Published in final edited form as:
Traumatology (Tallahass Fla). 2012 March ; 18(1): 20–28. doi:10.1177/1534765610395627.

A Latent Growth Mixture Modeling Approach to PTSD Symptoms in Rape Victims

Cherie Armour[1,2], **Mark Shevlin**[1], **Ask Elklit**[2], and **Dan Mroczek**[3]

[1]University of Ulster, Magee Campus, Londonderry, Northern Ireland, UK

[2]The National Centre for Psychotraumatology, University of Southern Denmark, Odense, Denmark

[3]Purdue University, West Lafayette, IN, USA

Abstract

The research literature has suggested that longitudinal changes in posttraumatic stress disorder (PTSD) could be adequately described in terms of one universal trajectory, with individual differences in baseline levels (intercept) and rate of change (slope) being negligible. However, not everyone who has experienced a trauma is diagnosed with PTSD, and symptom severity levels differ between individuals exposed to similar traumas. The current study employed the latent growth mixture modeling technique to test for multiple trajectories using data from a sample of Danish rape victims ($N = 255$). In addition, the analysis aimed to determine whether a number of explanatory variables could differentiate between the trajectories (age, acute stress disorder [ASD], and perceived social support). Results concluded the existence of two PTSD trajectories. ASD was found to be the only significant predictor of one trajectory characterized by high initial levels of PTSD symptomatology. The present findings confirmed the existence of multiple trajectories with regard to PTSD symptomatology in a way that may be useful to clinicians working with this population.

Keywords

posttraumatic stress disorder; longitudinal changes; LGMM; acute stress disorder; social support

Introduction

Posttraumatic stress disorder (PTSD) was first introduced to the *Diagnostic and Statistical Manual of Mental Disorders* in the third edition (*DSM-III*; American Psychiatric Association [APA], 1980). Since its inclusion, an area of interest relates to the stability or change of symptoms across time. Studies of this nature generally pertain to large-scale epidemiological studies that are often retrospective (e.g., Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995) or based on combat veteran samples (e.g., Solomon & Mikulincer, 2006). However, the above is not exclusive and other trauma samples, for example, individuals who have experienced motor vehicle accidents (e.g., Blanchard et al., 1996; Koren, Arnon, & Klein, 1999) have also been assessed. Overall, studies based on varying trauma samples

Corresponding Author: Cherie Armour, School of Psychology, Faculty of Life and Health Sciences, University of Ulster at Magee Campus, Londonderry, BT48 7JL, Northern Ireland, UK, armour-c@email.ulster.ac.uk & carmour@health.sdu.dk.

Declaration of Conflicting Interests
The author(s) declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

have tended to report that PTSD symptomatology decreases across time (cf. Riggs, Rothbaum, & Foa, 1995; Rothbaum, Foa, Riggs, Murdock, & Walsh, 1992; van Griensven et al., 2006; Wu & Cheung, 2006). However, other studies have reported increasing PTSD symptoms (Clipp & Elder, 1996; Kahana, 1992; Port, Engdahl, & Frazier, 2001), and the rarer occurrence of delayed onset PTSD symptoms (Clipp & Elder, 1996; Koren et al., 1999). More interestingly, the large majority of studies that have reported an increase in PTSD symptoms across time are based on veteran samples. A recent study conducted by Hepp et al. (2008) reported the occurrence of all three in one sample: decreasing, increasing, and delayed onset. Thus, it is reasonable to assume that varying PTSD trajectory groups exist. Whether the varying trajectories are a result of the varying sample characteristics remains to be seen.

Researchers have generally assessed the longitudinal changes in PTSD symptomatology in terms of one universal trajectory, with individual differences in baseline levels and the rate of change surrounding the overall trajectory. However, as various trajectories have been identified, an interesting, yet sparse, line of enquiry is whether multiple PTSD trajectory groups exist. The statistical technique commonly used to determine the overall baseline level and rate of change for a single trajectory group is latent growth modeling (LGM). LGM is based on the assumption that only a single trajectory group exists and that there is individual variability surrounding the baseline level (intercept) and the rate of change (slope). An extension of this technique is latent growth mixture modeling (LGMM; Muthén & Muthén, 2000; Muthén & Sheddon, 1999) that assesses the existence of multiple trajectory groups. Each trajectory group is said to differ with regard to a particular variable or process (McLachlan & Peel, 2000). LGMM employs growth parameters such as slopes and intercepts to uncover the existence of multiple trajectory groups across multiple measurement occasions, thus allowing researchers to extend their analysis to investigate which variables differentiate group membership.

Only two prior studies have directly employed LGMM with regard to PTSD data. The first was conducted by Orcutt, Erickson, and Wolfe (2004) based on data from a veteran sample. A model with two trajectory groups provided the best fit to the data. The slopes were both positive indicating an increase in symptomatology. Group membership was investigated using a number of explanatory variables: age, gender, race, education, military rank, military status, and combat exposure. It was concluded that those individuals who were male, White, with higher education, and less combat exposure were more likely to belong to the less symptomatic group. The second study was conducted by Elliot, Biddle, Hawthorne, Forbes, and Creamer (2005). This study differed from the previous as it assessed PTSD symptom trajectories in response to treatment. A model with three trajectory groups provided the best fit to the data. Again, group membership was investigated using a number of explanatory variables. It was concluded that higher scores on the baseline measures of alcohol use, anxiety, depression, anger, combat exposure, and clinician rated PTSD were indicative of membership of the most symptomatic group.

