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Age differences in DSM-IV borderline personality disorder symptom expression: Results from a national study using item response theory (IRT)

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ABSTRACT

Limited literature suggests that there may be age-related differences in borderline personality disorder (BPD) symptom expression. The present study used item response theory (IRT) methods to examine whether there are age differences in the likelihood of endorsing DSM-IV symptoms of BPD, when equating for levels of BPD symptom severity. Data were drawn from a nationally representative survey of adults in the US (n = 34,653), the second wave of the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC). We found that 7 out of the 9 DSM-IV symptoms of BPD were age invariant. However, there were statistically and clinically significant differences between the oldest and youngest age groups in two BPD symptoms: oldest adult women were less likely to report suicidal/self-harm behavior than the youngest adult women across levels of BPD severity and unstable/intense interpersonal relationships discriminated BPD severity better in the youngest age group compared to the oldest age group in both genders. Overall, our findings indicate substantial age-related differences in BPD symptom expression. Mental health care providers should be alert to these two age-related differences in BPD symptom expression when making assessment and treatment decisions across adult age groups.

1. Introduction

Borderline personality disorder (BPD) affects between 0.7% and 2.7% of the United States population (Lenzenweger et al., 2007; Torgersen et al., 2001; Trull et al., 2010) and is characterized by impulsivity, self-harm, suicidality, emotional and interpersonal instability (American Psychiatric Association, 2013). Prior research indicates that the prevalence of most psychiatric disorders is lower in older than younger adults (Hoertel et al., 2015b; Pascal de Raykeer et al., 2018). However, BPD in older adults has received relatively less attention than other psychiatric disorders (Tackett et al., 1999). Because BPD is associated with pervasive social and occupational dysfunction, substantial use of mental health services, and a high risk for suicide (McGlashan et al., 2000; Sansone, 2004; Skodol et al., 2002), more research is needed to understand possible changes in presentation of BPD symptoms by age.

Previous research has suggested age differences in overall BPD symptom severity and symptom expression. There is evidence that the prevalence of overall BPD symptomology decreases with age (Gunderson et al., 2011; Paris and Zweig-Frank, 2001; Sansone and Wiederman, 2014; Zanarini et al., 2006) and that older adults are less likely than younger adults to endorse specific BPD symptoms such as impulsivity (Morgan et al., 2013; Stevenson et al., 2003), self-harm/suicidality (Morgan et al., 2013; Sansone and Wiederman, 2014; Stepp and Pilkonis, 2008) and affective instability (Morgan et al., 2013). Findings from one longitudinal study also suggest that patterns of unstable and intense interpersonal relationships decrease over time (Paris and Zweig-Frank, 2001). However, those findings have been

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Table 1
Item response theory discrimination and severity parameter estimates of DSM-IV Borderline Personality Disorder (BPD) symptom by age group in the full NESARC sample.

Age minimum, maximum, mean age (SE)	Group A N = 7274		Group B N = 6612		Group C N = 7111		Group D N = 6743		Group E N = 6741	
	20, 33, 26.91 (0.10)		34, 42, 38.11 (0.06)		43, 52, 47.38 (0.04)		53, 65, 58.35 (0.04)		66, 90, 75.53 (0.06)	
DSM-IV symptoms	a (SE)/Rank a	b (SE)/Rank b	a (SE)/Rank a	b (SE)/Rank b	a (SE)/Rank a	b (SE)/Rank b	a (SE)/ank a	b (SE)/Rank b	a (SE)/ank a	b (SE)/Rank b
Frantic efforts to avoid real/imagined abandonment	1.45 (.09)/4	1.75 (.07)/4	1.31 (.09)/4	1.83 (.08)/5	1.26 (.09)/3	1.95 (.08)/8	1.42 (.09)/4	1.76 (.07)/4	1.30 (.13)/6	1.98 (.10)/5
Unstable/intense interpersonal relationships	1.51 (.09)/5	1.62 (.07)/3	1.40 (.09)/5	1.62 (.07)/2	1.33 (.09)/4	1.66 (.08)/3	1.45 (.09)/5	1.67 (.07)/3	1.15 (.10)/3	1.73 (.07)/3
Identity disturbance	1.31 (.08)/3	1.98 (.07)/7	1.28 (.09)/3	2.01 (.10)/7	1.50 (.10)/6	1.84 (.09)/5	1.33 (.10)/3	1.97 (.09)/6	1.29 (.15)/5	1.99 (.12)/6
Impulsivity	1.17 (.06)/2	1.56 (.06)/2	1.08 (.06)/1	1.65 (.06)/3	1.15 (.07)/1	1.55 (.06)/1	1.24 (.07)/2	1.51 (.06)/2	1.09 (.09)/2	1.63 (.06)/1
Suicidal/self-harm behavior	1.12 (.08)/1	2.44 (.10)/9	1.15 (.09)/2	2.37 (.11)/9	1.26 (.12)/2	2.39 (.14)/9	1.14 (.10)/1	2.50 (.12)/9	0.93 (.14)/1	3.21 (.20)/9
Affective instability	1.89 (.11)/8	1.79 (.08)/5	1.87 (.15)/8	1.87 (.12)/6	1.92 (.16)/8	1.88 (.13)/6	1.50 (.12)/7	2.04 (.12)/8	1.40 (.24)/7	2.17 (.24)/8
Chronic feelings of emptiness	1.96 (.14)/9	1.86 (.10)/6	2.26 (.19)/9	1.80 (.12)/4	2.10 (.18)/9	1.78 (.12)/4	2.13 (.18)/9	1.79 (.12)/5	1.59 (.20)/8	2.02 (.16)/7
Inappropriate/intense anger	1.56 (.08)/6	1.49 (.06)/1	1.64 (.09)/7	1.49 (.06)/1	1.48 (.09)/5	1.60 (.07)/2	1.58 (.11)/8	1.49 (.07)/1	1.26 (.12)/4	1.67 (.08)/2
Stress-related paranoid ideation	1.60 (.10)/7	1.99 (.09)/8	1.40 (.10)/6	2.04 (.10)/8	1.69 (.13)/7	1.89 (.11)/7	1.48 (.13)/6	2.02 (.11)/7	1.74 (.24)/9	1.91 (.18)/4
Cohen's d	Reference		−0.048		−0.101		−0.250		−0.661	

