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Development and psychometric analysis of a pediatric cancer survivors Psychosocial Late Effects Scale (PCSLES)

Sevcan Atay Turan [a], Aslı Akdeniz Kudubeş [b], Meltem Gürcan [a], Arzu Akcan [c,*], Süreyya Sarvan [a], Murat Bektaş [d]

[a] Department of Pediatric Nursing, Faculty of Nursing, Akdeniz University, Antalya, Türkiye
[b] Department of Pediatric Nursing, Faculty of Health Sciences, Bilecik Şeyh Edebali University, Bilecik, Türkiye
[c] Department of Public Health Nursing, Faculty of Nursing, Akdeniz University, Antalya, Türkiye
[d] Department of Pediatric Nursing, Faculty of Nursing, Dokuz Eylül University, İzmir, Türkiye

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ABSTRACT

Purpose: Although the physiological late effects of childhood cancer survivors are more obvious, appropriate assessment of psychosocial effects is needed. Therefore, it was aimed to develop a scale to evaluate psychosocial late effects in cancer survivors and to test its validity and reliability.

Design and methods: This methodological study was conducted with 100 children and adolescents who survived were collected at the oncology center in the south of Türkiye in 2022. Data were collected with the "Personal Information Form" and "Pediatric Cancer Survivors Psychosocial Late Effects Scale (PCSLES)" IBM SPSS 24.0 and IBM AMOS 24.0 software programs were used for data analysis, and descriptive statistics were used to analyze numeric variables. Exploration and confirmatory factor analyses were performed to determine the scale's factorial structure.

Results: The factorial analysis was used to test the structural validity of the scale. A four-factor structure consisting of 17 items was developed. The Cronbach's alpha coefficient for "1" was 0.89, "2" was 0.87, "3" was 0.80, "4" was 0.82 and the total score was 0.92. Fit indices resulting from the study were $\chi 2/SD$: 1.497, root mean square error of approximation (RMSEA): 0.071, goodnessof-fit index (GFI): 0.85, comparative-of-fit index (CFI): 0.94, and normed fit index (NFI): 0.85.

Conclusion: The scale is a valid and reliable scale that can be used to determine psychosocial late effects in pediatric cancer patients.

Practice implications: Utilizing the PCSLES can assist in identifying the psychosocial symptoms of child survivors/adolescents and facilitate the planning of appropriate interventions.

Introduction

It is estimated that 400,000 children or adolescents aged 0–19 will be diagnosed with cancer every year (Steliarova-Foucher et al., 2017; World Health Organization, 2021). In recent years, improving with in cancer diagnosis and treatment, five-year survival rates in children with cancer exceed 80% in high-income countries, while this rate is below 30% in low-middle income countries (Erdmann et al., 2021; Lam et al., 2019; World Health Organization, 2021). Childhood cancers differ significantly in terms of the originating cell, causative factors, and treatment approaches.

As the number of childhood cancer survivors continues to increase, there are growing concerns about the late effects of intensive cancer treatment that may impact survivors later in life (Frederiksen et al., 2019). These children may experience numerous and varied late side effects as a result of cancer itself, chemo/radiotherapy, and supportive care treatments (Bottomley & Kassner, 2003). These effects may occur months or even years after the completion of treatment (Oeffinger et al., 1998). The burden of morbidity may increase for a child who has undergone a bone marrow transplant, leading to a higher frequency of late side effects (Landier et al., 2015). While physiological late effects are well-documented in patients with childhood cancers, there is a need to assess the psychosocial late effects (Bottomley & Kassner, 2003). The frequency of children experiencing late effects is associated with factors such as the location and primary illness, the type and intensity of

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* Corresponding author at: Akdeniz University, Faculty of Nursing, Dumlupinar Boulevard 07058 Campus, Antalya, Türkiye.

E-mail addresses: asli.akdeniz@bilecik.edu.tr (A.A. Kudubeş), meltemgurcan@akdeniz.edu.tr (M. Gürcan), aarzu@akdeniz.edu.tr (A. Akcan), ssarvan@akdeniz.edu.tr (S. Sarvan), murat.bektas@deu.edu.tr (M. Bektaş).

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treatment, the child's age at diagnosis, and their physiological and developmental status during treatment (Bottomley & Kassner, 2003).

