

# The Factor Structure of Traumatic Stress in Parents of Children With Cancer: A Longitudinal Analysis\*

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**Objectives** To determine the factor structure of posttraumatic stress symptoms (PTSS) and assess its stability over time among parents of children diagnosed with cancer. **Methods** Parents of children with cancer included in a longitudinal study completed the posttraumatic stress disorder (PTSD) Checklist–Civilian Version 2 weeks ( $n = 249$ ) and 2 ( $n = 234$ ) and 4 ( $n = 203$ ) months after their child's diagnosis. Confirmatory factor analysis (CFA) was used to assess 3 models of the underlying dimensions of PTSD and invariance tests were used to assess stability over time. **Results** A longitudinal CFA with the factors reexperiencing, avoidance, dysphoria, and hyperarousal provided best fit to the data. Invariance testing suggested that the pattern and size of loadings were equivalent across the three assessments. **Discussions** Findings tentatively suggest that PTSS among parents of children with cancer consist of four factors. Implications for research and clinical practice are discussed.

**Key words** assessment; cancer and oncology; children; longitudinal research; parent stress; psychosocial functioning.

## Introduction

The past decade has witnessed an increase in the number of studies reporting on the prevalence of traumatic stress among parents of children with cancer (Best, Streisand, Catania, & Kazak, 2001; Jurbergs, Long, Ticono, & Phipps, 2009; Kazak, Boeving, Alderfer, Hwang, & Reilly, 2005; Norberg, Lindblad, & Boman, 2005; Phipps, Long, Hudson, & Rai, 2005; Pöder, Ljungman, & von Essen, 2008). This growing body of research has built on the posttraumatic stress disorder (PTSD) symptomatology as described in the *Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition (DSM-IV; American Psychiatric Association, 2000)*. The criteria for PTSD

requires exposure to a traumatic event, after which a response of intense fear, helplessness, or horror follows (Criterion A). According to the *DSM-IV*, medical stressors such as “learning that one's child has a life-threatening illness” can be a traumatic event potentially leading to PTSD. PTSD comprises 17 posttraumatic stress symptoms (PTSS) pertaining to three factors or symptom clusters: reexperiencing (Criterion B), avoidance/numbing (Criterion C), and hyperarousal (Criterion D). However, an increasing number of studies have failed to confirm the validity of the *DSM-IV* three-factor solution for a wide variety of populations, suggesting that reexperiencing, avoidance/numbing, and hyperarousal, respectively, may not adequately capture the underlying dimensions of PTSD. In view of this emerging literature, the present study aimed to investigate the construct validity of competing models of the underlying dimensions of PTSD among parents of children with cancer.

\*Data presented in this study have in part been published previously in Pöder et al. (2008), Lindahl Norberg et al. (2011), and Pöder et al. (2010). Data not presented in this study but from the same sample have also been published previously in Pöder and von Essen (2009).

Research focusing on the levels of PTSS among parents of children with cancer is certainly a matter of dispute, as existing data demonstrate inconsistencies concerning the levels of PTSS among parents of children with cancer when compared to parents of healthy children (Barakat et al., 1997; Brown, Madan-Swain, & Lambert, 2003; Jurbergs et al., 2009; Kazak et al., 2005; Pelcovitz et al., 1996). This underscores the need of employing more sophisticated research strategies (Bruce, 2006; Jurbergs et al., 2009; Pöder et al., 2008) especially as there is a lack of conceptual models to guide clinical practice and empirical research targeting traumatic experiences among parents of pediatric oncology patients. The application of the PTSD symptomatology to this population has been called in question, given the apparent difference between common sources of trauma and medical stressors (Mundy & Baum, 2004). One key difference is that common traumatic stressors in general are past-event oriented, whereas medical stressors not only may refer to past events, such as the specific situation surrounding a diagnosis, but also to future-oriented aspects relating to fears and worries about treatment, recurrence, survival, and so forth.

