with the formation and identification with commitments, and as such exacerbate distress surrounding identity formation. Conversely, commitment making, identification with commitment and exploration in breadth showed a negative association with psychopathology [43, 49]. Additionally, exploration in breath and commitment making might protect against the detrimental influence of early adversity on adolescent mental health. Due to the cross-sectional nature of our data, it is impossible to draw conclusions about the directionality of these findings. Indeed, it is important to consider that psychopathology may also influence identity development [50]. For instance, anxiety can disrupt the process of identity development by heightening feelings of uncertainty and impairing decision-making abilities. Supporting this notion, a five-wave longitudinal study conducted by Crocetti and colleagues [51] demonstrated that adolescents with elevated levels of anxiety reported decreasing levels of commitment over time. Furthermore, anxious adolescents between 10 and 20 years old, revealed higher initial levels of uncertainty regarding their commitment, which further increased throughout the duration of the study. On the other hand, longitudinal studies have shown that ruminative exploration in adolescence precedes the development of depressive symptoms, and not vice versa [44, 49]. Hatano and colleagues [40], in their longitudinal study, found identity processes (i.e., ruminative versus adaptive exploration) and psychosocial problems (i.e., conduct disorders and depressive symptoms) to be bidirectionally interwoven. Research thus suggests a bidirectional association between identity development and psychopathology.

Developing a stable and coherent identity structure (i.e., a synthesized sense of self that can support self-directed decision making) represents a lifelong task, requiring ongoing processes of identity exploration and commitment. Indeed, in a longitudinal study, Bogaerts and colleagues [28] found identity processes (proactive versus ruminative) to be bidirectionally associated with identity structure (synthesis vs. confusion) in adolescence at both a between-person and within-person level. The authors thereby stress that the concept of identity consolidation (i.e., one's overall sense of self) represents the confluence among identity synthesis and identity exploration and commitment processes. That is, someone consolidating a sense of identity knows who they are, has engaged in consideration of alternatives, and selected one or more of these alternatives. Given that identity consolidation is a key concept in understanding healthy identity development [13], Bogaerts and colleagues [28] propose that future research should focus on identity consolidation above and beyond contributions of synthesis and confusion, e.g., by assessing other identity constructs such as identity processes.

Identity development should be viewed as a dynamic process, depending on the developmental period [45]. As individuals move through adolescence, they start questioning their childhood identity (which was mostly shaped by their caregivers) and throughout different contexts explore, choose and integrate their own values and beliefs. Their sense of self may be repeatedly challenged by different contexts, such as the transition to secondary

school or to college, leaving the parental home or finding a job [45]. Waterman [52] hypothesized that, over time, adolescents will move out of the diffusion status (characterized by low commitment) and into the achievement status (characterized by high commitment), which has been supported by empirical studies [45, 53]. In our study, older adolescents indeed reported higher exploration, both in breadth and in depth, consistent with exploring new roles for the future. Additionally, consistent with this increase in exploration, we also found a significant association between age and increased ruminative exploration.

Furthermore, personal identity may operate differently in boys versus girls, as previous studies have found gender differences in personal identity processes [41, 54, 55]. In our study, boys displayed higher levels of identification with commitment than girls. This seems to correspond to findings by Bogaerts and colleagues [45], reporting lower levels of identity synthesis and increased levels of identity confusion in girls, but only in early and mid-adolescence (12–17-years old). In our study, gender did not influence the association between identity processes and psychopathology. In contrast, Ritchie and colleagues [41] reported that ruminative exploration had more detrimental effects on well-being for young men than for young women.

Several important strengths in our study should be noted. First, it stresses the importance of shared etiological risk factors in the development of an admixture of symptoms, instead of focusing on depression, anxiety or psychosis separately. Secondly, our study compares the impact of various forms of CA on identity development and psychopathology. Furthermore, we conducted this investigation during adolescence, a pivotal period for the development of identity and the emergence of mental health issues. Lastly, findings from a preclinical community sample are broadly applicable to the general population and can stimulate further investigation of identity-focused prevention and intervention strategies. Nevertheless, our results should be interpreted considering the following limitations. First, the potential mediation role of identification with commitment and ruminative exploration in the association between childhood adversity and psychopathology should be interpreted with caution, as the current study consisted of cross-sectional data [56]. Longitudinal data are imperative to draw firm conclusions about causal relations between CA, identity development and psychopathology. Second, all measures in the current study are based on self-report, potentially introducing the common method variance-bias. Furthermore, using retrospective reports of CA, we should be conscious of potential recall bias. Nonetheless, recent research revealed that retrospective subjective reports of CA, but not objective measures without subjective recall of maltreatment, were associated with psychopathology in early adulthood [57]. Moreover, the prevalence of CA in the current study was particularly high compared to previous research [58]. Future studies could benefit from a more extensive measure of CA, such as the Juvenile Victimization Questionnaire in interview format, rather than a self-report questionnaire. Third, we measured identity processes, but did not assess identity distress. Identity distress has shown to better account for variance in psychopathology in adolescents compared to identity development [59] and should be included in future studies. Fourth, our sample is representative for the general adolescent population of Flanders in terms of educational trajectory and ethnicity (for detailed sample characteristics, see [29]) and caution should be taken before generalizing these results to other regions, especially collectivistic countries. In previous research, a similar identity development trajectory has been found in young adults in Flanders, the US and South-Africa [15, 49, 60]. Nonetheless, identity development processes in particular may be especially important in individualistic countries [60]. Finally, depending on the instrument, we had up to 28% of missing data, as some questions were dropped throughout the study due to time constraints [29]. This missingness could have biased our inferences, yet we found largely similar results when looking only at complete cases (Supplementary Tables 10–12).

Conclusion

The aim of our study was to examine the potential moderating and mediating role of identity processes in the association between CA and depressive, anxiety and psychosis symptoms. In our community sample of 869 Flemish adolescents, CA was associated with increased ruminative exploration. In turn, ruminative exploration was positively associated with psychopathology, whereas exploration in breadth, commitment making and identification with commitment were negatively associated with psychopathology. Commitment making attenuated the association between CA and psychopathology. Moreover, identification with commitment and ruminative exploration potentially mediated this association. Thus, in our study, healthy identity processes may protect against the detrimental influence of early adversity on adolescent mental health, while ruminative exploration may partially explain the positive association between CA and psychopathology. These findings further underscore the importance of healthy identity processes in adolescence, regardless of exposure to adverse childhood experiences. Future research should investigate specific intervention strategies, both from a clinical and a general health perspective, aimed at strengthening healthy identity processes during adolescence.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12888-025-06649-y.

Supplementary Material 1

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Author contributions
IMG, UR, BB and RVW conceived of and designed the SIGMA study; OJK coordinated the SIGMA study; AL, RA, NH, KSFM and APH collected the data; CS developed the concept for the current study, performed the statistical analyses and interpreted the data; CS and SL drafted the manuscript. All authors provided critical revisions and approved the final manuscript.

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Data availability
The data analyzed in the current study are not publicly available due to privacy but can be obtained from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The study received ethical approval from the UZ/KU Leuven Medical Ethics Committee (S61395) and was performed according to the principles of the Declaration of Helsinki. Written informed assent was obtained from all participants in this study, as well as written informed consent from their parent or legal guardian.

Consent for publication
All participants in this study, as well as their parent or legal guardian, provided consent for publication.

Competing interests
The authors declare no competing interests.

Clinical trial number
Not applicable.

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