

## RESEARCH ARTICLE

# Developing Scales for the Assessment of Fatigue in Turkish Pediatric Oncology Patients Aged 13-18 and their Parents

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### Abstract

**Background:** This study was planned in an attempt to develop scales for the assessment of fatigue in pediatric oncology patients aged 13-18 and also for their parents. **Materials and Methods:** In collecting the study data, we used the Child and Parent Information Form, Visual Fatigue Scale, Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18 and the Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18 for Parents. We also used Pearson correlation analysis, Cronbach alpha coefficient, factor analysis and ROC analysis for the study data. **Results:** In this study, the total Cronbach alpha value of the parent form was 0.99, the total factor load was 0.72-0.94 with 95% the total variance being explained. The cutoff point of the parent form is 73 points. The total Cronbach alpha value of the child form was 0.99, the total factor load was 0.82-0.95, with 89.4% of the total variance being explained. The cutoff point of the child form was 75.5 points. **Conclusions:** This study suggests that the Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18 and the Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18 for Parents are valid and reliable instruments in assessing the fatigue symptoms of children in Turkey.

**Keywords:** Pediatric cancer - parents of children with cancer - fatigue scale - assessment tools

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### Introduction

Cancer is one of the important health problems in developed and under-developed countries. The number of cancer children and adults is gradually increasing in world population. While childhood cancers constitute approximately 0.5-1% of total cancers, this rate differs depending on age periods. It is estimated that the new case number will be 11.630 in children among 0-14 ages in America (American Cancer Society, 2013). Childhood cancers five-year survival now exceeds 70-80% (Vegian et al., 2012). Of the cancers seen in a human being's lifetime, 1-2% are diagnosed in children. In Turkey, 2500-3000 children under the age of 15 are newly diagnosed with cancer each year (Emir, 2009). Depending on both the disease and the treatment, a great many of physical and psychosocial problems are encountered in cancer child (Bessel, 2001; Citak et al., 2013). The fatigue has an important place among this problem (Bessel, 2001).

Being defined by patients as one of the most disturbing symptoms throughout the cancer treatment, fatigue is an important factor in the care of children with cancer (Knowles et al., 2000). According to the National Comprehensive Cancer Network (NCCN), fatigue caused by cancer is a subjective weakness and exhaustion that is nonproportional with activities, restrains the daily routine and causes a constant distress regarding the cancer and

its treatment (NCCN, 2010). Fatigue caused by cancer treatment in children is defined as a deep exhaustion or difficulty in moving the extremities or opening the eyes, which is affected by environmental, personal/social factors and the factors regarding the treatment and may create problems about playing a game, lack of concentration and negative feelings (like anger) (Hockenberry and Hinds, 2000). Examining the literature, 49% of parents of patients with cancer stated that their children had the symptom of fatigue (Gibson, 2005; Phianmongkhon and Suwan, 2008). In another study, 86% of parents stated that their children had physical fatigue and 76% complained about the decrease in their actions (Jalmsell, 2006). In a study, it was determined that 69.8% of children had the symptom of fatigue and 56.7% in another (Arslan et al., 2013; Chan and Ismail, 2014).

Fatigue is a subjective experience. Children and adults may show differences in the ability of expressing this subjective experience. Thus, we should consider the data about both adults and children in an interrelated way. Hinds and Hockenberry (2001) defined the characteristics of fatigue and the factors intensifying and easing the fatigue, and also stated that patients and parents had different viewpoints regarding this issue. Thus, the fatigue assessment should be multi-factorial and its interventions multilateral, and it should be applied to children and parents simultaneously (Hinds and Hockenberry, 2001).

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In the management of fatigue caused by cancer and its treatment, we should primarily identify the fatigue. We should determine the factors increasing or decreasing the fatigue and plan convenient interventions aimed at decreasing the fatigue experienced by the child (Hockenberry-Eaton and Hinds, 2000; Gedaly-Duff et al., 2006; Demirbağ et al., 2013; Kudubes et al., 2014).

Fatigue caused by cancer has recently been identified as a clinical problem and there is a limited number of studies in this area. Even though there are various scales assessing the fatigue abroad, there is a limited number of studies analyzing the validity and reliability of these scales (Varni et al., 2004; Gerçeker and Bal, 2012). In our country, there is not a sufficient amount of studies aimed at identifying the fatigue of pediatric oncology patients and the assessment of fatigue by the medical personnel (Gerçeker and Bal, 2012). Studies that are conducted by using an assessment instrument in determining the symptoms and fatigue of patients with cancer generally include adults (Phianmongkhol and Suwan, 2008; Huan-Keat and Ismail, 2014) and it is seen that there is a limited number of studies on childhood cancers (Gerçeker ve Bal, 2012), which consequently disables the medical personnel and especially the nurses caring about children with cancer to identify the symptom of fatigue and plan the convenient interventions. In order to increase the number of these limited studies in our country, we need more valid and reliable instruments. Accordingly, this study aims to develop the Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18 and the Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18 for Parents.