Note: a = discrimination parameter estimate, b = severity parameter estimate, SE = standard error.
Sampling weights and design effects of the NESARC were taken into account.
Age group cut-offs (i.e., A: 20–33, B: 34–42, C: 43–52, D: 53–65 and E: > 65 years) were determined a priori by dividing participants' age distribution into quintiles..

constrained by the need to rely on relatively small sample sizes or samples that excluded the elderly. Importantly, much of this research also did not clarify whether these differences in the expression of specific symptoms are indicative of true age differences, or only attributed to decreases in BPD severity in older age. To address this gap in the literature, more research in larger samples is needed to disentangle age-related differences in BPD symptom expression and severity.

Statistical approaches based on Item Response Theory (Lord, 2012) provide the ability to investigate the likelihood of endorsing a particular symptom given a specific level of BPD severity. These approaches allow to determine whether age differences in BPD symptom expression are due to true differences between older and younger adults, or only due to differences in age differences in overall BPD severity (Hoertel et al., 2014; Peyre et al., 2014). Furthermore, IRT methods are increasingly used in the evaluation of DSM diagnostic criteria, including alcohol dependence (Kahler et al., 2003), nicotine dependence (Saha et al., 2010), amphetamine, cocaine, and prescription drugs (Saha et al., 2012), unipolar and bipolar depression (Aggen et al., 2005; Hoertel et al., 2015a, 2016; Simon and Von Korff, 2006; Uebelacker et al., 2009; Weinstock et al., 2010, 2009), mania (Carragher et al., 2013), post-traumatic stress disorder (Rivollier et al., 2015), bulimia (Rowe et al., 2002), attention-deficit/hyperactivity disorder (Peyre et al., 2014), and personality disorders (Harford et al., 2013; Hoertel et al., 2018, 2014). To our knowledge, this approach has not been used to investigate differences in BPD symptom expression among adults of different age groups.

Therefore, the present study used IRT methods to examine whether there are age-related differences in the expression of DSM-IV-TR BPD symptoms, while adjusting for overall severity of BPD. We conducted these analyses with five age adult age groups, ranging from 20 years old to over 65 years old, using a large, nationally representative sample from the USA, the second wave of the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC).

2. Method

2.1. Sample

Data were drawn from the Wave 1 and Wave 2 of the NESARC, a nationally representative face-to-face survey of the U.S adult population, conducted in 2001–2002 (wave 1) and 2004–2005 (wave 2) by the by the U.S. Census Bureau under the supervision of the National Institute on Alcoholism and Alcohol Abuse (NIAAA) (Grant et al., 2004a,b; Grant et al., 2009b). The target population included the civilian noninstitutionalized population, aged 18 years and older, residing in the United States. The overall response rate at Wave 1 was 81%. Excluding participants ineligible for the Wave 2 interview because they were deceased, deported, on active military duty throughout the follow-up period, or mentally or physically impaired, the Wave 2 response rate was 86.7%, reflecting 34,653 completed Wave 2 interviews. The cumulative response rate at Wave 2 was the product of the Wave 2 and Wave 1 response rates, or 70.2%. The Wave 2 NESARC data were weighted to adjust for non-response, demographic factors and psychiatric diagnoses, to ensure that the Wave 2 sample approximated the target population, that is, the original sample minus attrition between the two waves. The research protocol, including written informed consent procedures, received full human subjects review and approval from the U.S. Census Bureau and the Office of Management and Budget (Grant et al., 2009a).