These nosological issues were subjected to a closer inspection at the [National Child Traumatic Stress Network \(2003\)](#), in which a collaborative effort aimed at elaborating on clinical and empirical knowledge concerning pediatric patients and their next of kin was made. To this end, a conceptual model of pediatric medical traumatic stress (PMTS) was established to bring new dimensions to this line of research (Kazak et al., 2006; Pai & Kazak, 2006). PMTS was defined as “a set of psychological and physiological responses of children and their families to pain, injury, serious illness, medical procedures, and invasive or frightening treatment experiences” (The [National Child Traumatic Stress Network, 2003](#)). Like PTSD and acute stress disorder (ASD), PMTS covers key traumatic symptoms such as reexperiencing, avoidance/numbing, and hyperarousal, though PMTS is not proposed as a diagnostic entity. Rather, PMTS is conceptualized as a continuum of symptoms, which not necessarily entails a formal diagnosis of PTSD or ASD. Thus, PMTS is operationalized as symptoms of traumatic stress (yet in a pediatric context) and is therefore assessed with instruments developed for assessing symptoms of traumatic stress (Kazak et al., 2006; Pai & Kazak, 2006).

The advent of PMTS may contribute to an increased conceptual clarity of psychosocial aspects related to pediatric oncology as it provides a framework from where symptoms of traumatic stress could be understood and at the same time avoiding some of the conceptual problems that the application of pure ASD and PTSD nomenclature

entails in the context of medical stressors (as outlined above). One way of further adding to such clarity would be to determine the underlying dimensions of PTSD among parents of children with cancer by examining the factor structure of PTSS. Yet, to the best of our knowledge, the factor structure of PTSS in this group has thus far not been addressed. However, a growing body of evidence from various studies indicates that the predominant PTSD model, as defined in the *DSM-IV*, is indeed a question at issue. Prior research encompassing both exploratory factor analytic (EFA) and confirmatory factor analysis (CFA) has repeatedly failed to prove empirical support for the *DSM-IV* three-factor model (Baschnagel, O'Connor, Colder, & Hawk, 2005; DuHamel et al., 2004; Elklit & Shevlin, 2007; King, Leskin, King, & Weathers, 1998; Krause, Kaltman, Goodman, & Dutton, 2007; Marshall, 2004; McWilliams, Cox, & Asmundson, 2005; Palmieri & Fitzgerald, 2005; Palmieri, Weathers, Difede, & King, 2007; Simms, Watson, & Doebbeling, 2002). Instead, there are two competing four-factor models (King et al., 1998; Simms et al., 2002) that by means of CFA have gained the strongest empirical support when evaluated against other proposed models of PTSD. In the first of these four-factor models, King et al. (1998) distinguished the symptoms pertaining to the factor of avoidance/numbing (Criterion C) into two separate factors: effortful avoidance (C1 and C2) and emotional numbing (C3–C7). Thus, the King et al. (1998) model was comprised of the reexperiencing (B1–B5), effortful avoidance (C1 and C2), emotional numbing (C3–C7), and hyperarousal (D1–D5) factors.

However, Simms et al. (2002) found that a different four-factor model provided the best fit to their data. In conformity with the King et al. (1998) model, Simms et al. (2002) found an intrusion (or reexperiencing) factor (B1–B5) and an avoidance factor (C1 and C2) comprising only two symptoms. However, the Simms et al. (2002) model included a factor of nonspecific, general distress that was termed dysphoria, which comprised symptoms of emotional numbing (C3–C7) and hyperarousal (D1–D3). The remaining two symptoms loaded on a distinctive factor, termed hyperarousal (D4 and D5).

In the published CFA studies that support either the King et al. (1998) model (DuHamel et al., 2004; King et al., 1998; Marshall, 2004; McWilliams et al., 2005; Palmieri & Fitzgerald, 2005) or the Simms et al. (2002) model (Baschnagel et al., 2005; Elklit & Shevlin, 2007; Krause et al., 2007; Palmieri et al., 2007; Simms et al., 2002), data have been collected from a variety of populations, e.g., undergraduate students in New York after the September 11, 2001 terrorist attacks (Baschnagel et al., 2005),

survivors of bone marrow or stem cell transplantation (DuHamel et al., 2004), low-income minority women exposed to intimate partner violence (Krause et al., 2007), victims of community violence (Marshall, 2004), and sexually harassed women (Palmieri & Fitzgerald, 2005).

