



Heterogeneity of associations between dissociation and attention deficit symptoms

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Abstract

Childhood trauma and dissociative experiences are suggested to be predisposing transdiagnostic factors for attention deficit /hyperactivity disorder (ADHD) as well as many psychiatric disorders. Trauma-related symptoms such as motor restlessness, emotional instability, and concentration problems can mimic, trigger, or exacerbate ADHD symptoms. Moreover, given the relationship between ADHD and trauma-induced distress, it has been suggested that dissociative experiences and attention problems may reveal overlapping characteristics. The aim of this study was to investigate the associations between dissociative experiences and attention deficits by carrying out mixture analysis. A thousand and thirty-seven participants volunteered to the online investigation. Participants completed a test battery that included a sociodemographic form as well as the Adult ADHD Severity Rating Scale (ASRS), Wender Utah Rating Scale (WURS), Childhood Trauma Questionnaire (CTQ), Dissociative Experiences Scale (DES), and Somatoform Dissociation Questionnaire (SDQ). Item responses on the DES and attention deficit symptoms as indexed by the ASRS were subjected to latent class analysis. The three-latent-class model outperformed alternative mixture models. Mixture analysis classified the sample into three homogenous subgroups as follows: (1) No/low dissociation or attention problems; (2) Moderate dissociation with attention problems; and (3) High dissociation with attention problems. High dissociators with attention problems were characterized by heightened scores on somatoform dissociation and emotional neglect. No/low dissociation or attention problems latent class reported significantly lower scores on hyperactivity/impulsivity, depression, attention deficit in childhood, and sexual abuse than both moderate and high dissociation latent classes. High dissociators and moderate dissociators significantly differed on conduct problems and physical abuse. We concluded that impulsive hyperactivity, depression, and childhood sexual abuse were common features in heightened dissociation latent classes, as well as attention deficit.

Keywords ADHD · Childhood trauma · Dissociation · Depression

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Attention deficit /hyperactivity disorder (ADHD) is a childhood-onset neurodevelopmental disorder characterized by attention deficit, overactivity, and impulsivity. Although ADHD symptoms tend to decrease in adulthood, a significant proportion of adults with ADHD remain symptomatic, which negatively affects their academic performance, educational achievement, interpersonal relationships, and social functioning (Faraone et al., 2006). ADHD is a predisposing factor for many psychiatric disorders in adulthood, including mood, anxiety, personality, substance-related, trauma-related, and dissociative disorders (Adler et al., 2004; Fragkaki et al., 2019).

The emerging evidence points out significant associations between ADHD and childhood traumatic experiences. In a more recent systematic review of associations of ADHD with maltreatment in childhood, Craig, Bondi, O'Donnell, Pepler, and Weiss (2020) identified that early exposure to severe traumatic experiences appear to be exerting significant influence on the formation of ADHD symptoms later in the development. Some of the ADHD symptoms might be associated with maltreatment that is an integral part of post-traumatic stress disorder (Famularo et al., 1992). Several persistent symptoms of inflated arousal in trauma-related disorders overlap with ADHD symptoms clusters, including sleeplessness, hypervigilance, motor restlessness, emotional instability, and difficulty in concentration. Moreover, it is thought that children with ADHD are more likely to have experienced traumatic events (Dahmen et al., 2012; Ford et al., 2000; Ruiz, 2014; Szymanski et al., 2011; Weinstein et al., 2000).

Dissociation is the disruption and/or discontinuity of one or more of the mental functions that are normally work synchronously, such as memory, identity, consciousness, emotion regulation, environment, and body perception. Moreover, as a prevailing notion, dissociation serves as a buffering mechanism in response to adverse life events to protect the ego from the negative consequences of trauma-induced cognitions and emotions that can affect body perception/representation (somatoform dissociation) and mental functions (psychoform dissociation) (Şar, 2008). Studies using neuropsychological tests and fMRI have documented that, in comparison to individuals with normal levels of dissociation, individuals with pathological dissociation were more prone to reveal deficiency in execution function, particularly attentional control difficulties and failures in response inhibition (Fani et al., 2019; Giesbrecht et al., 2004; Schurle Bruce et al., 2007). Additionally, a more recent study indicated that somatoform dissociation scores were significantly higher among the high-risk ADHD group than were in the low-risk group when participants were divided into two groups based on the Adult ADHD Severity

Rating Scale (ASRS) cutoff score (Kandeger & Tekdemir, 2020).

Epidemiological studies conducted in Turkey reported dissociative disorders are common in the general population and have been reported above 10% in psychiatric outpatients and inpatients (Akyüz et al., 1999; Şar et al., 2007). A study conducted in the province of Istanbul found that the prevalence of dissociative disorders was 35.7%, which was the highest rate in the literature in psychiatric emergency admissions (Sar et al., 2003). Studies conducted in Turkey have revealed robust correlations between ADHD and dissociative symptoms that the authors suggested that ADHD/dissociative symptoms may predispose or exacerbate other psychopathologies (Kandeger et al., 2022; Özdemir et al., 2015).

