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BASIC RESEARCH ARTICLE

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Psychological risk factors that characterize acute stress disorder and trajectories of posttraumatic stress disorder after injury: a study using latent class analysis

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ABSTRACT

Background: The course and different characteristics of acute and posttraumatic stress disorder (ASD, PTSD) in trauma populations are unclear.

Objective: The aims were to identify longitudinal trajectories of PTSD, to establish a risk profile for ASD and PTSD based on patients' sociodemographic, clinical, and psychological characteristics, and to study the effect of ASD and dissociation on PTSD during 12 months after trauma.

Method: Patients completed questionnaires after inclusion and at 3, 6, 9, and 12 months afterwards. Trajectories were identified using repeated measures latent class analysis (RMLCA). The risk profile was based on a ranking of importance of each characteristic using Cohen's d effect sizes and odds ratios. The impact of ASD and dissociation on PTSD was examined using logistic regression analyses.

Results: Altogether, 267 patients were included. The mean age was 54.0 (*SD* = 16.1) and 62% were men. The prevalence rate of ASD was approximately 21.7% at baseline, and 36.1% of trauma patients exhibited PTSD at 12 months after injury. Five trajectories were identified: (1) no PTSD symptoms, (2) mild, (3) moderate, (4) subclinical, and (5) severe PTSD symptoms. These trajectories seemed to remain stable over time. Compared with patients in other trajectories, patients with ASD and (subclinical) PTSD were younger and scored higher on anxiety, depressive symptoms, neuroticism, and trait anxiety. Regarding dissociation symptoms, inability to recall memories about the event was significantly more present than an altered sense of reality, (105 (40.7%) versus 56 (21.7%), p = .031), although that symptom had the strongest likelihood for PTSD. Patients with dissociation were significantly at risk for PTSD than patients without dissociation (OR = 4.82; 95%CI: 1.91–12.25).

Conclusions: Psychological factors characterized ASD and trajectories of PTSD during 12 months post-trauma. Healthcare providers who are aware of these findings could early identify patients at risk for ASD and PTSD and refer them for patient-centred interventions.

Factores de riesgo psicológico que caracterizan el trastorno por estrés agudo y las trayectorias del trastorno por estrés postraumático después de una lesión: un estudio mediante análisis de clases latentes

Antecedentes: El curso y las diferentes características del trastorno de estrés agudo y postraumático (TEA, TEPT) en poblaciones traumatizadas no están claros.

Objetivo: Los objetivos fueron identificar las trayectorias longitudinales del TEPT, establecer un perfil de riesgo para el TEA y el TEPT basado en las características sociodemográficas, clínicas y psicológicas de los pacientes, y estudiar el efecto del TEA y la disociación en el TEPT durante los 12 meses posteriores al trauma.

Método: Los pacientes completaron cuestionarios tras la inclusión y a los 3, 6, 9 y 12 meses después. Las trayectorias se identificaron mediante un análisis de clases latentes de medidas repetidas (RMLCA). El perfil de riesgo se basó en una clasificación de la importancia de cada característica utilizando los tamaños del efecto d de Cohen y cocientes de probabilidades (odds ratios). El impacto del TEA y la disociación en el TEPT se examinó mediante análisis de regresión logística.

Resultados: En total, se incluyeron 267 pacientes. La edad media era de 54,0 (*SD* = 16,1) y el 62% eran hombres. La tasa de prevalencia de TEA fue de aproximadamente el 21,7% al inicio, y el 36,1% de los pacientes traumatizados presentaban TEPT a los 12 meses de la lesión. Se identificaron cinco trayectorias: (1) sin síntomas de TEPT, (2) leve, (3) moderada, (4) subclínica y (5) síntomas graves de TEPT. Estas trayectorias parecían permanecer estables a lo largo del tiempo. En comparación con los pacientes de otras trayectorias, los pacientes con TEA y TEPT (subclínico) eran más jóvenes y puntuaban más alto en ansiedad, síntomas depresivos, rasgos

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Trastorno de estrés agudo; trastorno de estrés postraumático; trauma; lesión; cohorte prospectiva observacional; longitudinal; trayectorias; análisis de clases latentes de medidas repetidas

关键词
急性应激障碍; 创伤后应激障碍; 创伤; 受伤; 观察性前瞻性队列; 纵向; 轨迹; 重复测量潜在类别分析

HIGHLIGHTS

- Longitudinal trajectories of posttraumatic stress disorder (PTSD) after physical trauma were evaluated.
- A risk profile for ASD and PTSD was subsequently determined.
- Overall, only psychological characteristics determined ASD and PTSD.
- No clinical characteristics were found.

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Supplemental data for this article can be accessed here.

de neuroticismo y ansiedad. En cuanto a los síntomas de disociación, la incapacidad de recordar el suceso estaba significativamente más presente que la alteración del sentido de la realidad (105 (40,7%) frente a 56 (21,7%), p = 0,031), aunque este síntoma tenía la probabilidad más alta de TEPT. Los pacientes con disociación tenían un riesgo significativo de TEPT que los pacientes sin disociación (OR = 4,82; IC 95%: 1,91-12,25).
Conclusiones: Los factores psicológicos caracterizaron el TEA y las trayectorias del TEPT durante los 12 meses posteriores al trauma. Los profesionales de la salud que conozcan estos hallazgos podrían identificar precozmente a los pacientes con riesgo de TEA y TEPT y remitirlos a intervenciones centradas en el paciente.

表征急性应激障碍的心理风险因素和受伤后创伤后应激障碍的轨迹:一项使用潜在类别分析的研究

背景: 创伤人群中急性和创伤后应激障碍 (ASD, PTSD) 的病程和不同特征尚不清楚。
目的: 旨在确定 PTSD 的纵向轨迹, 根据患者的社会人口学, 临床和心理特征确定 ASD 和 PTSD 的风险剖面, 并研究 ASD 和解离对创伤后 12 个月内 PTSD 的影响。
方法: 患者在被纳入后以及之后的 3, 6, 9 和 12 个月完成问卷。使用重复测量潜在类别分析 (RMLCA) 确定轨迹。风险剖面基于使用 Cohen's d效应量和优势比对每个特征的重要性进行排序。使用逻辑回归分析考查 ASD 和解离对 PTSD 的影响。
结果: 共纳入267 例患者。平均年龄为 54.0 (SD = 16.1), 62% 为男性。基线时 ASD 流行率约为 21.7%, 36.1% 的创伤患者在受伤后 12 个月时表现出 PTSD。确定了五个轨迹:(1) 无 PTSD 症状, (2) 轻度, (3) 中度, (4) 亚临床和 (5) 重度 PTSD 症状。随着时间的推移, 这些轨迹似乎保持稳定。与其他轨迹患者相比, 患有 ASD 和 (亚临床) PTSD 的患者更年轻, 在焦虑, 抑郁症状, 神经质和特质焦虑方面得分更高。关于解离症状, 无法回忆起事件相关记忆显著多于现实感改变 (105 (40.7%) 对 56 (21.7%), p = .031), 尽管这一症状最有可能发生 PTSD。与无解离患者相比, 有解离患者患 PTSD 的风险显著 (OR = 4.82; 95% CI:1.91-12.25)。
结论: 心理因素表征了 ASD 和创伤后 12 个月内 PTSD 的轨迹。了解这些发现的医护提供者可以尽早识别出 ASD 和 PTSD 风险患者, 并为其提供以患者为中心的干预措施。

1. Introduction

The number of Dutch patients who are treated in the emergency department (ED) after injury has increased in recent years, from approximately 68,000 in 2010 to approximately 78,000 in 2018 (Landelijke Netwerk Acute Zorg [LNAZ], 2019). Injury patients have reported impaired functioning and psychological problems and disorders. These consequences occurred directly, months, or years later (Visser, Gosens, Den Oudsten, & De Vries, 2017). Moreover, symptoms of posttraumatic stress disorder (PTSD) are a major barrier to recovery up to 24 months after injury (Haagsma et al., 2012). Several risk factors for PTSD after injury have been found, including female patients, younger age (de Munter et al., 2019; Lowe et al., 2020), admission to the intensive care unit (ICU), anxiety, and depressive symptoms (Bryant et al., 2015; Hatch et al., 2018; Mason, Wardrope, Turpin, & Rowlands, 2002). Although it is known that neuroticism and low scores in extraversion are predictors for PTSD (Breslau & Schultz, 2013; Jakšić, Brajković, Ivezić, Topić, & Jakovljević, 2012), the literature about personality traits as possible predictors of PTSD after a physical injury is scarce (Merz, Zane, Emmert, Lace, & Grant, 2019; Van Son et al., 2017). Furthermore, injury patients who are diagnosed with acute stress disorder (ASD) have a higher risk of developing PTSD (Fuglsang, Moergeli, & Schnyder, 2004; Holbrook, Hoyt, Stein, & Sieber, 2001). Also, it is unknown which sociodemographic and psychosocial factors are associated with ASD and how these characteristics predicts PTSD symptom severity.