Although many explanatory variables have been shown to be related to PTSD, some have yet to be investigated with regard to the longitudinal changes in PTSD. Acute stress disorder (ASD) was introduced in 1994 (*DSM-IV*; APA, 1994) as an attempt to identify those individuals who had experienced a trauma and would subsequently develop chronic PTSD. Results thus far have reported that between 30% (Creamer, O'Donnell, & Pattison, 2004) and 83% (Brewin, Andrews, Rose, & Kirk, 1999) of individuals who have already met the criteria for an ASD diagnosis subsequently meet the criteria for a PTSD diagnosis. However, it has also been shown that 10% to 72% (Schnyder, Moergeli, Klaghofer, & Buddeberg, 2001, and Creamer et al., 2004, respectively) of individuals who meet PTSD diagnostic

criteria did not initially meet ASD diagnostic criteria. This can be regarded as a major limitation.

Another potentially important explanatory variable is that of perceived social support. It has been reported that when an individual perceives a high availability of social support after a traumatic event, this is directly associated with experiencing fewer PTSD symptoms (Bal, Crombez, Van Oost, & Debourdeaudhuij, 2003). Despite this, other studies have reported that social support may be detrimental to an individual's recovery as it is seen as an unwanted burden (e.g., Buunk & Hoorens, 1992) and that veterans diagnosed with PTSD often see a decrease in their levels of social support as time since discharge increases (Keane, Scott, Chavoya, Lamparski, & Fairbank, 1985; Solomon & Mikulincer, 1992). In addition, as social support is based on a reciprocal relationship, PTSD symptoms, such as avoidance, often make it difficult for it be properly received (Kaniasty & Norris, 2008).

Many other variables have been highlighted as influencing the severity and course of PTSD. For example, Brewin, Andrews, and Valentine (2000) concluded that for some populations, factors such as female gender, being of younger age, and being a member of a minority status race group were regarded as risk factors. However, it is important to note that the effect sizes of the demographic factors within Brewin et al.'s (2000) review were small and explained less about the development of PTSD than the other variables under investigation such as previous psychiatric history. More interestingly, the strongest weighted effect size was reported at .40 for lack of social support.

The current study had two main aims. First, to test whether there are different trajectory groups of PTSD across three measurement points after the experience of rape. On the basis of the research literature, it was hypothesized that multiple trajectory groups would exist. The second aim was to determine whether membership within a particular trajectory group can be defined by a number of explanatory variables (age, ASD, and perceived social support). We hypothesized that the explanatory variables would help differentiate between different groups. For example, those high on ASD would be expected to belong to a trajectory group characterized by a high intercept (high PTSD symptom levels), whereas those individuals' reporting high perceived social support would be expected to belong to a trajectory group characterized by a low intercept (low PTSD symptom levels). Hopefully, the aims of the current study will benefit the practitioner working with rape victims by highlighting those victims most at risk for developing prolonged and severe PTSD symptomatology.

Methods

Sample

Participants in this longitudinal study included 255 (baseline) rape victims, of which 96.8% were female, who had been in contact with a center for rape victims (CRV) at the University Hospital of Aarhus, Denmark. When victims first came into contact with the CRV, all were interviewed with regard to their demographic information. Every participant was offered the opportunity to speak with a counseling psychologist. Participants attended one therapy session approximately 2 weeks after first coming into contact with the CRV. Participants age ranged from 12 to 71 years ($M = 23.07$, $SD = 10.28$). All victims willing to participate and capable of participating completed an initial questionnaire between 2 and 3 weeks post rape (baseline). This questionnaire assessed a variety of demographics, ASD, and levels of perceived social support. Further data collection with regard to PTSD symptoms as measured using the Harvard Trauma Questionnaire (HTQ; Mollica et al., 1992) occurred at 3 (T1), 6 (T2), and 12 months (T3). The study followed the Nordic ethical guidelines set for psychologists. According to the regional Helsinki committee, practices that are primarily

used as part of the treatment program, such as questionnaires used for monitoring, do not need to be considered by regional ethics boards. This is the case for the present study. Furthermore, the participants gave informed consent, were secured full anonymity, and were not compensated for their participation.

Measures

HTQ Part IV—The HTQ is composed of 30 items that measure the presence and severity of PTSD (Mollica et al., 1992). Questions are answered on a 4-point Likert-type scale (1 = *not at all* to 4 = *to all the time*). PTSD severity is determined by summing scores. Sixteen items correspond to the 17 items as specified by the *DSM-IV* (APA, 1994). Mollica et al. (1992) reported good reliability and validity of the HTQ. The reliability scores of the scale, based on Cronbach's alpha, in the current study at Time Point 1, Time Point 2, and Time Point 3 were .89, .92, and .90, respectively.

The Crisis Support Scale (CSS)—The CSS is composed of seven items that measure the level of perceived social support (Joseph, Andrews, Williams, & Yule, 1992). Questions are answered on a 7-point Likert-type scale (1 = *never* to 7 = *always*). The CSS has been reported as having good reliability and validity and has been reported as having reliability coefficients of .74 (Elklit, Pedersen, & Jind, 2001). The reliability score of the scale, based on Cronbach's alpha, in the current study was .61.

ASD Scale (ASDS)—The ASDS is composed of 19 items that measure dissociative, reexperiencing, avoidance, and hyper-arousal symptoms as specified by the *DSM-IV* (Bryant, Moulds, & Guthrie, 2000). Questions are answered on a 5-point Likert-type scale (1 = *not at all* to 5 = *very much*). The ASDS has been reported as having good reliability, with a reliability coefficient of .90 (Elklit & Christiansen, 2010). The reliability score of the scale, based on Cronbach's alpha, in the current study was .85.