Significant associations between ADHD and pathological dissociation have consistently emerged in the literature (Bozkurt et al., 2015; Fragkaki et al., 2019; Sar et al., 2014). In a clinical investigation conducted by Endo et al. (2006), one-thirds of children with ADHD who reported abuse had a comorbid dissociative disorder. Matsumoto and Imamura (2007) identified that childhood ADHD symptoms persisting into adulthood revealed significant associations with adult dissociative symptomatology. Harrison and Wilson (2005) identified greater levels of overlaps between dissociative experiences and attention deficit symptoms based on the similarities in symptom patterns of these two clinical phenomena such as difficulty sustaining attention, concentration problems/distractibility, forgetfulness, and failure to follow instructions in tasks in a study, investigating linkages within ADHD and early traumatic experiences. Evidence is compelling that these two clinical entities may have overlapping features. Moreover, the phenomenon of 'hyperfocus', which is characterized by intense and difficult-to-shift attention and diminished awareness of time and environment (like a hypnotic spell) has recently been associated with ADHD (Hupfeld et al., 2019; Ozel-Kizil et al., 2016; Groen et al., 2020) comparatively addressed the overlapping features of hyperfocus experiences with ADHD in community and clinical samples and reported that frequency of hyperfocus experiences were positively tied to ADHD symptoms among healthy individuals. In contrast, frequency, duration and pervasiveness of hyperfocus states did not significantly differ between ADHD patients and matched healthy controls. This mental state seems to be very similar to the "highway hypnosis", in which it is subsequently noticed that awareness is losing during any activity in dissociative experiences (Dell, 2017). Additionally, alterations in consciousness such as mind wandering and maladaptive daydreaming have been reported to be associated with both dissociation and ADHD (Bozhilova et al., 2018; Marcusson-Clavertz et al., 2012; Ross et al., 2020; Somer et al., 2017). Chui and

colleagues have demonstrated the switching function of dissociative experiences that individuals with a high tendency to dissociate reveal an enhanced ability to divert attention to a new mental set under negative emotional load (Chiu et al., 2009, 2016). Therefore, fluctuations across hyperfocus experiences and mental dissociative states may operate sequentially in cognitive functioning in cases of ADHD. Finally, functional brain connectivity analyses studies have revealed altered brain connectivity, especially in the default mode network in both dissociation and ADHD (McKinnon et al., 2016; Rubia, 2018).

As emphasized above, the evidence emerged in the research is that dissociative experiences are significantly associated with symptom clusters of the ADHD, particularly attention deficit symptoms. Even though, early traumatic experiences are consistently identified as a substantial vulnerability factor in the etiology of dissociative symptomatology, the connections between these two clinical entities of dissociation and attention problems in relation to childhood traumatic experiences, somatization, affective problems are still yet to be elaborated. Thus, we speculated several hypotheses as follows: (i) heterogeneity of the community sample would exist in the mixture analysis concerned with the associations among dissociation and attention deficits, (ii) considering the symptom patterns subjected to the mixture analysis, dissociative experiences would be tied to attention deficit symptoms, and (iii) individuals allocated in various homogenous subgroups would differ in affect regulation and behavioral problems.

Methods

Participants and procedures

This study was conducted as a cross-sectional design research using the online survey method between 06/01/2020 and 09/01/2020. The study was also announced to the undergraduates in the majors of faculties allocated in the Selçuk University Central Campus settled in the Middle Anatolia region of Turkey. The online survey link was sent to the volunteers who provided their email address during the announcements. In the invitation email, the undergraduates were asked to post the online survey link via social networks (mobile phone, email, WhatsApp) to invite the potential volunteers in their schoolmates to the research study. A thousand two hundred seventy participants completed the online survey. Individuals who confirmed that they studied at Selçuk University were included in the study. In the online survey, all items of scales were marked as “mandatory response”. Participants who quit before completing the survey were not included in the study. Hence,

there were no missing observation in the data set. While filling out the online survey, since cognitive abilities and executive function may be affected, participants who reported substance use, regular alcohol use, and any current diagnosis of psychiatric disorders in the sociodemographic form were also excluded from the study. The data consisted of 1037 participants were subjected to analyzed.

The purpose and study procedures of the study granted approval from the Local Ethics Committee of Faculty of Medicine (Date: 03.18.2020; Decision Number: 2020/122). In addition, the permission was obtained from the University to announce the study in the central campus. In the data recruitment process, the general purpose and procedure of the study (E.g., cross-sectional online survey, voluntary participation, to be possible to withdraw from the study at any time) were briefly explained in the invitation email. As the participants provided written consent, they could get access to the psychometric instruments.

Psychometric instruments

The participants completed an online survey including, a consent form regarding voluntary participation, the socio-demographic form, ASRS, Wender Utah Rating Scale (WURS), Childhood Trauma Questionnaire (CTQ), Dissociative Experiences Scale (DES), and Somatoform Dissociation Questionnaire (SDQ).

Adult ADHD self-report scale (ASRS)

It is an 18-question self-report scale that measures ADHD symptoms in adults based on the criteria of Diagnostic and Statistical Manual of Mental Disorders: Fourth Edition (DSM-IV-TR) (APA, 2000; Kessler et al., 2005). The validity and reliability of the Turkish form have been demonstrated in two different studies (Dogan et al., 2009; Evren et al., 2016). Using factor analytic strategy in 579 university students, Dogan et al. (2009) showed that nine items (items 1, 2, 3, 4, 7, 8, 9, 10, and 11) tapped into the Attention Deficit subscale, and the remained nine items (items 5, 6, 12, 13, 14, 15, 16, 17, and 18) tapped into the Hyperactivity subscale. Additionally, the Turkish version of ASRS had high-level internal consistency (Cronbach alpha: 0.88). Higher scores indicate higher ADHD symptoms. It is suggested that the cut-off score should be determined as 30, and this cutoff score is reported to correspond to sensitivity = 0.75, specificity = 0.79, Kappa = 0.44, positive predictive value = 0.46, and negative predictive value = 0.93 (Evren et al., 2016).