One of the main distinctions between ASD and PTSD, is the presence of dissociative symptoms (e.g. feelings of being detached from an experience or being unable to remember the event) in ASD and not in PTSD. There is a significant overlap between dissociative symptoms, as these symptoms are predictors for PTSD (Bryant, Friedman, Spiegel, Ursano, & Strain, 2011). In addition, not every patient with ASD develops PTSD (Visser et al., 2017). This questions the discriminatory power and conceptual independence of the dissociative criteria (Harvey & Bryant, 1999). Therefore, research is needed that focus on the effect of dissociative symptoms of ASD on PTSD and whether patients with or without one of these dissociative symptoms develop PTSD.

Results demonstrated that ASD and PTSD have different courses across time (Bryant et al., 2015; Osenbach, 2012; Osenbach et al., 2014; Visser et al., 2017). These courses fluctuated during recovery and could, because of natural remission (Blanchard et al., 1997; Glynn et al., 2007) or psychological treatment, decrease throughout the year. In the last decade, the development of PTSD has been increasingly studied using repeated measures latent class analysis (RMLCA) (Bryant et al., 2015; Lowe et al., 2020; O'Donnell, Elliott, Lau, & Creamer, 2007). However, trajectories have mostly been evaluated in a subset of the trauma population (Andersen, Karstoft, Bertelsen, & Madsen, 2014; Bonanno, Kennedy, Galatzer-Levy, Lude, & Elfström, 2012). Research is needed that will consider a variety of causes of trauma exposure as

well as single and multiple severe injuries (Lowe et al., 2020). The follow-up period and measurements in recent studies have often been limited (Bonanno et al., 2012; deRoon-Cassini, Mancini, Rusch, & Bonanno, 2010), or investigations have used a cross-sectional design (Bell, Sobolev, Anderson, Hewko, & Simons, 2014; Campbell, Trachik, Goldberg, & Simpson, 2020). Hence, multiple measurements during a longer follow-up period are needed.

To our knowledge, no study has established a risk profile for ASD and PTSD after trauma based on sociodemographic, clinical, and psychological aspects. Thus, this study aimed to identify distinct trajectories of PTSD up to 12 months after injury. Further, patients' sociodemographic, clinical, and psychological characteristics were scrutinized for ASD and for each trajectory, allowing to develop a risk profile and to determine which patients are at risk for ASD and PTSD. Finally, the effect of ASD and ASD dissociation on PTSD over time was studied to determine the odds of developing PTSD given earlier ASD dissociative symptoms.

2. Method

2.1. Participants

Trauma patients aged 18 or older treated in the trauma room between November 2016 and November 2017 at Elisabeth-TweeSteden (ETZ) Hospital were asked to participate in this study. The ETZ Hospital in Tilburg, the Netherlands, is a level-1 trauma centre in the province of Noord-Brabant. The exclusion criteria were severe traumatic brain injury (i.e. Glasgow coma score [GCS] ≤ 8), dementia, or insufficient knowledge of the Dutch language (verbally and in writing). Information concerning race or ethnicity was not obtained, because, in the Netherlands, that information will not be registered expect when it is related to a specific health issue.

2.2. Procedure

Patients were asked to participate by either the emergency doctor or the researcher (EV). The patients signed two informed consent forms: first, in the ED after receiving treatment in the shock room and being informed by the doctor; then, 1–5 days later, patients again confirmed their participation to ensure that they had had sufficient time to consider it. As soon as they were lucid, previously unconscious patients were informed and asked to participate. All obtained information was destroyed for patients who did not sign the second informed consent form and declined further participation.

This study is part of a mixed-method study. The study protocol has been published elsewhere (Visser, Gosens, Den Oudsten, & De Vries, 2018). This study (protocol number: NL55386.028.15) was reviewed and approved by the Medical Ethical Committee Brabant (METC Brabant) on 4 December 2015. The study is registered in the Netherlands Trial Registry (number NTR6258). To strengthen validity and comprehensiveness, this study was conducted and reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist (Von Elm et al., 2007). Participation was voluntary, and the participants did not receive any financial reward.

2.3. Measures

Sociodemographic information (i.e. sex, age, living situation, education level, and employment) was obtained from patients at baseline (after confirming their participation). Using their medical records, clinical information were prospectively gathered, including the type of trauma mechanism (e.g. motor vehicle accident), type of injury (e.g. spinal cord injury), injury severity score (ISS), GCS, surgery (yes/no), hospital stay (yes/no), ICU admission, length of stay, psychiatric history (yes/no), and consultation or treatment by a medical psychologist (yes/no).

The patients completed a baseline questionnaire on sociodemographics, ASD, PTSD, anxiety, depressive symptoms, and personality. Clinical information was retrieved from the patients' medical records. PTSD was further assessed at 3, 6, 9, and 12 months after injury (Visser et al., 2018).

The MINI International Neuropsychiatric Interview (MINI-Plus), for diagnosing ASD and PTSD, and the Impact of Event Scale-Revised (IES-R), for diagnosing PTSD, were employed both in this study to generate confirmatory results despite differences in methods of data collection, analysis, and interpretation. Moreover, they are often used (together) in clinical practice. However, the IES-R has a higher sensitivity than the MINI-Plus. Therefore, the results from the IES-R are considered the most important. The IES-R is a self-report questionnaire to assess the symptom severity of PTSD, which is based on the DSM-IV (no edition of the DSM-5 was available at time of measurement) (Weiss & Marmar, 1997). It consists of 22 items that gauge intrusive re-experiences (Weiss & Marmar, 1997). It contains a 4-point Likert scale ranging from 0 (*not at all*) to 4 (*often*). The cut-off score for the diagnosis of PTSD is ≥33 and shows good diagnostic accuracy (Cronbach's alpha = .96) (Creamer, Bell, & Failla, 2003; Wohlfarth, van den Brink, Winkel, & Ter Smitten, 2003). The Dutch translation has good psychometric properties (Brom & Kleber, 1985) and is reliable and valid in various trauma populations (van der Ploeg, Mooren, Kleber, van der Velden, & Brom, 2004).

The MINI-Plus is a short-structured interview based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (Sheehan et al., 1998; Van Vliet, Leroy, & Megen, 2000). The researcher (EV) conducted

the interviews to assess ASD at baseline and PTSD symptoms at follow-up (American Psychiatric Association, 2014, 2013). For ASD, the MINI-Plus contains 14 dichotomous items (i.e. the absence or presence of symptoms) and 20 dichotomous items for PTSD. Patients can be diagnosed with ASD if at least nine symptoms are present in any of the five categories (e.g. intrusion, negative emotions, dissociation, avoidance, and arousal) (American Psychiatric Association, 2014). In contrast, PTSD is indicative when at least one or two symptoms are present in each domain (i.e. intrusion ≥1, avoidance ≥1, negative emotion ≥2, and ≥2 arousal) (American Psychiatric Association, 2014).

The Hospital Anxiety and Depression Scale (HADS) is a generic questionnaire that measures anxiety and depressive symptoms (Zigmond & Snaith, 1983). It determines levels of anxiety (7 items) and depression (7 items) with a 4-point rating scale ranging from 0 (*not at all*) to 3 (*very much*). The scores for both subscales range from 0 to 21, with a cut-off score for disorder is ≥11 (Zigmond & Snaith, 1983). The Cronbach's alpha for anxiety ranged between .68 and .93 (Mean = .83) and for depression between .67 and .90 (Mean = .82) (Bjelland, Dahl, Haug, & Neckelmann, 2002). The questionnaire is reliable and valid in patients with traumatic brain injury (Whelan-Goodinson, Ponsford, & Schonberger, 2009).

The 60-item NEO Five Factor Inventory (NEO-FFI) measures the Big Five personality domains: (1) neuroticism, (2) extraversion, (3) openness to experience, (4) agreeableness, and (5) conscientiousness based on the five-factor model (Costa & McCrae, 1992; Hoekstra, Ormel, & de Fruyt, 1996). Each statement is rated on a five-point rating scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Scores in each domain range between 12 and 60. The Cronbach's alpha are .88 (neuroticism), .81 (extraversion), .74 (openness), .77 (agreeableness), and .87 (conscientiousness) (Spence, Owens, & Goodyer, 2012). The psychometrics (i.e. internal consistency, test-retest reliability, and validity) are acceptable to good in injury patients (Haider et al., 2002).

