Psychological Trauma:
Theory, Research, Practice, and Policy

ISSN: 1942-9681
2020, Vol. 12, No. 7, 799–806
http://dx.doi.org/10.1037/tra0000596

Posttraumatic Stress Disorder Among Older Adults: A Differential Item Functioning Analysis of PTSD in *ICD-11* and *DSM–5*

Robert Fox and Philip Hyland
Maynooth University

Joanna McHugh Power
Maynooth University and Queen's University Belfast

Andrew N. Coogan
Maynooth University

Objective: Distinct models of posttraumatic stress disorder (PTSD) are outlined in the 5th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM–5*) and the 11th version of the *International Classification of Diseases* (*ICD-11*). Limited data exists about the validity of these models among older adults. This study examines the probable prevalence rates of PTSD in older adults; the factorial validity of both models; and symptom-endorsement bias across sex. ***Method:*** Using a nationally representative (United States) sample (n = 5,366) of older adults aged 60 years and older, alternative PTSD factor models were tested using confirmatory factor analysis (CFA), and item bias was assessed using differential item functioning (DIF) analysis. PTSD was measured without the functional impairment criterion, likely resulting in inflated prevalence rates. ***Results:*** *DSM–5* (9.5%) PTSD prevalence was significantly higher than *ICD-11* (8.7%). Women were more likely to meet criteria for *DSM–5* (OR = 1.79) and *ICD-11* (OR = 1.38) PTSD. CFA results showed that both models of PTSD had excellent fit. Four *DSM–5* symptoms demonstrated DIF, with females more likely to endorse three symptoms (B1: "unwanted memories"; B4: "feeling upset"; and E6: "sleep problems") and males more likely to endorse one symptom (E2: "reckless or self-destructive behavior"). No DIF was present for the 6 *ICD-11* symptoms. ***Conclusion:*** Both PTSD models perform well among older adults, although there is evidence of DIF in the *DSM–5* model. A considerable proportion of older adults met diagnostic requirements for PTSD, thus highlighting the importance of trauma-related research among older adult populations.

Clinical Impact Statement

This study found that the 5th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM–5*) and the 11th version of the *International Classification of Diseases* (*ICD-11*) models of posttraumatic stress disorder (PTSD) performed well among older adults. Approximately 9% of older adults met requirements for a PTSD diagnosis suggesting that PTSD is also a concern among this cohort. As with younger populations, older women are more likely than older men to meet criteria for PTSD. Some of the observed sex difference in risk for *DSM–5* PTSD, specifically, may be due to item bias.

Keywords: posttraumatic stress disorder (PTSD), *DSM–5*, *ICD-11*, older adults, differential item functioning (DIF)

Supplemental materials: http://dx.doi.org/10.1037/tra0000596.supp

The global population is rapidly aging, with the number of older adults (defined as those aged 60 years and older) expected to increase from 12% in 2015 to 22% in 2050. The World Health Organization (WHO) reports that 15% of older adults currently

This article was published Online First May 28, 2020.
Robert Fox and Philip Hyland, Department of Psychology, Maynooth University; Joanna McHugh Power, Department of Psychology, Maynooth University, and UKCRC Centre of Excellence for Public Health, Queen's University Belfast; Andrew N. Coogan, Department of Psychology, Maynooth University.
The NESARC-III was sponsored by the National Institute on Alcohol Abuse and Alcoholism (NIAAA), with supplemental support from the National Institute on Drug Abuse. This article was prepared using a limited access dataset obtained from the NIAAA and does not necessarily represent the opinions or views of NIAAA or the U.S. Government. On behalf of all authors, the corresponding author states that there is no conflict of interest.
Correspondence concerning this article should be addressed to Robert Fox, Department of Psychology, Maynooth University, Kildare, Ireland. E-mail: robert.fox@mu.ie

suffer from a mental disorder (WHO, 2017), however, epidemiological surveys find that while cognitive and physical illnesses increase with age, mental illnesses decrease with age (Thomas et al., 2016). This effect has also been observed specifically in relation to posttraumatic stress disorder (PTSD; Gum, King-Kallimanis, & Kohn, 2009; Reynolds, Pietrzak, Mackenzie, Chou, & Sareen, 2016). For example, in the National Comorbidity Survey Replication (NCS-R; Gum et al., 2009) study, in the United States (U.S.), adults aged 65 years and older had a past-year PTSD prevalence rate of 0.4%, substantially lower than those aged 18–44 (3.7%) and 45–64 (5.1%).

There is no agreement about why older adults report lower rates of mental illness. Various explanations have been offered including a tendency for older adults to mis-attribute psychological symptoms to physical illness; a reluctance to report psychological symptoms due to fears of stigma; an inability to accurately report psychological symptoms due to cognitive impairments; survival effects whereby older adults who survive into older adulthood have better mental health; and, of most interest to this study, that diagnostic criteria may be inappropriate for older adults (see Palmer, Jeste, & Sheikh, 1997; Thomas et al., 2016). It is possible that posttraumatic symptomatology manifests differently among older adults because of the effects of the normal aging process. For example, physical impairments might reduce the frequency of individuals coming in contact with external cues that symbolize the traumatic event, or hearing loss may negate a hypervigilant or exaggerated startle response to sounds (Cook & Simiola, 2018).

In psychiatry, there are two distinct diagnostic models of PTSD. One is outlined in the 5th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM–5*; American Psychiatric Association, 2013), and the other is outlined in the 11th version of the *International Classification of Diseases* (*ICD-11*; WHO, 2018). *DSM–5* describes PTSD by 20 symptoms that are distributed across four symptom clusters (Intrusions, Avoidance, Negative Alterations in Cognitions and Mood [NACM], and Hyperarousal), and *ICD-11* describes PTSD by 6 symptoms distributed across three symptom clusters (Reexperiencing in the Here and Now, Avoidance, and a Sense of Current Threat). A crucial element in establishing the validity of these diagnostic criteria is to determine if the latent structures of these symptoms match the proposed diagnostic requirements (Elhai & Palmieri, 2011; Elklit & Shevlin, 2007). If the latent structure of PTSD symptoms is distinct from diagnostic requirements, this will result in inaccurate diagnostic estimates (Shevlin, Hyland, Karatzias, Bisson, & Roberts, 2017).

