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Parental Stress Scale (PSS): A evaluation Psychometric on family caregivers of children with cancer

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Article

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Abstract

Chronic diseases are a source of stress for parents, particularly when they act as caregivers of the minor patient. Valid and reliable instruments are necessary to objectively evaluate this condition and design strategies that allow an adaptive interaction between parent caregivers and children. The objective of this study was to evaluate the psychometric properties of the Parental Stress Scale in parents of children with cancer. In Mexico City, a total of 633 family caregivers of children with cancer hospitalized at a National Health Institute were interviewed. The family caregivers complete the Parental Stress Scale and the Zarit Caregiver Burden Interview. Empirical findings suggest that the model with two factors ("Stressors" and "Rewards") showed an acceptable to excellent fit, $\chi 2/df = 4.95$; RMSEA = 0.079 (0.070 to 0.089); SRMR = 0.052; CFI = 0.97; TLI = 0.96. Each factor adequately represented (AVE > 0.50) and with discriminant validity ($p < 0.05$) and high internal consistency ($\omega > 0.80$). Strict factorial invariance was detected when comparing the sex of the minor, but partial when evaluating the sex of the caregiver. Divergent and convergent validity was detected with the factors of the Zarit Caregiver Burden Interview. The Parental Stress Scale is a valid and reliable instrument to evaluate emotional aspects of the interaction between family caregivers of children with cancer.

Introduction

Childhood cancers are those occurring between the ages of 0 and 19; in 2023, the Global Burden of Disease (GBD) study estimated 18.5 million incident cancer cases in the general population[1]. Regarding childhood cancer, 377,000 cases, 144,000 deaths, and 11.7 million disability-adjusted life-years (DALYs) were reported[2]. Among the Mexican pediatric population, an incidence of 150 new cases per million per year has been reported. Data on prevalence showed that acute leukemias account for 50% of all childhood cancer cases, followed by lymphoma (Hodgkin and non-Hodgkin) and primary malignant brain tumors. The national mortality rate for all cancer types was 5.2 per 100,000 per year[3].

Parental stress can be defined as a repulsive reaction to parental obligations[4]. In general, we can say that it occurs when the demands of care exceed resources and are inconsistent with the expectations that parents have regarding their children[5]. According to the conceptual model presented by Webster-Stratton[6], parental stress will be determined by extra-familial factors, such as: a low socioeconomic level, unemployment, stressful events and daily problems; ainterpersonal: such as a divorce process in the parents, that the parents are single or that there are marital problems, and finally childhood factors: such as behavioral or temperament problems in children. Thus, a study identified an association between parental depression, general childhood problems, child externalizing and internalizing problems, social support, parental education level, and parental stress[7]. Whether such factors harm the functioning of parents, as well as the interactions they have with their children, will depend on their psychological well-being, their personal resources, and the social and family support they have. Likewise, the evaluation of the stressful context by the parents will determine how much it affects their parenting practices, as well as the degree of risk that the minors will have future behavioral problems, since according to Patterson[8] the stress response in the children will be mediated by the quality and sensitivity of interactions between parents and children.

Recent evidence has shown that parental stress can have negative consequences for both parents and children. A recent meta-analysis found a significant negative association between parental stress and parental well-being, indicating that greater parental stress is associated with lower levels of well-being[9]. Likewise, parental stress can affect the emotional and behavioral functioning of children. A systematic review and meta-analysis conducted by Ribas et al.[10] found an association between parental stress and emotional and behavioral problems in children. These findings highlight the relevance of parental stress not only for parents' well-being but also for children's psychological adjustment, emphasizing the importance of its assessment and management.

Parental Stress in family caregivers of children with cancer

Now, it is relevant to refer to the parental stress experienced by parents of children with chronic illnesses. Regarding this, Toledano-Toledano et al.[11] points out the presence of a particular profile, in which parental stress is accompanied by high levels of anxiety, depression, burden and low levels of family support, resilience and well-being.

With respect to parental stress in parents of children with cancer, its study and subsequent evaluation is pertinent, since due to the effects of treatment, pediatric oncology patients will have symptoms that will strongly affect their physical and psychosocial well-being[12,13], and due to parental attachment, symptomatic burden will directly affect the so-called parental stress and the perception of the quality of life that parents have for their children[14], which could even impact the medical care that the child receives. It should be noted that cancer is the chronic disease that causes the greatest stress and anxiety in the parents of those who suffer from such disease, and these parents usually classify it as the most terrifying condition[15,16,17,18,19]. In this regard, in a systematic review of non-experimental studies published between 2010 and 2020, it was found that the high category of parental distress reached 17.6% and the very high category reached 5.8% in parents of pediatric patients with cancer, it was also found that suicidal ideation, insomnia, and poor health were related to such a level of distress[20]. Vlachos et al.[21] also identified that the majority of parents who had children diagnosed with cancer had moderate psychosocial risk (54%), which was coupled with an underestimation of psychosocial risk by health care providers. In 57%-59% of cases, the level of psychosocial risk was also related to levels of anxiety and depression.

Regarding the factors that influence the level of parental stress of parents of infants with cancer, Çınar et al.[22] points out the impact of economic status, as well as the physical and mental health of parents after the child's diagnosis, the child's mental health problems, and the child's diagnosis at a young age. Vlachos et al.[21] adds that the parents' reaction to stress, family structure and family social support are factors that contribute significantly, an issue that is confirmed in a study in which a significant negative correlation was identified between the perceived social support and maternal stress ($r = -0.40$, $p < 0.05$),

in addition to a significant positive correlation between perceived social support and self-esteem ($r = 0.57$, $p < 0.05$)[23]. Finally, with respect to the factors that can generate more effective coping with stress, it has been shown that the empowerment of parents, as well as a cooperative association with health professionals, such as nurses, have been useful for this purpose[24].