Several countries have developed guidelines to direct the care of long-term childhood cancer survivors. Among the most significant organizations are the Children's Oncology Group (COG), the Pan-European Network for Care of Survivors After Childhood and Adolescent Cancer (PanCare), and the International Late Effects of Childhood Cancer Guideline Harmonization Group (IGHG) (Landier et al., 2018). Guidelines have been developed for surveillance of long-term follow up care for Childhood cancer survivors (CCS). These guidelines provide a risk-adapted, lifelong plan for CCS. They encompass screening and preventive interventions for potential late effects (Children's Oncology Group (COG), 2023; Stal et al., 2022). The models of survivorship care delivery for CCS are diverse, and currently, there is no evidence-based consensus on which models are most effective in supporting long-term health and quality of life (American Society of Clinical Oncology (ASCO), 2023). The Children's Oncology Group provides a guide under the titles of general and psychosocial. This guide covers various aspects including nutrition, physical activity, returning to school after treatment, mental health, finding and paying for healthcare, an introduction to long-term follow-up, and vaccination schedules (Children's Oncology Group (COG), 2023). There is no guide regarding the psychosocial problems of children with cancer.

Survivors may experience emotional, social, economic and academic problems as well as physical problems that can affect any organ or system (Erdmann et al., 2021). The morbidity burden on childhood cancer survivors is high, with approximately 40% reported to experience severe, life-threatening, disabling, or fatal late effects within 30 years of diagnosis (Oeffinger et al., 1998). Cognitive problems and diagnosis may affect psychosocial outcomes and the achievement of expected functional and social independence and health-related quality of life. Especially, children with neurocognitive deficits, may encounter challenges in developing expected social behaviors in adulthood (Ehrhardt et al., 2018; Tonning Olsson et al., 2020). In the study of Brinkman et al. (2018), it is emphasized that most of the current studies on psychosocial symptoms in children with cancer survivors consist of small sample sizes, inappropriate comparison groups, and diagnostically heterogeneous samples.

Psychosocial adjustment is the psychosocial adaptation of a person to a life- modulating occurrence or change (Stubley & McCroy, 2014). Cancer trajectory and its psychosocial consequences are not very understood (Yallop et al., 2013). Several studies suggest that children and adolescents diagnosed with cancer are at a higher risk of experiencing multiple psychosocial adjustment problems. These may include issues such as low self-esteem, less ambitious goals, poor self-satisfaction, depression, death anxiety, deficient social skills, challenges with school reintegration, and school phobia (Barrera et al., 2005; Bessell, 2001; Erdmann et al., 2021).

One situation contributing to psychosocial problems is the fear of cancer recurrence (FCR). Individuals experiencing high FCR frequently report significant psychological distress, such as depression and anxiety. This is often accompanied by increased utilization of health ervices and negative behavioral changes, including avoidance and engaging in excessive self-examination behaviors (Lebel et al., 2013; Otto et al., 2018). The limited research on fear of cancer in pediatric patients may be attributed, in part, to a belief that young children lack the cognitive capacity to self-report or experience fear of cancer (Tutelman & Heathcote, 2020). Additionally, there is a notion that they cannot experience fear of cancer because they were too young to remember the cancer experience (Kelada et al., 2019). Wroot et al. (2020) reported that 43% of survivors of childhood cancer experiencing FCR at least once over a 5-year period.

Knowing the risk factors and incidence of late effects in children with cancer survivors is crucial for planning necessary interventions (Landier et al., 2004). All healthcare providers should be aware of the potential psychosocial late effects and should be know current treatment options (Bitsko et al., 2016). In most institutions, psychosocial care for children with cancer and their families is not provided systematically (Kazak et al., 2015). For psychosocial care, assessment of the psychosocial needs of the child and family is the first step. Systematic screening and medical documentation is important. These data have important implications for psychosocial care and facilitate for early intervention psychosocial risks for children and their families (Kazak et al., 2011; Steele et al., 2015). The utilization of valid and reliable tools to identify psychosocial symptoms may help minimize certain barriers to assessment (Kazak et al., 2015). The literature review revealed the absence of a valid and reliable scale for measuring psychosocial late effects in childhood cancer survivors. Therefore, there is a need for a measurement tool to assess the long-term problems of these children. The aim of this study is to develop a scale to evaluate psychosocial late effects in cancer survivors and to test its validity and reliability.

Materials and methods

Study design

This research is a methodological, correlational, and descriptive study.

Setting and sample

The study population comprised children aged 10–18 undergoing follow-up at the pediatric hematology-oncology clinic of a university hospital in a city in the west-south region of Turkey between January 1, 2022, and December 31, 2022. Data were collected in outpatient clinics using the random sampling method. By recommendations in the literature for validity and reliability studies, the sample size should ideally involve 5 to 10 individuals per item, and in cases of limited samples, a minimum of 100 participants is advised (DeVellis, 2016; Jonhson & Christensen, 2014). For this study, 100 children aged between 10 and 17, undergoing follow-up in the hematology-oncology clinic, having completed bone marrow transplantation or cancer treatment at least one year prior, aged above seven years at the time of diagnosis, with parental consent, and expressing willingness to participate, were included in the research.

Data collection tools

The Personal Information Form and Psychosocial Late Effects Scale (PCSLES) of the participants were used as data collection tools in the study.