Wender Utah rating scale (WURS)

WURS is a 25-item, five-point Likert type self-report scale that retrospectively questions childhood ADHD symptoms. It consists of five subscales: irritability (7 questions), affect (5 questions), academic problems (3 questions), behavioral problems/impulsivity (5 questions), and attention deficit (5 questions). The total score of the scale is obtained by adding the scores from all questions (Ward, 1993). 36 points were determined as the cut-off value for childhood ADHD symptoms. The WURS translated into Turkish by Oncu et al. (2005). The internal reliability of the Turkish version was $\alpha=0.93$. The instrument was demonstrated to have an excellent concurrent validity with a sensitivity of 82.5% and specificity of 90.8% for ADHD (Oncu et al., 2005).

Childhood trauma questionnaire (CTQ)

The CTQ is accepted as an easy-to-use measurement tool based on self-report, showing validity and reliability, useful in retrospectively and quantitatively evaluating experiences of abuse and neglect before 20 years of age. Developed by Bernstein et al., the CTQ consists of 28 questions and 5 sub-dimensions; emotional abuse, physical abuse, physical neglect, emotional neglect and sexual abuse (1994). The Turkish version of the CTQ's validity and reliability has been performed with a Cronbach's alpha value as 0.93, which shows the internal consistency of the scale. The Gutmann half test coefficient was 0.97 (Sar et al., 2012).

Dissociative Experiences Scale (DES)

The DES originally measures psychoform dissociation along a continuum ranging from minor dissociative experiences such as absorption to pathological forms of dissociative symptomatology such as depersonalization–derealization and dissociative amnesia (Holmes et al., 2005; Putnam, 1997). The DES had good validity and reliability (Carlson et al., 1993). A Bayesian probabilistic algorithm based on these eight items of the DES is utilized to obtain a probabilistic value for pathological dissociation. A Bayesian probability value ≥ 0.90 is indicative of DES-Taxon membership (Waller & Ross, 1997). The Turkish version of the scale was demonstrated to have excellent reliability and validity, with a Cronbach's alpha of $\alpha=0.91$ and test-re-test correlation coefficient of $r=.78$ (Yargic et al., 1995).

Somatoform Dissociation Questionnaire (SDQ)

The SDQ is a 20-item self-report scale used to assess somatoform dissociation. The scale investigating negative symptoms (anesthesia, analgesia and motor inhibitions)

and positive symptoms (localized pain, taste change, and odor preferences/reluctance) can be scored in the range of 20–100 (Nijenhuis et al., 1996). The Turkish validity and reliability study was conducted by Sar et al., (1998). The Turkish version revealed good psychometric properties with a Cronbach's alpha of $\alpha=0.94$.

Data analysis

We began with computing descriptive statistics for the sample using SPSS version 23 (IBM Corporation, 2015). Then, mixture analysis was conducted to uncover the optimal latent profiles. The latent profile algorithm of the mixture analysis is used to obtain optimal number of latent classes. Mixture analysis resembles factor analytic procedures that observed variables are grouped into subsets of variables accurately representing the observed covariance matrix in exploratory factor analysis; contrarily, individuals are classified into latent homogenous subgroups according to their responses in the mixture analysis (Collins & Lanza, 2010). The mixture analyses were carried out using MPlus Version 8.4 (Muthén & Muthén, 1998–2017). To identify the optimal number of latent classes, we used Lo-Mendell-Rubin adjusted likelihood ratio test (LMR-LRT) to compare k-class latent profile model with k-1 class latent profile model. In comparison to k-1-latent-class model, the LMR-LRT assesses the optimal fit of the k-class latent mixture model considering sample size, log-likelihood values, number of parameters and number classes of the baseline and nested models (Lo et al., 2001). In addition, optimal latent profile models were evaluated using the Akaike information criterion (Akaike, 1987), the Bayesian information criterion (Schwarz, 1978), and the adjusted Bayesian information criterion with the lowest values preferred (Burnham & Anderson, 2004; Nylund et al., 2007; Preacher & Hayes, 2008). Entropy values greater than $>.80$ are indicative of excellent homogeneity for the k-class mixture model (Celeux & Soremenho, 1996; Clark, 2010; Wedel & Kamakura, 2000).

In the mixture analytic investigation of sample characteristics, item responses on the 28 items of the DES and 9 items of the ASRS capturing the inattention subscale were subjected to the latent class analysis using MPlus 8.4 (Muthén & Muthén, 1998–2017). We used LMR-LRT to identify most parsimonious mixture model with optimal number of latent classes. Once the best class solution was determined, the optimal number of latent classes were obtained. Next, to explore cardinal features of the latent classes extracted through mixture analysis, the posterior Bayesian membership classification probabilities of each latent class was used as dependent variable in regression analysis. The DES total and the ASRS attention deficits subscale scores were

Table 1 Sample socio-demographic and clinical characteristics (N = 1037)

Age		Mean, SD	21.46	3.35
Body Mass Index		Mean, SD	22.52	3.59
Gender	Man	n, %	329	31.73%
	Woman	n, %	708	68.27%
Alcohol use	No alcohol use	n, %	833	80.33%
	Social drinker/ occasional use	n, %	204	19.67%
Tobacco use	No tobacco use	n, %	834	80.42%
	Tobacco use	n, %	203	19.58%
Daily coffee consumption (cups/day)		Mean, SD	1.21	1.36
Family psychopathology	Familial loading	n, %	276	26.62%
Pathological Dissociation	(DES > 30)	n, %	376	36.26%
DES-Taxon Membership		n, %	247	23.86%
Pathological Somatoform Dissociation	(SDQ > 35)	n, %	194	18.71%

Note. DES: Dissociative Experiences Scale; SDQ: Somatoform Dissociation Questionnaire. The age of the participants ranged from 18 to 57

regressed onto membership classification probabilities for each latent class separately. In addition, using Mplus 8.4 (Muthén & Muthén, 1998–2017), we carried out 3-step regression analysis (Asparouhov & Muthén, 2014) to explore the relationships of socio-demographic variables (age, gender, BMI, alcohol use, tobacco use, daily coffee consumption, and psychopathology among family members) with latent classes of the optimal mixture model.