2.2. Assessment of DSM-IV-TR borderline personality disorder symptoms

Borderline personality disorder (BPD) symptoms were assessed using the *Alcohol Use Disorder and Associated Disabilities Interview Schedule-IV* (AUDADIS-IV), a fully structured diagnostic interview designed for experienced interviewers who are not clinicians (Grant et al.,

2009a, 2008). All NESARC participants were asked a series of BPD symptom questions about how they felt or acted most of the time throughout their lives, regardless of the situation or whom they were with (Grant et al., 2008; Harford et al., 2013). Participants were instructed not to include symptoms occurring only when they were depressed, manic, anxious, drinking heavily, using medicines or drugs, experiencing withdrawal symptoms or physically ill. For the purpose of this analysis, a BPD symptom had to cause social or occupational dysfunction to be considered met by participants (Hoertel et al., 2014; Trull et al., 2010). To receive a diagnosis of BPD, respondents had to endorse at least 5 DSM-IV-TR criteria, each of which must have caused social or occupational dysfunction. NESARC estimates of prevalence of BPD was 2.7% (Trull et al., 2010). Test-retest reliability of AUDADIS-IV BPD diagnosis was good ($\kappa = 0.71$, SE = 0.06) and intraclass test-retest reliability coefficient fell within the good range (95% ICC = [0.74–0.79], $\alpha = 0.83$) (Ruan et al., 2008).

Analyses for this study focused on the 9 DSM-IV-TR BPD criteria. These symptoms are presented in Table 1 and eTable 1. Since all individuals were asked about these symptoms at Wave 2, the present analysis includes the 34,653 participants who completed interviews at both waves.

3. Analyses

3.1. Age groups

Age-group cut-offs (i.e., 20–33, 34–42, 43–52, 53–65 and > 65 years) were determined a priori by dividing participants' age distribution into quintiles. Number of participants, age range and mean age of each age group are given in eTable 1.

3.2. Prevalence of BPD symptoms

Differences in prevalence of each BPD symptom across age groups were tested using chi-square tests.

3.3. Assessing unidimensionality

Prior to item response theory modeling, including testing for differential item functioning, it is imperative to confirm the unidimensionality of the set of symptoms. Eigenvalue analysis of the tetrachoric correlation matrices of the nine symptoms was performed separately in the 5 age groups. A scree plot with an elbow after one eigenvalue and a well-fitting one-factor model according to standard goodness of fit tests (RMSEA < 0.05, TLI > 0.95 and CFI > 0.95) were used to indicate unidimensionality.

3.4. Item response theory (IRT)

A series of two-parameter item response theory models were fit to the set of symptoms of BPD in the 5 age groups in order to examine whether the symptoms of BPD were endorsed similarly across the age groups after adjusting for differences in underlying BPD severity (Lord, 2012). A severity and a discrimination parameter are estimated for each symptom indicating where along the latent severity continuum a symptom has a probability of 50% of being endorsed (the severity parameter), and how rapidly the probability of observing the symptom changes across increasing levels of the latent severity continuum (the discrimination parameter). Age groups differences on the latent severity continuum were estimated using the Cohen's d, *i.e.* standardized mean difference. We performed statistical analyses using MPLUS 7.0 (Muthen and Muthen, 2010) to take into account NESARC's complex design.

3.5. Testing differential item functioning (DIF)

Multi-sample confirmatory factor analysis was used to test the DIF across the 5 age groups of (a) factor loadings (i.e., item discrimination parameters) and (b) thresholds (i.e., severity parameters). The different models varied in terms of the parameters constrained to be equal in the 5 age groups (Millsap and Yun-Tein, 2004). Initially, an unconstrained model was fit allowing all parameters to differ across the 5 age groups. Following a method previously described by McBride and colleagues (McBride et al., 2010), analyses were conducted iteratively to determine which IRT parameters differ across age groups. Nested models were compared using the chi-square difference test (implemented using the DIFFTEST option in Mplus). To explore for DIF in IRT parameters of one item between two age groups, the discrimination and severity parameters of the other items were constrained to be equal between these two age groups. For each item, a chi-square difference test DIF comparing models with and without the discrimination parameter of the item constrained to be equal between two age groups was used to identify DIF in the discrimination parameter (the severity parameter of the item was freely estimated between two age groups in both models). To identify DIF in the severity parameter, a chi-square difference test DIF was used to compare models with and without the severity parameter of the item constrained to be equal between the two age groups (the discrimination parameter constrained to be equal between the two age groups in both models).

Small differences in IRT parameters between groups could be statistically significant but may not be clinically meaningful (Strong et al., 2009). Thus, it was decided a priori that only differences greater than 0.25 in symptom discrimination and severity would be considered as clinically meaningful (Steinberg and Thissen, 2006). Such differences in symptom severity can be interpreted as one quarter of the "standard unit difference between the value of the (underlying) trait necessary to have a 50–50 chance of responding positively in one group compared to another" and can be considered as measures of effect size (Steinberg and Thissen, 2006). We successively examined DIF in IRT parameters between the youngest age group (i.e., group A) and the other age groups (i.e., groups B to E). Due to multiple comparisons implemented in this study, we set alpha at 0.05 and used the Benjamini–Hochberg procedure to adjust p-values for all 1 df tests (Benjamini and Hochberg, 1995). Due to sex differences in item response characteristics of BPD criteria (Hoertel et al., 2014), we conducted supplementary analyses and examined whether significant results hold when stratifying for gender.