## Materials and Methods

### *Population and sample*

The sample calculation that was required for the study was performed in the GPOWER statistical analysis program by taking the Type I error as 0.05 and Type II error 0.20 (80% POWER), and in the study of Gerçeker and Bal (2012), the required sample size was determined as 159 by using the score averages of the 24-hour fatigue. Another method being suggested for calculating the sample in scale development studies includes three rules as 5s, 10s and 100s rule. It is emphasized that the researcher is required to include at least five individuals for each item in order to perform the factor analysis. It is also emphasized that there should be 10 individuals for each item unless there is a problem about reaching the sample (Sencan, 2005). In the study, we reached 184 children with cancer and their parents, who applied to a training and research hospital and a university hospital between 15 April-15 August 2014.

Inclusion criteria for the study were accepted as: 1) children aged 13-18 and diagnosed with cancer and their parents who were primarily responsible for their care, 2) Being literate, 3) Children and parents who were volunteer to participate in the study.

### *Data collecting instruments*

Child and Parent Information Form: "Child and Parent Information Form" that is improved by basing

on literature was consisted of 8 questions including the children's socio-demographic features, diagnosis, disease phase, treatments they received, period of receiving diagnosis, treatment period, ages of parents and sex (Collins et al., 2000; Woodgate and Degner, 2003; Woodgate et al., 2003).

Visual Fatigue Scale-VFS: "Visual Fatigue Scale" is an assessment instrument that assesses the fatigue visually. It is graded between "1" and "5" and the increase of the scale score signifies the increase of the fatigue level of the child (Oncology Nursing Society, 2000).

Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18: The researcher examined the literature and reached general and child-specific scales regarding the fatigue. As a result of the literature review, dimensions were formed to determine the fatigue from all aspects (Hinds and Hockenberrt-Eaton, 2001; Varni et al., 2002; Hinds, 2007; Gerçeker and Bal, 2012). It consists of totally 32 items and 4 lower dimensions. Lower dimension of general problems: This lower dimension includes the statements between the first 1. and 19. items aimed at determining the fatigue of pediatric oncology patients. Lower dimension of sleep problems: This lower dimension includes the statements between the first 20. and 25. items aimed at determining the sleep problems of pediatric oncology patients caused by fatigue. Lower dimension of cognitive problems: This lower dimension includes the statements between the first 26. and 29. items aimed at determining the cognitive problems of pediatric oncology patients caused by fatigue. Lower dimension of problems regarding the treatment: This lower dimension includes the statements between the first 30. and 32. items aimed at determining the effect of treatment received by pediatric oncology patients upon fatigue.

Being a likert scale, this scale is graded between "1" and "5". While the lowest score to be obtained from the scale is 27, the highest score is 135. The increase of the scale score signifies the decrease of the fatigue level of the child.

Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18 for Parents: The researcher examined the literature and reached general and child-specific scales regarding the fatigue. As a result of the literature review, dimensions were formed to determine the fatigue from all aspects (Hinds and Hockenberrt-Eaton, 2001; Varni et al., 2002; Hinds, 2007; Gerçeker and Bal, 2012). According to literature, the fatigue assessment should be multi-factorial and its interventions multilateral, and it should be applied to children and parents simultaneously (Hinds and Hockenberry, 2001). Thus, we formed the Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18 for Parents. It consists of totally 32 items and 4 lower dimensions. This lower dimension includes the statements between the first 1. and 19. items aimed at determining the fatigue of pediatric oncology patients. Lower dimension of sleep problems: This lower dimension includes the statements between the first 20. and 25. items aimed at determining the sleep problems of pediatric oncology patients caused by fatigue. Lower dimension of cognitive problems: This lower dimension includes the statements between the

first 26. and 29. items aimed at determining the cognitive problems of pediatric oncology patients caused by fatigue. Lower dimension of problems regarding the treatment: This lower dimension includes the statements between the first 30. and 32. items aimed at determining the effect of treatment received by pediatric oncology patients upon fatigue.

Being a likert scale, this scale is graded between "1" and "5". While the lowest score to be obtained from the scale is 32, the highest score is 160. The increase of the scale score signifies the decrease of the fatigue level of the child.

Scale for the Determination of Symptoms Causing the Fatigue: Being formed by the researchers through examining the literature, the scale includes symptoms causing the fatigue (Yesilbalkan et al., 2005). Being a likert scale, this scale is graded between "1" and "5". The increase of the scale score signifies that the symptom increases the fatigue.