Research on the factor structure of PTSS among parents of children with cancer would shed new light on the phenomenology and construct validity of the model of PMTS for this population. A central research objective is to determine whether items designed to measure PTSS function in the same way among parents of children with cancer as they do in other trauma populations, and whether the symptom structures, or patterns of factor loadings, remain stable over time. To date, only two studies have examined the structural invariance of PTSS over time (Baschnagel et al., 2005; Krause et al., 2007), albeit with somewhat disparate data analytic strategies and with dissimilar samples. Based on data from two time points, 1 and 3 months after the September 11, 2001 terrorist attacks, Baschnagel et al. (2005) found that the Simms et al. (2002) model provided the best-fitting factor solution when evaluated against several other proposed models, including the King model. Moreover, Krause et al. (2007) collected data from two samples of low-income minority women exposed to intimate partner violence at two time points: approximately within 3 months after exposure to violence, and then around 1 year thereafter. Krause et al. (2007) also found that the Simms et al. (2002) model represented the best-fitting factor solution across time and setting compared to other examined models such as the King et al. (1998) model.

In the present study, we used the PTSD Checklist-Civilian Version (PCL-C; Weathers, Litz, Herman, Huska, & Keane, 1993) to measure PTSS and to compare three models of the underlying dimensions of PTSD among parents of children diagnosed with cancer shortly after diagnosis and 2 and 4 months after diagnosis. The PCL-C consists of 17 items that map directly on the corresponding symptoms in one of the three-symptom clusters of reexperiencing (Criterion B), avoidance/numbing (Criterion C), and hyperarousal (Criterion D) in the DSM-IV. We hypothesized that a four-factor model would provide better fit to the data than the current DSM-IV three-factor conceptualization. Furthermore, based on the findings by Krause et al. (2007) and Simms et al. (2002), we hypothesized that the best-fitting factor solution would evidence stability over time when testing model invariance with data collected 2 and 4 months after diagnosis.

## Methods

Data were collected in a project with a longitudinal design investigating disease and care-related responses of parents of children with cancer. The design covers seven assessments: 2 weeks after diagnosis (T1), 2 (T2), and 4 (T3) months after diagnosis, 1 week after end of treatment (T4), and 3 (T5), 12 (T6), and 60 (T7) months after end of treatment or the child's death. Participants were included between April 2002 and February 2004. Results from this project have been reported previously and these publications focused on describing proportions of PTSD caseness at T1–T3 (Pöder et al., 2008), perceptions of support and satisfaction with care at T1–T3 (Pöder & von Essen, 2009), perceptions of the child's cancer-related symptoms at T1–T3 (Pöder, Ljungman & von Essen, 2010), and the relationship between avoidance symptoms at T1–T4 and levels of PTSS at T6 (Lindahl Norberg, Pöder, & von Essen, 2011). None of these publications were concerned with the factor structure of PTSS. For the purpose of the present analyses, we used data from T1, T2, and T3.

## Participants

There were 315 eligible parents during the inclusion period. Two hundred and forty-five parents (128 mothers and 121 fathers) of 137 children treated for cancer at four pediatric oncology centers in Sweden consented to participation representing a 79% response rate. At the time of diagnosis, the mothers' mean age (*SD*) was 37 (6.3) and the fathers' mean age (*SD*) was 40 (6.8). Regarding educational level, 33% of the parents had completed university education, 51% upper secondary school, and 14% had finished elementary school. The children's mean age (*SD*) at the time of diagnosis was 8 (5.2) years. The distribution of diagnoses was as follows: Leukemia 40%, Lymphoma 19% Sarcoma 14%, CNS tumor 13%, and other malignant disease 14%. A series of one-way ANOVAs indicated that there were no significant effects of recruitment center on the level of PTSS at any time point, neither in terms of the full scale nor any of the subscales ( $df=3$ ,  $F$ 's ranging between 2.28 and 0.07,  $p$ -values ranging between .797 and .079).

Out of the 249 parents at T1, 234 provided data at T2 and 203 provided data at T3, respectively.

## Measures

PTSS was assessed with the PCL-C (Weathers et al., 1993), which contains 17 items corresponding to the DSM-IV symptom clusters of reexperiencing (Items 1–5), avoidance/numbing (6–12), and hyperarousal (13–17). The respondents were asked to rate to which extent they had

been bothered by each symptom during the previous month. Items were keyed to the child's disease thus providing an indicator of PTSS associated with their child's disease (i.e., PMTS). Ruggiero, Ben, Scotti, and Rabalais (2003) have provided the most thorough investigation on the psychometric properties of the PCL-C. They report that the instrument has adequate internal consistency, test-retest reliability, and that there is evidence for convergent and discriminant validity when compared to other well-established PTSS measures as well as measures of depression and general anxiety. A value of 44 or above on the full scale has been suggested as a clinical cut off suggesting a diagnosis of PTSD (Blanchard, Jones-Alexander, Buckley & Forneris, 1996).