The State-Trait Anxiety Inventory (STAI) (short form) consists of 20 items for measuring state anxiety (10 items) and trait anxiety (10 items) (Spielberger, Gorsuch, & Lushene, 1970). In this study, only the STAI-Trait scale was used, which describes a person's tendency to experience feelings of anxiety and stress. The STAI-Trait scale has a four-point rating scale ranging from 1 (*almost never*) to 4 (*almost always*). The Dutch version of the STAI is a reliable and valid instrument in the general population (alpha = .91) (Spielberger et al., 1970).

2.4. Data analysis

Before imputation took place, the pattern of missing values was examined using Little's missing completely at random (MCAR) test. Missing item-level data of the IES-R and the HADS at a particular time point were imputed with individual subscale means at that time point, according to the half-rule whereby at least half of the items were answered (Bell, Fairclough, Fiero, & Butow, 2016; Weiss & Marmar, 1997).

Baseline characteristics of participants versus non-participants were compared using independent t-tests and chi-square tests. Non-normally continuous data was analysed with Mann-Whitney U tests or Fisher's exact tests.

The software Latent Gold (version 5.1) (Vermunt & Magidson, 2016) was used to conduct RMLCA to identify the number of non-observed (latent) trajectories in the courses of PTSD (dependent variable). Latent trajectory classes were estimated using the continuous ASD and PTSD scores. The absence or presence of an ASD or PTSD diagnosis was used as a predictor in all other analyses. Time was modelled as a categorical predictor with five measurements, allowing for the estimation of nonlinear PTSD trajectories over time. Missing values on the dependent variables were handled through full information maximum likelihood estimation, preventing listwise deletion by harnessing patient data at all available time points. The number of parameters (NPar) and the log-likelihood (LL) were used to calculate the Bayesian information criterion (BIC) (Vermunt & Magidson, 2002) to determine the number of trajectories that best fit the data based on the rule that lower BIC values indicate a better model fit (Collins & Lanza, 2010). Class membership was determined using Latent Gold's model class assignment procedure, and patients were assigned to the trajectory with the highest membership probability. The trajectories were labelled based on the course of PTSD scores across time.

Chi-square tests and ANOVAs were used to determine the sociodemographic, clinical, and psychological characteristics of ASD and each identified PTSD trajectory. Bonferroni-Holm correction was used to adjust the significance level for the large number of performed statistical tests (Holm, 1979).

For all significant (based on Bonferroni-Holm correction) continuous characteristics, Cohen's d effect sizes were calculated to determine which characteristics most strongly influenced class membership (Cohen, 1992). Odds ratios were used as effect sizes for categorical variables. For each trajectory, the three characteristics with the largest effect sizes were reported. While comparing trajectories, the trajectory of subclinical PTSD symptoms served as the reference class and was compared with the class of patients with no symptoms (i.e. 'No PTSD symptoms trajectory') and the class of patients with the worst PTSD symptoms (i.e. 'severe trajectory'). In that way, differences between the trajectories of subclinical PTSD symptoms and severe PTSD symptoms could be evaluated. Then, a risk profile was developed to determine which patients are at risk for ASD and PTSD.

Logistic regression analyses were used to examine the effect of ASD (absent versus present) and symptoms of

ASD dissociation (i.e. one of the two symptoms of dissociation; 'Experiences an altered sense of reality' or 'Inability to recall certain details of the traumatic incident') on PTSD (absent versus present) at 3, 6, 9, and 12 months afterwards. The first block (i.e. Model 1) included PTSD. ASD or ASD dissociation was subsequently included in the second block (i.e. Model 2). Crossover using Venn diagrams were designed to scrutinize the number of patients with ASD and ASD dissociation at baseline and PTSD at 3, 6, 9, and 12 months later. Only the MINI-Plus was used for these analyses, since symptoms of ASD dissociation cannot be measured using the IES-R. The data imputation, patients' sociodemographic traits, and responses to the questionnaires were analysed using SPSS version 24.

3. Results

In total, 267 patients were included at baseline (27% response rate; see Figure 1). The mean age was 54.0 (*SD* = 16.1), and 61.8% of the patients were male. The number of injuries was higher among participants than non-participants. Moreover, compared with non-participants, participants showed more spinal cord injuries, thorax or abdominal injuries with a combination of other injuries and more multitrauma or burn wounds. In addition, participants more often experienced trauma as cyclists. Participants more frequently had an isolated head injury than non-participants, whereas non-participants more often had multitrauma than participants (see Table 1).

Even though Little's MCAR test showed that there could be a pattern of missing for the IES-R at baseline, 3, 6, and 9 months measurements, missings were completely at random for the IES-R's at 12 months and the HADS at baseline (see Supplemental Table 1). After imputing the data, no differences were found in the number of participants since the missing items continued 12 months after trauma. Missing sum scores for the IES-R ranged from 21 (7.9%) at baseline to 6 (2.8%), 8 (4.0%), 5 (2.6%), and 8 (4.3%) at 3, 6, 9, and 12 months after trauma, respectively. Three (1.1%) missing sum scores for the HADS anxiety and 1 (0.4%) missing sum score for HADS depression were imputed.

3.1. Trajectories for posttraumatic stress disorder

Five latent trajectory classes best fit the data for both the IES-R and the MINI-Plus based on the lowest BIC value (see Supplemental Table 2). For both questionnaires, the trajectories were labelled as follows: (1) no PTSD symptoms (i.e. almost no PTSD symptoms present), (2) mild (i.e. PTSD symptoms are present a little), (3) moderate (i.e. PTSD symptoms are moderately present), (4) subclinical (i.e. the presence of symptoms that are almost not severe enough to be diagnosed as PTSD. For example, patients who lack one or two symptom criteria short of the full disorder), and (5) severe (i.e. PTSD symptoms are severely present) (see Figure 2(a,b)).

Regarding the IES-R, patients (15.0%) in the severe trajectory showed PTSD because their scores were above the cut-off point (IES-R ≥ 33). Approximately 7.2% exhibited subclinical symptoms (trajectory 4) within the first three months after trauma, followed by PTSD after three months (IES-R mean scores ≥33 cut-

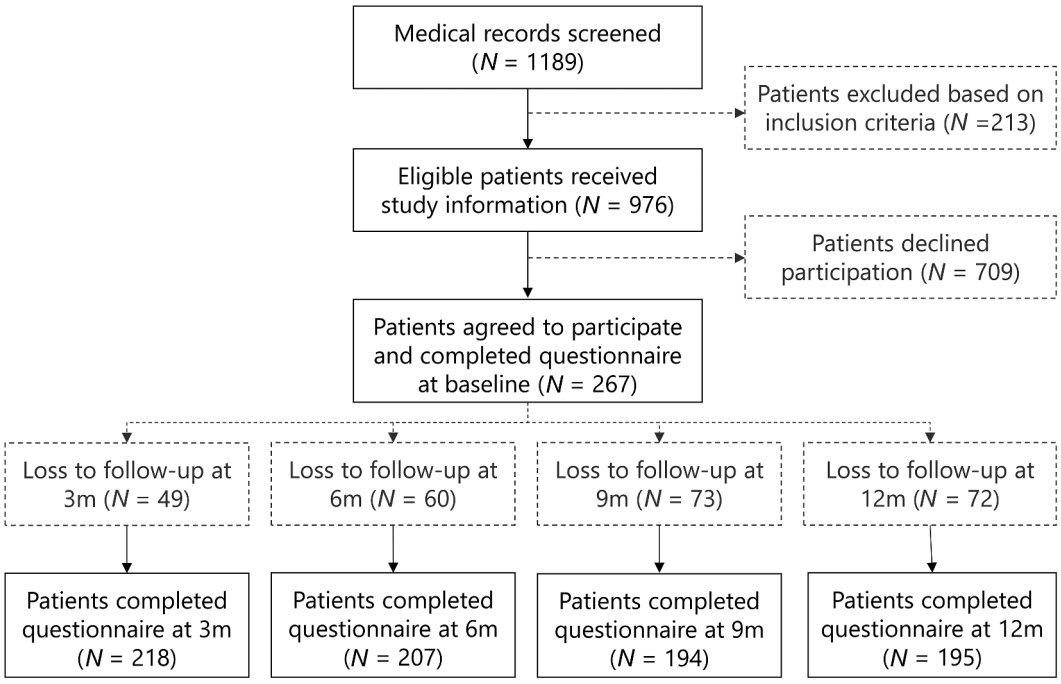

Figure 1. Flowchart of study population.

Table 1. Characteristics of the total cohort, participants who completed the baseline questionnaire and non-participants who were excluded from analysis.