#### *Stages of the study*

The stages to be followed in developing the Fatigue Scale and analyzing the validity and reliability are explained as follows; Stage of forming the item pool: An extensive examination should be made about the variable to be measured while designing the scale statements. The statements to be written should comprise all the ideational, affective and action-aimed elements involved in experiences regarding the variable to be measured or their dimensions that are required to be measured. As a consequence, the statements in the scale should constitute a sample that comprises the dimension of the measured and to-be-measured variable from all aspects and represents it (Akgul, 2003; Gozum and Aksayan, 2003; Ozdamar, 2005; Sencan, 2005; Simsek, 2007). While forming the item pool of the Fatigue Scale for Pediatric Oncology Patients and Parents, we examined the literature and reached studies defining the fatigue and general and child-specific scales regarding the fatigue. As a result of the literature review, dimensions were formed to determine the fatigue from all aspects and item pools were developed for these dimensions (Hinds and Hockenberry-Eaton, 2001; Varni et al., 2002; Hinds, 2007; Gerçeker and Bal, 2012).

Stage of forming the expert opinion: It is suggested to apply to at least ten expert opinions in order to determine the content validity of scales (Akgul, 2003; Gozum and Aksayan, 2003; Ozdamar, 2005; Sencan, 2005; Simsek, 2007). Fourteen expert opinions were received for the scales (ten academic members in the Department of Pediatric Health and Diseases Nursing, three academic members in the Department of Oncology Nursing and one academic member in the Department of Psychiatric Nursing). The experts were given the scale form and required to grade between 1-4 in order to assess the convenience of scale items (1=Requires a great change, 4=Very convenient). As a result of expert opinions, 9 items were excluded from the scale (I can do my daily work, I'm having difficulty playing games, I'm quieter / I'm calm than before, I'm furious than before, I feel better than before, I'm sad than before, I'm worried than before, I feel too tired to talk with family and my friends, I have

difficulty to get help from my family and my friends) one item was revised (I'm having trouble at the start and finish my work) and the scale was used in its final form with 32 items.

Stage of forming the preliminary test: After receiving the expert opinions, it is suggested to apply the scale to a sample of 10-20 individuals, who have similar features with individuals to be measured, but are not involved in the sample (Akgul, 2003; Gozum and Aksayan, 2003; Ozdamar, 2005; Sencan, 2005; Simsek, 2007). The outline that was formed by receiving the expert opinions was applied to 25 children and their parents matching the scale sample criteria and since no negative feedback was received, it was decided to be applied to the larger group.

#### *Ethical issues*

The implementation of the research was started after 03.04.2014 dated and 1397-GOA protocol numbered resolution of Dokuz Eylul University Non-Invasive Research Ethics Committees. Institutional permissions were obtained in order to carry out the research. Besides, child and parents' written and verbal permissions were obtained by meeting them and giving them information about the aim of the research.

#### *Analysis of the data*

In the data analysis, we used; the content validity analysis for the coherence analysis of descriptive statistics and expert opinions, Pearson's correlation analysis for the total item score analysis of scales and lower dimensions, Cronbach Alpha coefficient for the internal consistency of scales and lower dimensions, explanatory factor analysis for the item-factor relationship, t test for the known group comparison and Pearson's correlation analysis for the relationship between the scale factors (Akgul, 2003; Gozum and Aksayan, 2003; Ozdamar, 2005; Sencan, 2005; Simsek, 2007). We used the ROC analysis in determining the cutoff point of the scale. The margin of error was taken as  $p=0.05$  in the assessment of the data.

## **Results**

The children who participated in the study had an age average of  $14.6 \pm 1.4$ ; 52.2% were male, 4.78% female, 60.3% in the remission stage; 57.6% were diagnosed with leukemia, 59.8% received only chemotherapy. Parents who participated in the study had an age average of  $40.4 \pm 3.1$  and 74.5% were mothers.

#### *Validity analyses*

Content validity: Scores of fourteen experts were assessed with the content validity analysis and the coherence between expert scores was determined as 0.803. The expert scores were observed to be coherent.

#### *Construct validity*

Construct Validity of the Parent Form: Construct validity of scales is tested through a number of different approaches. One of these approaches is the factor analysis. As a result of the factor analysis, the Kaiser-Meyer-Olkin coefficient (KMO) was determined as 0.799 and the

Barlett test  $X^2=17304,069$ ,  $p=0.000$ . The factor loads were determined as 0.72-0.94 for the lower dimension of general problems, 0.82-0.90 for the lower dimension of sleep problems, 0.78-0.92 for the lower dimension of cognitive problems and 0.86-0.92 for the lower dimension of problems regarding the treatment. The lower dimension of general problems explains 78.6% of the total variance, the lower dimension of sleep problems explains 6.6%, the lower dimension of cognitive problems explains 2.8% and the lower dimension of problems regarding the treatment explains 2.5%. The total variance being explained is 90.5%.