### Procedure

Participants were included within 2 weeks after their child's diagnosis at four pediatric oncology centers. Potential participants were approached by a nurse who provided written and oral information about participation. The same nurse obtained oral informed consent to participate and to be contacted via telephone by a research assistant. The research assistant then, via telephone, conducted the interview where the PCL-C and other instruments (not reported herein) were administered. Permission to be contacted again was obtained at the end of the interview. The procedure was approved by the ethical review board at each respective faculty of medicine.

### Statistical Analyses

Confirmatory factor analysis (CFA) using Mplus 6.1 (Muthén & Muthén, 1998–2010) were performed as the primary method of analyses. The analytic strategy consisted of subjecting the three theoretical models (DSM-IV, Simms and King outlined in the 'Introduction' section) of PTSS factor structure to CFA to determine the best model fit to the current data. This was conducted by performing a longitudinal CFA and testing for measurement invariance across time for each of the three models. In order to control for the dependent nature of the data, i.e., parent dyads nested in children, which can potentially bias standard errors and  $\chi^2$  estimates, we used the TYPE = COMPLEX and CLUSTER commands in Mplus. We used MLR estimation which is the default estimator in Mplus for this procedure which produce estimates of  $\chi^2$  and standard errors that are robust to nonindependence and non-normality (Muthén & Muthén, 1998–2010). Measurement invariance was tested in three steps. First, a configural model was tested where all factor loadings and covariances were allowed to be freely estimated. Secondly, metric invariance was tested by constraining factor loadings to be

equal across time. Thirdly, phi invariance was investigated by adding constraints on factor covariances to be equal across time. Measurement invariance was investigated with the Satorra–Bentler scaled  $\Delta \chi^2$ -test, which is recommended when using MLR estimation (Satorra, 2000), and  $\Delta$  CFI where convention suggests values equal to or lower than  $-.01$  as nonsignificant (Cheung & Rensvold, 2002). Model test statistics of fit included  $\chi^2$ -tests, and approximate fit indexes used were Steiger–Lind root-mean-square error of approximation (RMSEA; Steiger, 1990) and Bentler comparative fit index (CFI; Bentler, 1990). According to Byrne (2010) RMSEA, values  $< 0.05$  indicate good fit and values ranging between 0.08 and 0.10 moderate fit, while CFI values close to 0.95 indicate good fit and values  $> 0.90$  acceptable fit. For the purpose of comparing fit between models, sample size adjusted Bayesian information criteria (BIC; Raftery, 1995) was used, with lower values indicating better model fit.

Standardized factor loading estimates were used as indices of construct validity and values exceeding .50 were considered to reflect adequate construct validity (Hair, Black, Babin, & Anderson, 2010). Internal consistency for each factor at each assessment was analyzed with Cronbach's  $\alpha$ . Finally, descriptive statistics were used to describe the participants in terms of the chosen model. In order to control for the dependent nature of the data, we used linear mixed models with child as random intercept to estimate and test differences in PTSS between mothers and fathers at each assessment point. Repeated measures ANOVA was used to estimate and test change over time among mothers and fathers, respectively. Linear mixed models and repeated measures ANOVA were conducted in IBM SPSS Statistics 19.0.

### Results

As a first step, we evaluated all three models cross-sectionally with data from each of the three assessments. As is evident from Table I, all models evidenced good to acceptable fit at all three assessments. Inspection of BIC reveals that the Simms model provided best fit at T1 and T2 and that the King model provided best fit at T3. Results from the primary analyses incorporating data from all three assessments in longitudinal CFA are presented in Table II. Comparing baseline configural models, the Simms model had the highest CFI (indicating acceptable fit), equally low RMSEA as the King model (indicating good fit) and the lowest BIC value, indicating that this was the best representation of a longitudinal analyses of the factor structure. When testing for metric invariance (i.e., factor loadings

constrained to be equal across time), both the King and the Simms model evidenced nonsignificant Satorra–Bentler scaled  $\Delta\chi^2$ -test and  $\Delta CFI$  closer to zero than  $-.01$ . In comparison, the *DSM-IV* model exhibited a significant increase in the Satorra–Bentler scaled  $\Delta\chi^2$ -test and a  $\Delta CFI$  closer to  $-.01$ . However, when testing for phi invariance all three models had significant Satorra–Bentler scaled  $\Delta\chi^2$ -tests and  $\Delta CFI$  closer to  $-.01$  than zero. Thus, both the King and the Simms model evidenced acceptable to good fit, metric invariance, and phi noninvariance. However, when comparing models with BIC, the Simms model evidenced best fit (i.e., lower value) and was therefore chosen for further descriptive analyses.