Personal information form

This form includes questions such as the child's age, gender, diagnosis, age at diagnosis, and the time elapsed since the completion of the treatment.

Psychosocial Late Effects Scale (PCSLES)

The scale was developed to determine psychosocial late effects in children receiving treatment for hematology-oncological diagnoses. The draft scale has 30 items, and all of the items are in a five-point Likert type. Responses are scored as 1 = Never, 2 = Rarely, 3 = Occasionally, 4 = Frequently, and 5 = Always.

Study procedure

Generation of the item pool

A comprehensive literature review was conducted between January 2021 and February 2021 to formulate the item pool. The search utilized keywords such as “pediatric cancer survivors,” “cognitive late effects,” “psychosocial late effects childhood cancer survivors,” “late effects,” "long-term follow-up," and "psychosocial assessment tool" for screening purposes. Consistent with the literature findings, it was hypothesized that the scale might exhibit various dimensions, leading to the generation of 30 items corresponding to these dimensions (Bitsko et al., 2016; Bottomley & Kassner, 2003; Brinkman et al., 2018; Hjorth et al., 2015b; Jacobs & Pucci, 2013; Kazak et al., 2018; Langer et al., 2017; National Cancer Institute, 2023; Siegwart et al., 2022). The scale encompasses 30 items related to psychosocial late effects in pediatric cancer survivors. Among these items are those addressing psychosocial late effects observed in pediatric cancer survivors, such as irritability, experiencing sudden, unfounded fears, feeling lonely, indifference and unwillingness towards the environment and life, losing hope for the future, and feeling worthless, etc.

Expert opinions

After the creation of the item pool, expert opinions were sought to assess the content validity. Insights regarding the scale were gathered from five faculty members within the Department of Child Health and Diseases Nursing, three faculty members specialized in pediatric hematology and oncology, and two specialist nurses from the pediatric hematology-oncology outpatient clinic. The content validity of the scale was evaluated using the "Davis Technique" method. In the form prepared through the Davis technique, the scale included both its original version and its language adaptation. Specialists assigned scores ranging from 1 to 4 points (4 = Very suitable; 3 = Suitable but requires minor modification; 2 = The item needs appropriate replacement; 1 = Not applicable) to determine whether the items effectively measured the relevant concept and if they should be retained in the scale. Items receiving scores of 1 and 2 points were subsequently revised. In line with expert opinions, 13 out of 30 items were removed from the scale due to a low content validity index (weight gain, oversleeping, inability to sleep, feeling restless, decreased interest in activities that were enjoyed in the past, remembering the undesirable situations of the disease, feeling physical discomfort when thinking about the disease, postponing or refusing to go for a health check, refusing to talk about the disease, decreased success in school, learning difficulties, and deterioration in relationships with friends and family relationships). The final version of the scale consisted of 17 items.

Pilot test application

Following the completion of the content validity assessment, a pilot test was conducted with five children undergoing treatment in the clinic who were not part of the sample to examine surface validity. The pilot study aimed to evaluate the clarity of the items, wording, and answering time. Results from the pilot test indicated that the items were deemed understandable.

Given the absence of negative feedback post-pilot testing, it was determined to proceed with applying the scale to the sample. The data collection tools were administered using Google Forms, enabling online data collection during outpatient appointments.

Creating the draft scale

Following the pilot application, the scale was administered to the main sample. In the initial analysis of the scale, the 2nd item exhibited a Kaiser-Meyer-Olkin (KMO) below 0.60 and an item-total score correlation of 0.096, leading to its removal. Additionally, the 6th, 7th, and 28th items, collectively yielding a cumulative value below 0.50, were excluded from the scale. These decisions were informed by their low factor loadings in the initial Confirmatory Factor Analysis (CFA) and their adverse impact on Composite Reliability (CR) and Average Variance Extracted (AVE) values in the assessment of convergent-divergent validity. Moreover, the 10th, 11th, 12th, 15th, 16th, 17th, 18th, 19th, and 27th items, identified for removal due to recommendations from the analysis, were subsequently excluded. The Validity and reliability analyzes of the scale were completed with the remaining items.

Data analysis

Data were analyzed using SPPS for Windows 24.0 (IBM Statistical Package for Social Science) and 24.0 AMOS (Analysis of Moment Structures) statistical package programs. Data were analyzed according to a 95% confidence interval and $p < 0.05$ significance level. While evaluating the data, descriptive statistical methods (number, percentage, mean, and standard deviation) were used. Whether the data were normally distributed or not was evaluated with skewness and kurtosis measures. Content validity, surface validity, and structural validity were applied in the validity analysis of the scale. The Content Validity Index and Content Validity Ratio were calculated by using The Davis Technique for content validity. A pilot test application was made for surface validity. Exploratory (EFA) and Confirmatory Factor Analysis (CFA) were applied for structural validity. The Principle Axis Factoring Technique and the Promax Rotation Method were used for exploratory factor analysis. The maximum likelihood technique was used for CFA. In the CFA, variance inflation factor (VIF) and tolerance values were examined for multicollinearity. To meet the multiple normality assumption in CFA analysis, it is recommended that the critical ratio value for skewness and kurtosis values be between ±2. In this study, CFA critical ratio values are between ±2 and meet the assumption of multiple normality (Brown, 2015; Tabachnick & Fidell, 2015; Xia & Yang, 2019; Yaşlıoğlu, 2017). Convergent-divergent validity was evaluated based on CFA. Cronbach Alpha, item-total correlations, and split-half analysis were used in the reliability analysis of the scale.