Construct Validity of the Child Form: As a result of the factor analysis, the Kaiser-Meyer-Olkin coefficient (KMO) was determined as 0.777 and the Barlett test  $X^2=16087.784$ ,  $p=0.000$ . The factor loads were determined as 0.84-0.95 for the lower dimension of general problems, 0.82-0.88 for the lower dimension of sleep problems, 0.85-0.86 for the lower dimension of cognitive problems and 0.82-0.89 for the lower dimension of problems regarding the treatment. The lower dimension of general problems explains 78.2% of the total variance, the lower dimension of sleep problems explains 6.2%, the lower dimension of cognitive problems explains 2.8% and the lower dimension of problems regarding the treatment explains 2.2%. The total variance being explained is 89.4%.

#### Cutoff point

One of the most effective methods being used in determining the optimum cutoff point is the Diagnostic index that is calculated through the values obtained from the ROC analysis and the Youden index (Perkin and Schisterman, 2005). The value of the Youden index varies between -1 and  $\pm 1$  and it is indicated that the closer it is to  $\pm 1$ , the greater the power of distinguishing becomes (Sencan, 2005). The scale score where these two indexes obtain the highest value and coincide determines the optimum cutoff point for that scale (Perkin and Schisterman, 2005).

Table 1 shows the values of Diagnostic index (DI) and Youden index (YI) that were calculated as a result of the ROC analysis, which was performed to determine the cutoff point. Especially YI is defined as the point that is closest to  $\pm 1$  where the best distinction could be made and it is suggested to determine the cutoff point through the comparison with the point where DI obtains the highest value (Perkin and Schisterman, 2005; Sencan, 2005). We determined 75.5 points, where the child form obtains the highest DI and YI values, as the cutoff point and measured the sensitivity of the scale as 1.00 and specificity 0.06 at this point and those who obtained 75.4 and below were evaluated as highly exhausted (Table 1). We determined 73 points, where the parent form obtains the highest DI and YI values, as the cutoff point and measured the sensitivity

of the scale as 1.00 and specificity 0.06 at this point and those who obtained 72.9 and below were evaluated as highly exhausted (Table 1).

Table 1. Cutoff Point, Prediction Values and Values of the Area under the Curve (AUC) in Predicting the State of Fatigue in the ROC Analysis of the Child and Parent Form

#### The known group comparison

One of the methods being used in determining the construct validity of scales is the known group comparison (Erkus, 2002; Gozum and Aksayan, 2003). In this analysis, a significant difference is expected between the fatigue score averages of children with and without fatigue according to the cutoff points. According to the parent form, we determined the score average of those with fatigue as  $51.2 \pm 14.6$  and the score average of those without fatigue as  $94.1 \pm 4.5$ . According to the state of fatigue, a statistically significant difference was determined between the score averages of the parent form ( $t=30.210$ ,  $p=0,000$ ).

According to the child form, the score average of those with fatigue was determined as  $51.6 \pm 14.8$  and the score average of those without fatigue was determined as  $94.1 \pm 4.4$ . According to the state of fatigue, a statistically significant difference was determined between the score averages of the child form ( $t=29.747$ ,  $p=0,000$ ).

#### Reliability analyses

Internal consistency analysis: The reliability coefficients of the lower dimensions of the parent form were determined as;  $\alpha=0.98$  in the lower dimension of General Problems,  $\alpha=0.96$  in the lower dimension of Sleep Problems,  $\alpha=0.94$  in the lower dimension of Cognitive Problems and  $\alpha=0.95$  in the lower dimension of Problems regarding the Treatment. And  $\alpha=0.99$  in total for the scale (Table 2).

The reliability coefficients of the lower dimensions of the parent form were determined as;  $\alpha=0.99$  in the lower dimension of General Problems,  $\alpha=0.95$  in the lower dimension of Sleep Problems,  $\alpha=0.96$  in the lower dimension of Cognitive Problems and  $\alpha=0.90$  in the lower dimension of Problems regarding the Treatment. And  $\alpha=0.99$  in total for the scale (Table 2).

#### Reliability analysis of the parents and child form

Fatigue Scale for Parents Form mean score was  $62.4 \pm 22.8$ , floor and ceiling effect were 22.8 % and 0.0 %, respectively, skewness was 0.140.

Fatigue Scale for Child Form mean score was  $62.7 \pm 22.7$ , floor and ceiling effect were 22.7 % and 0.0 %, respectively, skewness was 0.115.