Table I. Fit Statistics for Cross-Sectional Models

| Model        | MLR $\chi^2$ | df  | CFI  | RMSEA | RMSEA 90% CI | BIC       |
|--------------|--------------|-----|------|-------|--------------|-----------|
| T1 (n = 249) |              |     |      |       |              |           |
| DSM-IV       | 159.09       | 116 | .949 | .039  | 0.022–0.054  | 12,384.17 |
| King         | 157.24       | 113 | .948 | .040  | 0.078–0.102  | 12,388.56 |
| Simms        | 152.02       | 113 | .954 | .038  | 0.020–0.053  | 12,383.98 |
| T2 (n = 234) |              |     |      |       |              |           |
| DSM-IV       | 194.87       | 116 | .927 | .055  | 0.041–0.068  | 10,674.17 |
| King         | 188.88       | 113 | .929 | .055  | 0.041–0.068  | 10,673.22 |
| Simms        | 183.16       | 113 | .935 | .053  | 0.038–0.066  | 10,666.66 |
| T3 (n = 203) |              |     |      |       |              |           |
| DSM-IV       | 235.49       | 116 | .894 | .072  | 0.059–0.086  | 8,648.31  |
| King         | 208.25       | 113 | .915 | .065  | 0.051–0.079  | 8,621.43  |
| Simms        | 208.05       | 113 | .916 | .065  | 0.051–0.079  | 8,623.86  |

Note. *DSM-IV*, *Diagnostic Manual for Mental Disorders—4th edition*; MLR, maximum likelihood estimator robust to non-normality and nonindependence; CFI, Bentler comparative fit index; RMSEA, Steiger–Lind root-mean-square error of approximation; CI, confidence interval; BIC, sample size adjusted Bayesian information criteria.

Table II. Fit Statistics for Longitudinal Models and Test of Model Invariance

| Model         | MLR $\chi^2$ | df    | S-B $\Delta\chi^2$ | CFI  | $\Delta CFI$ | RMSEA | RMSEA 90% CI | BIC       |
|---------------|--------------|-------|--------------------|------|--------------|-------|--------------|-----------|
| <i>DSM-IV</i> |              |       |                    |      |              |       |              |           |
| Config.       | 1,635.35     | 1,153 |                    | .898 |              | .042  | 0.037–0.046  | 30,384.90 |
| Metric        | 1,694.98     | 1,180 | 58.83***           | .892 | -.006        | .043  | 0.038–0.047  | 30,387.07 |
| Phi           | 1,704.72     | 1,184 | 69.37***           | .890 | -.008        | .043  | 0.038–0.047  | 30,387.68 |
| King          |              |       |                    |      |              |       |              |           |
| Config.       | 1,616.83     | 1,146 |                    | .901 |              | .041  | 0.037–0.046  | 30,375.97 |
| Metric        | 1,652.14     | 1,172 | 35.19              | .899 | -.002        | .041  | 0.037–0.046  | 30,353.14 |
| Phi           | 1,677.71     | 1,178 | 61.98**            | .895 | -.006        | .042  | 0.037–0.047  | 30,367.47 |
| Simms         |              |       |                    |      |              |       |              |           |
| Config.       | 1,604.62     | 1,146 |                    | .903 |              | .041  | 0.036–0.046  | 30,365.13 |
| Metric        | 1,632.67     | 1,172 | 28.05              | .903 | .000         | .041  | 0.036–0.045  | 30,334.92 |
| Phi           | 1,661.01     | 1,178 | 56.78**            | .898 | -.005        | .041  | 0.037–0.046  | 30,351.07 |

Note. All models contain data from all three assessments. *DSM-IV*, *Diagnostic Manual for Mental Disorders—4th edition*; MLR, maximum likelihood estimator robust to non-normality and nonindependence; S–B, Satorra–Bentler; CFI, Bentler comparative fit index; RMSEA, Steiger–Lind root-mean-square error of approximation; CI, confidence interval; BIC, sample size adjusted Bayesian information criteria.