The differences in psychological constructs across latent classes were investigated using the analysis of variance (ANOVA). We carried out the one-way ANOVAs to explore the differences between latent profiles on the mean scale scores on the DES total and subscales (Depersonalization/Derealization, Absorption/Imaginative involvement, and Amnesia), SDQ total, ASRS total and subscales (Inattention and Hyperactivity/Impulsivity), WUS total and subscales (Irritability, Depression, School problems, Conduct problems/Impulsivity, and Attention deficit), and the CTQ total and subscales (Emotional Neglect, Emotional Abuse, Physical Neglect, Physical Abuse, and Sexual Abuse).

Finally, the multivariate differences in variables of interest across latent classes were explored by using multinomial logistic regression analysis. Demographic characteristics (age, gender, body mass index, alcohol use, tobacco use, daily coffee consumption, and family psychopathology), the SDQ total, Hyperactivity/Impulsivity subscale of the ASRS, irritability, depression, school problems, conduct problems/impulsivity and attention deficit subscales of the WURS (childhood ADHD symptoms), and five subscales of the CTQ (emotional neglect, emotional abuse, physical neglect, physical abuse, and sexual abuse) were regressed onto the categorical dependent variable. The high dissociation with attention problems latent class group were taken as reference category in the logistic model.

Results

The socio-demographic characteristics of the sample are presented in Table 1.

We carried out mixture analysis of the data to identify the optimal model best representing the associations between item responses to 28-item of the DES and to 9-item inattention subscale of the ASRS. We carried out latent profile analysis beginning from 1-latent-class to 4-latent-class model. We identified the best latent-class model using the Lo-Mendel-Rubin adjusted likelihood test (LMRT) which compares the k-latent-class model with k-1-latent-class model to indicate the significance of increase in model fit. The LMR-LRT showed that 4-latent-class model did not statistically significantly differ from 3-latent-class model (LMR-LRT = 1120.591, $p = .4015$). According to the parsimonious principle, we concluded that 3-latent-class model best fit the current data. In addition, the information criteria computed for the 3-latent-class model was lower than the nested models (AIC = 281205.185, BIC = 281946.798, and ABIC = 281470.379). Findings are presented in Table 2.

We assessed the internal consistency of the optimal 3-latent-class model using the relative entropy index = 0.94 which was indicative of high homogeneity of the overall latent classes greater than 0.80 (Celeux & Soromenho, 1996; Clark, 2010; Wedel & Kamakura, 2000). In addition, we found that average classification probabilities for the most likely latent class membership were high with the values of 0.980, 0.958, and 0.981, respectively. According to the guidelines (Nagin, 2005; Wang & Wang, 2020), we concluded that the 3-latent-class model had excellent level homogeneity within latent classes.

In an attempt to investigate the characteristics of the latent classes in terms of dissociative symptomatology and attention problems, we conducted two separate regression analyses on latent-class-membership probabilities for each latent class, in which the DES and ASRS inattention

Table 2 Latent class analysis model fit statistics

	1-latent-class	2-latent-class	3-latent-class	4-latent-class
AIC	292394.813	283648.868	281205.185	280156.347
BIC	292760.675	284202.606	281946.798	281085.836
ABIC	292525.642	283846.880	281470.379	280488.724
LMR-LRT	-	8788.639	2510.171	1120.591
P value		<0.0001	0.0238	0.4015
Entropy index	-	0.970	0.940	0.934

Note. - = Not applicable; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; ABIC = Adjusted Bayesian Information Criterion; LMR-LRT = Lo-Mendel-Rubin adjusted likelihood ratio test

Table 3 Regression analysis on latent class membership probabilities of the optimal model

Dependent variable:						
Latent-class-1 membership probabilities (n = 595, 57.38%)						
Independent variables	R²	β	t	p	F(1, 1035)	P
Dissociative Experiences Scale	0.678	-0.823	-46.643	<0.001	2175.600	<0.001
ASRS – Inattention Subscale	0.267	-0.517	-19.427	<0.001	377.397	<0.001
Dependent variable:						
Latent-class-2 membership probabilities (n = 322, 31.05%)						
Independent variables	R²	β	t	p	F(1, 1035)	p
Dissociative Experiences Scale	0.135	0.368	12.735	<0.001	162.184	<0.001
ASRS – Inattention Subscale	0.110	0.331	11.291	<0.001	127.481	<0.001
Dependent variable:						
Latent-class-3 membership probabilities (n = 120, 11.57%)						
Independent variables	R²	β	t	p	F(1, 1035)	P
Dissociative Experiences Scale	0.531	0.729	34.246	<0.001	1172.816	<0.001
ASRS – Inattention Subscale	0.101	0.318	10.802	<0.001	116.679	<0.001