3.6. Total test information (TIF)

The TIF was estimated in each age group. The TIF is a graphic representation of the total quantity of information yielded by a set of items at each latent trait level (i.e. BPD severity). The area under the TIF curve (AUC) corresponds to the total amount of information provided by the set of items (Weiss and Davison, 1981).

4. Results

4.1. Sample characteristics

Of the 34,653 participants, 172 (0.47%, SE = 0.02) did not answer for at least one BPD item question and were excluded from our analyses. In the remaining sample of 34,481 participants, we a priori defined 5 age groups (i.e., A: 20-33y, B: 34-42y, C: 43-52y, D: 53-65y and E: > 65 years) by dividing participants' age distribution into quintiles (eTable 1). In the full NESARC sample, 47.9% (SE = 0.16) were men and 52.1% (SE = 0.16) were women. The proportion of men by age groups A to E was as follows: 49.9%, 49.0%, 48.9%, 48.6%, and 42.5%.

4.2. BDP symptoms endorsement rates

The most frequently reported BPD DSM-IV symptoms in all age groups were impulsivity, inappropriate/intense anger and unstable/

intense interpersonal relationships, while the criterion suicidal/self-harm behavior was the least commonly endorsed (eTable 1). The prevalence rates of all BPD DSM-IV symptoms as well as of DSM-IV diagnosis of BPD and the mean number of BDP symptoms were significantly greater in the youngest age group than in the two oldest age groups. The prevalence of affective instability was significantly higher in the youngest age group than in the group of participants aged 34–42 years. The symptoms Frantic efforts to avoid real/imagined abandonment, Suicidal/self-harm behavior, Affective instability, Inappropriate/intense anger, as well DSM-IV diagnosis of BPD were significantly less frequently reported by participants aged 43–52 years compared with those of the youngest age group (i.e., aged 20–33 years).

4.3. Unidimensionality of BPD symptoms

In all age groups, fit indices indicated an adequate fit to the data (Group A: first factor eigenvalue = 6.35, second factor eigenvalue = 0.72, CFI = 0.99, TLI = 0.99, RMSEA = 0.03; Group B: first factor eigenvalue = 6.28, second factor eigenvalue = 0.66, CFI = 0.99, TLI = 0.99, RMSEA = 0.02; Group C: first factor eigenvalue = 6.41, second factor eigenvalue = 0.58, CFI = 0.99, TLI = 0.99, RMSEA = 0.01; Group D: first factor eigenvalue = 6.32, second factor eigenvalue = 0.59, CFI = 0.99, TLI = 0.99, RMSEA = 0.02; Group E: first factor eigenvalue = 5.88, second factor eigenvalue = 0.74, CFI = 0.99, TLI = 0.99, RMSEA = 0.01). Based on a good fit of the unidimensional model to the data, analyses proceeded to testing model parameters for invariance.

4.4. IRT item parameters

Mean BPD severity gradually and substantially decreased after age 53 (groups D and E) (Table 1). The ranking of IRT parameters was similar across age groups. Spearman's correlation coefficients of Group A vs the other groups ranged from 0.76 [Group A vs Group E] to 0.94 [Group A vs Group B] for severity parameters and from 0.85 [Group A vs Group E] to 0.97 [Group A vs Group B] for discrimination parameters.

4.5. Differential item functioning (DIF)

Two BPD symptoms exceeded our criteria for both statistical (i.e., $p < 0.05$ following adjustment for multiple testing using the Benjamini-Hochberg procedure) and clinical (i.e., DIF > 0.25) significance in DIF: the symptoms “unstable/intense interpersonal relationships” for the discrimination parameter between the oldest and the youngest age groups and “suicidal/self-harm behavior” for the severity parameter between the oldest and the youngest age groups (Tables 1 and 2).

Inspection of the item response curves (IRC) for these 2 symptoms (Figs. 1 and 2) revealed that: (i) given equivalent levels of BPD severity, older participants were consistently less likely to report suicidal/self-harm behavior than younger respondents and (ii) unstable/intense interpersonal relationships appeared to discriminate BPD severity better in the youngest age group compared to the oldest age group.

Stratifying by gender, DIF of the discrimination parameter of the item “unstable/intense interpersonal relationships” were 0.43 (SE = 0.16, $p < 0.05$) between the oldest (N = 2578) and the youngest age group (N = 3050) in men, and 0.29 (SE = 0.14, $p < 0.05$) between the oldest (N = 4163) and the youngest age group (N = 4224) in women. These results indicate that age differences in “unstable/intense interpersonal relationships” remain significant across both men and women. DIF of the severity parameter of the item “suicidal/self-harm behavior” were 0.11 (SE = 0.25, $p > 0.05$) between the oldest and the youngest age group in men and −1.00 (SE = 0.16, $p < 0.05$) between the oldest and the youngest age group in women, indicating that DIF of this item only reached statistical and clinical significance in women.