Factor-analytic studies of *DSM–5* PTSD symptoms provide tentative support for the *DSM–5*'s four-factor model. This model has been shown to reasonably approximate observed sample data, however, alternative models have been shown to provide superior model fit including a four-factor "Dysphoria" model (Miller et al., 2013); a five-factor "Dysphoric Arousal" model (Elhai et al., 2011); distinct six-factor "Anhedonia" (Liu et al., 2014), "External Behaviors" (Tsai et al., 2015), and "Alternative Dysphoria" (Zelazny & Simms, 2015) models; and a seven-factor "Hybrid" model (Armour et al., 2015; see Table 1). While typically providing superior fit than the *DSM–5*'s four-factor model, the clinical utility of these alternative models has been challenged because none have been aligned to a workable diagnostic algorithm (Shevlin et al., 2017). Regarding *ICD-11* PTSD, the vast majority of factor analytic studies have supported the *ICD-11*'s three-factor model and have found it to be superior to alternative one- and two-factor models (see Brewin et al., 2017; Glück, Knefel, Tran, & Lueger-Schuster, 2016; Hansen et al., 2017; Hyland, Brewin, & Maercker, 2017; see Table 2).

Table 1
Items and Factor Structure of Alternative Models Using the 20 Symptoms Outlined in the DSM–5

Symptoms	*DSM–5* 4 factors	Dysphoria 4 factors	Dysphoric Arousal 5 factors	Anhedonia 6 factors	External Behaviors 6 factors	Alternative Dysphoria 6 factors	Hybrid 7 factors
Unwanted memories	Int	Int	Int	Int	Int	Int	Int
Distressing dreams	Int	Int	Int	Int	Int	Int	Int
Feelings of recurrence	Int	Int	Int	Int	Int	Int	Int
Feeling upset	Int	Int	Int	Int	Int	Int	Int
Physical reactions	Int	Int	Int	Int	Int	Int	Int
Internal avoidance	Av	Av	Av	Av	Av	Av	Av
External avoidance	Av	Av	Av	Av	Av	Av	Av
Amnesia	NACM	Dys	NACM	NACM	NACM	Dys	NACM
Negative self-beliefs	NACM	Dys	NACM	NACM	NACM	Dys	NACM
Self-blame	NACM	Dys	NACM	NACM	NACM	Dys	NACM
Negative feelings	NACM	Dys	NACM	NACM	NACM	Dys	NACM
Loss of interest	NACM	Dys	NACM	Anh	NACM	Anh	Anh
Distant	NACM	Dys	NACM	Anh	NACM	Anh	Anh
No positive feelings	NACM	Dys	NACM	Anh	NACM	Anh	Anh
Aggression	Hyp	Dys	Dys-Ar	Dys-Ar	EB	EB	EB
Risky behavior	Hyp	Dys	Dys-Ar	Dys-Ar	EB	EB	EB
On guard	Hyp	Hyp	Anx-Ar	Anx-Ar	Anx-Ar	Anx-Ar	Anx-Ar
Easily startled	Hyp	Hyp	Anx-Ar	Anx-Ar	Anx-Ar	Anx-Ar	Anx-Ar
Concentration	Hyp	Dys	Dys-Ar	Dys-Ar	Dys-Ar	Dys	Dys-Ar
Sleep problems	Hyp	Dys	Dys-Ar	Dys-Ar	Dys-Ar	Dys	Dys-Ar

Note. Int = intrusions; Av = avoidance; NACM = negative alterations in cognitions and mood; Hyp = hyperarousal; Dys = dysphoria; Dys-Ar = dysphoric arousal; Anx-Ar = anxious arousal; Anh = anhedonia; EB = externalized behavior; *DSM–5* = Diagnostic and Statistical Manual of Mental Disorders.

Table 2
Items and Factor Structure of Alternative Models Using the Symptoms Outlined in the ICD-11

Symptoms	*ICD-11* model	2-factor model	1-factor model
Distressing dreams	Re	Re-Av	PTSD
Reliving the event	Re	Re-Av	PTSD
Internal avoidance	Av	Re-Av	PTSD
External avoidance	Av	Re-Av	PTSD
On guard	Th	Th	PTSD
Easily startled	Th	Th	PTSD

Note. Re = re-experiencing in the present; Av = avoidance; Th = sense of threat; PTSD = posttraumatic stress disorder; *ICD-11* = International Classification of Diseases

The majority of the *DSM–5* and *ICD-11* PTSD factor-analytic studies are based on samples of young and middle-aged adults. We are aware of only one study that has evaluated the factorial validity of *ICD-11* PTSD on an exclusively older adult sample (Glück et al., 2016), and are aware of no studies evaluating the *DSM–5* model of PTSD exclusively among older adults. Consequently, it is currently not established if the *ICD-11* and *DSM–5* models of PTSD are valid representations of the latent structure of PTSD symptoms among older adults.

The current study used a nationally representative sample of older adults (60 years and older) from the U.S. to address three objectives. First, we wished to estimate the probable prevalence rates, and sex differences, of *DSM–5* and *ICD-11* PTSD among older adults. Second, we employed confirmatory factor analysis (CFA) to test the factorial validity of the *DSM–5* and *ICD-11* models of PTSD. Finally, based on evidence from nonolder adult samples that males and females systematically differ in their responses to several *DSM–5* PTSD symptoms (e.g., Murphy, Elklit, Chen, Ghazali, & Shevlin, 2019), we performed a differential item functioning (DIF) analysis on the *DSM–5* and *ICD-11* PTSD symptoms to determine if there are sex differences in symptom endorsements among older adults.