Ethics approval

The study was approved by the Scientific Research and Publication Ethics Board of the university (approval number KAEK-441, approval date June 23, 2021). Written consent was obtained from the parents, and verbal consent was obtained from the children. This study was conducted and performed according to the ethical rules stated in the Declaration of Helsinki (Morris, 2013). In this study, written consent was obtained from the parents and children.

Results

The study participants exhibited a mean age of 15.35 ± 2.27 years, ranging from 11 to 18 years. The average age at diagnosis was 9.92 ± 2.54 years, spanning from 7 to 17 years, while the mean duration since the completion of treatment was 3.34 ± 2.00 years, with a range of 1 to 9 years. Of the participants, 68% were male ($n = 68$), and 56% ($n = 56$) received a diagnosis of Acute Lymphoblastic Leukemia (ALL). Hodgkin Lymphoma accounted for 18% ($n = 18$) of the cases, Acute Myeloid Leukemia (AML) for 8% ($n = 8$), and Ewing's Sarcoma for 4% ($n = 4$), with the remaining children diagnosed with various other conditions.

Results of validity analysis

Content validity

The Content Validity Index (CVI) score for the scale was computed as 0.96, indicating a high level of content validity. Moreover, the Content Validity Rate (CVR) score for each item on the scale ranged from 0.92 to 0.97.

Exploratory factor analysis

Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were employed to assess the appropriateness of the data for factor analysis. The analysis yielded a KMO value of 0.887, and Bartlett's test resulted in $\chi2 = 951.290$, $p < 0.01$. These findings affirm that the sample size and dataset are conducive to exploratory factor analysis. During the conducted Exploratory Factor Analysis (EFA) to elucidate the factor structure of the scale, it was established that the scale comprised four sub-dimensions. The cumulative variance explained by these four dimensions amounted to 61.097%. Specifically, the first sub-dimension accounted for 42.956% of the total explained variance, the second sub-dimension for 6.842%, the third sub-dimension for 5.865%, and the fourth sub-dimension for 5.434%. Factor loading values for items within these sub-dimensions ranged from 0.472 to 0.838 in the first sub-dimension, 0.682 to 0.866 in the second sub-dimension, 0.608 to 0.791 in the third sub-dimension, and 0.827 to 0.865 in the fourth sub-dimension (Table 1).

Confirmatory factor analysis

Confirmatory factor analysis (CFA) was employed to assess the appropriateness of the four-factor structure identified through exploratory factor analysis. In the first-order CFA, various goodness-of-fit indices, including CMIN/DF (Chi-Square Goodness), GFI (Goodness of Fit Index), CFI (Comparative Fit Index), IFI (Incremental Fit Index), RFI (Relative Fit Index), NFI (Normed Fit Index), TLI (Trucker-Lewis Index), and RMSEA (Root Mean Square Error of Approximation), were utilized. Examination of the goodness-of-fit indices for the scale revealed $\chi2 = 166.213$, DF = 111, $\chi2/DF = 1.497$, GFI = 0.85, CFI = 0.94, IFI = 0.94, NFI = 0.85, TLI = 0.92, and RMSEA = 0.071 (refer to Table 2). In the second-order CFA, it was found that $\chi2 = 162.473$, DF = 111, $\chi2/DF = 1.465$, GFI = 0.85, CFI = 0.94, IFI = 0.94, NFI = 0.85, TLI = 0.93, and RMSEA = 0.068 (Table 2). The modifications were implemented among four items in the CFA analysis.

As a result of the second-order CFA, it was determined that the factor loading for the first sub-dimension ranged from 0.66 to 0.81, for the second sub-dimension from 0.73 to 0.78, for the third sub-dimension between 0.53 and 0.82, and for the fourth sub-dimension between 0.80 and 0.87 (Fig. 1).

The first and second-order Confirmatory Factor Analysis (CFA) results were utilized to assess the convergent and divergent validity of the scale. The analysis revealed that the Composite Reliability (CR) values were >0.70, the Average Variance Extracted (AVE) values exceeded 0.50, and CR surpassed AVE in all four sub-dimensions. Additionally, the analysis showed that the Mean Shared Variance (MSV) was less than AVE, the Average Shared Variance (ASV) was less than AVE, and the square root of AVE was greater than the correlations between factors (Table 3). These findings provide evidence supporting the divergent validity of the scale.