\*\* $p < .01$ . \*\*\* $p < .001$ .

Table III displays factor loadings for each item and internal consistency for each factor according to the Simms model. Item factor loadings were acceptable in general with values exceeding  $.50$  with the exception of Item 3 (reliving) at T1, Item 6 (avoiding thoughts) at T2, Item 8 (trouble remembering) T1–T3, and Item 12 (future cut short) T1–T3. Internal consistency was acceptable with the exception of the avoidance factor at T1 and T2.

Table IV presents descriptive statistics for the PCL-C and its subscales according to the Simms model. As is evident, there were significant differences between mothers and fathers in the full scale and all subscales except for the avoidance factor at all assessment points. For mothers, there was a significant main effect of time in the full scale and all subscales except for the avoidance factor. (Full scale:  $F = 15.57$ ,  $df = 1.86$ ,  $p < .001$ ; reexperiencing:  $F = 5.90$ ,  $df = 1.63$ ,  $p < .01$ ; avoidance:  $F = 2.63$ ,  $df = 2$ ,  $p = .08$ ; dysphoria:  $F = 14.92$ ,  $df = 1.88$ ,  $p < .001$ ; hyperarousal:  $F = 15.23$ ,  $df = 2$ ,  $p < .001$ ). For fathers, there was a similar pattern with a main effect of time in the full scale and all subscales. (Full scale:  $F = 24.26$ ,  $df = 2$ ,  $p < .001$ ; reexperiencing:  $F = 23.38$ ,  $df = 2$ ,  $p < .001$ ; avoidance:  $F = 3.31$ ,  $df = 2$ ,  $p < .05$ ; dysphoria:  $F = 8.94$ ,  $df = 1.87$ ,  $p < .001$ ; hyperarousal:  $F = 22.95$ ,  $df = 1.79$ ,  $p < .001$ ). At T1, 43% of mothers and 21% of fathers scored above the suggested clinical cutoff (i.e., 44). The corresponding proportions at T2 were 33% for mothers and 19% for fathers, and 28% for mothers and 7% for fathers at T3. Thus, both mothers and fathers evidenced declining levels of PTSS across the assessments; however, a considerable number of parents, mothers especially, scored above the clinical cutoff.

## Discussion

In the current study, we investigated the factor structure of PTSS among parents of children with cancer. We used a longitudinal model-fitting approach based on CFA and tested three models of the underlying dimensions of PTSD and assessed model stability over time. In line with our hypothesis, a four-factor model provided the best fit to the data. Considering a confirmatory factor model including all three assessments, the Simms model evidenced better fit than the *DSM-IV* model and somewhat better fit

Table III. Internal Consistency of Factors and Item Factor Loadings across Assessments

| PCL–C factors and items             | T1       |           | T2       |           | T3       |           |
|-------------------------------------|----------|-----------|----------|-----------|----------|-----------|
|                                     | $\alpha$ | $\lambda$ | $\alpha$ | $\lambda$ | $\alpha$ | $\lambda$ |
| Reexperiencing                      | .68      |           | .79      |           | .82      |           |
| 1. Disturbing memories              |          | .62       |          | .75       |          | .76       |
| 2. Disturbing dreams                |          | .52       |          | .50       |          | .63       |
| 3. Suddenly reliving                |          | .46       |          | .56       |          | .57       |
| 4. Upset when reminded              |          | .59       |          | .73       |          | .78       |
| 5. Physical reactions when reminded |          | .62       |          | .72       |          | .72       |
| Avoidance                           | .47      |           | .49      |           | .73      |           |
| 6. Avoiding thoughts                |          | .53       |          | .49       |          | .72       |
| 7. Avoiding activities              |          | .56       |          | .63       |          | .82       |
| Dysphoria                           | .75      |           | .82      |           | .83      |           |
| 8. Trouble remembering              |          | .39       |          | .50       |          | .50       |
| 9. Loss of interest                 |          | .52       |          | .60       |          | .62       |
| 10. Feeling distant                 |          | .58       |          | .65       |          | .65       |
| 11. Emotionally numb                |          | .54       |          | .62       |          | .66       |
| 12. Future cut short                |          | .40       |          | .46       |          | .46       |
| 13. Trouble sleeping                |          | .55       |          | .61       |          | .61       |
| 14. Irritable/angry outburst        |          | .60       |          | .66       |          | .68       |
| 15. Difficulty concentrating        |          | .68       |          | .73       |          | .75       |
| Hyperarousal                        | .70      |           | .79      |           | .77      |           |
| 16. Being “super alert”             |          | .83       |          | .86       |          | .82       |
| 17. Jumpy/easily startled           |          | .67       |          | .78       |          | .78       |