subscale scores were independent variables, respectively. Dissociative symptoms ($R^2 = 0.678$, $\beta = -0.823$, $t = -46.643$, $p < .001$) and attention problems ($R^2 = 0.267$, $\beta = -0.517$, $t = -19.427$, $p < .001$) were found to be negatively associated with latent-class-1 membership probabilities. Therefore, this latent class was labeled as “No/low dissociation or attention problems”. In the second set of regression analyses, the membership probabilities of latent-class-2 was the dependent variable. We found that both the DES ($R^2 = 0.135$, $\beta = 0.368$, $t = 12.735$, $p < .001$) and inattention subscale of the ASRS ($R^2 = 0.110$, $\beta = 0.331$, $t = 11.291$, $p < .001$) was statistically significantly associated with the classification probabilities of the respective latent class. The determination coefficients of the independent variables showed relatively moderate relationships with the latent-class probabilities. That is, the latent-class-2 was labeled as ‘moderate dissociation with attention problems.’ Finally, in the third set of regression analyses, the DES and ASRS-inattention subscale scores were regressed onto the membership probabilities of latent-class-3. Regression analyses indicated that the DES scores highly ($R^2 = 0.531$, $\beta = 0.729$, $t = 34.246$, $p < .001$), and inattention moderately ($R^2 = 0.101$, $\beta = 0.318$, $t = 10.802$, $p < .001$) contributed to the unique variation of latent class probabilities. Hence, this latent class was labeled as ‘High dissociation with attention problems.’ Findings are represented in Table 3.

To explore the differences in socio-demographic characteristics (age, gender, BMI, alcohol use, tobacco use, daily coffee consumption, and psychopathology among family members) across latent classes, we conducted 3-step-regression analysis using Mplus 8.4 (Asparouhov & Muthén, 2014; Muthén & Muthén, 1998–2017). In the 3-step regression analysis, the 3-latent-class model was dependent and socio-demographic characteristics were independent variables. 3-step-regression analyses showed that individuals who had moderate dissociation with attention problems was younger than those classified into the no/low dissociation or attention problems ($\beta = -0.098$, $p = .040$); whereas individuals who had high dissociation with attention problems did not differ from other latent classes in their age ($p > .05$). Individuals who had moderate dissociation with attention problems reported higher frequency of family psychopathology than those classified into no/low dissociation or attention problems ($\beta = 0.501$, $p = .003$); whereas individuals who had high dissociation with attention problems did not statistically significantly differ from other two latent classes ($p > .05$). Individuals who had high dissociation with attention problems reported more daily coffee consumption than those classified into no/low dissociation or attention problems ($\beta = 0.193$, $p < .001$) as well as than those individuals with attention problems ($\beta = 0.260$, $p = .001$). Latent classes

did not statistically differentiate in gender, body mass index, alcohol use, and tobacco use across latent classes ($p > .05$).

To explore the differences in psychological constructs across latent classes, we conducted one-way analysis of variance (ANOVA). Using the Bonferroni multiple comparison test, post-hoc comparisons between latent classes were carried out. We compared the scores on the DES total and subscales (Depersonalization/ Derealization, Absorption/ Imaginative involvement, and Amnesia) and the SDQ total using ANOVAs. The analyses indicated that high dissociators with attention problems reported the highest scores on all aspects of dissociation (mental and somatoform dissociation), followed by those individuals who had moderate dissociation with attention problems. In comparison to both latent classes, individuals allocated into the no/low dissociation or attention problems had the lowest scores on overall and subscales of the DES and SDQ total.

As with the psychoform and somatoform dissociation scores, high dissociation with attention problems latent class had the greatest levels of inattention and hyperactivity/impulsivity, followed by those individuals classified into the moderate dissociation with attention problems latent class, and the individuals with no/low dissociation or attention problems reported the lowest scores on the total and subscales of the ASRS. The same was true for the WURS overall and subscale scores (childhood ADHD symptoms such irritability, depression, school problems, conduct problems/impulsivity, and attention deficit) which retrospectively measures emotional, behavioural and attentional problems during childhood.

Participants classified into the high dissociation with attention problems latent class reported more severe childhood traumatic experiences on overall and five subscales (emotional neglect, emotional abuse, physical neglect, physical abuse, and sexual abuse) of the CTQ than either moderate dissociation with attention problems latent class or no/low dissociation or attention problems latent class. Those individuals who were classified into moderate dissociation with attention problems latent class reported greater scores than no/low dissociation or attention problems group as well. ANOVA results are presented in Table 4.

To explore the multivariate associations between latent class membership and psychological variables, we conducted a multinomial logistic regression analysis. In the logistic model, scores on the SDQ total, Hyperactivity/Impulsivity subscale of the ASRS, WURS subscales (Childhood ADHD symptoms; Irritability, Depression, School Problems, Conduct Problems/Impulsivity, and Attention Deficit), and CTQ subscales (Emotional Neglect, Emotional Abuse, Physical Neglect, Physical Abuse, and Sexual Abuse) were regressed onto the three-latent-class categorical dependent variable after controlling for demographic

characteristics (age, gender, body mass index, alcohol use, tobacco use, daily coffee consumption, and family psychopathology). The independent variables in the model explained 46.8% of the unique variance of the dependent variable (Cox and Snell pseudo $R^2 = 0.468$). The high dissociation with attention problems latent class was treated as the reference group in the analysis.