Analytic Plan

All statistical analyses used Mplus 5.2 software (Muthén & Muthén, 1998–2008). All analyses were conducted by calculating average scores. If individuals displayed missing data on more than four items on the HTQ, or two items on the CSS and ASDS, they were excluded. The first stage of analysis utilized LGMM (Muthén & Muthén, 2000; Muthén & Shedden, 1999). The LGMM technique was employed to identify varying change trajectories of individual's levels of PTSD symtomatology. Each subgroup trajectory is defined by two latent variables: intercept and slope (Cicchetti & Rogosch, 1999). LGMM can be likened to an amalgamation of LGM and latent class analysis. However, whereas LGM identifies change trajectories based on the variance around the mean of a single growth curve, LGMM allows for multiple change trajectories based on the variance around multiple means. Therefore, LGMM classifies individuals into subgroups based on their similarity of model parameters across varying time points. However, as it is not possible to definitively determine an individual's group membership, the probability with which an individual belongs to a particular group is used. These posterior probabilities are calculated from an individual's scores across time (Nagin, 1999). Each individual is assigned a probability score for each latent class, the highest probability value is indicative of that individual's group membership. Group members are such because they have answered items in a similar manner across multiple time points.

To determine the model with the most parsimonious number of classes, a series of models specifying one- to six-class solutions were estimated. Model fit is determined by a variety of fit indices: the Akaike Information Criterion (AIC; Akaike, 1987), the Bayesian Information Criterion (BIC; Schwartz, 1978), the sample size adjusted BIC (ssaBIC; Sclove, 1987), the

Lo–Mendell–Rubins Adjusted Likelihood Ratio Test (LRT; Lo, Mendell, & Rubin, 2001), entropy values (Ramaswamy, DeSarbo, Reibstein, & Robinson, 1993), and the likelihood ratio chi-square. Guidelines state that with reference to the AIC, BIC, and ssaBIC, the lower the values, the superior the fit (Muthιn & Muthιn, 2004). However, as more classes are added to the model, fit tends to improve with the AIC, BIC, and ssaBIC continually lowering. To determine what improvement is made to the model by adding an additional class, the difference between the values for the AIC, BIC, and ssaBIC can be calculated. If the difference between the values of one additional class is small, an additional class is said to add little to the model (DiStefano & Kamphaus, 2006). On the basis of parsimony, the solution with fewest classes should be accepted. If the LRT for a particular class solution is deemed significant (<.05), then the solution is deemed acceptable; however, if the LRT value is nonsignificant (>.05), this indicates that a solution with one less class should be used. Ramaswamy et al. (1993) reported that high entropy values indicate good classification, with 1 indicating perfect classification. Fit indices for model comparison are displayed in Table 2.

Subsequently, during the second stage of the analysis, to determine whether membership within a particular trajectory can be defined by a number of covariates, class membership was used as a dependent categorical variable within a logistic regression. The predictor variables were age and scores on the ASDS and CSS.

Results

All analyses were conducted using Mplus 5.2 software (Muthén & Muthén, 1998–2008).

LGMM

Table 1 shows the descriptive statistics for the total sample and for each of the two groups. Figure 1 shows the mean HTQ scores for each group across the three time points.

Fit indices for model comparison are shown in Table 2. The two-class solution was considered the optimal solution. The Lo–Mendell–Rubin's is nonsignificant for the three-class solution, whereas the two-class solution is significant. The entropy value indicates that a high proportion of participants is correctly classified. The AIC and ssaBIC both show a large drop from the one- to two-class solutions, and subsequent decreases through to the six-class solution are much smaller suggesting that additional classes do not add to the model (DiStefano & Kamphaus, 2006).

The probability value of individuals in Group 1 belonging to Group 1 was .906. The probability value of individuals in Group 1 belonging to Group 2 was .094. The probability value of individuals in Group 2 belonging to Group 1 was .089. The probability value of individuals in Group 2 belonging to Group 2 was .911. The parameter estimates for the intercepts and slops of each group can be viewed in Table 3.

The parameter estimates reported in Table 3 show that the trajectory of individuals in Group 1 (Low Stable: 35.0%) remains stable across the three time points as is evident from the nonsignificant slope mean. With regard to the trajectory of individuals in Group 2 (High Decline: 65.0%), the slope significantly declines across the three time points as is evident from the significant slope mean, in other words the fixed effect for Class 2 is adequate at explaining longitudinal changes. The significant variance of the slope in Group 1 indicates that there was significant variability around the slope mean across the three time points. The nonsignificant variance of the slope in Group 2 indicates that there was no significant variability around the slope mean across the three time points. With regard to the intercepts for Slope 1, the mean was statistically significant, whereas the variance was non-significant

indicating that there was no significant variability in the individual intercepts at the initial time for Group 2. With regard to the intercepts for Group 2, the mean and variance were both statistically significant indicating that there was significant variability in the individual intercepts at the initial time for Group 1. For both Group 1 and Group 2, the correlation between the intercept and slope factors was not statistically significant indicating that there is no significant relationship between initial status and subsequent growth within each group.