Results of reliability analysis

In the study aimed at assessing the reliability of the PCSLES, the findings were examined through Cronbach's Alpha, item analysis (item-total correlations), and test split-half analysis. Cronbach's Alpha reliability coefficient was employed to evaluate the internal consistency of the scale, yielding a coefficient of 0.92 for the entire scale. Sub-dimension Cronbach's Alpha reliability coefficients were determined as $\alpha = 0.89$ for the first sub-dimension, $\alpha = 0.87$ for the second, $\alpha = 0.80$ for the third, and $\alpha = 0.82$ for the fourth (Table 4).

Table 2
Model fit index values of PCSLES ($n = 100$).

Model fit indices	First Order CFA Model fit index values	Second Order CFA Model fit index values	Acceptable fit index values
χ^2	166.213	162.473	
DF	111	111	
χ^2/DF	1.497	1.464	≤2 good fit, ≤5 fit
RMSEA	0.071	0.068	≤0.08
CFI	0.94	0.94	≥0.85
IFI	0.94	0.94	≥0.85
GFI	0.85	0.85	≥0.85
NFI	0.85	0.85	≥0.85
TLI	0.92	0.93	≥0.85

Abbreviations: CMIN/DF, chi-square goodness; RMSEA, root mean square error of approximation; CFI, comparative fit index; IFI, incremental fit index; GFI, goodness of fit index; NFI, normed fit index; TLI, trucker-lewis index.

An additional approach to assessing the internal consistency was the split-half reliability analysis, with odd-numbered items constituting the first half and even-numbered items forming the second half. The Cronbach's Alpha values for the first and second halves were 0.87 and 0.84, respectively. The correlation between the two halves, reflected by the equivalence coefficient, was 0.77. The Spearman-Brown coefficient was calculated as 0.924, and the Gutmann Split-Half confidence coefficient as 0.918 (Table 4). The correlation between the two halves was found to be 0.859. Notably, the analysis resulted in a Hotelling's T^2 value of 151.780, F = 8.049, and $p < 0.001$.

In item analysis, the correlation of each item with the total and its sub-dimension score of the scale was evaluated. The item-total score correlation values for all items ranged from 0.431 to 0.721, while the item-sub-scale score correlation values ranged from 0.490 to 0.730 ($p < 0.001$) (Table 5).

Discussion

In the present study, the primary objective was the development of a psychometrically sound measurement instrument for the assessment of psychosocial late effects in cancer survivors, encompassing the evaluation of its validity and reliability. Content validity, which assesses the extent to which the items within a measurement tool accurately represent the intended phenomenon, is a crucial criterion, with a recommended threshold of at least 80% for the entire scale

Table 1
Exploratory factor analysis results of the PCSLES ($n = 100$).

Sub-dimensions	Items	Factor loadings	Eigen value	Explained variance
1st sub-dimension	Item 9. Feeling hopeless	0.472	7.685	42.956
	Item 20. Hyperactivity/attention deficit	0.556		
	Item 24. Indifference and reluctance towards the environment and life	0.678		
	Item 25. Don't lose hope for the future	0.838		
	Item 26. Feeling of worthlessness	0.795		
	Item 29. Feeling of social detachment	0.678		
2nd sub-dimension	Item 8. Fear of being alone	0.682	1.547	6.842
	Item 13. Feeling anger when thinking about one's illness	0.866		
	Item 14. Feeling sad when thinking about one's illness	0.703		
	Item 22. Feeling sudden fears for no reason	0.685		
	Item 23. Feeling lonely	0.696		
3rd sub-dimension	Item 4. Easily crying without reason	0.791	1.362	5.865
	Item 5. Decreased energy level and fatigue	0.688		
	Item 21. Increase in irritability	0.683		
	Item 30. Difficulty performing daily activities	0.608		
4th sub-dimension	Item 1. Decreased appetite	0.865	1.255	5.434
	Item 3. Weight loss	0.827		
Total explained variance (%)			61.097	