	Total cohort (N = 973)		Participants (n = 267)		Non-participants (n = 706)		
	M, N or *Mdn*	*SD*, % or range	*M, N* or *Mdn*	*SD*, % or range	*M, N* or *Mdn*	*SD*, % or range	*p*-value
Age (years)*	50.7	20.0	54.0	16.1	49.5	21.2	**<.001**
18–44[§]	358	368	61	22.8	297	42.1	
45–64[§]	353	36.3	133	49.8	220	31.2	
65–74[§]	131	13.5	52	19.5	79	11.2	
≥75[§]	131	13.5	21	7.9	110	15.6	
Sex							.882
Women	368	37.8	102	38.2	266	37.7	
Men	605	62.2	165	61.8	440	62.3	
Trauma mechanism							**.014**
Motor vehicle accident	217	22.3	61	22.8	156	22.1	
Motorcycle	98	10.1	31	11.6	67	9.5	
Pedal cycle[§]	185	19.0	64	24.0	121	17.1	
Pedestrian	20	2.1	4	1.5	16	2.3	
Fall	364	37.4	92	34.4	272	38.6	
Struck by/collision	66	6.8	15	5.6	51	7.2	
Other[§]	23	2.4	0	0	23	3.3	
Number of injuries*	2.0	0.0–31.0	3.0	32.0–7.0	2.0	0.0–11.0	**<.001**
0–2[§]	591	60.7	116	43.4	475	67.3	
3–5[§]	301	30.9	107	40.1	194	27.5	
6–8[§]	53	5.4	23	8.6	30	4.2	
≥9[§]	28	2.9	21	7.9	7	1.0	
Type/nature of injury							**<.001**
Isolated head injury[§]	71	7.3	7	2.6	64	9.1	
Head and other injuries	351	36.1	93	34.8	258	36.5	
Spinal cord injury	100	10.3	30	11.2	70	9.9	
Orthopaedic injuries only	131	13.5	27	10.1	104	14.7	
Chest/abdominal alone	51	5.2	12	4.5	39	5.5	
Chest/abdominal and other injuries	66	6.8	24	9.0	42	5.9	
Other multi-trauma and burn[§]	191	19.6	74	27.7	117	16.6	
Other[§]	10	1.0	0	0	10	1.4	
ISS score*[‡]	N = 609		n = 263		n = 346		**<.001**
	5.0	1.0–48.0	5.0	1–38	6.0	1.0–48.0	
1–3	209	34.3	111	42.2	98	28.3	
4–8	157	25.8	71	27.0	86	24.9	
9–15	120	19.7	47	17.9	73	21.1	
≥16	123	20.2	34	12.9	89	25.7	
Glasgow Coma Score*	14.6	1.0	14.7	0.8	14.6	1.1	.156
9–12	45	4.7	8	3.0	37	5.2	
13–15	914	95.3	259	97.0	655	92.8)	
Living situation							
Alone			45	16.9			
With parents			18	6.7			
With a partner, no children			101	37.8			
With a partner and children			86	32.2			
Alone, with children			15	5.6			
Educational level							
Low			49	19.7			
Middle			103	41.4			
High			97	39.0			
Employment							
Employed			159	59.8			
Unemployed			108	40.2			
Hospitalization			173	64.8			
Surgery			43	25.1			
Admission to ICU			36	20.8			
Length of stay*			3.0	0.0–29.0			
1–2 days			76	28.5			
3–7 days			54	20.2			
8–14 days			21	7.9			
>15 days			9	3.4			
Psychiatric history[¥]			17	6.4			
Treatment by medical psychologist after trauma			4	1.5			

*Number of patients (percentages) are provided for categorical variables. Missing data was not included in calculating percentages. [§]A significant difference between the participants and non-participants [‡]ISS scores could be calculated only for patients who were hospitalized after treatment in the shock room and not for patients who were discharged after treatment in the shock room. Abbreviations: *n*: Number, *SD*: standard deviation, *Mdn*: Median, ICU: Intensive Care Unit, ISS: Injury severity score.

off) and a decrease in PTSD symptoms to a subclinical level between six and 12 months later.

Approximately 7.1% of the patients showed PTSD because their scores were above the cut-off (MINI-Plus ≥9) (trajectory 5) in the 12 months after trauma. In addition, 30.5% of the patients reported subclinical PTSD symptoms, as their scores were just under the cut-off score (trajectory 4). Although patients in this subclinical trajectory suffered from PTSD symptoms, they did not present enough symptoms to be

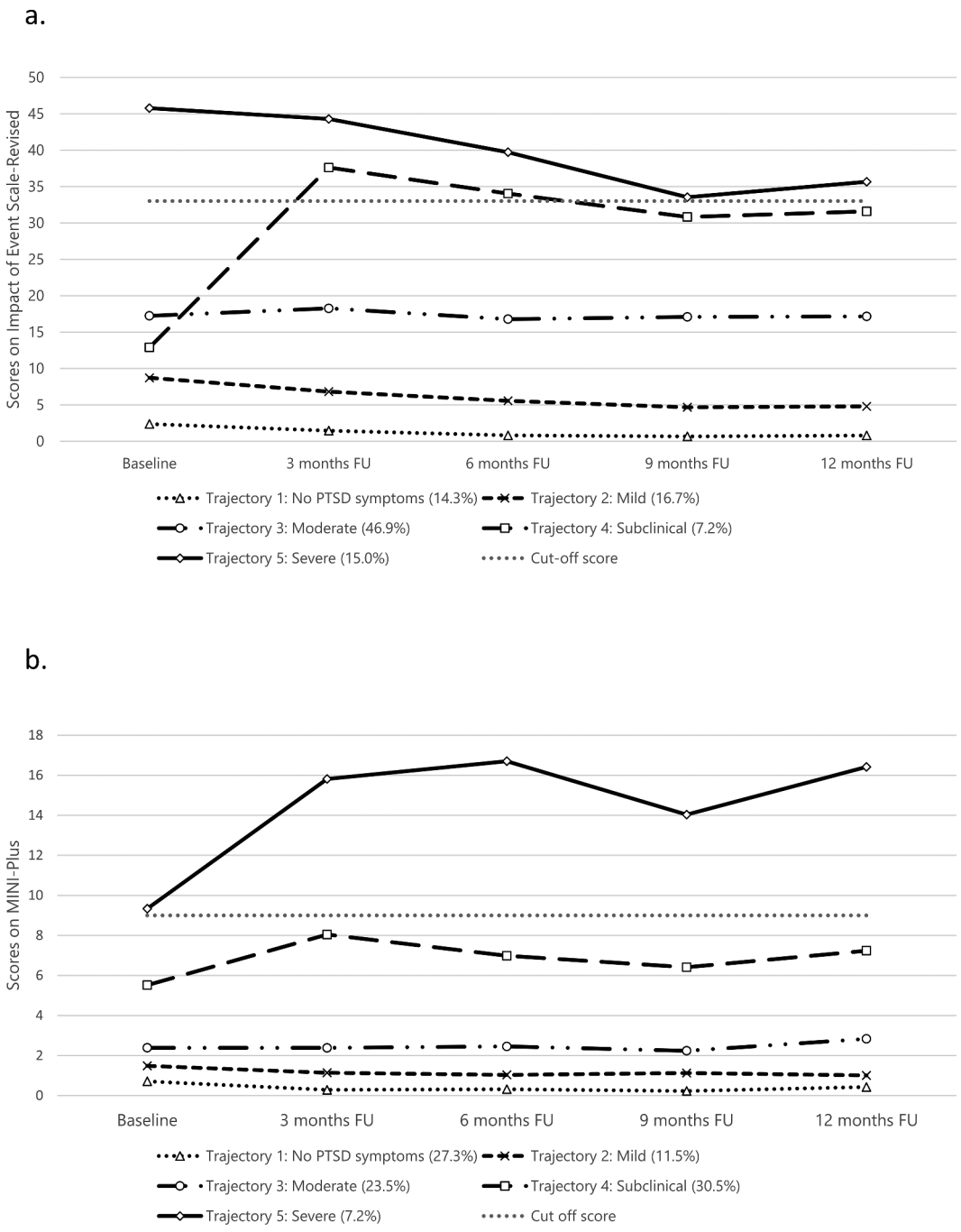

Figure 2. (a) Trajectories of PTSD based on impact of event scale-revised. Notes: After using repeated measures latent class analysis, five trajectories were identified over 12-months follow-up: (1) No PTSD symptoms (14.3%), (2) Mild (16.7%), (3) Moderate (46.9%), (4) Subclinical (7.2%), and (5) Severe (15.0%). PTSD was found when patients' mean score was above cut-off point (IES-R ≥ 33). Abbreviations: FU: Follow up. (b). Trajectories of PTSD based on MINI-Plus. *Notes*: After using repeated measures latent class analysis, five trajectories were identified over 12-months follow-up: (1) No PTSD symptoms (27.3%), (2) Mild (11.5%), (3) Moderate (23.5%), (4) Subclinical (30.5%), and (5) Severe (7.2%). PTSD was found when patients' mean score was above cut-off (MINI-Plus ≥9). Abbreviations: FU: Follow up.

diagnosed with PTSD. PTSD symptoms increased during the first three months, whereas they subsequently decreased up to 9 months after trauma. Then, symptoms increased again up to 12 months after trauma. These PTSD symptoms continued on a subclinical level for 12 months after trauma and did not increase to a full-blown diagnosis (above the cut-off point).