Logistic Regression

A logistic regression was preformed to determine whether a number of explanatory variables predicted group membership. Three covariates were included: age (OR = 1.010; CI = 0.983–1.037; $p = .475$), scores on ASDS (OR = 4.198; CI = 2.343–7.524; $p = .000$), and scores on CSS (OR = 0.969; CI = 0.674–1.394; $p = .867$). The results of the logistic regression indicated that only ASD was a significant predictor of group membership. The odds ratio was 4.198 which indicates that high scores on ASD at baseline are predictive of Group 2 (High Decline: 35%) membership.

Discussion

The specific aims of the current study were twofold. The first aimed to identify whether there were different trajectory groups of PTSD across three measurement points after the experience of a rape, and the second aimed to determine whether membership within a particular trajectory group could be defined by a number of explanatory variables (age, ASD, and perceived social support). It was hypothesized that different trajectory groups would coexist within a sample of rape victims and that the explanatory variables would help differentiate the existence of the varying trajectory groups.

The results suggested two PTSD trajectory groups. The first trajectory group (Group 1: Low Stable, 35.0%) was characterized by a low intercept and a nonsignificant slope. In other words, individuals in this group experienced PTSD symptoms that remained stable across time. The second trajectory group (Group 2: High Decline, 65.0%) was characterized by a high intercept and a significant negative slope. In other words, individuals within this trajectory group can be said to have experienced high levels of PTSD symptomatology shortly after the experience of a rape that gradually subsided as time passed. The results therefore confirm the first hypothesis pertaining to the existence of multiple trajectory groups.

The existence of a trajectory group characterized by a high intercept and a declining slope has been well established in the preceding PTSD literature (more recently in Galea et al., 2003; van Griensven et al., 2006; Wu & Cheung, 2006). With regard to trauma experiences such as motor vehicle accidents, Wu and Cheung (2006) have proposed that the decreasing slope may be attributable to the notion that individual's experience heightened anxiety levels directly after traumatic events that decrease across time. These heightened anxiety levels, in part, are said to exacerbate the severity of the PTSD symptomatology. However, as time passes it is thought that an individual's initial level of perceived threat and the accompanying levels of anxiety decrease because of the everyday life experiences correcting the negative cognitions associated with the trauma experience. This may also hold true for the current sample. Notably, this analysis failed to identify a trajectory group that was characterized by an increasing slope, despite this being found previously within the literature (e.g., Clipp & Elder, 1996). This may be attributable to the sample characteristics of the current study in that it is a noncombat veteran sample. Increasing trajectory slopes are generally identified in veteran samples and are possibly attributable to the reported tendency of such samples to exaggerate symptoms (Frueh, Gold, & de Arellano, 1997). This symptom

exaggeration has been linked to the positive correlation between PTSD symptom severity and increasing monetary compensation that is awarded by Veterans Affairs Centers in the United States (Frueh et al., 1997; Gold & Frueh, 1999).

Wu and Cheung (2006) suggested that the existence of different PTSD trajectory groups may indeed be attributable to the presence and severity of symptoms across the individual PTSD symptom clusters. They concluded that individuals who experienced severe avoidance symptomatology were continuously distressed by their symptoms that failed to decrease over time. This raises questions as to whether the severity and presence of avoidance symptoms has had implications for the trajectory groups within this current study. It is possible that the individuals within trajectory Group 1 (Low Stable) were experiencing severe avoidance symptomatology, whereas those in Group 2 (High Decline) were experiencing fewer avoidance symptoms. Likewise, Wu and Cheung (2006) concluded that the severity of reexperiencing and hyperarousal symptomatology decreases over time and therefore could be a characteristic of Group 2 (High Decline). In addition, previous theories of PTSD (e.g., Ehlers & Clark, 2000; Foa & Kozak, 1986) have focused on avoidance and escape behaviors with regard to the recovery from PTSD symptoms. Maybe the key differentiation between the two trajectory groups lies with the presence and severity of avoidance symptomatology. It has been suggested that the presence of such prevents the natural recovery process and is implicated in the maintenance of PTSD symptoms. Therefore a possible lack of avoidance symptomatology in Group 2 (High Decline) has allowed the natural recovery process to occur that explains the decreasing slope; however, the possible presence of avoidance symptomatology in Group 1 (Low Stable) may be attributable to the lack of change and so the maintenance of PTSD symptomatology. Unfortunately, the current study did not assess the role of different symptom clusters. However, this is an important issue that should be addressed by future LGMM research concerning PTSD.

The second hypothesis was related to whether membership within a particular trajectory group could be defined by a number of explanatory variables (age, ASD, and perceived social support). The results of the current study concluded that only ASD was a significant predictor of group membership. It was concluded that for every one unit increase in ASD, the odds of membership in Group 2 (High Decline) compared with Group 1 (Low Stable) increased by a factor of 4.198. The fact that the higher ASD scores are a significant predictor of the trajectory group characterized with the highest PTSD intercept scores (Group 2: High Decline). This is in accordance with previous research that has concluded that an ASD diagnosis has good predictive utility with regard to a subsequent PTSD diagnosis (cf. Creamer et al., 2004; Elklit & Brink, 2004; Harvey & Bryant, 1998; Schnyder et al., 2001). For example, the proportion of individuals who were diagnosed with ASD and then went on to develop PTSD ranged between 30% and 83% (Bryant, Harvey, Dang, & Sackville, 1998; Creamer et al., 2004). However, it is also important to note that the proportion of individuals who were diagnosed with PTSD who did not meet the initial ASD criteria ranged from 10% to 72% (Schnyder et al., 2001, and Creamer et al., 2004, respectively).