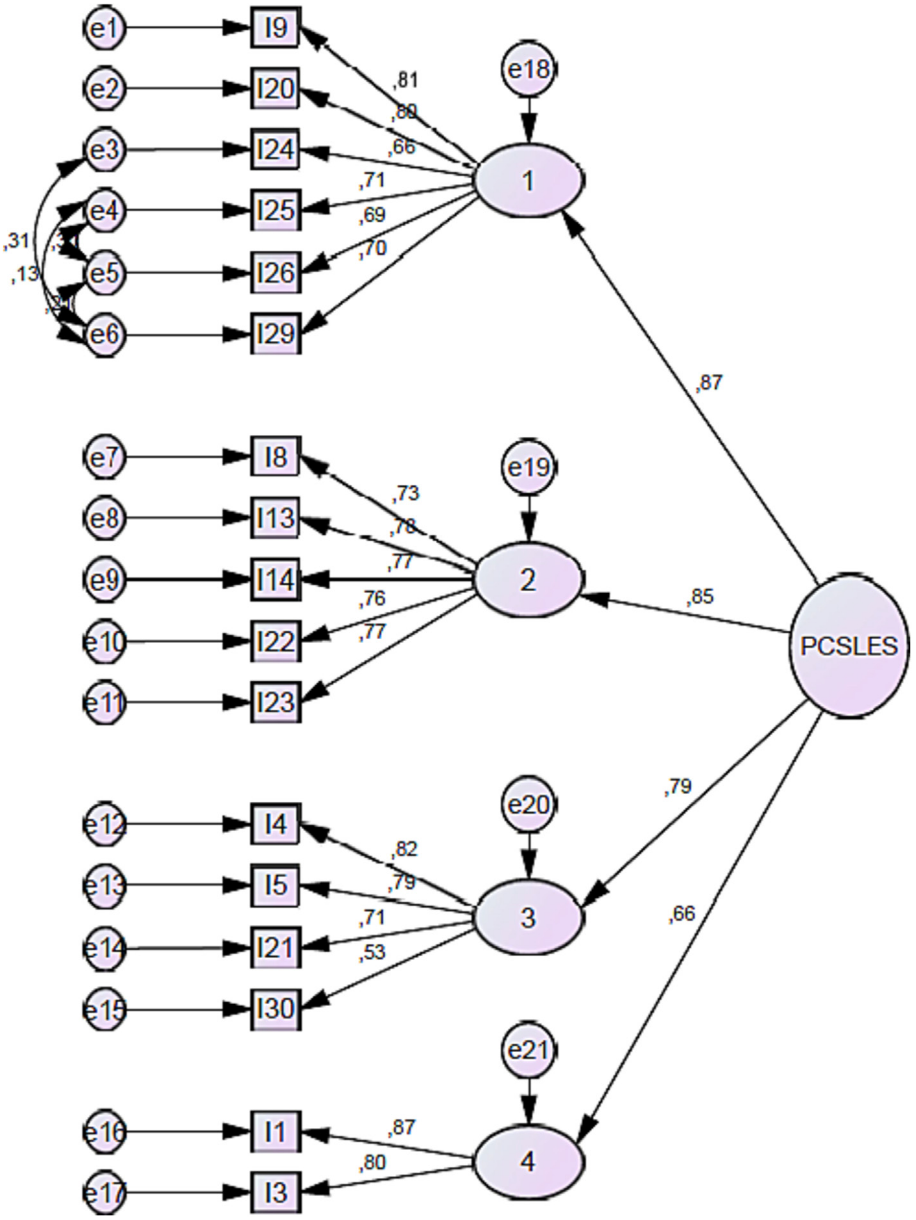

Fig. 1. Second Order Confirmatory factor analysis results of the PCSLES.

(Çapık et al., 2008; Özdamar, 2016; Yusoff, 2019). Our investigation revealed individual item values ranging from 0.92 to 0.97, with an overall scale value of 0.96. These findings substantiate the comprehensibility of the scale and its fidelity in accurately reflecting the elements under scrutiny.

The EFA, a multivariate statistical approach, holds paramount significance in the development and validation of conceptual frameworks and measurement tools (Kartal & Bardakçı, 2018; Watkins, 2018). The KMO and the Bartlett sphericity test are instrumental in scrutinizing the factor structure. The KMO assesses the adequacy of the sample for data analysis, with values between 0.90 and 1.00 denoting excellence, 0.80–0.89 indicating a high level of adequacy, 0.70–0.79 signifying good adequacy, 0.60–0.69 representing moderate adequacy, and 0.50–0.59 suggesting poor adequacy (Yaşlıoğlu, 2017). In the current

Table 3
Convergent-divergent validity results of the first and second order CFA ($n = 100$).

	Sub-dimensions	CR	AVE	MSV	MaxR(H)	1	2	3	4	ASV
First Order CFA	1st sub-dimension	0.876	0.542	0.537	0.881	0.737				0.44
	2nd sub-dimension	0.874	0.581	0.537	0.875	0.732*	0.762			0.44
	3rd sub-dimension	0.811	0.523	0.477	0.838	0.691*	0.662*	0.723		0.39
	4th sub-dimension	0.828	0.707	0.333	0.840	0.558*	0.577*	0.512*	0.841	0.30
Scond Order CFA		0.872	0.634		0.890	0.796				0.07

Abbreviations: CR, composite reliability; AVE, average variance extracted; MSV, maximum squared variance; ASV, average shared squered variance.
* $p < 0.001$.