3.2. Risk profile for acute and posttraumatic stress disorder

Compared to patients without ASD symptoms, patients with such symptoms were younger, scored higher on anxiety, depressive symptoms, neuroticism, and trait anxiety and they scored lower for agreeableness and extraversion (see Table 2).

Table 2. Sociodemographic, clinical, and psychological characteristics for ASD, based on the MINI-Plus.

	MINI-Plus ASD symptoms				
	Absent		Present		
Characteristics	Mean or *n* *n* = 230	*SD* or % 92.7	Mean or *n* *n* = 18	*SD* or % 7.3	*p*-value
Anxiety*	6.6	4.6	11.3	2.2	**<.001**
Depressive symptoms*	4.9	2.4	8.2	2.0	**<.001**
Neuroticism*	28.3	8.0	37.4	4.7	**<.001**
Trait anxiety*	16.7	5.5	25.9	6.5	**<.001**
Age*	54.1	15.7	40.9	14.9	**.001**
Agreeableness*	41.9	4.4	39.2	3.9	**.011**
Extraversion*	42.0	6.6	38.2	6.3	**.019**
Psychiatric history (yes)	13	5.7	3	16.7	.099
ISS*	7.1	7.2	4.9	5.8	.214
Education (high)	90	42.3	4	22.2	.252
Conscientiousness*	45.4	6.2	43.7	6.4	.287
LOS*	4.9	5.4	6.8	8.8	.331
GCS*	14.7	.9	6.8	8.8	.332
Hospital stay (yes)	148	64.3	10	55.6	.456
Admission to ICU (yes)	35	23.6	1	10	.457
Living together (yes)	189	82.9	14	77.8	.529
Sex (men)	145	63	10	55.6	.615
Paid job (yes)	144	62.9	10	55.6	.616
Surgery (yes)	35	24	3	30	.707
Openness*	35.6	6.4	35.5	6.0	.964

Number of patients (percentages) are provided for categorical variables. *Means and standard deviations. Missing data was not included in calculating percentages. Using a Holm adjusted significance level, significant *p*-values for differences in a characteristic between all classes are shown in bold. Ranking of characteristics is based on *p*-value (low-high). *Abbreviations*: ASD: acute stress disorder, SD: standard deviation, LOS: length of stay, ISS: injury severity score, GCS: Glasgow coma score, ICU: intensive care unit.

With regard to PTSD, based on the IES-R, patients in the severe trajectory were younger and had higher scores for anxiety, depressive symptoms, neuroticism, and trait anxiety than patients in other trajectory classes (see Table 3). Most patients (32.4%) with ASD symptoms at baseline had a moderate trajectory. Although the characteristics of the MINI-Plus were similar to the characteristics of the IES-R, and the differences between trajectories mainly concerned psychological characteristics, the largest number of hospitalized patients (94.1%) was in the mild class (trajectory 2). Patients in the moderate class (trajectory 3) exhibited significantly more depressive symptoms and neuroticism than patients with fewer PTSD symptoms (trajectories 1 and 2). Patients with subclinical PTSD symptoms (trajectory 4) were less likely to have been hospitalized (51.3%) than those with mild PTSD symptoms (trajectory 2, 94.1%). Patients with subclinical (trajectory 4) and severe PTSD symptoms (trajectory 5) scored lower on agreeableness than patients without PTSD symptoms (trajectory 1). No clinical predictors were found for PTSD symptoms over 12 months after trauma.

The most pronounced differences (i.e. large effect sizes) between patients with ASD and without ASD were found for trait anxiety, depressive symptoms, and neuroticism (see Table 4). Concerning PTSD, based on the IES-R, the most pronounced differences between patients with subclinical presence of PTSD (trajectory 4) and no PTSD symptoms (trajectory 1) were found for psychological characteristics, including neuroticism, trait anxiety, anxiety, and ASD. Patients in the subclinical trajectory class scored substantially higher for neuroticism, trait anxiety, and anxiety than patients without PTSD symptoms. The odds of having ASD were lower for patients without symptoms (trajectory 1) than for patients with subclinical PTSD symptoms. Patients in the subclinical (class 4) and severe (class 5) trajectories differed most prominently in terms of trait anxiety, depressive symptoms, and anxiety, and ASD. Patients with subclinical PTSD trajectories had substantially lower scores for trait anxiety, depressive symptoms, and anxiety than patients with severe PTSD trajectories. The odds of having ASD were lower for patients in the severe trajectory class than for patients in the subclinical trajectory class (based on the IES-R).

With regard to PTSD, based on the MINI-Plus, the most discernable differences between the subclinical trajectory (class 4; reference group) and no PTSD symptom trajectory (class 1) were noted for psychological characteristics, including ASD, trait anxiety, neuroticism, anxiety, and the clinical characteristic admission to the hospital (see Table 4). Patients with a subclinical PTSD trajectory scored substantially higher for trait anxiety and neuroticism, and they scored lower for anxiety than patients without PTSD symptoms (trajectory 1). The odds of being hospitalized were lower for patients without PTSD symptoms (trajectory 1) than for patients in the subclinical trajectory. The odds of having ASD were similar for patients with subclinical PTSD symptoms compared to patients without PTSD symptoms. Patients in the subclinical trajectory (class 4) and severe trajectory (class 5) differed the most prominently in terms of depressive symptoms and trait anxiety. A medium effect size was found for neuroticism. Patients in the subclinical class exhibited substantially fewer depressive symptoms and lower scores for trait anxiety and neuroticism than patients with severe PTSD trajectories. The odds of being hospitalized and having ASD were lower for patients in the subclinical trajectory class than for patients in the severe trajectory class (based on the MINI-Plus). No statistically significant differences in patient characteristics were found between the classes with the lowest PTSD scores (i.e. no PTSD symptoms and the mild and moderate presence trajectories).

3.3. Effect of ASD on PTSD

Figure 3(a–c) display the number and percentage of ASD or dissociative symptoms of ASD, PTSD, and ASD+PTSD diagnoses at 3, 6, 9, and 12 months after

Table 3. Sociodemographic, clinical, and psychological characteristics for ASDand the five trajectories, based on the impact of event scale-revised and the MINI-Plus.