Total item score correlations of the parent form and test-retest correlations of items: Examining the item-total score correlations of the scale consisting of 32 items for the reliability study, it was determined that the correlation

**Table 1. Cutoff Point, Prediction Values and Values of the Area Under the Curve (AUC) in Predicting the State of Fatigue in the ROC Analysis of the Child and Parent Form**

	Cut Point	Sensitivity	Specificity	p	EAA (% 95 Confidence Interval)	Youden Index	Diagnostic Index
Child Form	75.5	1,000	0,068	0,000	0,995 (0,986-1,000)	0,931	1,931
Parents Form	73.0	1,000	0,069	0,000	0,998 (0,995-1,000)	0,931	1,931

**Table 2. Cronbach Alpha Coefficient, Sub-Dimensions of the Parents and Child Form**

Fatigue Scale	Parents Form Cronbach Alpha ( $\alpha$ )	Child Form Cronbach Alpha ( $\alpha$ )
General Problems Sub-Dimension	0.988	0.990
Sleep Problems Sub-Dimension	0.967	0.956
Cognitive Problems Sub-Dimension	0.947	0.964
Problems Related to Treatment Sub-Dimension	0.951	0.904
Total Of Scale	0.991	0.991

coefficients of the lower dimension of general problems (Pearson Product-Moment Correlation Coefficient) were statistically significant between 0.72-0.94, the lower dimension of sleep problems 0.83-0.90, the lower dimension of cognitive problems 0.79-0.92 and the lower dimension of problems regarding the treatment between 0.86-0.92 ( $p=0.000$ ).

Besides, examining the correlation between the first and second application scores of each item, it was determined that the test-retest reliability coefficient of the lower dimension of general problems were between  $r=0.55-0.98$ , the lower dimension of sleep problems were between  $r=0.53-0.97$ , the lower dimension of cognitive problems were between  $r=0.84-0.98$  and the lower dimension of problems regarding the treatment were between  $r=0.95-0.98$  and statistically significant ( $p=0.000$ ).

Total item score correlations of the child form and test-retest correlations of items: Examining the item-total score correlations of the scale consisting of 32 items for the reliability study, it was determined that the correlation coefficients of the lower dimension of general problems (Pearson Product-Moment Correlation Coefficient) were statistically significant between 0.87-0.95, the lower dimension of sleep problems 0.82-0.88, the lower dimension of cognitive problems 0.85-0.86 and the lower dimension of problems regarding the treatment between 0.82-0.89 ( $p=0.000$ ).

Besides, examining the correlation between the first and second application scores of each item, it was determined that the test-retest reliability coefficient of the lower dimension of general problems were between  $r=0.79-1.00$ , the lower dimension of sleep problems were between  $r=0.88-0.97$ , the lower dimension of cognitive problems were between  $r=0.92-0.97$  and the lower dimension of problems regarding the treatment were between  $r=0.83-0.95$  and statistically significant ( $p=0.000$ ).

#### *Test-retest reliability of the child and parent form (Stability)*

After applying the parent form for twice every three weeks, we assessed the stability, in other words the test-retest reliability coefficient of the scale with the Pearson Product-Moment Correlation Coefficient. A positive and statistically significant relationship was determined between the test-retest score averages of the scale ( $r=0.979$ ,  $p=0.000$ ).

After applying the child form for twice every three weeks, we assessed the stability, in other words the test-retest reliability coefficient of the scale with the Pearson Product-Moment Correlation Coefficient. A positive and statistically significant relationship was determined

between the test-retest score averages of the scale ( $r=0.979$ ,  $p=0.000$ ).

Besides, we conducted the t test for dependent groups in order to determine whether there was a difference between the score averages obtained from the lower dimensions as a result of two measurements that were applied every three weeks; however, we determined no statistically significant difference between the score averages ( $p>0.05$ ).

#### *Relationship between the study variables of the child and parent form*

We assessed the relationship between the variables with the Pearson correlation analysis and determined a statistically significant relationship between the parent form and child form at a level of  $r=0.990$ , between the parent form and parent VAS score at a level of  $r=-0.748$  and the child VAS score at a level of  $r=-0.748$  ( $p<0.01$ ).

## Discussion

In this part, we discussed about the development and validity / reliability results of the Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18 for Parents and the Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18.

If an instrument will be used in a different language it is necessary to show that it has the same validity and reliability as the instrument's original format (Savasir and Sahin, 2002; Gozum and Aksayan, 2003; Sencan, 2005). For this reason it was necessary to evaluate the validity and reliability of the Parents and Child Form, which will be used in a Turkish sample.