Contrary to the research literature, is the lack of significant findings with regard to the level of perceived social support. On the basis of the research literature (e.g., Bal et al., 2003; Brewin et al., 2000), it would have been agreeable whether perceived social support was a significant predictor of Group 2 (High Decline) as the individuals within this group improve with regard to their PTSD symptomatology. Alternatively, as some research has suggested that social support may be detrimental to an individual's recovery as it is seen as an unwanted burden (e.g., Buunk & Hoorens, 1992), it would have been equally agreeable if perceived social support was a significant predictor of Group 1 (Low Stable). The current

results, however, suggest that the level of perceived social support in the initial aftermath of a traumatic experience has no role with regard to differentiating the current two trajectory groups. The conclusions of recent research (e.g., Kaniasty & Norris, 2008) may partly account for the lack of significant finding. For example, Kaniasty and Norris (2008) concluded that social support may indeed be beneficial to an individual in the immediate aftermath of a traumatic experience, but as time passes, the levels of social support decrease. These "sequential transactions between social support and distress" (p. 280) are thought to occur as people are initially sympathetic to what is regarded as a natural response to trauma; however, as time passes and symptomatology persists, other individual's (social networks) begin to distance themselves from the PTSD-afflicted individual as they become overburdened by their symptoms. Likewise, the PTSD-afflicted individual begins to distance themselves from social networks and so from social support through avoidance symptoms and symptoms such as feelings of detachment and diminished interest (Kaniasty & Norris, 2008). The lack of a significant finding within the current results may, therefore, be attributable to the longitudinal nature of the study and the fluctuating role played by social support across time. Perhaps if perceived social support had been measured at each time point rather than just at baseline, the results would have differed. The explanatory variables of age also failed to differentiate between the two trajectory groups despite the fact that younger age has been implicated as a risk factor for the development of PTSD in some populations (cf. Brewin et al., 2000). However, as demographic variables have been implicated as risk factors to a far lesser extent than variables pertaining to trauma severity and psychiatric history (Brewin et al., 2000) the lack of a significant finding is not totally surprising.

A strength of the current study can be related to its use of LGMM with longitudinal PTSD data. All previous studies that have applied this technique have been based on data from veteran samples. Therefore, the current study is novel in that it applies LGMM to PTSD data of noncombat trauma survivors. However, it is important to note that some have criticized the LGMM approach (Bauer, 2007; Bauer & Curran, 2003). Notably, Bauer (2007) suggested that the LGMM technique can be misleading as classes can emerge from particular distributions of data rather than different groups at the population level. However, this issue still remains unresolved and others disagree with the criticisms and in fact advocate its use (e.g., Cudeck & Henly, 2003; Muthén, 2003; Rindskopf, 2003). Other limitations of the current study pertain to the use of only three measurement points. It has been stated that three measurement points may limit the complexity of the growth curve and that at least four measurement points is required to allow for a deeper exploration of longitudinal data (Orcutt et al., 2004). However, in light of the nature of the current research questions, longitudinal research is advantageous and so the design of the current study can be regarded as a strength. In addition, the current study is based on a Danish rape victim sample and therefore may pose problems with regard to the generalizability of results to other cultures and indeed to other trauma victims. Due to the notable lack of LGMM studies with regard to longitudinal PTSD data, studies like this must be conducted to confirm or indeed refute the results. Future research may also wish to consider conducting LGMM analysis while accounting for the varying symptom clusters. This will allow researchers to assess the role that symptoms from the varying clusters have with regard to differentiating the varying trajectory groups.

Clinical Implications

The results of the current research have indicated that not everyone who experiences a similar trauma will experience PTSD symptoms marked by similar severity and course. The results have indicated that people who have low levels of PTSD symptoms will not tend to increase. Therefore, it could be argued that treatment resources should be focused on people

with high levels of PTSD at baseline and on those who have high levels of ASD within the month immediately following the traumatic experience. However, that is not to say that those with initial low levels of PTSD should not receive therapy. All individuals suffering from PTSD symptomatology should be offered help; however, this study suggests that those with higher levels of PTSD and ASD at initial assessment may be regarded as priority cases. Identifying at risk individuals is essential with regard to deciding who receives the necessary treatment and when such interventions will have the greatest positive effect.

Acknowledgments

Funding

The author(s) received no financial support for the research and/or authorship of this article.

References

Akaike H. Factor-analysis and AIC. Psychometrika. 1987; 52:317–332.

American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 3. Washington, DC: Author; 1980.

American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4. Washington, DC: Author; 1994.

Bal S, Crombez G, Van Oost P, Debourdeaudhuij I. The role of social support in well-being and coping with self-reported stressful events in adolescents. Child Abuse & Neglect. 2003; 27:1377–1395. [PubMed: 14644056]

Bauer DJ. Observations on the use of growth mixture models in psychological research. Multivariate Behavioral Research. 2007; 42:757–786.

Bauer DJ, Curran PJ. Over-extracting latent trajectory classes: Much ado about nothing? Psychological Methods. 2003; 8:384–393.

Blanchard EB, Hickling EJ, Barton KA, Taylor AE, Loos WR, JonesAlexander J. One-year prospective follow-up of motor vehicle accident victims. Behaviour Research and Therapy. 1996; 34:775–786. [PubMed: 8952120]

Brewin CR, Andrews B, Rose S, Kirk M. Acute stress disorder and posttraumatic stress disorder in victims of violent crime. American Journal of Psychiatry. 1999; 156:360–365. [PubMed: 10080549]

Brewin CR, Andrews B, Valentine JD. Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. Journal of Consulting and Clinical Psychology. 2000; 68:748–766. [PubMed: 11068961]

Bryant RA, Harvey AG, Dang ST, Sackville T. Assessing acute stress disorder: Psychometric properties of a structured clinical interview. Psychological Assessment. 1998; 10:215–220.