Note. PCL-C, PTSD Checklist—Civilian; T1, 2 weeks after diagnosis; T2, 2 months after diagnosis; T3, 4 months after diagnosis;  $\alpha$ , Cronbach's alpha;  $\lambda$ , standardized factor loading.

than the King model. We therefore decided to choose the Simms model as the best fitting model. This model, comprising the factors reexperiencing, avoidance, dysphoria, and hyperarousal, provided acceptable fit when analyzing data collected 2 weeks, and 2 and 4 months after diagnosis. There was evidence for configural and metric invariance over time, indicating that the basic factor loading pattern and size of loading were equivalent over time, which is in line with previous investigations in other populations (Baschnagel et al., 2005; Elklit & Shevlin, 2007; Krause et al., 2007; Palmieri et al., 2007; Simms et al., 2002). However, it should be noted that we did not find evidence for phi invariance in the longitudinal model, which indicates that factor covariance's seemed to vary across time.

To our knowledge, this is the first report on the factor structure of PTSS among parents of children with cancer. A particular strength of the current investigation is its longitudinal design allowing for the test of model invariance over time, and the extension of this type of investigation to a new population and language context provides cross-cultural validation of previous findings. However, a notable limitation of the current study is the relatively small sample size. A larger sample size would have enabled a comparison of model fit between mothers and fathers, and future research should investigate model invariance across gender. Another limitation is that measures of general anxiety and depression were not administered, which would have enabled further validation of the construct of PTSD and its underlying factor structure in this context. Future research should include such measures in longitudinal designs of PTSS in parents of children with cancer.

In the present study, we did not find support for the conceptualization of the underlying dimensions of PTSD according to the *DSM-IV*, which proposes three intercorrelated factors reexperiencing (5 items), avoidance/numbing (7), and hyperarousal (5). Instead, when considering all three assessment points, we found best

Table IV. Descriptive Statistics of PTSS among Participants across Assessments Based on the Simms et al. (2002) Model

| PCL-C          | T1                             |                                |          | T2                             |                                |          | T3                             |                                |          |
|----------------|--------------------------------|--------------------------------|----------|--------------------------------|--------------------------------|----------|--------------------------------|--------------------------------|----------|
|                | Mothers <i>M</i> ( <i>SD</i> ) | Fathers <i>M</i> ( <i>SD</i> ) | Estimate | Mothers <i>M</i> ( <i>SD</i> ) | Fathers <i>M</i> ( <i>SD</i> ) | Estimate | Mothers <i>M</i> ( <i>SD</i> ) | Fathers <i>M</i> ( <i>SD</i> ) | Estimate |
| Full scale     | 42.06 (12.72)                  | 35.26 (9.59)                   | −6.81*** | 39.65 (12.67)                  | 32.82 (10.54)                  | −6.98*** | 36.29 (12.76)                  | 29.92 (8.80)                   | −6.68*** |
| Reexperiencing | 12.17 (4.50)                   | 10.25 (3.44)                   | −1.91*** | 11.68 (4.51)                   | 9.31 (3.51)                    | −2.38*** | 10.81 (4.64)                   | 8.14 (2.91)                    | −2.72*** |
| Avoidance      | 3.79 (1.98)                    | 3.35 (1.69)                    | −0.44    | 3.49 (1.75)                    | 3.03 (1.39)                    | −0.44*   | 3.79 (1.98)                    | 3.35 (1.69)                    | −0.44    |
| Dysphoria      | 20.46 (6.43)                   | 16.90 (4.99)                   | −3.55*** | 19.30 (6.21)                   | 16.66 (5.87)                   | −2.71*** | 17.65 (6.12)                   | 15.38 (5.10)                   | −2.37*** |
| Hyperarousal   | 5.56 (2.39)                    | 4.76 (2.00)                    | −0.81**  | 5.18 (2.23)                    | 3.87 (1.86)                    | −1.34*** | 4.52 (2.11)                    | 3.67 (1.52)                    | −0.88*** |