We found that, in comparison to high dissociators with attention problems latent class, being classified into the healthy control group were less likely to be associated with somatoform dissociation (Odds ratio = 0.792, 95% confidence interval = 0.762–0.822, $p < .001$), hyperactivity / impulsivity (Odds ratio = 0.841, 95% confidence interval = 0.793–0.892, $p < .001$), depression (Odds ratio = 0.909, 95% confidence interval = 0.832–0.992, $p = .032$), attention deficit (Odds ratio = 0.914, 95% confidence interval = 0.842–0.991, $p = .030$), emotional neglect (Odds ratio = 0.897, 95% confidence interval = 0.835–0.963, $p = .003$), and sexual abuse (Odds ratio = 0.909, 95% confidence interval = 0.826–0.999, $p = .047$).

In comparison to high dissociative participants, individuals' classification into moderate dissociation with attention problems latent class was less likely to be associated with somatoform dissociation (Odds ratio = 0.924, 95% confidence interval = 0.901–0.948, $p < .001$), school problems (Odds ratio = 0.874, 95% confidence interval = 0.786–0.971, $p = .012$), childhood emotional neglect (Odds ratio = 0.901, 95% confidence interval = 0.845–0.960, $p = .001$), and childhood physical abuse (Odds ratio = 0.888, 95% confidence interval = 0.796–0.990, $p = .032$). Intriguingly, both being grouped into no/low dissociation latent class (Odds ratio = 1.152, 95% confidence interval = 1.040–1.275, $p = .007$) and moderate dissociation latent class (Odds ratio = 1.189, 95% confidence interval = 1.089–1.300, $p < .001$) was positively significantly associated with childhood emotional abuse as compared to participants allocated into the high dissociation latent class.

When the no/low dissociation or attention problems latent class was taken as the reference category, the multinomial logistic analysis indicated that moderate dissociation latent class was positively significantly associated with somatoform dissociation (Odds ratio = 1.167, 95% confidence interval = 1.133–1.203, $p < .001$), hyperactivity/impulsivity (Odds ratio = 1.129, 95% confidence interval = 1.088–1.172, $p < .001$), depression (Odds ratio = 1.101, 95% confidence interval = 1.038–1.167, $p = .001$), attention deficit (Odds ratio = 1.078, 95% confidence interval = 1.023–1.136, $p = .005$), and childhood sexual abuse (Odds ratio = 1.107, 95% confidence interval = 1.029–1.192, $p = .007$). Findings are presented in Table 5.

Table 4 ANOVAs across latent classes^a

	Latent Classes												Post-hoc			
	Overall sample (n = 1037, 100.00%)			No/low dissociation or attention problems (n = 595, 57.38%) LC1			Moderate dissociation with attention problems (n = 322, 31.05%) LC2			High dissociation with attention problems (n = 120, 11.57%) LC3						
	M	SD		M	SD		M	SD		M	SD					
<i>Dissociative Experiences Scale</i>	29.24	14.27		19.45	5.35		36.79	6.52		57.53	8.62		2242.232	<0.001	0.813	LC1 < LC2 < LC3
Depersonalization/ Derealization	25.77	16.46		16.05	6.63		32.51	12.72		55.95	13.73		926.840	<0.001	0.642	LC1 < LC2 < LC3
Absorption/Imaginative involvement	37.68	17.33		25.89	9.09		49.49	10.13		64.45	11.33		1134.751	<0.001	0.687	LC1 < LC2 < LC3
Amnesia	22.38	13.43		14.75	4.73		25.82	7.54		51.03	12.39		1421.752	<0.001	0.733	LC1 < LC2 < LC3
<i>Somatiform Dissociation Questionnaire</i>	29.25	9.55		24.92	4.92		32.38	8.52		42.32	13.60		301.122	<0.001	0.368	LC1 < LC2 < LC3
<i>Adult ADHD Self-Report Scale</i>	31.05	10.59		26.38	9.04		36.17	8.88		40.42	9.32		196.094	<0.001	0.275	LC1 < LC2 < LC3
Inattention	16.10	6.11		13.45	5.19		19.06	5.13		21.33	5.74		187.087	<0.001	0.266	LC1 < LC2 < LC3
Hyperactivity/Impulsivity	14.94	5.54		12.93	4.96		17.11	5.06		19.08	4.98		120.021	<0.001	0.188	LC1 < LC2 < LC3
<i>WURS (Childhood ADHD symptoms)</i>	28.07	16.40		22.35	13.92		33.24	15.93		42.53	15.53		121.892	<0.001	0.191	LC1 < LC2 < LC3
Irritability	7.94	6.20		6.20	5.50		9.52	6.42		12.33	5.64		72.698	<0.001	0.123	LC1 < LC2 < LC3
Depression	5.95	3.94		4.78	3.49		7.17	3.86		8.47	4.10		76.201	<0.001	0.128	LC1 < LC2 < LC3
School problems	2.28	2.62		1.81	2.33		2.47	2.59		4.08	3.18		42.073	<0.001	0.075	LC1 < LC2 < LC3
Conduct problems/Impulsivity	5.03	3.74		3.95	3.21		6.05	3.79		7.58	4.03		73.707	<0.001	0.125	LC1 < LC2 < LC3
Attention deficit	6.87	4.41		5.61	3.92		8.03	4.51		10.05	4.04		76.177	<0.001	0.128	LC1 < LC2 < LC3
<i>Childhood Trauma Questionnaire</i>	37.91	12.04		34.39	8.90		40.57	12.60		48.25	15.80		91.037	<0.001	0.150	LC1 < LC2 < LC3
Emotional Neglect	11.64	4.86		10.67	4.54		12.36	4.81		14.50	5.11		38.758	<0.001	0.070	LC1 < LC2 < LC3
Emotional Abuse	7.72	3.63		6.68	2.70		8.81	4.13		9.89	4.40		67.852	<0.001	0.116	LC1 < LC2 < LC3
Physical Neglect	6.44	2.28		5.94	1.66		6.73	2.48		8.19	3.21		58.169	<0.001	0.101	LC1 < LC2 < LC3
Physical Abuse	5.94	2.28		5.56	1.67		6.03	2.28		7.58	3.69		42.791	<0.001	0.076	LC1 < LC2 < LC3
Sexual Abuse	6.18	3.02		5.54	1.80		6.65	3.55		8.09	4.75		44.974	<0.001	0.080	LC1 < LC2 < LC3