4.6. Test information function (TIF)

The TIF curve for the oldest age group was lower at its peak than the TIF curve of other age groups and the area under the TIF curve (AUC), corresponding to the total amount of information provided by the set of BPD symptoms (Weiss and Davison, 1981) was also 12.0%–14.7% lower in the oldest age group than in other age groups. This result indicates that DSM-IV symptoms for BPD provide substantially less information in older than in younger adults (Fig. 3).

5. Discussion

We examined whether there are age differences in the expression of borderline personality disorder (BPD) symptoms using methods based on Item Response Theory. The IRT-based methodology allowed us to identify differences in specific BPD symptoms among five different adult age groups (ranging from 20 to 90 years old), while adjusting for BPD severity. We found a significant decrease in the prevalence rates for BPD symptoms and diagnosis across age groups. There were no significant differences in the expression of seven out of the nine DSM criteria for BPD across all age groups. However, after adjusting for BPD severity, we found statistically and clinically significant differences between the oldest (> 65 years) and youngest age groups (20–33 years) in two out of the nine DSM-IV BPD symptoms: 1) instability of interpersonal relationships and 2) suicidal or self-harm behaviors. Oldest adult women were less likely to report suicidal/self-harm behavior than the youngest women at similar levels of BPD severity. Unstable/intense interpersonal relationships discriminated BPD severity better in the youngest age group compared to the oldest age group across both men and women. Therefore, our findings suggest substantial age-related differences in the expression of two out of the nine DSM diagnostic criteria for BPD.

First, we found that most (7 out of 9) of the DSM diagnostic criteria for BPD function similarly across the different adult age groups. Specifically, we found that the symptoms 1) frantic efforts to avoid abandonment, 2) identity disturbance, 3) impulsivity, 4) affect instability, 5) chronic feelings of emptiness, 6) inappropriate or intense anger, and 7) stress-related paranoid ideation were age invariant. These findings suggest that there may not be significant age differences in the endorsement of these symptoms beyond these general decreases in BPD in older age and can be used when making diagnostic assessment of BPD at all ages.

We found that the prevalence rates for BPD symptoms and diagnosis was significantly higher in younger adults compared to older adults, in line with previous evidence of overall decreases in BPD severity and symptoms across the lifespan (Paris and Zweig-Frank, 2001; Sansone and Wiederman, 2014; Zanarini et al., 2006). Furthermore, we found that adult women in the oldest age group (i.e. 66–90 years old) were less likely to endorse self-harm and suicidality than adult women in the youngest age group (i.e. 20–33 years old) across levels of BPD severity, consistent with previous research demonstrating age differences in self-harm/suicidality among individuals with BPD (Morgan et al., 2013; Sansone and Wiederman, 2014; Stepp and Pilkonis, 2008).

These age-related differences may be due to changes in mechanisms underlying BPD across the lifespan, especially in women. Because emotion dysregulation is a core mechanism underlying BPD (Gratz et al., 2006; Linehan, 1993) and self-harm behavior (Chapman et al., 2006), one potential explanation for these differences is that emotion regulation processes tend to improve in older adulthood (Carstensen et al., 2000; Urry and Gross, 2010). There is enhanced differentiation of negative emotions (Carstensen et al., 2000), decreased memory of negative images (Charles et al., 2003), and decreased amygdala responsiveness for negative emotions (Mather, 2012; Mather et al., 2004; Williams et al., 2006) in older adulthood. Improved emotion regulation

Table 2
Differential item functioning (DIF) of DSM-IV Borderline Personality Disorder (BPD) symptoms by age group in the full NESARC sample.

	DIFTESTa (SE) A vs. B	DIFTESTa (SE) A vs. C	DIFTESTa (SE) A vs. D	DIFTESTa (SE) A vs. E	DIFTESTb (SE) A vs. B	DIFTESTb (SE) A vs. C	DIFTESTb (SE) A vs. D	DIFTESTb (SE) A vs. E
DSM-IV symptoms								
Frantic efforts to avoid real/imagined abandonment	0.14 (0.09)	0.19 (0.09)	0.03 (0.09)	0.15 (0.11)	−0.08 (0.08)	−0.20 (0.07)	−0.01 (0.07)	−0.24 (0.09)
Unstable/intense interpersonal relationships	0.11 (0.09)	0.19 (0.09)	0.07 (0.09)	**0.37 (0.09)**	0.00 (0.07)	−0.05 (0.07)	−0.05 (0.07)	−0.11 (0.07)
Identity disturbance	0.04 (0.08)	−0.18 (0.09)	−0.01 (0.09)	0.03 (0.11)	−0.03 (0.09)	0.14 (0.08)	0.01 (0.08)	−0.01 (0.10)
Impulsivity	0.08 (0.06)	0.02 (0.07)	−0.07 (0.07)	0.08 (0.08)	−0.10 (0.06)	0.00 (0.06)	0.04 (0.06)	−0.07 (0.06)
Suicidal/self-harm behavior	−0.03 (0.08)	−0.14 (0.10)	−0.02 (0.09)	0.19 (0.11)	0.07 (0.10)	0.05 (0.12)	−0.07 (0.11)	**−0.78 (0.15)**
Affective instability	0.02 (0.13)	−0.03 (0.14)	0.38 (0.12)	0.48 (0.18)	−0.08 (0.10)	−0.09 (0.10)	−0.25 (0.10)	−0.38 (0.16)
Chronic feelings of emptiness	−0.29 (0.16)	−0.14 (0.16)	−0.17 (0.16)	0.37 (0.17)	0.06 (0.11)	0.08 (0.11)	0.06 (0.11)	−0.16 (0.13)
Inappropriate/intense anger	−0.07 (0.09)	0.09 (0.09)	−0.01 (0.09)	0.30 (0.10)	0.01 (0.06)	−0.11 (0.07)	0.00 (0.07)	−0.18 (0.07)
Stress-related paranoid ideation	0.21 (0.10)	−0.08 (0.12)	0.13 (0.11)	−0.14 (0.17)	−0.06 (0.10)	0.10 (0.10)	−0.03 (0.10)	0.08 (0.13)