Table 4
Reliability analysis results of the PCSLES and its sub-dimensions ($n = 100$).

		Total scale	1st sub-dimension	2nd sub-dimension	3rd sub-dimension	4th sub-dimension
Cronbach α		0.92	0.89	0.87	0.80	0.82
Split-Half Analysis	First Half Cronbach α	0.87				
	Second Half Cronbach α	0.84				
	Spearman-Brown	0.924				
	Guttman Split-Half	0.918				
	Correlation Between Two Halves	0.859				

study, the KMO was determined to be 0.887, signifying a highly suitable sample for data analysis. Conversely, the Bartlett sphericity test, assessing the sufficiency of correlation between variables, yielded significance with $p < 0.001$ (Karakoç & Dönmez, 2014), indicative of a substantial relationship between items and the appropriateness of the data for factor analysis.

It is emphasized that the total explained variance ratio, which is an important indicator of structural validity, should be above 40% on multidimensional scales. The higher the explained variance ratio of the scale, the stronger the structural validity (Boateng et al., 2018; DeVellis, 2016; Finch, 2019). The fact that the total explained variance was 61.09% in this study shows that the structural validity is strong.

Exploratory factor analysis is an important analysis to determine under which sub-dimension the items of the scale will be placed. It is recommended that a factor loading threshold of at least 0.30 be adhered to, with emphasis on the exclusion of items falling below this threshold (Finch, 2019; Karagöz, 2016). In the present study, the factor loadings of items across the four sub-dimensions were determined to range from 0.47 to 0.86, indicative of a robust factor structure and affirming the scale's strong dimensional validity.

It is recommended that scrutinize the structure identified through the EFA using the CFA (Brown, 2015; Xia & Yang, 2019). The CFA outcomes in this study yielded a RMSEA value of 0.071, with a corresponding Chi-square value divided by the degrees of freedom ($\chi2/df$) at 1.497. Furthermore, the fit indices demonstrated consistency with values advocated in the literature. In current scholarly discourse, model fit indices exceeding 0.85 are considered indicative of good fit, while the $\chi2/df$ value should be below five, and the RMSEA value should be <0.08 (Marsh et al., 2020; Seçer, 2018). Recognizing that certain items may measure concepts beyond their designated sub-dimensions, leading to measurement error in CFA, it is suggested that employ statistical corrections of mitigate this issue. In this study, modifications were recommended for four items that appeared to measure an alternative concept collectively, aimed at reducing measurement errors (Marsh et al., 2020; Seçer, 2018). The CFA outcomes in this investigation align with the established criteria in the literature.

Table 5
Item scale total score and sub-dimension total score correlations of PCSLES ($n = 100$).

Sub-dimensions	Items	Item total score correlation (r)*	Sub-dimension total score correlation (r)*
1st sub-dimension	Item 9	0.545	0.687
	Item 20	0.527	0.705
	Item 24	0.635	0.666
	Item 25	0.666	0.727
	Item 26	0.617	0.704
	Item 29	0.721	0.712
2nd sub-dimension	Item 8	0.632	0.679
	Item 13	0.640	0.730
	Item 14	0.695	0.713
	Item 22	0.543	0.697
	Item 23	0.656	0.688
3rd sub-dimension	Item 4	0.678	0.709
	Item 5	0.579	0.671
	Item 21	0.619	0.632
	Item 30	0.616	0.490
4th sub-dimension	Item 1	0.674	0.704
	Item 3	0.431	0.704

* $p < 0.001$.

The CFA outcomes were pivotal in scrutinizing the convergent and discriminant validity of the scale. The convergent validity assessment revealed CR values exceeding 0.70, AVE values surpassing 0.50, and CR greater than AVE across all four sub-dimensions. Additionally, discriminant validity analysis indicated that MSV < AVE, ASV < AVE, and the square root of AVE exceeded the correlation between factors. By established recommendations in the literature, it is advised that all CR values surpass AVE values, AVE exceeds 0.5, MSV < AVE, ASV < MSV, and the square root of AVE is greater than the correlation between factors (Tabachnick & Fidell, 2015; Yaşlıoğlu, 2017). These findings affirm the scale's robust convergent and discriminant validity.

Cronbach's alpha coefficient, a measure that assesses the internal consistency of items within a scale, is crucial in determining the extent to which items capture the same underlying construct and their relevance to the intended measurement. In the scale studies, a Cronbach's alpha value approaching 1 is desirable, indicative of the high internal consistency. The literature recommends a range for this coefficient between 0.60 and 1.00 (Nunnally & Bernstein, 2010). In the present study, the Cronbach's alpha values for the overall scale and sub-dimensions exceeded 0.80, signifying adequate measurement of the intended construct and demonstrating high reliability.