Method

Participants and Recruitment Strategy

Participants in this study were drawn from the National Epidemiologic Survey on Alcohol and Related Conditions-III (NESARC-III) study, which is a nationally representative sample of noninstitutionalized adults from the U.S. aged 18 years and older (N = 36,309). Information on the NESARC-III data are available elsewhere (Grant et al., 2014). Protocols of the NESARC-III project received ethical approval from the institutional review boards of the National Institutes of Health and Westat, and all participants provided their informed consent. Approval for secondary analysis was granted by the ethical review board of the first author's affiliated institution.

Participants in this study (n = 5,366) were selected from the full NESARC-III dataset if they (a) were aged 60 years or older, (b) reported experiencing or witnessing at least one traumatic event in their lifetime, and (c) responded to all PTSD symptom questions corresponding to the *DSM–5* and *ICD-11* descriptions. Data were adjusted for oversampling (of ethnic/racial minorities) and nonresponses and were weighted to reflect the U.S. civilian population as per the 2012 American Community Survey (Bureau of the Census, 2013). All parameter estimates were adjusted for the complex survey design of the NESARC-III based on the stratification, clustering, and weighting of the study population, whereas sample size was based on the unweighted data. Consequently, reported proportions may not correspond to the reported sample/subsample sizes. The sample included a similar proportion of females (52.5%, n = 3,026) and males (47.5%, n = 2,340), and the average age was 62.92 years (SD = 9.73; see supplemental Table 1 for other sample characteristics).

Measures

All data were gathered using the Alcohol Use Disorder and Associated Disabilities Interview Schedule–5 (AUDADIS-5; Grant et al., 2011). The AUDADIS-5 is a structured, diagnostic interview that assesses participants for symptoms associated with an array of psychiatric disorders including PTSD. Previous research has examined the procedural validity of the AUDADIS-5 (compared to the semistructured, clinician-administered PRISM-5 [Psychiatric Research Interview for Substance and Mental Disorders, *DSM–5* version]), and indicated that the concordance of *DSM–5* PTSD diagnosis between the AUDADIS-5 and PRISM-5 was fair to moderate, whereas the concordance between dimensional measures was good (Hasin et al., 2015). Furthermore, test–retest reliability of past-year, prior-to-past-year, and lifetime PTSD diagnosis was fair to moderate, and the test–retest reliability of the dimensional measure was good (Grant et al., 2015).

Traumatic exposure. Participants were first asked if they had personally experienced any of 19 traumatic events or witnessed/learned about any of 13 traumatic events (event types are listed in supplemental Table 2). Respondents could report experiencing a maximum of four different types of traumatic events, and were instructed to specify their most stressful traumatic event. All PTSD items were responded to in relation to this most distressing event. Witnessing/learning about someone with a serious or life-threatening illness was the most commonly reported traumatic experience (30.2%, n = 1,548) and the event most frequently endorsed as being "most stressful" (17.7%, n = 909).

PTSD symptoms. Items were extracted from the AUDADIS-5 that corresponded to the 20 *DSM–5* symptoms (Cronbach's alpha = .90; see Table 1) and the 6 *ICD-11* symptoms (Cronbach's alpha = .77; see Table 2). Symptoms were answered using a dichotomous response format ("yes" = 1, "no" = 0). A *DSM–5* PTSD diagnosis requires the presence of at least one of five "Intrusion" symptoms, one of two "Avoidance" symptoms, two of seven NACM symptoms, and two of six "Hyperarousal" symptoms. An *ICD-11* PTSD diagnosis requires the presence of at least one of two "Reexperiencing" symptoms, one of two "Avoidance" symptoms, and one of two "Sense of Threat" symptoms. The *DSM–5* and *ICD-11* also require that these symptoms cause functional impairment, however, the AUDADIS-5 does not screen for this criterion with all participants. As such, diagnostic rates are calculated based on the traumatic exposure and symptom requirements only. As a result, PTSD prevalence rates are likely to be inflated.

Analytical Plan

First, probable PTSD rates were computed based on the diagnostic requirements of the *DSM–5* and *ICD-11*, and these were compared using the exact McNemar binomial test. Diagnostic agreement between these algorithms was examined using Cohen's Kappa, where values from .61–.80 indicate substantial agreement and values $>$ .80 indicate almost perfect agreement (Landis & Koch, 1977). Sex differences in diagnostic rates (and symptom endorsement) were compared using the design-adjusted, second-order Rao-Scott chi-square (χ^2) test of independence (reported as an F statistic). This version of the χ^2 test accounts for the complex survey design used in the NESARC-III (i.e., weighting, stratification, and clustering) and involves a correction to the conventional Pearson χ^2 statistic, thereby providing better control of Type-I errors (Rao & Scott, 1984; Thomas & Decady, 2004). Odds ratios (OR) with 95% confidence intervals were used to determine the magnitude of difference between sexes.

Second, seven alternative *DSM–5* PTSD models (see Table 1) and three alternative *ICD-11* PTSD models (see Table 2) were tested using CFA. All models were estimated using the robust weighted least squares estimator as this estimator performs best with categorical data (Brown, 2006). Model adequacy was assessed in relation to a number of goodness-of-fit indices for dichotomous data (Hu & Bentler, 1999; Yu, 2002). A nonsignificant χ^2 indicates excellent model fit, but this test is positively related to sample size, therefore a significant result ($p < .05$) should not lead to the rejection of a model (Tanaka, 1987). Comparative fit index (CFI; Bentler, 1990) and Tucker-Lewis index (TLI; Tucker & Lewis, 1973) values $\geq$ .95 indicate good model fit. Additionally, root mean square error of approximation (RMSEA; Steiger, 1990) values $\leq$ .05 indicate good model fit. In order to compare model fit among nested models, changes (Δ) in the CFI, TLI, and RMSEA were used as criteria to determine improvement in model fit. ΔCFI and ΔTLI $\geq$ .010, and ΔRMSEA $\geq$ .015 indicate significant improvement in model fit (Chen, 2007; Cheung & Rensvold, 2002; Putnick & Bornstein, 2016). Nonnested models were compared using the Bayes Information Criterion (BIC; Schwarz, 1978) produced using the robust maximum likelihood estimator, and lower values on the BIC indicate better fit.