Content validity of the scale; Being prepared to determine the content validity, the scale is examined by experts and reviewed and reprepared according to criticisms (Ozguven, 2000; Sencan, 2005). It is possible to use a form that would enable the experts to evaluate the coherence of items through giving points. Consensus of the majority of experts may be accepted as an indicator for the content validity (Gozum and Aksayan, 2003; Sencan, 2005). In this study, we received fourteen expert opinions in order to assess the coherence of the items of the parent and child form for the language and culture. We also assessed the suggestions of experts regarding the expression and content of items, excluded some of the items and changed the statements of one item. In the content validity analysis, minimum values regarding the number of experts also signify the statistical significance of the item. In the content validity analysis, the minimum value for fourteen experts is 0.51 at a significance level of  $p=0.05$  (Yurdugul, 2005). We assessed the scores of fourteen experts with the content validity analysis and determined the coherence between the expert scores as 0.803. The expert scores were observed to be coherent. According to these results, it is possible to assert that the statements of the parent and child form are convenient for the Turkish culture and represent the area to be measured, and the content validity is ensured.

Factor and explanatory factor analyses: One of the main objectives of the factor analysis is to reveal some new structures by using the relationships between variables. In other words, it is aimed to form common factors by grouping the variables in the factor analysis (Tavsanel,

2002; Gozum and Aksayan, 2003; Sencan, 2005). As a result of the factor analysis in this study, the Kaiser-Meyer-Olkin coefficient (KMO) of the parent form was determined as 0.799 and the Barlett test  $X^2=17304.069$ ,  $p=0.000$ . These values showed that the number of samples was convenient for a factor analysis. The factor loads were determined as 0.72-0.94 for the lower dimension of general problems, 0.82-0.90 for the lower dimension of sleep problems, 0.78-0.92 for the lower dimension of cognitive problems and 0.86-0.92 for the lower dimension of problems regarding the treatment. The lower dimension of general problems explains 78.6% of the total variance, the lower dimension of sleep problems explains 6.6%, the lower dimension of cognitive problems explains 2.8% and the lower dimension of problems regarding the treatment explains 2.5%. The total variance being explained is 90.5%.

As a result of the factor analysis in this study, the Kaiser-Meyer-Olkin coefficient (KMO) of the child form was determined as 0.777 and the Barlett test  $X^2=16087.784$ ,  $p=0.000$ . These values showed that the number of samples was convenient for a factor analysis. The factor loads were determined as 0.84-0.95 for the lower dimension of general problems, 0.82-0.88 for the lower dimension of sleep problems, 0.85-0.86 for the lower dimension of cognitive problems and 0.82-0.89 for the lower dimension of problems regarding the treatment. The lower dimension of general problems explains 78.2% of the total variance, the lower dimension of sleep problems explains 6.2%, the lower dimension of cognitive problems explains 2.8% and the lower dimension of problems regarding the treatment explains 2.2%. The total variance being explained is 89.4%.

The factor structure of the scale becomes stronger as the rate of the obtained variance is higher. In the studies, the variance rates between 40-60% are accepted as sufficient (Tavsanel, 2002; Sencan, 2005). In this study, on the other hand, we obtained a high and sufficient total variance through obtaining a variance that could be explained at a rate of 85% in both scales. As a result of the analysis, it was suggested that the parent and child form had a coherent construct validity.

**Cutoff point:** As a result of the ROC analysis that was performed to determine the cutoff point, we determined 73 points, where the sensitivity was the highest and the specificity was the lowest in the parent form, as the cutoff point and detected the sensitivity of the scale as 1.00 and the specificity 0.06 at this point (Table 1). Those who obtained 72.9 and below from the parent form were evaluated as highly exhausted. As a result of the ROC analysis that was performed to determine the cutoff point, we determined 75.5 points, where the sensitivity was the highest and the specificity was the lowest in the child form, as the cutoff point and detected the sensitivity of the scale as 1.00 and the specificity 0.06 at this point (Table 1). Those who obtained 75.4 and below from the child form were evaluated as highly exhausted. The ROC curve gives a coherent cutoff point for the assessment instrument and the decisions that are made according to this cutoff enable us to obtain the sensitivity and specificity rates. While Sensitivity is shortly defined as “the condition where those who are sick in reality are also sick according to the cutoff point that is taken during the test”, the Specificity is defined as “the condition where those who are healthy in reality are

also found healthy as a result of the test”. The curve moves upward (high sensitivity area) and to the left (low false positive rate area) as the test becomes better. If the area under the ROC curve (AUC) is 0.5, there is no distinction, if between 0.5 and 0.7, the power of distinguishing the test is statistically insignificant, if between 0.7 and 0.8, it is acceptable, if between 0.8 and 0.9, it is very good and if above 0.9, it is excellent (Dirican, 2001). Accordingly, it is seen that the EAA of the parent form is between 0.913-1.001 and has an excellent level of distinction, and it also has the ability of significantly distinguishing the children with and without fatigue (Table 1). On the other hand, the EAA of the child form is between 0.995-1.003 and has an excellent level of distinction, and it also has the ability of significantly distinguishing the children with and without fatigue (Table 1).