Note: a = discrimination parameter estimate, b = severity parameter estimate, SE = standard error.
In bold: values for DIF are clinically significant (DIF > 0.25) and chi square tests are statistically significant ($p < 0.05$ after Benjamini correction).
Sampling weights and design effects of the NESARC were taken into account.
DIFFTEST a = comparing both models with the factor loading respectively free and fixed for the corresponding item.
DIFFTEST b = comparing both models with the threshold respectively free and fixed for the corresponding item.
Age group cut-offs (i.e., A: 20–33, B: 34–42, C: 43–52, D: 53–65 and E: > 65 years) were determined a priori by dividing participants' age distribution into quintiles.

in older adults may be driven by older adults' tendency to prioritize emotional wellbeing when time is viewed as limited (Carstensen et al., 1999) and to optimize and select emotion regulation strategies given their resources (Urry and Gross, 2010). These improvements in emotion regulation may be more pronounced in women, as women increase their use of adaptive emotion regulation strategies, such as reappraisal, across the lifespan (John and Gross, 2004) and are more likely than men to use adaptive strategies in older age groups (Nolen-Hoeksema and Aldao, 2011). Alternatively, other lifestyle changes across the lifespan could account for age differences in BPD, such as lower drug use and alcohol consumption (Blazer and Hybels, 2005), that decrease with age, particularly among women (Compton et al., 2007; Grant et al., 2001). Therefore, changes in psychological and behavioral processes from younger to older adulthood may drive age-related differences in BPD severity and suicidality/self-harm.

These age-related differences may also be partially due to cohort effects. Self-harm behavior is more prevalent among younger people than older people in general (Krug et al., 2002) and older adults may be less likely to report suicidal ideation and self-harm than younger adults (Chan et al., 2007). In addition, premature mortality among individuals with psychopathology (Bruce and Leaf, 1989) and increasing rates of completed suicide in older age (Chan et al., 2007; Conwell et al., 2011) may account for the lower prevalence of individuals with BPD or suicidality in older adults.

Furthermore, we found that patterns of unstable and intense interpersonal relationships were significantly more discriminant for severity in the youngest age group compared to the oldest age group, in line with previous research demonstrating age differences in this symptom (Paris and Zweig-Frank, 2001). In other words, endorsement of unstable and intense relationships discriminates the youngest adults of different levels of BPD severity better than the oldest adults. Results from the supplementary analyses stratifying for gender differences suggest the robustness of these findings. As emotion dysregulation is associated with interpersonal dysfunction in BPD (Herr et al., 2013), improvements in emotion regulation across the lifespan may partially account for these findings. These age differences may also be explained