Finally, DIF analysis was performed to determine if any *ICD-11* or *DSM–5* PTSD symptoms evidenced bias for sex. DIF was assessed using a multiple indicators multiple causes (MIMIC) model, which is advantageous because it allows covariates (categorical or continuous) to be entered into the model simultaneously without needing to subdivide the sample (Gallo, Anthony, & Muthén, 1994). MIMIC models include a measurement model (identified in the CFA analyses) and a structural model (i.e., the latent variables of PTSD regressed onto sex). This tests for sex differences on the latent variables of PTSD. The direct paths between sex and the PTSD symptom indicators are fixed to zero, and the modification indices (MIs) are inspected to determine which items may be exhibiting DIF. MIs denote a reduction in the χ^2 value if a certain parameter was freely estimated and a reduction of 3.84 (with one degree of freedom; α = .05) denotes a significant improvement in model fit. It has been argued that viewing DIF as a dichotomous classification (i.e., DIF/no DIF) based on statistical significance is problematic as DIF exists along a continuum (Borsboom, 2006) and Type I errors are likely to occur with large sample sizes. It is important to determine the degree of DIF that is present in order to make correct inferences regarding the practical significance of the DIF across groups. We therefore followed the method advanced by Saris, Satorra, and van der Veld (2009) for model evaluation and determined DIF to be present if an MI was $>$ 3.84 with a corresponding standardized expected parameter change (EPC) value $\geq$ 0.10. Assessing for DIF is an iterative process, and the symptom/parameter with the largest DIF effect size (i.e., standardized EPC $\geq$ 0.10) is freely estimated and the model is reassessed for further evidence of DIF. The process continues until no there is no further evidence of DIF.

All analyses were performed using Mplus 7.4 (Muthén & Muthén, 2012) and the survey package (Lumley, 2004, 2019) in R 3.4.4 (R Development Core Team, 2018). These statistical programs can account for the complex survey design elements of the NESARC-III, and thus provide accurate parameter estimates, standard errors, and model fit results.

Results

DSM–5 and *ICD-11* Diagnostic Rates

The probable *DSM–5* PTSD diagnostic rate was 9.5% (95% CI [8.6%, 10.5%]), significantly higher than the probable *ICD-11* PTSD diagnostic rate of 8.7% (95% CI [7.7%, 9.8%]), McNemar binomial test, p = .012. There was substantial agreement between the two diagnostic systems (Cohen's κ = .68, 95% CI [.65, .72], $p < .001$), with 6.5% (n = 393) meeting both diagnostic criteria, 3.0% (n = 189) meeting *DSM–5* diagnostic criteria but not *ICD-11* criteria, and 2.2% (n = 109) meeting *ICD-11* criteria but not *DSM–5* criteria.

Females were significantly more likely than males to meet requirements for *DSM–5* PTSD, $F(1, 113) = 26.59$, OR = 1.79, 95% CI [1.43, 2.25], $p < .001$, and *ICD-11* PTSD, $F(1, 113) = 7.19$, OR = 1.38, 95% CI [1.09, 1.74], p = .008. Sex differences for the individual PTSD symptoms are reported in supplemental Tables 3 (*DSM–5*) and 4 (*ICD-11*). Females were significantly more likely than males to endorse 16 (of 20) *DSM–5* PTSD symptoms (*OR*s ranging from 1.19 to 2.00), and males were significantly more likely to endorse one symptom ("risky behaviors"; $F(1, 113) = 4.09$, OR = 0.69, 95% CI [0.48, 0.99], p = .045). Females were significantly more likely to endorse five (of six) *ICD-11* PTSD symptom (*OR*s ranging from 1.20 to 1.60).

CFA Results

Table 3 presents the fit statistics for the alternative models of the *DSM–5* PTSD symptoms. Based on the CFI, TLI, and RMSEA results, all models fit the data extremely well. The seven-factor Hybrid model had the lowest BIC value, suggesting its statistical superiority. However, the ΔCFI, ΔTLI, and ΔRMSEA values indicated that the Hybrid model was not significantly different for the *DSM–5* model. Given the similar model fit results for all models, the fact that the *DSM–5* model is the most parsimonious, and it is the only model with a clear diagnostic algorithm (Shevlin et al., 2017), we concluded that the original four-factor *DSM–5* model was the optimal representation of the symptom structure of PTSD. Interfactor correlations ranged from .82 to .96, and stan-

Table 3
Model Fit Statistics and Inter-Factor Correlations for the Different Models of PTSD

PTSD model	χ^2	*df*	CFI	TLI	RMSEA (90% CI)	BIC	Inter-factor correlations mean (range)
DSM–5 symptoms							
DSM–5 model	608.782***	164	.989	.987	.022 (.021–.024)	38,266	.86 (.82–.96)
Dysphoria model	603.889***	164	.989	.987	.022 (.020–.024)	38,198	.84 (.79–.89)
Dysphoric Arousal model	561.674***	160	.990	.988	.022 (.020–.024)	38,047	.84 (.79–.94)
Anhedonia model	470.244***	155	.992	.990	.019 (.017–.021)	37,452	.84 (.77–.94)
External Behaviors model	519.098***	155	.991	.989	.021 (.019–.023)	37,639	.83 (.75–.95)
Alternative Dysphoria model	551.822***	155	.990	.988	.022 (.020–.024)	37,667	.84 (.75–.94)
Hybrid model	424.449***	149	.993	.991	.019 (.017–.021)	37,030	.84 (.75–.94)
ICD-11 Symptoms							
ICD-11 model	9.267	6	1.000	.999	.010 (.000–.022)	19,584	.76 (.71–.80)
Two-factor model	211.150***	8	.978	.959	.069 (.061–.077)	20,069	.79
One-factor model	336.476***	9	.965	.941	.082 (.075–.090)	20,372	—

Note. n = 5,366; Estimator = WLSMV; χ^2 = χ-square goodness-of-fit statistic; *df* = degrees of freedom; CFI = comparative fit index; TLI = Tucker Lewis index; RMSEA (90% CI) = root-mean-square error of approximation with 90% confidence intervals; BIC = Bayesian information criterion; PTSD = posttraumatic stress disorder; *ICD-11* = International Classification of Diseases; *DSM–5* = Diagnostic and Statistical Manual of Mental Disorders.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

dardized factor loadings ranged from .66 to .92 (see supplemental Table 5).