Note. ^aPost-hoc analyses are conducted using Bonferroni multiple comparison test ($p < .05$). WURS = Wender Utah Rating Scale

Table 5 Multinomial logistic regression analysis

	Latent Classes												χ^2 (2)	p	Group comparisons
	No/low dissociation or attention problems (n = 595, 57.38%) LCI			Moderate dissociation with attention problems (n = 322, 31.05%) LC2			High dissociation with attention problems (n = 120, 11.57%) LC3			P	OR	95% CI			
	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P						
<i>Somatiform Dissociation Questionnaire</i>	0.792	0.762–0.822	<0.001	0.924	0.901–0.948	<0.001	1.000	***	***	222.054	<0.001	LC1 < LC2 < LC3			
<i>Adult ADHD Self-Report Scale</i>	0.841	0.793–0.892	<0.001	0.949	0.900–1.001	0.055	1.000	***	***	55.369	<0.001	LC1 < LC2 = LC3			
<i>Hyperactivity/Impulsivity</i>	1.020	0.961–1.083	0.513	0.985	0.934–1.039	0.581	1.000	***	***	3.085	0.214	-			
<i>WURS (Childhood ADHD symptoms)</i>	0.909	0.832–0.992	0.032	1.000	0.925–1.081	0.999	1.000	***	***	10.784	0.005	LC1 < LC2 = LC3			
Irritability	0.927	0.823–1.044	0.213	0.874	0.786–0.971	0.012	1.000	***	***	7.172	0.028	LC1 = LC2 < LC3			
Depression	0.946	0.860–1.041	0.254	0.975	0.895–1.061	0.553	1.000	***	***	1.489	0.475	-			
School problems	0.914	0.842–0.991	0.030	0.985	0.914–1.060	0.681	1.000	***	***	8.942	0.011	LC1 < LC2 = LC3			
Conduct problems/Impulsivity	0.897	0.835–0.963	0.003	0.901	0.845–0.960	0.001	1.000	***	***	11.132	0.004	LC1 = LC2 < LC3			
Attention deficit	1.152	1.040–1.275	0.007	1.189	1.089–1.300	<0.001	1.000	***	***	16.330	<0.001	LC1 = LC2 > LC3			
<i>Childhood Trauma Questionnaire</i>	0.887	0.768–1.025	0.104	0.945	0.841–1.063	0.348	1.000	***	***	2.699	0.259	-			
Emotional Neglect	0.973	0.859–1.104	0.675	0.888	0.796–0.990	0.032	1.000	***	***	6.563	0.038	LC1 = LC2 < LC3			
Emotional Abuse	0.909	0.826–0.999	0.047	1.006	0.936–1.082	0.869	1.000	***	***	8.248	0.016	LC1 < LC2 = LC3			
Physical Neglect															
Physical Abuse															
Sexual Abuse															

Note. The high dissociation with attention problems latent class was the reference category in the analysis. The multinomial regression analysis was conducted after controlling for demographic characteristics (age, gender, body mass index, alcohol use, tobacco use, daily coffee consumption, and family psychopathology). Significant P values are presented in bold. WURS: Wender Utah Rating Scale

Discussion

This study hypothesized that attention deficits specific to ADHD and dissociative experiences may overlap in symptom structures. The responses of a relatively large community sample of university students for the DES and attention deficit subscale of the ASRS were subjected to a latent class analysis. The results extracted three latent homogenous subgroups characterized by normal levels of dissociation and attention problems labeled as “No/low dissociation or attention problems”, moderate dissociation with attention problems subgroup, and high dissociation with attention problems subgroup. Group differences in psychological variables of interest were identified by using ANOVAs and multinomial logistic regression analysis. The findings showed that dissociative individuals with attention deficits were more likely to report hyperactivity/impulsivity, depression, attention deficit in childhood, and sexual abuse in comparison to latent homogenous latent class of no/low dissociation or attention problems.

Childhood trauma is a vulnerability factor for both psychoform and somatoform dissociation. Individuals exposed to childhood traumatic experiences are suggested to reveal a tendency to use dissociation to distance the psychologically injured self from disturbing sensations and cognitions related to trauma. The process may result in complicated clinical manifestations ranging from amnesia or paresthesia to identity fragmentation (Lyssenko et al., 2018; Şar, 2008). In line with the fragmented-self model of dissociation, we observed that individuals allocated in the high and moderate dissociation with attention difficulties latent classes revealed severe somatoform dissociative tendency accompanied by severe hyperactivity and impulsivity.