Bryant RA, Moulds ML, Guthrie RM. Acute Stress Disorder Scale: A self-report measure of acute stress disorder. Psychological Assessment. 2000; 12:61–68. [PubMed: 10752364]

Buunk BP, Hoorens V. Social comparison and stress: The role of social comparison and social exchange processes. British Journal of Clinical Psychology. 1992; 31:445–457. [PubMed: 1483155]

Cicchetti, D.; Rogosch, FA. Conceptual and methodological issues in developmental psychopathology research. In: Butcher, JN.; Kendall, PC., editors. Handbook of research methods in clinical psychology. New York, NY: John Wiley; 1999.

Clipp, EC.; Elder, GH. The aging veteran of World War II: Psychiatric and life course insights. In: Ruskin, PE.; Talbott, JA., editors. Aging and posttraumatic stress disorder. Washington, DC: American Psychiatric Press; 1996.

Creamer MC, O'Donnell ML, Pattison P. The relationship between acute stress disorder and posttraumatic stress disorder in severely injured trauma survivors. Behaviour Research and Therapy. 2004; 42:315–328. [PubMed: 14975772]

Cudeck R, Henly SJ. A realistic perspective on pattern representation in growth data: Comment on Bauer and Curran. Psychological Methods. 2003; 8:378–383. [PubMed: 14596498]

DiStefano C, Kamphaus RW. Investigating subtypes of child development: A comparison of cluster analysis and latent class cluster analysis in typology creation. Educational and Psychological Measurement. 2006; 66:778–794.

Ehlers A, Clark D. A cognitive model of posttraumatic stress disorder. Behaviour Research and Therapy. 2000; 38:319–345. [PubMed: 10761279]

Elklit A, Brink O. Acute stress disorder as a predictor of post-traumatic stress disorder in physical assault victims. Journal of Interpersonal Violence. 2004; 19:709–716. [PubMed: 15140320]

Elklit A, Christiansen DM. ASD and PTSD in rape victims. Journal of Interpersonal Violence. 2010; 25:1470–1488. [PubMed: 20068117]

Elklit A, Pedersen SS, Jind L. The Crisis Support Scale: Psychometric qualities and further validation. Personality and Individual Differences. 2001; 31:1291–1302.

Elliot P, Biddle D, Hawthorne G, Forbes D, Creamer M. Patterns of treatment response in chronic posttraumatic stress disorder: An application of latent growth mixture modeling. Journal of Traumatic Stress. 2005; 18:303–311. [PubMed: 16281227]

Foa EB, Kozak MJ. Emotional processing of fear: Exposure to corrective information. Psychological Bulletin. 1986; 99:20–35. [PubMed: 2871574]

Frueh BC, Gold PB, de Arellano MA. Symptom over-reporting in combat veterans evaluated for PTSD: Differentiation on the basis of compensation seeking status. Journal of Personality Assessment. 1997; 68:369–384. [PubMed: 9107014]

Galea S, Vlahov D, Resnick H, Ahern J, Susser E, Gold J, Kilpatrick D. Trends of probable post-traumatic stress disorder in New York city after the September 11 terrorist attacks. American Journal of Epidemiology. 2003; 158:514–524. [PubMed: 12965877]

Gold PB, Frueh BC. Compensation-seeking and extreme exaggeration of psychopathology among combat veterans evaluated for posttraumatic stress disorder. Journal of Nervous and Mental Disease. 1999; 187:680–684. [PubMed: 10579596]

Harvey AG, Bryant RA. Relationship of acute stress disorder and posttraumatic stress disorder following motor vehicle accidents. Journal of Consulting and Clinical Psychology. 1998; 66:507–512. [PubMed: 9642889]

Hepp U, Moergeli H, Buchi S, Bruchhaus-Steinert H, Kraemer B, Sensky T, Schnyder U. Post-traumatic stress disorder in serious accidental injury: 3-year follow-up study. British Journal of Psychiatry. 2008; 192:376–383. [PubMed: 18450664]

Joseph SA, Andrews B, Williams R, Yule W. Crisis support and psychiatric symptomatology in adult survivors of the Jupiter cruise ship. British Journal of Clinical Psychology. 1992; 31:63–73. [PubMed: 1559118]

Kahana, B. Late-life adaptation in the aftermath of extreme stress. In: Wykle, ML.; Kahana, E.; Kowal, J., editors. Stress and health among the elderly. New York, NY: Springer; 1992.

Kaniasty K, Norris FH. Longitudinal linkages between perceived social support and posttraumatic stress symptoms: Sequential roles of social causation and social selection. Journal of Traumatic Stress. 2008; 21:247–281. [PubMed: 18404635]

Keane TM, Scott WO, Chavoya GA, Lamparski DM, Fairbank JA. Social support in Vietnam veterans with posttraumatic stress disorder: A comparative analysis. Journal of Consulting and Clinical Psychology. 1985; 53:95–102. [PubMed: 3980835]

Kessler RC, Sonnega A, Bromet E, Hughes M, Nelson CB. Posttraumatic-stress-disorder in the national comorbidity survey. Archives of General Psychiatry. 1995; 52:1048–1060. [PubMed: 7492257]

Koren D, Arnon I, Klein E. Acute stress response and posttraumatic stress disorder in traffic accident victims: A one-year prospective, follow-up study. American Journal of Psychiatry. 1999; 156:367–373. [PubMed: 10080550]

Lo YT, Mendell NR, Rubin DB. Testing the number of components in a normal mixture. Biometrika. 2001; 88:767–778.