Table 3 also presents the fit statistics for the alternative models of the *ICD-11* PTSD symptoms. The three-factor *ICD-11* model demonstrated excellent fit according to the CFI, TLI, and RMSEA. The *ICD-11* model was statistically superior (ΔCFI and ΔTLI values > .010, ΔRMSEA > .015, lowest BIC value) to the competing models. Interfactor correlations ranged from .71 to .80, and standardized factor loadings ranged from .79 to .94 (see supplemental Table 6).

DIF Results

Females had significantly higher mean scores than males on the four *DSM–5* PTSD latent variables (see Table 4). Controlling for these latent variable mean differences, evidence of DIF was identified for four symptoms. The largest effect was for the "risky behavior" (E2) symptom, with males being more likely to endorse the symptom (MI = 16.65, EPC = −.18). This was followed by "feeling upset" (B4; MI = 16.16, EPC = .11), "sleep problems" (E6; MI = 13.91, EPC = .11), and "unwanted memories" (B1; MI = 13.47, EPC = .10) which were all more likely to be endorsed by females. Technical details are presented in supplemental Tables 7–11, and item characteristic curves illustrating DIF are presented in supplemental Figures 1–4.

Table 4
Effects of Sex on PTSD Latent Factors

PTSD latent factor	Baseline MIMIC model B (*SE*)	Baseline MIMIC model β (*SE*)	DIF corrected model B (*SE*)	DIF corrected model β (*SE*)
DSM–5 model of PTSD				
Intrusions	.20*** (.04)	.13 (.02)	.11** (.04)	.07 (.02)
Avoidance	.21*** (.04)	.13 (.03)	.21*** (.04)	.13 (.03)
NACM	.16*** (.03)	.12 (.03)	.16*** (.03)	.12 (.03)
Hyperarousal	.18*** (.04)	.11 (.02)	.15*** (.04)	.09 (.02)
ICD-11 model of PTSD				
Re-experiencing	.10* (.04)	.05 (.02)	—	—
Avoidance	.21*** (.04)	.13 (.03)	—	—
Sense of threat	.12** (.03)	.07 (.02)	—	—

Note. Sex coded as 0 = male, 1 = female; MIMIC = multiple indicators multiple causes; DIF = differential item functioning; B = unstandardized estimates; β = standardized estimates; *SE* = standard error; NACM = negative alterations in cognitions and mood PTSD = posttraumatic stress disorder; *ICD-11* = International Classification of Diseases; *DSM–5* = Diagnostic and Statistical Manual of Mental Disorders.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Females also had significantly higher mean scores than males on the three *ICD-11* PTSD latent variables (see Table 4), however, there was no evidence of DIF for any *ICD-11* symptom (see supplemental Table 12).

Discussion

Little data exist regarding the validity of the *DSM–5* and *ICD-11* models of PTSD in older adults. The CFA results obtained in this study support the factorial validity of the *DSM–5* and *ICD-11* models of PTSD among older adults. This is important as it suggests that the diagnostic algorithms for PTSD derived from these models are meaningful and valid for adults aged 60 years and older in the general population. Clinicians working with people in this age cohort can therefore use these systems with confidence.

Witnessing/learning about someone with a serious or life-threatening illness was the most commonly reported traumatic event and most frequently endorsed as being the most stressful event experienced. This finding is in line with previous research noting that this type of traumatic event is common among older adults (Pietrzak, Goldstein, Southwick, & Grant, 2012). It is likely that the frequent occurrence of this type of traumatic event is reflective of normative age-related events of the current sample (e.g., illness of spouse; Cook, McCarthy, & Thorp, 2017). It was also noteworthy that 8.7% and 9.5% of this sample met symptom criteria for a probable diagnosis of *ICD-11* and *DSM–5* PTSD, respectively. These findings are similar to other estimates of PTSD in the U.S. general population. For example, in a household sample of U.S. adults aged 18–70 years, Cloitre et al. (2019) reported a rate of 7.2%. The current result calls into question the assumption that PTSD is substantially lower among those over 60 years of age.

Of course, probable PTSD rates in this study were estimated without a measure of functional impairment among a trauma-exposed sample and are therefore likely to be somewhat overestimated.

This finding is inconsistent with those of the NCS-R (Gum et al., 2009), which showed that a very minor proportion of adults over the age of 65 exhibit clinically meaningful levels of PTSD. Interestingly, Gum and colleagues (2009) noted that those aged between 45 and 64 years presented with the highest rates of PTSD and that without sufficient training and consideration for geriatric populations, it is likely that we will be faced with a crisis within the psychiatric health care system for older adults. Similarly, this higher rate of PTSD among middle-aged adults has been found in the previous NESRAC-II study (Reynolds et al., 2016). Therefore, this noticeable increase in PTSD prevalence rates among adults aged 60 years and older in the current study, compared to the NCS-R and NESRAC-II, may reflect this predicted crisis within the health care system. However, this increase may be attributable to other factors such as a greater propensity for older adults to display higher levels of subsyndromal PTSD than full PTSD (Pietrzak et al., 2012). It is possible that due to the absence of the functional impairment criterion, the reported prevalence rates are closer to the general U.S. population as the result of this criterion being somewhat ill-suited to psychiatric diagnostic assessments among older adults (Bodner, Palgi, & Wyman, 2018), and may therefore underestimate the true prevalence. For example, older adults may be less likely to attribute occupational impairment to PTSD symptomatology if they are retired, or social impairment if they are physically impaired. Additionally, varying prevalence estimates across the literature may also be due to differences in methodologies such as the use of different PTSD diagnostic classifications in the current study, and different cut-off scores for age.