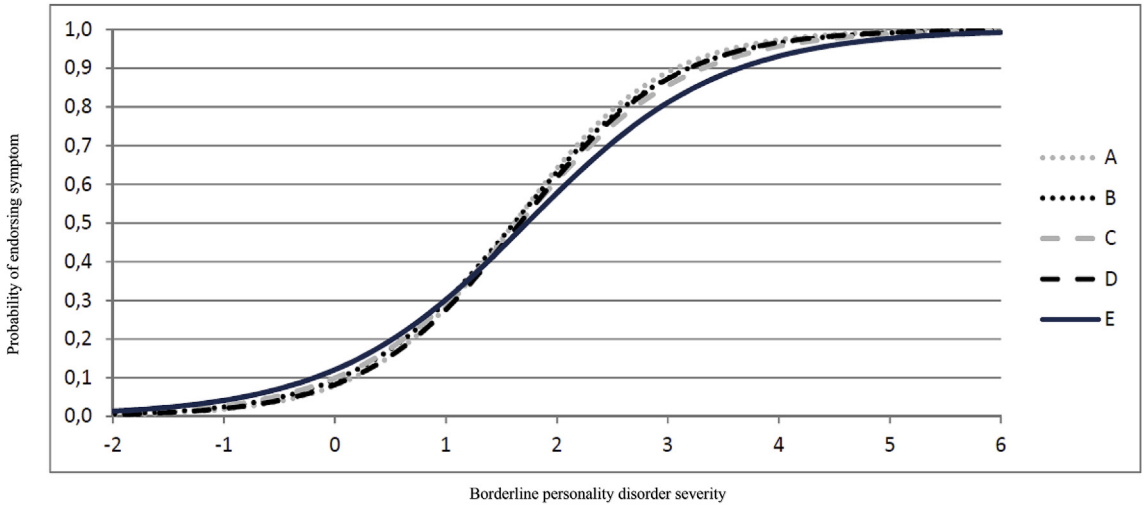

Fig. 1. Differences across age groups in the probability of endorsing unstable/intense interpersonal relationships across levels of borderline personality disorder severity.
Note: Item response curves for the DSM-IV borderline personality disorder symptom of patterns of "unstable/intense interpersonal relationships" by age group. Age group cut-offs (i.e., A: 20–33, B: 34–42, C: 43–52, D: 53–65 and E: > 65 years) were determined a priori by dividing participants' age distribution into quintiles. Steeper curves indicate stronger relations to increasing levels of BPD severity, or better ability to discriminate BPD severity. These curves suggest that this symptom discriminated BPD severity better in the youngest age group compared to the oldest age group.

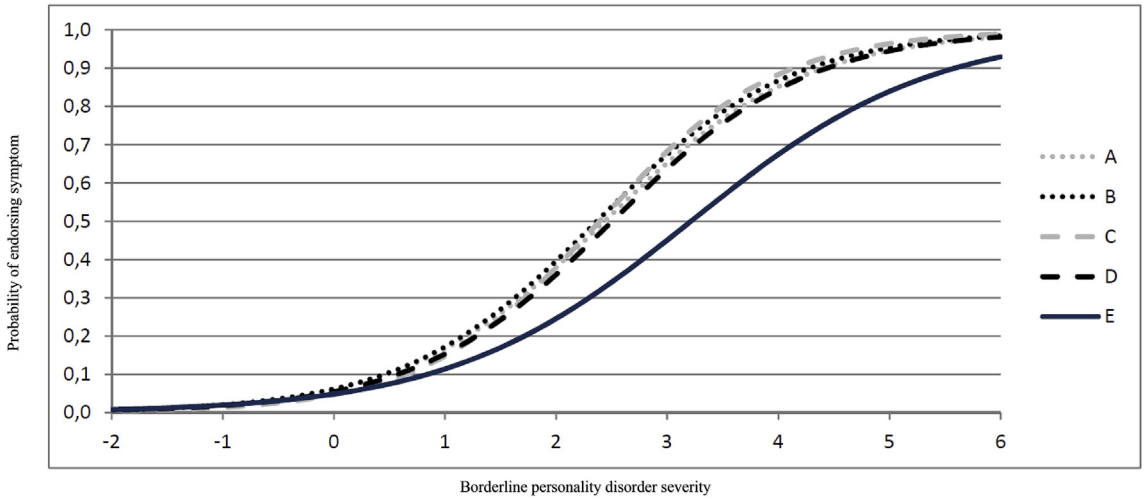

Fig. 2. Differences across age groups in the probability of endorsing suicidal/self-harm behavior across levels of borderline personality disorder severity.
Note: Item response curves for the DSM-IV borderline personality disorder symptom of patterns of "suicidal/self-harm behavior" by age group. Age group cut-offs (i.e., A: 20–33, B: 34–42, C: 43–52, D: 53–65 and E: > 65 years) were determined a priori by dividing participants' age distribution into quintiles. Higher curves indicate greater probability of endorsing this symptom at similar levels of BPD severity. These curves suggest that, at similar levels of BPD severity, older participants were less likely to report suicidal/self-harm behavior than younger respondents.