**The known group comparison:** One of the methods being used in determining the construct validity of scales is the group comparison (Erkus, 2002; Gozum and Aksayan, 2003). In this analysis, a significant difference is expected between the fatigue averages of children with and without fatigue. In this study, we determined the fatigue states of children according to the cutoff point with the help of the parent form and assessed those with a score of 72.9 and below as exhausted and those with a score of 73 and above as non-exhausted. As a result of the analysis, a significant difference was determined between the scale score averages of children with and without fatigue in the parent form ( $t=30.210$ ,  $p=0.000$ ). The presence of the difference not only indicates that the parent form could significantly determine the exhausted children, but also reveals the construct validity of the scale (Erkus, 2002; Gozum and Aksayan, 2003). This study determined the fatigue states of children according to the cutoff point with the help of the child form and assessed those with a score of 75.4 and below as exhausted and those with a score of 75.5 and above as non-exhausted. As a result of the analysis, a significant difference was determined between the scale score averages of children with and without fatigue in the child form ( $t=29.747$ ,  $p=0.000$ ). The presence of the difference not only indicates that the child form could significantly determine the exhausted children, but also reveals the construct validity of the scale (Erkus, 2002; Gozum and Aksayan, 2003).

**Internal consistency analysis of the lower dimensions of the scale:** Ranking the responses to items, the likert attitude scales calculate the Cronbach alpha coefficient as an indicator of homogeneity. This test shows not only the internal consistency, but also whether the items measure the same feature and whether they are related with the subject to be measured or not. The reliability coefficient in an assessment instrument should be close to 1 as much as possible (Tavsanel, 2002; Gozum and Aksayan, 2003; Sencan, 2005). The reliability coefficients of the parent form were determined as;  $\alpha=0.98$  in the lower dimension of General Problems,  $\alpha=0.96$  in the lower dimension of Sleep Problems,  $\alpha=0.94$  in the lower dimension of Cognitive Problems and  $\alpha=0.95$  in the lower dimension of Problems regarding the Treatment (Table 2). The reliability coefficients of the child form were determined as;  $\alpha=0.99$  in the lower dimension of General Problems,  $\alpha=0.95$  in the lower dimension of Sleep Problems,  $\alpha=0.96$  in the lower

dimension of Cognitive Problems and  $\alpha = 0.90$  in the lower dimension of Problems regarding the Treatment (Table 2). Both the scale and its lower dimensions had a Cronbach alpha coefficient above 0.90, which shows that the scale has a very good reliability (Gozum and Aksayan, 2003).

Item-total score analysis of the lower dimensions of the scale: There are different methods that are followed in selecting items in the scale development studies. One of these methods is used in assessing the item total score correlations of scale items and in excluding the items with lower correlation values from the scale. The value to be used in the item selection is suggested to be between 0.20-0.25 and above. Highness of the correlation coefficient is accepted as an indicator of the coherence of that item for the theoretical structure being measured (Dirican, 2001; Erkus, 2002; Gozum and Aksayan, 2003).

Examining the item-total score correlations of the scale consisting of 32 items for the reliability study, it was determined that the correlation coefficients of the lower dimension of general problems (Pearson Product-Moment Correlation Coefficient) were statistically significant between 0.72-0.94, the lower dimension of sleep problems 0.83-0.90, the lower dimension of cognitive problems 0.79-0.92 and the lower dimension of problems regarding the treatment between 0.86-0.92 ( $p=0.000$ ). Examining the item-total score correlations of the scale consisting of 32 items for the reliability study, it was determined that the correlation coefficients of the lower dimension of general problems (Pearson Product-Moment Correlation Coefficient) were statistically significant between 0.87-0.95, the lower dimension of sleep problems 0.82-0.88, the lower dimension of cognitive problems 0.85-0.86 and the lower dimension of problems regarding the treatment between 0.82-0.89 ( $p=0.000$ ). It is observed that the items in the scale are compatible with the theoretical structure of the scale and provide a sufficient correlation. Item-total score analysis is accepted as an indicator of not only the reliability, but also the validity (internal consistency) and it reflects the construct validity of the scale (Erkus, 2002).