McLachlan, GJ.; Peel, D. Finite mixture models. New York, NY: Wiley-Interscience; 2000.

Mollica RF, Caspi-Yavin Y, Bollini P, Truong T, Tor S, Lavelle J. The Harvard Trauma Questionnaire. Journal of Nervous and Mental Disease. 1992; 180:111–116. [PubMed: 1737972]

Muthén B, Shedden K. Finite mixture modeling with mixture outcomes using the EM algorithm. Biometrics. 1999; 55:463–469. [PubMed: 11318201]

Muthén, B.; Muthén, L. Mplus user's guide. 5. Los Angeles, CA: Author; 1998–2008.

Muthén B, Muthén L. Integrating person-centered and variable-centered analysis: Growth mixture modeling with latent trajectory classes. Alcoholism: Clinical and Experimental Research. 2000; 24:882–891.

Nagin DS. Analyzing development trajectories: A semi-parametric, group-based approach. Psychological Methods. 1999; 4:139–157.

Orcutt HK, Erickson DJ, Wolfe J. The course of PTSD symptoms among gulf war veterans: A growth mixture modeling approach. Journal of Traumatic Stress. 2004; 17:195–202. [PubMed: 15253091]

Port CL, Engdahl B, Frazier P. A longitudinal and retrospective study of PTSD among older prisoners of war. American Journal of Psychiatry. 2001; 158:1474–1479. [PubMed: 11532734]

Ramaswamy V, DeSarbo WS, Reibstein DJ, Robinson WT. An Empirical Pooling Approach for Estimating Marketing Mix Elasticities with PIMS Data. Marketing Science. 1993; 12:103–124.

Riggs DS, Rothbaum BO, Foa EB. A prospective examination of symptoms of posttraumatic-stress-disorder in victims of nonsexual assault. Journal of Interpersonal Violence. 1995; 10:201–214.

Rindskopf D. Mixture or homogeneous? Comment on Bauer and Curran. Psychological Methods. 2003; 8:364–368. [PubMed: 14596496]

Rothbaum BO, Foa EB, Riggs DS, Murdock T, Walsh W. A prospective examination of posttraumatic-stress-disorder in rape victims. Journal of Traumatic Stress. 1992; 5:455–475.

Schnyder U, Moergeli H, Klaghofer R, Buddeberg C. Incidence and prediction of posttraumatic stress disorder symptoms in severely injured accident victims. American Journal of Psychiatry. 2001; 158:594–599. [PubMed: 11282694]

Schwarz GE. Estimating the dimension of a model. Annals of Statistics. 1978; 6:461–464.

Sclove SL. Application of model-selection criteria to some problems in multivariate-analysis. Psychometrika. 1987; 52:333–343.

Solomon Z, Mikulincer M. Aftermaths of combat stress reactions: A three-year study. British Journal of Clinical Psychology. 1992; 31:21–32. [PubMed: 1559115]

Solomon Z, Mikulincer M. Trajectories of PTSD: A 20-year longitudinal study. American Journal of Psychiatry. 2006; 163:659–666. [PubMed: 16585441]

van Griensven F, Chakkraband ML, Thienkrua W, Pengjuntr W, Lopes Cardozo B, Tantipiwatanaskul P, Tappero JW. Mental health problems among adults in tsunami-affected areas in southern Thailand. Journal of the American Medical Association. 2006; 296:537–548. [PubMed: 16882960]

Wu KK, Cheung MWL. Posttraumatic stress after a motor vehicle accident: A six-month follow-up study utilizing latent growth modeling. Journal of Traumatic Stress. 2006; 19:923–936. [PubMed: 17195968]