	Impact of Event Scale-Revised										
	Trajectory 1: no PTSD symptoms		Trajectory 2: mild		Trajectory 3: moderate		Trajectory 4: subclinical		Trajectory 5: severe		
	Mean or *n*	*SD* or %	Mean or *n*	*SD* or %	Mean or *n*	*SD* or %	Mean or *n*	*SD* or %	Mean or *n*	*SD* or %	
Characteristics	*n* = 38	14.3	*n* = 45	16.7	*n* = 125	46.9	*n* = 19	7.2	*n* = 40	15.0	*p*-value
Age*	59.1	14.8[5]	55.4	14.2[5]	55.4	15.9[5]	54.3	17.8	43.5	15.4[1,2,3]	**<.001**
Anxiety*	3.0	3.5[2,3,4,5]	5.7	3.9[1,5]	7.7	4.7[1,5]	6.8	5.2[1,5]	10.6	3.3[1,2,3]	**<.001**
Depressive symptoms*	3.3	1.8[3,5]	4.3	2.1[5]	5.4	2.5[1,5]	4.8	2.2[1,5]	7.3	2.7[1,2,3,4]	**<.001**
Neuroticism*	22.8	5.2[2,3,4,5]	28.3	7.2[1,5]	28.6	7.7[1,5]	29.3	6.5[1,5]	36.2	7.7[1,2,3,4]	**<.001**
Trait anxiety*	12.9	2.7[3,4,5]	15.8	4.5[5]	16.9	5.2[1,5]	17.1	5.2[1,5]	24.2	6.7[1,2,3,4]	**<.001**
ASD (yes)	5	4.4	0	0	12	32.4	0	0	1	5.6	**<.001**
Education (high)	18	50.0	24	60.0	40	34.8	5	26.3	10	25.6	.006
Agreeableness*	42.3	3.7	42.1	5.0	42.2	4.5	41.1	4.3	39.6	4.3	.019
Extraversion*	43.5	6.5	42.3	7.1	42.2	5.9	40.8	6.3	38.9	7.3	.02
Admission to ICU (yes)	6	26.1	10	33.3	10	11.5	4	33.3	6	28.6	.045
Openness*	35.2	6.1	37.0	6.0	35.5	6.6	32.2	4.7	35.9	5.9	.078
ISS*	9.0	7.4	6.6	6.2	6.1	7.6	5.5	5.1	7.3	7.4	.135
Psychiatric history	2	5.1	1	2.3	7	5.6	1	5.0	6	15.0	.164
Hospital stay (yes)	23	59.0	30	68.2	87	70.2	12	60.0	21	52.5	.266
Living together (yes)	34	87.2	40	90.9	96	78.7	18	90.0	32	80.0	.288
GCS*	14.7	1.0	14.5	1.3	14.7	0.7	14.8	0.6	14.9	0.5	.299
Paid job (yes)	23	59.0	30	68.2	72	58.5	14	70.0	20	50.0	.428
Sex (men)	26	66.7	27	61.4	78	62.9	14	70.0	20	50.0	.495
LOS*	4.4	4.2	5.2	5.6	4.2	4.8	7.0	9.2	5.4	6.5	.538
Conscientiousness*	46.6	4.3	45.8	6.9	45.1	6.2	45.9	6.3	44.5	7.2	.572
Surgery (yes)	5	21.7	7	24.1	22	25.3	3	25.0	6	30.0	.982
	MINI-Plus										
	Trajectory 1: no PTSD symptoms		Trajectory 2: mild		Trajectory 3: moderate		Trajectory 4: subclinical		Trajectory 5: severe		
	Mean or *n*	*SD* or %	Mean or *n*	*SD* or %	Mean or *n*	*SD* or %	Mean or *n*	*SD* or %	Mean or *n*	*SD* or %	
Characteristics	*n* = 73	27.3	*n* = 31	11.5	*n* = 63	23.5	*n* = 81	30.5	*n* = 19	7.1	*p*-value
Age*	60.3	14.4[4,5]	54.3	17.1	56.8	16.7[4,5]	48.0	14.1[1,3]	44.1	15.8[1,3]	**<.001**
Anxiety*	4.6	4.5[4,5]	4.3	3.5[4,5]	6.3	6.3	9.4	4.2[1,2,3]	11.8	1.9[1,2,3]	**<.001**
Depressive symptoms*	4.1	2.1[4,3,5]	3.5	2.3[4,3,5]	5.4	2.3[1,2,5]	5.9	2.6[1,2,5]	8.7	1.7[1,2,3,4]	**<.001**
Neuroticism*	24.4	7.3[4,3,5]	24.9	4.9[4,5]	28.4	6.3[1,4,5]	33.2	7.2[1,2,3]	38.2	8.4[1,2,3]	**<.001**
Extraversion*	44.0	6.0[4,5]	42.8	5.6[5]	42.4	5.5[5]	39.9	6.9[1]	37.0	7.9[2,3,4]	**<.001**
Trait anxiety*	14.0	4.4[4,5]	14.1	2.8[4,5]	16.3	3.8[4,5]	20.4	5.6[1,2,3,5]	26.7	7.5 [1,2,3,4]	**<.001**
ASD (yes)	0	0	0	0	0	0	11	14.3	7	41.2	**<.001**
Hospital stay (yes)	49	64.5	32	94.1	39	65.0	41	51.3	12	70.6	**.001**
Agreeableness*	43.0	4.1[4,5]	42.2	4.4	42.2	4.2[5]	40.8	4.6[1]	38.7	5.1[1,3]	**.001**
Conscientiousness*	46.6	5.6	46.4	3.9	46.0	6.0	43.8	7.1	43.4	7.7	.021
Living together (yes)	66	86.8	24	82.4	48	80.0	68	87.2	10	58.8	.056
Sex (men)	53	69.7	23	67.6	38	63.3	40	50.0	11	64.7	.118
Education (high)	32	45.1	9	30.0	26	45.6	27	36.0	3	18.8	.184
Psychiatric history	5	6.6	0	0	2	3.3	8	10.0	2	11.8	.211
LOS*	3.7	3.6	4.9	7.1	5.9	6.0	5.3	6.0	2.6	1.6	.270
ISS*	6.6	6.2	9.0	7.4	7.3	7.4	6.1	7.6	5.5	5.1	.277

(*Continued*)

Table 3. (Continued).

	Impact of Event Scale-Revised										
	Trajectory 1: no PTSD symptoms		Trajectory 2: mild		Trajectory 3: moderate		Trajectory 4: subclinical		Trajectory 5: severe		
	Mean or *n*	*SD* or %	Mean or *n*	*SD* or %	Mean or *n*	*SD* or %	Mean or *n*	*SD* or %	Mean or *n*	*SD* or %	
Characteristics	*n* = 38	14.3	*n* = 45	16.7	*n* = 125	46.9	*n* = 19	7.2	*n* = 40	15.0	*p*-value
Paid job (yes)	42	55.3	20	58.8	37	61.7	53)	67.1	7	41.2	.293
GCS*	14.8	0.7	14.6	1.0	14.6	0.9	14.7	0.9	14.7	0.8	.520
Openness*	35.6	5.4	33.9	7.8	35.9	5.6	35.8	6.9	35.9	5.7	.601
Admission to ICU (yes)	11	22.4	5	15.6	8	20.5	11	26.8	1	8.3	.620
Surgery (yes)	11	22.4	8	25.8	10	25.6	12	29.3	2	18.2	.931

Number of patients (percentages) are provided for categorical variables. *Means and standard deviations. Missing data was not included in calculating percentages. [a,1,2,3,4,5]A significant difference between the specified class(es). Using a Holm adjusted significance level, significant *p*-values for differences in a characteristic between all classes are shown in bold. Ranking of characteristics is based on *p*-value (low-high). *Abbreviations*: SD: standard deviation, ASD: acute stress disorder, LOS: length of stay, ISS: injury severity score, GCS: Glasgow coma score, ICU: intensive care unit.

Table 4. Risk profile of ASD and PTSD using Cohens' d effect size and odds ratio.

	ASD based on MINI-Plus			
Characteristics	Cohen's d (absent vs. present)	CI interval (95%)		
Anxiety	1.05	[.56, 1.5]		
Depressive symptoms	1.39	[.09, 1.88]		
Neuroticism	1.16	[.67, 1.65]		
Trait anxiety	1.65	[1.15, 2.15]		
Age	−.84	[−1.33, −.36]		
Agreeableness	−.62	[−1.10, −.14]		
Extraversion	−.58	[−1.06, −.10]		
	PTSD based on Impact of Event Scale-Revised			
Characteristics	Cohen's d (Trajectory 4 vs. Trajectory 1)	CI interval (95%)	Cohen's d (Trajectory 4 vs. Trajectory 5)	CI interval (95%)
Age	−.30	[−.86, .25]	.67	[.11, 1.23]
Anxiety	.91	[.33, 1.48]	−.95	[−1.52, −.38]
Depressive symptoms	.77	[.20, 1.34]	−1.01	[−1.58, −.43]
Neuroticism	1.14	[.55, 1.73]	−.94	[−1.52, −.38]
Trait anxiety	1.13	[.544, 1.72]	−1.12	[−1.71, −.54]
ASD	.16	[.01, 2.98]	.68	[.03, 17.35]
	PTSD based on MINI-Plus			
	Cohen's d (Trajectory 4 vs. Trajectory 1)	CI interval (95%)	Cohen's d (Trajectory 4 vs. Trajectory 5)	CI interval (95%)
Age	−.86	[−1.19, −.53]	.25	[−.25, .75]
Anxiety	1.1	[.76, 1.44]	−.62	[−1.13, −.11]
Depressive symptoms	.74	[.42, 1.07]	−1.13	[−1.65, −.60]
Neuroticism	1.21	[.86, 1.55]	−.67	[−1.18, −.16]
Extraversion	−.63	[−.95, −.30]	.41	[−.09, .19]
Trait anxiety	1.27	[.92, 1.61]	−1.05	[−1.57, −.53]
Agreeableness	−.51	[−.83, .19]	.43	[−.07, .93]
Hospital stay (yes)*	.50	[.26, .97]	.60	[.21, 1.67]
ASD (yes)*	.16	[.00, 8.64]	.27	[.09, .83]

Trajectory 4: Subclinical is the reference class. *Odds ratios are provided for hospital stay and ASD. *Abbreviations*: ASD: acute stress disorder, vs: versus, CI: confidence interval, PTSD: posttraumatic stress disorder.