Consistent with data from nonolder adult community and clinical samples (see Brewin et al., 2017), we found that a significantly greater number of older U.S. adults met diagnostic requirements for PTSD based on the *DSM–5* guidelines compared to the *ICD-11* guidelines. However, while statistically significant, the actual difference in probable diagnostic rates between the two systems was very small and there was substantial agreement across the systems in who met criteria for PTSD. As such, we believe it reasonable to conclude that the *DSM–5* and *ICD-11* capture roughly equal numbers of older adults meeting criteria for a diagnosis of PTSD.

In line with the wider trauma literature (Cloitre et al., 2019; Tolin & Foa, 2006), females were more likely to meet diagnostic criteria for PTSD according to the *DSM–5* and *ICD-11* in this sample. A similar trend was observed for sex effects at the symptom and latent variable levels. The DIF analysis for the *DSM–5* symptoms revealed that several symptoms were systematically affected by a respondent's sex. Responses to one symptom (E2: "risky behaviors") were systematically biased toward males. In other words, despite equal levels on the underlying latent trait, males were more likely to endorse this symptom than females. Furthermore, three symptoms were found to be systematically biased toward females: namely, "unwanted memories," "feeling upset," and "sleep problems." Similar effects for the "feeling upset" and "risky behaviors" symptoms were previously reported in a sample of Malaysian adolescents (Murphy et al., 2019). Discovering the same DIF effects in two culturally distinctive samples—and two samples of varying age profiles—is strong evidence that these symptom indicators are systematically biased for sex. As such, it may be advisable to reconceptualize, or remove, these symptoms in the next version of the *DSM*.

These findings have several clinically relevant implications. First, the *ICD-11* and *DSM–5* models of PTSD appear to provide valid representations of the latent structure of PTSD symptoms among older adults and identify similar numbers of people meeting criteria for PTSD. Clinicians should therefore feel confident that the *ICD-11* and *DSM–5* models provide an accurate description of PTSD in older adults. Second, as the *ICD-11* provides a more parsimonious account of PTSD than the *DSM–5*—there are 27 possible symptom combinations for an *ICD-11* PTSD diagnosis, and 636,120 possible symptom combinations for a *DSM–5* PTSD diagnosis (Galatzer-Levy & Bryant, 2013; Shevlin, et al., 2018)—and there is no evidence of DIF, it can be argued that it offers clinicians a more parsimonious and statistically superior model of PTSD for use with older adults.

There are several important limitations associated with these results. First, as this study was based on a nationally representative household sample of U.S. older adults, the findings may not generalize to older adults in other nations, or to adults seen in clinical services. Second, the probable PTSD rates did not take into account the functional impairment criterion, meaning they are likely to be overestimated. Third, although we tested for DIF based on sex, other sources of bias such as ethnicity may be important to examine in future studies. Finally, PTSD symptoms were estimated using items from the AUDADIS-5. It will be important to replicate this study using measures specifically designed to capture the *DSM–5* and *ICD-11* PTSD symptoms.

In conclusion, in this study we have shown that the *DSM–5* and *ICD-11* models provide valid representations of PTSD symptom expression among members of the general population in later life. Moreover, we found that a substantial proportion of people over the age of 60 may be suffering from PTSD, or at the very least, considerable posttraumatic symptomatology. Thus, researchers, clinicians, and policymakers should not discount older adults when considering how to understand, identify, prevent, and treat trauma-based mental health problems.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Armour, C., Tsai, J., Durham, T. A., Charak, R., Biehn, T. L., Elhai, J. D., & Pietrzak, R. H. (2015). Dimensional structure of *DSM–5* posttraumatic stress symptoms: Support for a hybrid anhedonia and externalizing behaviors model. *Journal of Psychiatric Research, 61,* 106–113. http://dx.doi.org/10.1016/j.jpsychires.2014.10.012

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107,* 238–246. http://dx.doi.org/10.1037/0033-2909.107.2.238

Bodner, E., Palgi, Y., & Wyman, M. F. (2018). Ageism in mental health assessment and treatment of older adults. In L. Ayalon & C. Tesch-Römer (Eds.), *Contemporary perspectives on ageism* (pp. 241–262). Cham, Switzerland: Springer. http://dx.doi.org/10.1007/978-3-319-73820-8_15

Borsboom, D. (2006). When does measurement invariance matter? *Medical Care, 44,* S176–S181. http://dx.doi.org/10.1097/01.mlr.0000245143.08679.cc

Brewin, C. R., Cloitre, M., Hyland, P., Shevlin, M., Maercker, A., Bryant, R. A., . . . Reed, G. M. (2017). A review of current evidence regarding the *ICD-11* proposals for diagnosing PTSD and complex PTSD. *Clinical Psychology Review, 58,* 1–15. http://dx.doi.org/10.1016/j.cpr.2017.09.001

Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. New York, NY: Guilford Press.

Bureau of the Census. (2013). *American Community Survey, 2012*. Suitland, MD: Author.