In split-half analysis, a method elucidating the reliability of a scale, the expected coefficients, namely Spearman-Brown and Guttman Split-Half, typically surpass 0.70 (Chakrabartty, 2013; Nunnally & Bernstein, 2010). This study revealed coefficients exceeding 0.80, indicating a robust and statistically significant relationship between the two halves of the scale.

It is recommended to perform item-total score analysis to prove whether the items in the scale measure the variable to be measured. Thus, the relationship between the scores obtained from the items and the scale total score is explained (Jonhson & Christensen, 2014). Although it is an acceptable value for this value to be higher than 0.30, it is expected to be as close to 1 as possible and in a positive direction (Jonhson & Christensen, 2014). In this study, it was determined that the values were higher than 0.30, and there was a positive relationship.

Within the existing literature, it is asserted that inadequately identified and unaddressed late effects in children following cancer treatment can lead to significant manifestations of anxiety, stress disorders, fear of cancer recurrence, and symptoms of depression. This condition is emphasized to not only compromise the quality of life for affected children but also impede academic success and hinder the adjustment to social life. Furthermore, it is noted that physical changes, such as hair loss resulting from cancer treatment, may contribute to the deterioration of body image and a decline in self-esteem. Consequently, early identification and intervention for psychosocial late effects are underscored as crucial. The scale developed in this study is posited to serve as a valuable tool, particularly in the early detection of psychosocial issues and the formulation of tailored interventions for children (Bottomley & Kassner, 2003; Brinkman et al., 2018; Ehrhardt et al., 2018; Tonning Olsson et al., 2020; Hjorth et al., 2015a; Krull et al., 2018; Landier et al., 2015; van der Linden et al., 2020). Notably, the demonstrated good validity and reliability of the scale suggest its ability to accurately and consistently identify the psychosocial late effects experienced by children under similar conditions. Consequently, the scale holds significance as a valuable contribution to the literature by providing novel insights into the psychosocial challenges faced by children.

Limitations

This scale is a valid and reliable in determining the psychosocial late effects experienced by children with childhood cancer. It includes children and adolescents in the 10–17 age group diagnosed after the age of seven. A limitation of this study is the use of random sampling. However, despite this limitation, reaching 100 children with cancer in a sample that is difficult to reach, obtaining opinions from both children, parents, and health professionals during the creation of the item pool, developing a scale that has not been developed in this field before, and using advanced analyses for validity and reliability are the strengths of the study. Another limitation of the study is that the data were collected from a single hospital. However, since this hospital where children are treated is a children's hospital serving throughout the country, it is thought that the impact of this limitation will be low. Since there is no other scale that evaluates the late psychosocial effects of children with surviving cancer, the parallel form could not be used to evaluate convergent and divergent validity. It constituted another limitation of the study.

Implications to practice

The majority of long-term survivors of childhood cancer are living with few psychosocial late effects of their disease or treatment. It is thought that as cancer turns into a chronic health problem, the cases will increase and survivors may experience many psychosocial problems in their lives. If there are psychosocial late effects, it can seriously affect their lives. First of all, it is important to determine the psychosocial problems experienced by children who survive cancer. When determining these problems, standard valid, and reliable measurement tools are needed. It is necessary to scan for problems at regular intervals. It is recommended to determine psychosocial late effects with this scale and to plan and implement nursing interventions that will reduce or eliminate these effects.

This scale will be an important measurement tool in determining the psychosocial problems experienced by children surviving cancer. Future studies can be planned using this scale to examine the broader effects of psychosocial late effects experienced by children surviving cancer and when/how often these should be evaluated.

Conclusion

The Pediatric Cancer Survivors Psychosocial Late Effects Scale (PCSLES) is a valid and reliable measurement tool for determining the psychosocial problems experienced by children and adolescents with cancer. It is the first scale to evaluate the psychosocial effects of childhood cancer survivors. With this scale, the psychosocial symptoms of children and adolescents can be determined, and necessary interventions can be planned. In future studies, the scale can be applied to different groups and tested. It can be used to determine the psychosocial symptoms of children and adolescents from different cultures.

Ethical considerations

All procedures performed in studies involving human participants were in accordance with the ethical standards of Scientific Research and Publication Ethics Board of a university (approval number KAEK-441 dated June 23, 2021).

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CRediT authorship contribution statement

Sevcan Atay Turan: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Conceptualization. **Aslı Akdeniz Kudubeş:** Writing – original draft, Visualization, Methodology, Conceptualization. **Meltem Gürcan:** Writing – original draft, Visualization, Conceptualization. **Arzu Akcan:** Writing – original draft, Investigation. **Süreyya Sarvan:** Writing – original draft, Investigation. **Murat Bektaş:** Writing – original draft, Methodology, Formal analysis.

Declaration of competing interest

The authors declares that they have no conflict of interest.

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