Note. PCL-C, PTSD Checklist—Civilian; T1, 2 weeks after diagnosis; T2, 2 months after diagnosis; T3, 4 months after diagnosis.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

support for an intercorrelated four-factor model proposed by Simms et al. (2002) comprising reexperiencing (5 items), avoidance (2), dysphoria (8), and hyperarousal (2). Compared to the *DSM-IV* conceptualization, the reexperiencing factor is identical but the two explicit avoidance items are distinguished in a separate factor. Furthermore, five items from the *DSM-IV* avoidance/numbing factor and three items from the *DSM-IV* hyperarousal factor are collapsed into a separated factor, which Simms et al. (2002) termed dysphoria. Finally, in the Simms et al. (2002) model, only two items are designated to the factor labeled hyperarousal. The reason for the term dysphoria was that only this factor was highly correlated with measures of depression and general distress, such as generalized anxiety and panic symptoms (Simms et al., 2002). However, it should be noted that the Simms model and the King model provided almost equally good fit to the data and both evidenced metric invariance across time. These findings are also consistent with a recent meta-analytic investigation of the structure of PTSS, aggregating 50 data sets with different samples, which found best support for the Simms et al. (2002) and King et al. (1998) models, with evidence for slightly better fit for the Simms model (Yufik & Simms, 2010).

According to the results of the present study, the internal consistency of the factors in the Simms model was acceptable with the exception for the avoidance factor, which evidenced poor internal consistency at T1 and T2. The avoidance factor in the Simms model only consist of two items and since internal consistency is strongly linked to the number of items in a given scale (Streiner & Norman, 2008), the current results may have been due to too few items mapping on to this construct. This indicates that more items targeting the phenomenon of avoidance in relation to ones child's serious illness needs to be generated if reliable assessment of this construct is to be ensured. Furthermore, at all assessments items 8 (trouble remembering aspects of trauma) and 12 (sense of future cut short) evidenced poor factor loadings. These items have also produced the poorest factor loadings in previous factor analytic investigations in other populations (e.g., Baschnagel et al., 2005; King et al., 1998; Palmieri & Fitzgerald, 2005). This may of course indicate problems with the current conceptualization of PTSD/PTSS and is also in part consistent with our clinical and research experience using the PCL-C in interviews with the population under investigation, as the item assessing a sense of future cut short often is misunderstood by respondents. The poor factor loadings of trouble remembering aspects of the designated trauma may be especially problematic under

the current circumstances since the child's disease actually was ongoing and not a discrete past-oriented event.

The current findings with the avoidance factor evidencing poor psychometric properties and several items showing poor factor loadings may be indicative of a more inherent problem of applying measures designed to capture the construct of PTSD to the population of parents of children with serious illness. As outlined by Kazak et al. (2006), the construct of PMTS can be measured with instruments assessing traumatic stress and according to this view the PCL-C could be considered a good option as it maps directly onto the items forming PTSD in the *DSM-IV*. However, it may be the case that these items do not fully capture the phenomenology of traumatic stress reactions of parents of children with cancer. Future research is needed to determine whether there is a need for a new operationalization of PMTS to better assess this construct among parents of children with cancer.

Both mothers and fathers evidenced declining levels of PTSS during their child's treatment, which is in line with previous longitudinal investigations (e.g., Dolgin et al., 2007; Steele, Long, Reddy, Luhr & Phipps, 2003). A considerable number of individuals, especially mothers, scored above the suggested cutoff. This suggest that tailored intervention based on individual distress levels among parents of children with cancer might be warranted.

Evidence-based assessment is an integral part of research and practice in pediatric psychology (Kazak et al., 2007) and construct validation is an important aspect of measurement development and their use in clinical practice (Holmbeck & Devine, 2009; Streiner & Norman, 2008). Establishing valid factor models and measurement invariance is an important part of measurement development and practical use as it allows for cross-group comparisons of parameters such as means and regression coefficients. Furthermore, establishing a valid model of the underlying dimensions of PTSD among parents of children with cancer could allow for the investigation of how symptom clusters (i.e., factors) of PTSS are related to each other over time, which in turn could enhance interventions aiming to alleviate PTSS in this population. We see the present analysis as a first step in determining the best fitting model of PTSS in parents of children undergoing cancer treatment, and our results tentatively suggest using a four-factor model in favor of the *DSM-IV* three-factor model. However, constructive replication of the current results is needed before firm conclusions can be drawn regarding which model researchers and clinicians should use when assessing PTSS in this population.

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