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling, 14,* 464–504. http://dx.doi.org/10.1080/10705510701301834

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9,* 233–255. http://dx.doi.org/10.1207/S15328007SEM0902_5

Cloitre, M., Hyland, P., Bisson, J. I., Brewin, C. R., Roberts, N. P., Karatzias, T., & Shevlin, M. (2019). *ICD-11* posttraumatic stress disorder and complex posttraumatic stress disorder in the United States: A population-based study. *Journal of Traumatic Stress*. Advance online publication. http://dx.doi.org/10.1002/jts.22454

Cook, J. M., McCarthy, E., & Thorp, S. R. (2017). Older adults with PTSD: Brief state of research and evidence-based psychotherapy case illustration. *The American Journal of Geriatric Psychiatry, 25,* 522–530. http://dx.doi.org/10.1016/j.jagp.2016.12.016

Cook, J. M., & Simiola, V. (2018). Trauma and aging. *Current Psychiatry Reports, 20,* 93. http://dx.doi.org/10.1007/s11920-018-0943-6

Elhai, J. D., Biehn, T. L., Armour, C., Klopper, J. J., Frueh, B. C., & Palmieri, P. A. (2011). Evidence for a unique PTSD construct represented by PTSD's D1–D3 symptoms. *Journal of Anxiety Disorders, 25,* 340–345. http://dx.doi.org/10.1016/j.janxdis.2010.10.007

Elhai, J. D., & Palmieri, P. A. (2011). The factor structure of posttraumatic stress disorder: A literature update, critique of methodology, and agenda for future research. *Journal of Anxiety Disorders, 25,* 849–854. http://dx.doi.org/10.1016/j.janxdis.2011.04.007

Elklit, A., & Shevlin, M. (2007). The structure of PTSD symptoms: A test of alternative models using confirmatory factor analysis. *British Journal of Clinical Psychology, 46,* 299–313. http://dx.doi.org/10.1348/014466506X171540

Galatzer-Levy, I. R., & Bryant, R. A. (2013). 636,120 ways to have posttraumatic stress disorder. *Perspectives on Psychological Science, 8,* 651–662. http://dx.doi.org/10.1177/1745691613504115

Gallo, J. J., Anthony, J. C., & Muthén, B. O. (1994). Age differences in the symptoms of depression: A latent trait analysis. *Journal of Gerontology, 49,* P251–P264. http://dx.doi.org/10.1093/geronj/49.6.P251

Glück, T. M., Knefel, M., Tran, U. S., & Lueger-Schuster, B. (2016). PTSD in *ICD-10* and proposed *ICD-11* in elderly with childhood trauma: Prevalence, factor structure, and symptom profiles. *European Journal of Psychotraumatology, 7*. Advance online publication. http://dx.doi.org/10.3402/ejpt.v7.29700

Grant, B. F., Chu, A., Sigman, R., Amsbary, M., Kali, J., Sugawara, Y., . . . Goldstein, R. (2014). *Source and accuracy statement: National Epidemiologic Survey on Alcohol and Related Conditions-III (NESARC-III)*. Rockville, MD: National Institute on Alcohol Abuse and Alcoholism.

Grant, B. F., Goldstein, R. B., Chou, S. P., Saha, T. D., Ruan, W. J., Huang, B., . . . Hasin, D. S. (2011). *The Alcohol Use Disorder and Associated Disabilities Interview Schedule—Diagnostic and Statistical Manual of Mental Disorders—Fifth Edition version (AUDADIS-5)*. Rockville, MD: National Institute on Alcohol Abuse and Alcoholism.

Grant, B. F., Goldstein, R. B., Smith, S. M., Jung, J., Zhang, H., Chou, S. P., . . . Hasin, D. S. (2015). The Alcohol Use Disorder and Associated Disabilities Interview Schedule-5 (AUDADIS-5): Reliability of substance use and psychiatric disorder modules in a general population sample. *Drug and Alcohol Dependence, 148,* 27–33. http://dx.doi.org/10.1016/j.drugalcdep.2014.11.026

Gum, A. M., King-Kallimanis, B., & Kohn, R. (2009). Prevalence of mood, anxiety, and substance-abuse disorders for older Americans in the National Comorbidity Survey-Replication. *The American Journal of Geriatric Psychiatry, 17,* 769–781. http://dx.doi.org/10.1097/JGP.0b013e3181ad4f5a

Hansen, M., Hyland, P., Karstoft, K. I., Vaegter, H. B., Bramsen, R. H., Nielsen, A. B., . . . Andersen, T. E. (2017). Does size really matter? A multisite study assessing the latent structure of the proposed *ICD-11* and *DSM–5* diagnostic criteria for PTSD. *European Journal of Psychotraumatology, 8* (Supp.7). http://dx.doi.org/10.1080/20008198.2017.1398002

Hasin, D. S., Shmulewitz, D., Stohl, M., Greenstein, E., Aivadyan, C., Morita, K., . . . Grant, B. F. (2015). Procedural validity of the AUDADIS-5 depression, anxiety and post-traumatic stress disorder modules: Substance abusers and others in the general population. *Drug and Alcohol Dependence, 152,* 246–256. http://dx.doi.org/10.1016/j.drugalcdep.2015.03.027

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6,* 1–55. http://dx.doi.org/10.1080/10705519909540118

Hyland, P., Brewin, C. R., & Maercker, A. (2017). Predictive validity of *ICD-11* PTSD as measured by the Impact of Event Scale-Revised: A 15-year prospective study of political prisoners. *Journal of Traumatic Stress, 30,* 125–132. http://dx.doi.org/10.1002/jts.22171

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33,* 159–174. http://dx.doi.org/10.2307/2529310

Liu, P., Wang, L., Cao, C., Wang, R., Zhang, J., Zhang, B., . . . Elhai, J. D. (2014). The underlying dimensions of *DSM–5* posttraumatic stress disorder symptoms in an epidemiological sample of Chinese earthquake survivors. *Journal of Anxiety Disorders, 28,* 345–351. http://dx.doi.org/10.1016/j.janxdis.2014.03.008

Lumley, T. (2004). Analysis of complex survey samples. *Journal of Statistical Software, 9,* 1–19. http://dx.doi.org/10.18637/jss.v009.i08

Lumley, T. (2019). Survey: Analysis of complex survey samples (Version 3.35–1) [Computer software]. R package. Retrieved from https://cran.r-project.org/web/packages/survey/index.html

Miller, M. W., Wolf, E. J., Kilpatrick, D., Resnick, H., Marx, B. P., Holowka, D. W., . . . Friedman, M. J. (2013). The prevalence and latent structure of proposed *DSM–5* posttraumatic stress disorder symptoms in U.S. national and veteran samples. *Psychological Trauma: Theory, Research, Practice, and Policy, 5,* 501–512. http://dx.doi.org/10.1037/a0029730

Murphy, S., Elklit, A., Chen, Y. Y., Ghazali, S. R., & Shevlin, M. (2019). Sex differences in PTSD symptoms: A differential item functioning approach. *Psychological Trauma: Theory, Research, Practice, and Policy, 11,* 319–327. http://dx.doi.org/10.1037/tra0000355

Muthén, L. K., & Muthén, B. O. (2012). *Mplus user's guide* (7th ed.). Los Angeles, CA: Author.