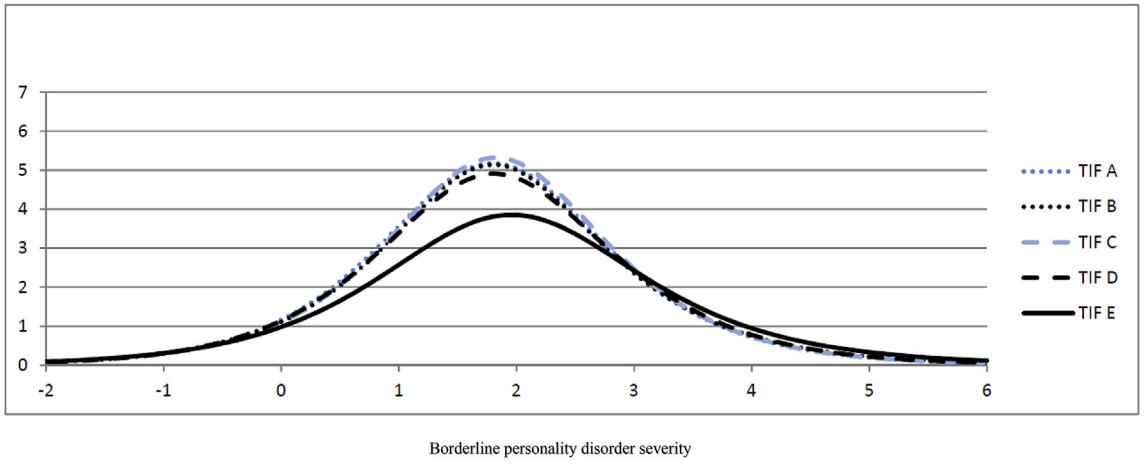

Fig. 3. Test information function (TIF) curves of DSM-IV symptoms for BPD by age group.
Note: Test information curves for DSM-IV symptom criteria by age group. Age group cut-offs (i.e., A: 20–33, B: 34–42, C: 43–52, D: 53–65 and E: > 65 years) were determined a priori by dividing participants' age distribution into quintiles. Larger areas under the TIF curve indicate greater amounts of information provided by BPD criteria. These curves suggest that BPD criteria provide less information in older than in younger adults.

by changes in quality and quantity of social interactions in older age. There is evidence that older adults are at greater risk of social isolation (Iliffe et al., 2007). In addition, the frequency of social interactions decreases with age (Carstensen, 1992) and older adults tend to maintain smaller but closer social networks (Carstensen et al., 2003). Therefore, this criterion may have limited diagnostic usefulness in assessing BPD severity in the elderly, who have lower frequency and variability of social interactions than younger adults. As such, clinicians assessing for BPD in patients may consider these age-related differences in expression of suicidality/self-harm and unstable relationship symptoms and take into account their limitations in indicating BPD severity in adults over the age of 65.

Although it is important to note that there may be other clinical features that differentiate BPD across the lifespan, our results contribute to our understanding of BPD symptom expression in older adulthood. First, although the age-related differences found in this study can reflect true group differences, it is important to keep in mind that DIF may also reflect some form of age-related bias in diagnostic criteria. Therefore, further research is needed before determining whether the BPD criteria for instability of interpersonal relationships and suicidality or self-harm should be reformulated. Second, we found that 7 out 9 criteria for BPD were age invariant, including some symptoms whose prevalence may be lower in older age groups, such as impulsivity and affect instability (Morgan et al., 2013; Stevenson et al., 2003). This finding suggests that most criteria for BPD are appropriate indicators of BPD pathology within a wide range of adult ages, despite changes in behavioral patterns across the lifespan. Third, our results may also generate hypotheses for age-related specific mechanisms underlying BPD. Determining these shared and specific mechanisms underlying BPD across the lifespan may help inform efforts to refine both biological and psychosocial approaches to treatment and prevention. Finally, because two symptoms (i.e. patterns of unstable interpersonal relationships, and suicidality/self-harm) function differently across age groups, clinicians should take these age-related differences into account when making assessment and treatment decisions. Particularly, mental health providers should be careful not to underdiagnose BPD or underestimate BPD severity in older adults who do not endorse self-harm, suicidality or unstable relationships.

This study had several notable strengths, including using a large, nationally-representative sample of adult participants who were asked about all 9 DSM-IV BPD symptoms and using a priori thresholds of both statistical and clinical significance to identify differences that were substantively meaningful. However, this study also had several limitations to consider. First, the data in the NESARC are cross-sectional and do not provide information on the longitudinal course of BPD (Hoertel et al., 2014). Second, the NESARC only assessed for BPD symptom criteria through self-report so the data may be subject to recall bias, especially in older adults (Robins et al., 1984). Third, NESARC sample does not include institutionalized individuals, e.g., incarcerated or hospitalized, for whom BPD symptom expression might be different than in the general population. Fourth, the age difference within the suicidality/self-harm criterion was not significant for men. This finding may be due to true gender differences in changes in BPD across the lifespan. Alternatively, it may also be attributed to relative lack of power, as we had fewer men in our sample and self-harm/suicidality is almost twice as prevalent in women compared to men (Hoertel et al., 2014). Future longitudinal studies that examine the interaction between gender and age on BPD criteria across the lifespan would be important to confirm our results.

Despite these limitations, this study is the first to examine age-related differences in BPD symptom expression using Item Response Theory in a large nationally representative sample. The findings from this study revealed that there are no significant age differences in the endorsement of seven out of the nine diagnostic criteria for BPD at same levels of overall BPD severity. However, older adults (66–90 years old) were less likely to endorse self-harm or suicidality than younger adults (23–33 years old) following adjustment for overall BPD severity. Additionally, patterns of unstable and intense interpersonal relationships were more discriminant of overall BPD severity in youngest adults compared to oldest adults. These findings highlight substantial age-related differences in BPD presentation, as our results suggest that these two symptoms (i.e. patterns of unstable interpersonal relationships, and suicidality/self-harm) function differently across age groups. Our findings should alert clinicians to these age-related differences in these two symptoms when making assessment and treatment decisions.

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Conflicts of interest

None.

Ethical standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1964 and its later amendments.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2018.12.019.

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