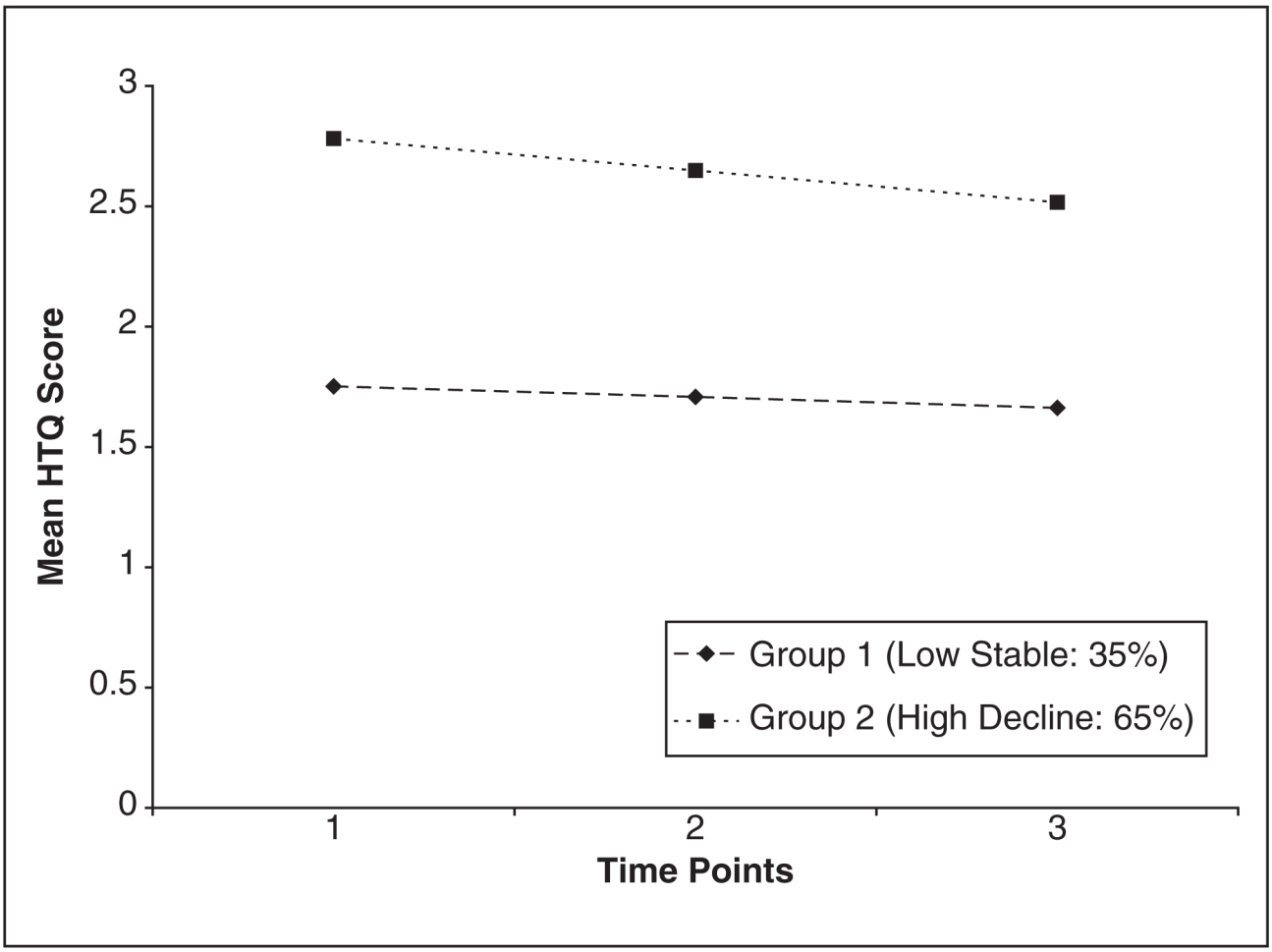

Figure 1.
Groups mean Harvard Trauma Questionnaire (HTQ) scores across three time points

Table 1

Variable Means and Standard Deviations by Full Sample (n = 255) and Groups

	HTQ (T1)		HTQ (T2)		HTQ (T3)		Age (baseline)		ASDS (baseline)		CSS (baseline)	
Variable	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Full sample	2.40	.67	2.33	.65	2.23	.65	23.07	10.28	3.05	.67	4.60	1.05
Group 1 (Low Stable: 35.0%)	1.67	.30	1.71	.52	1.58	.38	21.92	9.17	2.71	.68	4.73	1.12
Group 2 (High Decline: 65.0%)	2.79	.37	2.65	.46	2.54	.51	23.72	10.83	3.27	.57	4.52	.99

Notes: Variables Age, Gender, ASDS, and CSS were baseline measures and were not taken at subsequent time points. Gender was scored toward female. HTQ = Harvard Trauma Questionnaire (Mollica et al., 1992), ASDS = Acute Stress Disorder Scale (Bryant, Moulds, & Guthrie, 2000), CSS = Crisis Support Scale (Joseph, Andrews, Williams, & Yule, 1992).

Table 2

Fit Indices for the Estimated Latent Growth Mixture Models With Classes 1 Through 6

Model	Log likelihood	AIC	BIC	ssaBIC	Entropy	LRT
1	−25.55	667.10	695.85	670.49	—	—
2	−13.97	649.95	689.49	654.61	.69	21.85 0.03
3	−06.83	641.65	691.98	647.59	.72	13.49 0.15
4	−301.63	637.26	698.37	644.47	.78	9.81 0.12
5	−299.69	639.38	711.28	647.86	.78	3.66 0.25
6	−297.64	641.27	723.95	651.03	.75	3.87 0.50

Note: LRχ^2 = the likelihood ratio chi-square; AIC = Akaike Information Criterion (Akaike, 1987); BIC = Bayesian Information Criterion (Schwartz, 1978); ssaBIC = sample size adjusted BIC (Sclove, 1987); Entropy (Ramaswamy et al., 1993); LRT = Lo–Mendell–Rubins Adjusted Likelihood Ratio Test (Lo, Mendell, & Rubin, 2001).

Traumatology (Tallahass Fla). Author manuscript; available in PMC 2012 June 01.

Table 3

Parameter Estimates for Latent Growth Curve Model

	Parameter	Coefficient	Standard error
Group 1 (35%)—Low Stable	Intercept mean	1.752[a]	.060
	Intercept variance	0.127	.068
	Slope mean	−0.045	.044
	Slope variance	0.031[a]	.035
	Intercept—Slope correlation	−0.339	.445
Group 2 (65%)—High Decline	Intercept mean	2.782[a]	.044
	Intercept variance	0.127[a]	.068
	Slope mean	−0.132[a]	.036
	Slope variance	0.031	.035
	Intercept—slope correlation	−0.339	.445

[a]Indicates significant coefficients.