There is no consistent data on whether the subtypes of childhood traumatic experiences differentiate in predicting dissociative symptomatology. A recent meta-analysis aimed at answering this question, including 65 studies with 7352 abused or neglected individuals, reported that childhood sexual and physical abuse were the most robust correlates of dissociative symptoms (Vonderlin et al., 2018). In our study, the types of childhood trauma scores varied significantly between the latent classes which were highest in the high dissociation with attention problems group. In the logistic regression analysis, no/low dissociation or attention problems latent class membership was associated with low scores on sexual abuse, while high and moderate dissociation with attention problems latent class memberships were associated with high scores on emotional neglect. Another study demonstrated that emotional abuse was the most common type of childhood trauma in a sample of traumatized women, which was the strongest and most direct predictor of dissociation (Haferkamp et al., 2015). Although our

findings were supportive of previous literature, intriguingly, emotional abuse scores were inversely associated with both moderate and high dissociation latent class memberships in the multivariate logistic analysis after controlling for other types of childhood traumas, childhood and adult psychological symptoms. The finding can be accounted for by the moderation effects of childhood ADHD symptom clusters as measures by WURS and/or adult psychological symptoms on the relationship between dissociation and childhood emotional abuse. Further studies are needed addressing the issue in clinical samples.

It is well known that ADHD is characterized by delay and insufficiency in frontal cortex development and impaired executive functions. Research examining the relationship of dissociative symptoms with impairment in executive functioning was quite limited. In a sample of 185 university students, Giesbrecht et al. (2004) established the relationship between impairment in executive functions and dissociation as indexed by the DES, particularly amnesia but not with depersonalization or derealization. An experimental investigation of dissociative tendency in relation to executive functions showed that individuals high in dissociation endorsed significantly more executive difficulties than did individuals low in dissociation. Nevertheless, the observed difficulties were apparently not related to objective measures of their performance on the neuropsychological tests, rather subjective perception of executive impairment was an underpinning factor in the process of clinical manifestation of dissociation (Schurle Bruce et al., 2007). In another neuropsychological investigation of dissociative tendency showed that high-dissociative individuals revealed a better performance on executive function, but worse performance on a visual memory task than did low-dissociative participants. More importantly, dissociative symptoms were inversely associated with connectivity between the amygdala and right anterior insula in response to trauma-related scripts which can be interpreted as deficits in attentional control among highly dissociative traumatized individuals (Fani et al., 2019). Additionally, Chiu et al. (2016) showed that high dissociations had a better switch function, suggesting that this may be a cognitive endophenotype of dissociation, which helps to escape from traumatic cognitions and trauma-related focus. Mixture analysis of associations between the DES scores and attention deficit symptoms as indexed by ASRS showed that dissociative symptomatology and attention problems have overlapping features. Further multivariate logistic analyses unfolded the group differences that individuals high or moderate in dissociation with attention problems were more likely to report hyperactivity/impulsivity, depression, attention deficit in childhood, and sexual abuse. Consistent with the accumulating evidence, our findings may suggest that both dissociation and

ADHD symptoms may be involved in attentional processes, but they may operate in distinct levels of cognitive information processing in terms of attentional shift and sustained attention functions. However, evaluation of ADHD and dissociation symptoms with executive function tests in case-controlled studies are needed to warrant the distinct features of attention deficits and dissociative experiences.

A body of evidence in the literature consistently indicated that trauma, dissociative experiences, and ADHD symptoms may differ between genders. It appears that, in comparison to men, women are at greater risk of exposing sexual trauma and are more prone to experience dissociative symptoms. Additionally, women have more attention deficit symptoms and are more likely to exhibit internalizing defenses (e.g., anxiety, depression) related to ADHD (Briscoe-Smith & Hinshaw, 2006; Rucklidge, 2010). However, our findings did not reveal a gender difference across three latent classes, probably because of that the study sample consisted of healthy volunteers.

Although our study was conducted with a relatively large sample using advanced statistical methods, it has several limitations. First, psychological constructs were evaluated through self-report scales, which may include bias (e.g., response, social desirability and recall bias). Second, participants who stated that they did not have any psychiatric disorders were included in the study without any structured clinical examination. Third, the study was conducted in a single center with a cross-sectional research design, which compromises the generalizability of the current findings. Longitudinal studies that use functional brain connectivity analyses and objective neurocognitive tests (e.g., the Stroop Color and Word Test) would provide more comprehensive information in relation to distinct and overlapping features of both ADHD and dissociation. Forth, we used an online survey as a data collection procedure and only volunteers participated in the study. Although volunteering is an integral part of research ethics, as emphasized by Rosenthal and Rosnow (2009), volunteers differ from nonvolunteers in a number of ways that may lead to a serious bias in data collection process. In an attempt to adjust such bias, we suppressed data collected from those who reported a current psychiatric disorder. Nevertheless, afflicted people with psychiatric disorders, specifically those with ADHD or dissociative disorders who did not seek for professional help at that time might have more likely to be involved in the study. Fifth, the study includes participants' responses on a set of psychometric instruments without any validation check which may affect the quality and internal validity of the study. Finally, a body of evidence emerged in the literature is that COVID-19 pandemic has severe impacts on community mental health, particularly anxiety depression and dissociation (Berthelot et al., 2020). In line with the literature,

a sizable minority in our sample (36%) reported clinical levels of dissociative symptomatology. The relationships between attention problems and dissociative experiences should be warranted in further studies after adjusting for the tentative influences of health anxiety.

In conclusion, this study aimed to examine the associations between ADHD and dissociative experiences in a large population of university students. To this end, the DES and attention deficit subscale item responses subjected to latent class analysis showed the heterogeneity of the shared variance between symptoms of these two clinical conditions. Childhood traumas, dissociative experiences, and both childhood and adulthood ADHD scores were significantly differed across three latent classes. We concluded that dissociation and attention deficit symptoms may have overlapping aspects phenomenologically. Our findings should be warranted in future functional brain imaging studies of functional connectivity patterns serving as an endophenotype of ADHD and/or dissociation.

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Declarations

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