A positive Cohen's d indicates a higher mean score for patients with ASD or patient in the subclinical trajectory (class 4; reference group) compared to patients without ASD or patients in either the no PTSD symptoms trajectory (class 1) or severe trajectory (class 5). Whereas a negative Cohen's d indicates a lower mean score for patients with ASD or patient in the subclinical trajectory (class 4; reference group) compared to patients in either the no PTSD symptoms trajectory (class 1) or severe trajectory (class 5). If the 95% confidence interval does not contain the null hypothesis value (zero), the results are statistically significant.

trauma in the current patient sample. Approximately 7.3% had ASD according to the MINI-Plus at baseline. Of all patients diagnosed with ASD at baseline, 8 (44.4%), 4 (22.2%), 5 (27.8%), and 6 (33.3%) reported PTSD symptoms at 3, 6, 9, and 12 months after trauma, respectively. Although the overall model was significant, the odds of developing PTSD during the 12 months after trauma were similar for patients with ASD compared to patients without ASD (B = .81; p = .181; OR = 2.24; 95% CI = .69, 7.32).

Thirty (11.6%) patients reported ASD dissociation at baseline, based on the MINI-Plus. Focussing on dissociative symptoms, significantly more patients reported symptoms of inability to recall memories about the event compared to patients who only experienced an altered sense of reality (105 (40.7%) versus 56 (21.7%), p = .031). Of all patients who experienced inability to recall memories about the event (N = 56, 21.7%), 15 (26.8%), 11 (19.6%), 8 (14.3%), and 15 (26.8%) reported PTSD symptoms at 3, 6, 9, and 12 months after trauma, respectively. In addition, patients who only experienced an altered sense of reality (N = 105, 40.7%), 14 (17.1%), 16 (20.3%), 12 (16.0%), and 18 (25.4%) of them reported PTSD symptoms at 3, 6, 9, and 12 months after trauma, respectively. The odds of developing PTSD during 12 months after trauma were 4.8 times higher for patients with ASD dissociation at baseline than for patients without ASD dissociation at baseline (B = 1.58; p = .181; OR = 4.84; 95% CI = 1.91, 12.25). Focussing on both ASD dissociation symptoms, the odds of developing PTSD during 12 months after trauma were higher for patients experiencing 'An altered sense of reality' (B = 1.45; p < .001; OR = 4.28; 95% CI = 1.96, 9.34) than patients experiencing 'Inability to recall certain details of the traumatic incident' (B = .822; p = .034; OR = 2.28; 95% CI = 1.06, 4.87).

4. Discussion

This study aimed to identify distinct trajectories of PTSD up to 12 months after injury and to examine patients' sociodemographic, clinical, and psychological characteristics for each trajectory. Subsequently, a risk profile was established to scrutinize patients at risk for ASD and PTSD. Finally, the effect of ASD on PTSD over time was studied. This study found five PTSD trajectories during the 12 months after injury. A relatively large proportion (22.2% (IES-R) – 37.6% (MINI-Plus)) of the total study population showed (subclinical) symptoms of ASD and PTSD that remained stable 12 months after trauma. The number of patients with PTSD for the IES-R and the MINI-

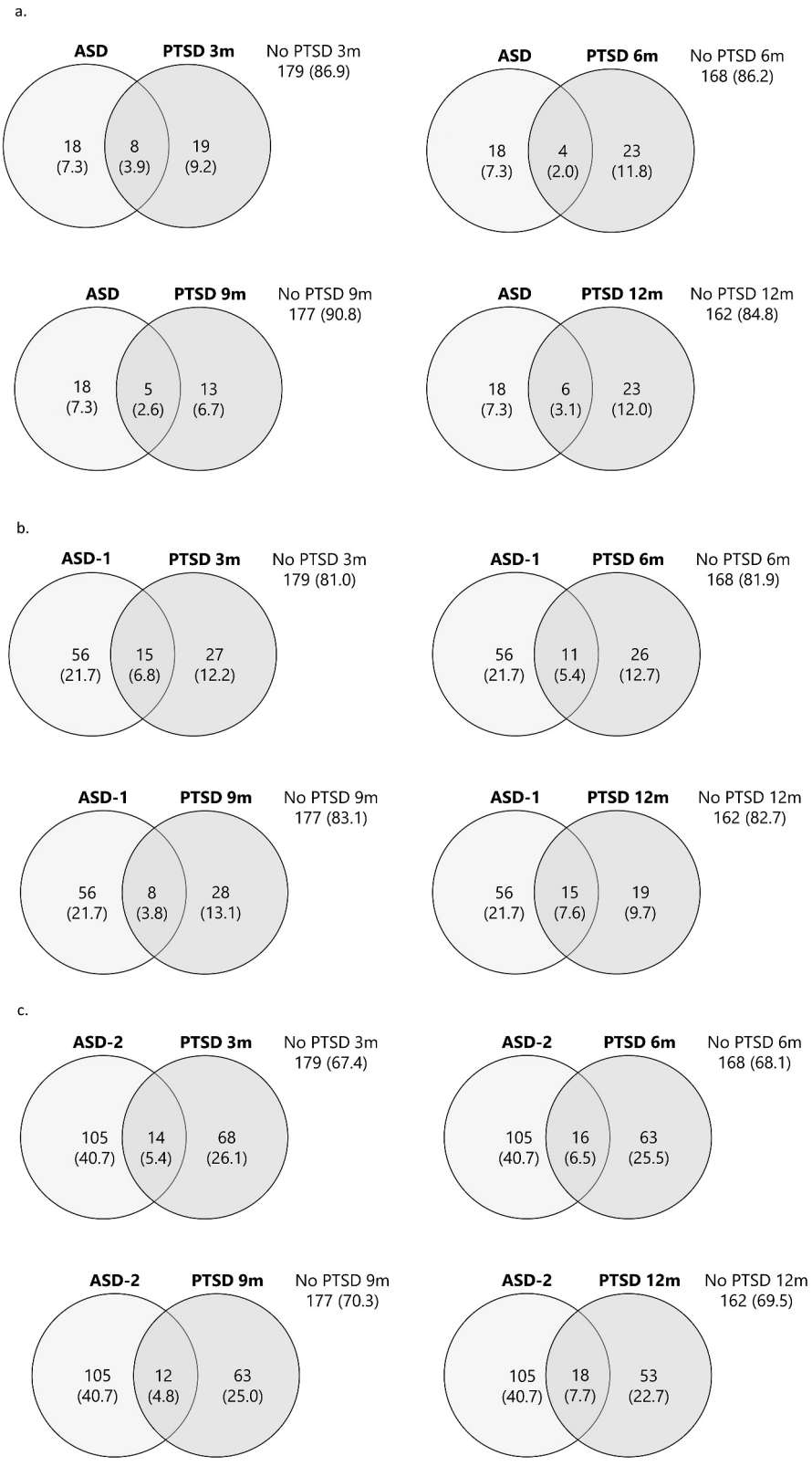

Figure 3. (a) Cross-over, using Venn diagrams, of numbers of patients with ASD (at baseline), ASD+PTSD, and PTSD (at 3, 6, 9, and 12 months after trauma) amongst the study population based on the MINI-Plus. Note: Numbers and percentages are provided. Missing data was not included in calculating numbers and percentages. Numbers and percentages for ASD are based on MINI-Plus at baseline, whereas ASD+PTSD and PTSD are based on a total of participants who completed the MINI-Plus at 3,6,9, and 12 months. (b) Cross-over, using Venn diagrams, of numbers of patients with dissociative symptom of ASD; 'an altered sense of reality' (at baseline), ASD+PTSD, and PTSD (at 3, 6, 9, and 12 months after trauma) amongst the study population based on the MINI-Plus. Note: Numbers and percentages are provided. Missing data was not included in calculating numbers and percentages. Numbers and percentages for ASD-1 are based on MINI-Plus at baseline, whereas ASD+PTSD and PTSD are based on a total of participants who completed the MINI-Plus at 3,6,9, and 12 months. ASD-1 describe the numbers and percentages of patients with dissociative symptom; 'the numbers of patients who only experienced an altered sense of reality'. (c) Cross-over, using Venn diagrams, of numbers of patients with dissociative symptom of ASD; 'inability to recall memories' (at baseline), ASD+PTSD, and PTSD (at 3, 6, 9, and 12 months after trauma) amongst the study population based on the MINI-Plus. Note: Numbers and

Plus was comparable at 12 months after trauma. In addition, the trajectories did not fluctuate and no spontaneous recovery or improvement in trajectories was found during the 12 months after injury, which is in line with earlier research (Hruska, Pacella, George, & Delahanty, 2016; O'Donnell et al., 2007; Zatzick et al., 2002). Nevertheless, results are conflicting, as there are several studies who found fluctuations or recovery in trajectories (Bryant et al., 2015; Bryant, O'Donnell, Creamer, McFarlane, & Silove, 2013; Osenbach, 2012; Osenbach et al., 2014; Visser et al., 2017). Moreover, the mean PTSD scores for the severe trajectory were seriously high (i.e. far above the cut-off point). This could have a negative impact on physiological and physical functioning (Haagsma et al., 2012; Kawamura, Kim, & Asukai, 2001; Olff, Guzelcan, de Vries, Assies, & Gersons, 2006) since psychological stress can affect wound repair and is related to pain and fatigue (Archer et al., 2014; Clay, Newstead, Watson, & McClure, 2010; Clay et al., 2010; Gouin & Kiecolt-Glaser, 2011; Wilson et al., 2014).