Palmer, B. W., Jeste, D. V., & Sheikh, J. I. (1997). Anxiety disorders in the elderly: *DSM–IV* and other barriers to diagnosis and treatment. *Journal of Affective Disorders, 46,* 183–190. http://dx.doi.org/10.1016/S0165-0327(97)00146-8

Pietrzak, R. H., Goldstein, R. B., Southwick, S. M., & Grant, B. F. (2012). Psychiatric comorbidity of full and partial posttraumatic stress disorder among older adults in the United States: Results from Wave 2 of the National Epidemiologic Survey on Alcohol and Related Conditions. *The American Journal of Geriatric Psychiatry, 20,* 380–390. http://dx.doi.org/10.1097/JGP.0b013e31820d92e7

Putnick, D. L., & Bornstein, M. H. (2016). Measurement invariance conventions and reporting: The state of the art and future directions for psychological research. *Developmental Review, 41,* 71–90. http://dx.doi.org/10.1016/j.dr.2016.06.004

Rao, J. N., & Scott, A. J. (1984). On chi-squared tests for multiway contingency tables with cell proportions estimated from survey data. *Annals of Statistics, 12,* 46–60. http://dx.doi.org/10.1214/aos/1176346391

R Development Core Team. (2018). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from http://www.R-project.org/

Reynolds, K., Pietrzak, R. H., Mackenzie, C. S., Chou, K. L., & Sareen, J. (2016). Post-traumatic stress disorder across the adult lifespan: Findings from a nationally representative survey. *The American Journal of Geriatric Psychiatry, 24,* 81–93. http://dx.doi.org/10.1016/j.jagp.2015.11.001

Saris, W. E., Satorra, A., & van der Veld, W. M. (2009). Testing structural equation models or detection of misspecifications? *Structural Equation Modeling, 16,* 561–582. http://dx.doi.org/10.1080/10705510903203433

Schwarz, G. (1978). Estimating the dimension of a model. *Annals of Statistics, 6,* 461–464. http://dx.doi.org/10.1214/aos/1176344136

Shevlin, M., Hyland, P., Karatzias, T., Bisson, J. I., & Roberts, N. P. (2017). Examining the disconnect between psychometric models and clinical reality of posttraumatic stress disorder. *Journal of Anxiety Disorders, 47,* 54–59. http://dx.doi.org/10.1016/j.janxdis.2017.02.006

Shevlin, M., Hyland, P., Vallieres, F., Bisson, J., Makhashvili, N., Javakhishvili, J., . . . Roberts, B. (2018). A comparison of *DSM–5* and *ICD–11* PTSD prevalence, comorbidity and disability: An analysis of the Ukrainian Internally Displaced Person's Mental Health Survey. *Acta Psychiatrica Scandinavica, 137,* 138–147. http://dx.doi.org/10.1111/acps.12840

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioral Research, 25,* 173–180. http://dx.doi.org/10.1207/s15327906mbr2502_4

Tanaka, J. S. (1987). "How big is big enough?": Sample size and goodness of fit in structural equation models with latent variables. *Child Development, 58,* 134–146. http://dx.doi.org/10.2307/1130296

Thomas, D. R., & Decady, Y. J. (2004). Testing for association using multiple response survey data: Approximate procedures based on the Rao-Scott approach. *International Journal of Testing, 4,* 43–59. http://dx.doi.org/10.1207/s15327574ijt0401_3

Thomas, M. L., Kaufmann, C. N., Palmer, B. W., Depp, C. A., Martin, A. S., Glorioso, D. K., . . . Jeste, D. V. (2016). Paradoxical trend for improvement in mental health with aging: A community-based study of 1,546 adults aged 21–100 years. *The Journal of Clinical Psychiatry, 77,* e1019–e1025. http://dx.doi.org/10.4088/JCP.16m10671

Tolin, D. F., & Foa, E. B. (2006). Sex differences in trauma and posttraumatic stress disorder: A quantitative review of 25 years of research. *Psychological Bulletin, 132,* 959–992. http://dx.doi.org/10.1037/0033-2909.132.6.959

Tsai, J., Harpaz-Rotem, I., Armour, C., Southwick, S. M., Krystal, J. H., & Pietrzak, R. H. (2015). Dimensional structure of *DSM–5* posttraumatic stress disorder symptoms: Results from the National Health and Resilience in Veterans Study. *The Journal of Clinical Psychiatry, 76,* 546–553. http://dx.doi.org/10.4088/JCP.14m09091

Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika, 38,* 1–10. http://dx.doi.org/10.1007/BF02291170

World Health Organization. (2017, December 12). *Mental health of older adults*. Retrieved from https://www.who.int/news-room/fact-sheets/detail/mental-health-of-older-adults

World Health Organization. (2018). *International statistical classification of diseases and related health problems* (11th revision). Retrieved from https://icd.who.int/browse11/l-m/en

Yu, C. Y. (2002). *Evaluating cutoff criteria of model fit indices for latent variable models with binary and continuous outcomes* (Unpublished doctoral dissertation). University of California, Los Angeles.

Zelazny, K., & Simms, L. J. (2015). Confirmatory factor analyses of *DSM–5* posttraumatic stress disorder symptoms in psychiatric samples differing in Criterion A status. *Journal of Anxiety Disorders, 34,* 15–23. http://dx.doi.org/10.1016/j.janxdis.2015.05.009

Received November 18, 2019
Revision received February 28, 2020
Accepted April 6, 2020 ■