Test-retest measurements are among the most frequently used reliability analyses assessing the stability of the assessment instrument. They are generally assessed by conducting the Pearson Product-Moment Correlation analysis (Gozum and Aksayan, 2003; Sencan, 2005). Being calculated to determine the stability (consistency) of an assessment instrument against time, the correlation coefficient is accepted to have a higher reliability as it gets closer to  $\pm 1$ . In instruments, the correlation coefficient between the test-retest scores is suggested to be at least 0.70 (Gozum and Aksayan, 2003; Sencan, 2005). In this study, we determined the stability coefficient of two applications of the parent form, which was repeated every three weeks, as 0.979 ( $p=0.000$ ). On the other hand, the stability coefficient of two applications of the child form, which was repeated every three weeks, was determined as 0.979 ( $p=0.000$ ). It was observed that the parent and child form had a high reliability and the results were similar in first measurements and in repeated measurements.

Even if the test-retest correlation coefficient is sufficient, it is suggested to examine the score averages and standard deviations of two measurement results and have similar measurement results (Gozum and Aksayan, 2003; Sencan,

2005). For that purpose, we examined whether there was a difference between the results that were obtained from the scale being applied every three weeks with the help of the "t test for dependent groups" and determined no statistically significant difference between the score averages ( $p>0.05$ ). Since individuals had similar and consistent responses to the items of the assessment instrument and the instrument proved to be stable when it was applied to them in different times (Tavsanel, 2002; Gozum and Aksayan, 2003; Sencan, 2005), the child and parent form were observed to be highly reliable.

Even though there may not be a significant difference between the total scores of individuals, they may give different answers to each item. Thus, it is required to also consider the consistency between the items in both applications (Tavsanel, 2002; Gozum and Aksayan, 2003; Sencan, 2005). Examining the correlation between the first and second application scores of each item, it was determined that the test-retest reliability coefficient of the lower dimension of general problems were between  $r=0.55-0.98$ , the lower dimension of sleep problems were between  $r=0.53-0.97$ , the lower dimension of cognitive problems were between  $r=0.84-0.98$  and the lower dimension of problems regarding the treatment were between  $r=0.95-0.98$  and statistically significant ( $p=0.000$ ). Examining the correlation between the first and second application scores of each item, it was determined that the test-retest reliability coefficient of the lower dimension of general problems were between  $r=0.79-1.00$ , the lower dimension of sleep problems were between  $r=0.88-0.97$ , the lower dimension of cognitive problems were between  $r=0.92-0.97$  and the lower dimension of problems regarding the treatment were between  $r=0.83-0.95$  and statistically significant ( $p=0.000$ ). Items in the parent form gave similar results in both measurements, which signifies that the items are comprehensible and they measure consistently.

The relationship between the study variables of the scale: It is observed that the relationship between the two variables becomes stronger as it gets closer to 1 (Tavsanel, 2002; Gozum and Aksayan, 2003; Sencan, 2005). The relationship between the variables was assessed with the Pearson correlation analysis and it was found to be high and statistically significant between the scores of the parent form and child form ( $r=0.990$ ), between scores of the parent form and parent VFS ( $r=0.748$ ) and between the scores of the child form and child VFS ( $r=0.748$ ) ( $p<0.01$ ). A high and significant relationship is observed between the scores of the child and parent form and between the scale scores and VFS scale fatigue scores. A high level of relationship signifies that the scales measure similar things and they measure them accurately. This result reveals that the scales are both valid and reliable.

There is no sufficient number of scales regarding the fatigue identification that are developed to be used in children aged 13-18 and analyzed in terms of validity and reliability abroad. In our country, on the other hand, there is a "Turkish Form of the Scale of Fatigue in Children with Cancer for Children, Parents and Medical Staff", which was aimed at identifying the fatigue in children and analyzed in terms of validity and reliability by Gerçeker and Bal (2012). However, we could reach no data regarding the efficiency of this scale in practice (Gerçeker and Bal, 2012). This

number is apparently insufficient. Thus, the scale for fatigue in children and parents that was developed in this study is a convenient and comprehensive scale for our hospitals as it not only identifies the fatigue of children aged 13-18, but also is peculiar to our country. Besides, a great majority of children and parents in the study sample were in regional hospitals receiving patients from every region of Turkey, which supports the generalizability of the scale.

In conclusion, it is suggested to apply this scale, which was developed as there was no sufficient number of valid/reliable identification instruments for pediatric patients in Turkey, in pediatric oncology clinics and to reassess the usage outcomes in the long term.

There is a need for valid-reliable instruments to manage the fatigue of pediatric oncology patients and to determine and apply the required nursing interventions. This study suggests that the Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18 and the Scale for the Assessment of Fatigue in Pediatric Oncology Patients Aged 13-18 for Parents are valid and reliable instruments in measuring the fatigue symptoms of children. This instrument is convenient for professionals to prevent and manage the fatigue. Professionals could develop interventions for children and parents concerning the results obtained from this scale.

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