The risk profile for patients with ASD contained, in addition to younger age, mainly psychological characteristics, including symptoms of anxiety, depression, neuroticism, and trait anxiety and lower scores for agreeableness and extraversion. Patients with subclinical and severe PTSD symptoms had similar risk profiles with regard to anxiety, trait anxiety, and ASD. However, neuroticism and hospitalization were found only in patients with subclinical PTSD. In contrast, depressive symptoms were found only in patients with severe PTSD symptoms. Most likely, symptoms of PTSD and depression (e.g. negative emotions) overlap, since past studies have discovered biological molecular processes between PTSD and major depression (Flory & Yehuda, 2015) Another reason for presence of anxiety, depression (Mergler et al., 2017), and neuroticism (Spindler & Elklit, 2003) could be found in an abnormal high activation in brain regions that are involved in arousal modulation and emotional regulation (Lanius et al., 2010). Abnormal high activation will cause emotion dysregulation and overmodulation of affect. This is found in patients with a dissociative subtype of PTSD. Another subtype of PTSD is the nondissociative subtype and is characterized by symptoms of re-experiencing and hyperarousal. There is increasing evidence for these two different trauma response subtypes (van Huijstee & Vermetten, 2018). That is why, for the first time, a dissociative subtype of PTSD (i.e. PTSD+DS) was included, in the DSM (i.e. DSM-5) (American Psychiatric Association, 2014; van Huijstee & Vermetten, 2018). Moreover, peri-traumatic dissociation must be taken into account when focussing on PTSD symptom severity and (non)dissociative subtypes, because negative thoughts about the self partially mediated the association between peri-traumatic dissociation and PTSD severity (Thompson-Hollands, Jun, & Sloan, 2017). Since the focus of this study was not on specific symptoms of PTSD, including dissociative subtypes, future research could evaluate whether risk profiles of trauma patients are different for these dissociation subtypes. Furthermore, in line with previous studies, no clinical predictors (e.g. ISS > 16 or lower GCS) were observed (de Munter et al., 2019; Quale, Schanke, Froslie, & Roise, 2009).

Even though results from the different PTSD measurements must be interpreted with caution, more patients with (subclinical) PTSD were identified using the IES-R than the MINI-Plus (based on the DSM-5). In line with previous results that used the International Classification of Diseases, 11th edition (ICD-11) to indicate PTSD symptom severity in injury patients (Brewin et al., 2017), an increased number of patients with PTSD who would not have been diagnosed by the DSM-5 was noted (Brewin et al., 2017). Hence, considering the high prevalence rate of subclinical PTSD, future research could examine whether more patients from the subclinical trajectory could be diagnosed with PTSD using the ICD-11. In line with other studies, structured interviews were used to investigate ASD (baseline) and PTSD (follow-up) and a questionnaire to study PTSD (baseline and follow-up). Notwithstanding, they are different tools, and they differ in symptom examination because dissociative symptoms (e.g. depersonalization, derealization, and dissociative amnesia) are emphasized only in ASD and not in PTSD.

Patients with subclinical PTSD symptoms (MINI-Plus, trajectory 4) were less likely to be hospitalized than patients with other trajectories. This could indicate that discharge after treatment in the shock room could be a risk factor for PTSD. In addition, in the case of being hospitalized, the largest prevalence rate (26.8%) of admission to the ICU was found for this trajectory. Patients needed more complex and intensive care than patients in other classes. Thus, the possible presence of postintensive care syndrome (PICS) must be taken into account (Colbenson, Johnson, & Wilson, 2019; Desai, Law, & Needham, 2011).

This study was able to determine the prevalence rates of dissociation at baseline, based on the MINI-Plus. Focussing on dissociative symptoms, significantly more patients reported symptoms of inability to recall memories about the event compared to patients who only experienced an altered sense of reality. However, our results showed that 'An altered sense of reality' had the strongest likelihood for PTSD than patients who experienced 'Inability to recall

percentages are provided. Missing data was not included in calculating numbers and percentages. Numbers and percentages for ASD-2 are based on MINI-Plus at baseline, whereas ASD+PTSD and PTSD are based on a total of participants who completed the MINI-Plus at 3,6,9, and 12 months. ASD-2 describe the dissociative symptom; 'inability to recall memories about the event'.

certain details of the event'. By focussing on these symptoms, more people who are at risk of developing PTSD can be identified in the acute phase after trauma (Bryant et al., 2011). Moreover, this may help clinicians identify early on which dissociative symptoms to target in treatment.

Psychological trauma after injury is being evaluated in the field of emergency and trauma surgery. Therefore, a major strength of the present study is that it is the first to include personality alongside sociodemographic, clinical, and other psychological features in a risk profile of PTSD after injury. Similar patient characteristics for ASD and PTSD symptoms were found for both questionnaires. Patients with ASD and severe PTSD symptoms were younger and scored higher for anxiety, depressive symptoms, neuroticism, and trait anxiety. These aspects might imply symptom severity, showing that patients with more psychological problems and those with anxious and neurotic personalities are at risk for developing ASD and PTSD during the 12 months after trauma. Another strength is that patients were examined on five measurement occasions within 12 months after trauma, which allowed us to identify symptom trajectories over time. As a result, the effect of ASD on PTSD as well as the prevalence rates of patients with ASD and dissociative symptoms of ASD at baseline and PTSD 12 months after injury could be determined.

Some limitations must be taken into account. First, this is not a multicenter study since only one level-1 trauma centre was involved, this centre mostly treat severely injured patients from the province of Noord-Brabant (LNAZ, 2019). Mildly and moderately injured patients are often treated in level-2 or level-3 trauma centres (LNAZ, 2019). For example, this province has 11 level-2 or level-3 hospitals with an ED (LNAZ, 2019). Hence, the results may limit the generalizability to the entire trauma population from other rural and urban regions, including mildly and moderately injured people and foreigner (versus indigenous) populations. Additionally, observed differences in the characteristics of participants and non-participants suggests that selection bias may have occurred. This limits the representativeness of our sample and hence the generalizability of our findings to the larger trauma population who are admitted to the ED.

Second, the response rate was 27%. The main reason for the decline in participation was that patients were not interested, as they did not experience any physical or psychological problems after trauma. In contrast, participation could be difficult because the patients may have been facing other problems or (physical) limitations. Further, concerning dropout rates, it is likely that patients who fully recovered were less interested in completing follow-up measurements than patients who still experienced PTSD symptoms or problems with functioning.

In addition, two kinds of missingness were taken into account. First, missing values on the dependent variable were handled through full information maximum likelihood estimation using Latent Gold software. This method is appropriate when one or two follow-up measurements are missing from a participant. Second, in the case of single missing item scores on the IES-R and the HADS, imputation took place via individual subscale means when at least half of the subscale items were answered (Bell et al., 2016; Lin, 2006; Weiss & Marmar, 1997). Unfortunately, overestimation of item variation and a lower Cronbach's alpha of the scale from that item could have occurred (Lodder, 2014). Before imputation took place, Little's MCAR test was used to examine the mechanism of missing values. This test was violated for a number of measurements. Finally, this study was largely based on self-report questionnaires in addition to a structured interview. Interpretation of an ASD or PTSD diagnosis must be performed with caution, as the IES-R is based on the DSM-IV, while the MINI-Plus is based on the DSM-5.

Our study has implications for daily clinical practice. Clinicians with knowledge of risk profiles can identify and screen patients at an early stage in the ED or department of surgery (Levett & Grimmett, 2019) by using the Psychosocial Screening Instrument for Physical Trauma Patients (PSIT) (Karabatzakis, Den Oudsten, Gosens, & De Vries, 2019). HCPs could ask at-risk patients about their needs for additional care in the form of consultation from a social worker or health psychologist. In this way, HCPs are able to positively affect patients' clinical outcomes, and patient-centred care can be offered.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement

Data cannot be shared publicly, because data from this study may contain potentially or sensitive patient information. Data are anonymized, however nevertheless, due to relatively few severe cases, patients could be identified (Medical Ethics Committee Brabant). Therefore, data from this study will be made available for researchers who meet criteria for access to confidential data. Requests may be sent to: wetenschapsbureau@etz.nl.

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