Instruments that assess parental stress

Having instruments that reliably assess parental stress can impact the development of interventions that reduce mental health problems in parents with chronic diseases, especially cancer. In this regard, we can point to systematic reviews such as that of Hughes et al.[25] that evaluates the effectiveness of mindfulness-based interventions (MBIs) and indicate that they are feasible and acceptable in improving anxiety and depression in children and adolescents who have conditions such as chronic pain, headaches, cancer, heart disease, esophageal atresia, inflammatory bowel disease, and polycystic ovary syndrome, and although support for such interventions is limited with respect to the family unit, we can identify decreases in concern of parents[26], a decrease in illness burden and a greater frequency of problem-solving behaviors[27,28].

It is then that one of the most commonly used instruments to evaluate parenting stress is the Parenting Stress Index (PSI), fourth edition, in its two forms (complete and short), which considers that parenting stress is made up of two parts: general stress derived from the demands of parents and stress derived from the demands of children[29]. The PSI has a Likert-type response form and its long version consists of 120 items, while its short version consists of 36. It has three dimensions (Parental Distress, Parent-Child Dysfunctional Interaction, and Difficult Child)[30] and according to different studies it denotes adequate internal consistency and good test-retest reliability. The PSI has been validated in countries such as China[31], France[32], Portugal[33], Canada[34], Finland[35] and the Netherlands[36], however, in a systematic review carried out by Ríos et al.[37] it is evident that the factorial studies of both versions of the PSI are methodologically weak.

On the other hand, there is the Pediatric Inventory for Parents (PIP), which is an instrument with 42 items that measures parental stress based on 4 dimensions: Communication with the Family/Medical Professionals, Medical Care, Role Function and Emotional Functioning. This evaluates, using a 5-point Likert scale, the frequency of each stressor during the last week, as well as how difficult it has been to face each stressor. The scale was developed in Philadelphia to evaluate the parental stress of parents of pediatric oncology patients and in addition to obtaining construct validity, valid indices of internal consistency $\alpha = 0.95$ and $\alpha = 0.96$ were found for the frequency of stressful events, as well as for the degree of difficulty associated with the situation or event, values $\alpha > 0.80$ were obtained[38]. Subsequently, the scale was validated in parents of children with type 1 diabetes mellitus, detecting adequate internal consistency for the total measure, as well as for the frequency of stressors and the degree of difficulty associated with the event ($\alpha = 0.95$, $\alpha = 0.94$ and $\alpha = 0.94$ respectively)[39]. The PIP was also validated in Sweden, obtaining adequate internal consistency values ($\alpha = 0.96$ for frequency, $\alpha = 0.97$ for difficulty) with values $\alpha = 0.77$ to $\alpha = 0.94$ for its subscales, and in this study it was identified concurrent validity with the Impact of Event Scale-Revised (IES-R)[40]. The PIP was also validated in the Netherlands using confirmatory factor analysis (CFA), obtaining acceptable fit indices for a model with 4 factors and a unifactorial model (for frequency in the 4-factor model: $\chi2 = 270.04$, $df = 88$, CFI = 0.869, TLI = 0.933, RMSEA = 0.109, SRMR = 0.091, for frequency in the unifactorial model: $\chi2 = 292.91$, $df = 88$, CFI = 0.852, TLI = 0.924, RMSEA = 0.105, SRMR = 0.091; for difficulty in the 4-factor model: $\chi2 = 235.73.91$, $df = 88$, CFI=0.895, TLI=0.956, RMSEA = 0.098, SRMR = 0.081; for difficulty in the unifactorial model: $\chi2 = 253.06$, $df = 87$, CFI = 0.882, TLI = 0.950, RMSEA = 0.105, SRMR = 0.085), in addition to this, an $\alpha = 0.94$ and an $\alpha = 0.95$ were obtained for the frequency of stressful events, as well as for the degree of difficulty associated with them, and with respect to the subscales, the consistency was adequate for all of them except for Communication with the Family/Medical Professionals, however, this issue was resolved by eliminating item 2[41]. The PIP was also validated in the French population, and the internal consistency values for the frequency and difficulty subscales were $\alpha = 0.87$ and $\alpha = 0.93$ respectively, in the case of the subscales they ranged from $\alpha = 0.63$ to $\alpha = 0.93$[42]. Finally, its psychometric properties were evaluated in the Persian population based on a CFA, from which optimal fits were found ($\chi2/df = 3.48$, RMSEA = 0.778, CFI >0.9, IFI >0.9, NFI >0,9 and the good fit index (GFI) was slightly <0.9) and internal consistency ranging from $\alpha = .834$ to $\alpha = .890$ was obtained for the frequency of stressors and an internal consistency which ranged from $\alpha = .808$ to $\alpha = .890$ for the difficulty represented by such factors[43].

Speaking specifically of instruments validated in parents of children suffering from cancer, we can mention the Parenting Concerns Questionnaire (PCQ), which was validated in a sample of Portuguese parents of children with cancer. Psychometric analysis was conducted using item response theory which indicated that the majority of items were highly discriminatory which were best characterized as moderate versus low or high levels of parental concerns on the three PCQ factors confirmed by CFA, from which factor loadings ranging from moderate to high (.45 a .90), with adequate fit indices: $\chi2(84) = 226.187$, $\chi2/gl = 2.69$, $p < .001$; CFI = 0.93; RMSEA = 0.09; CI del 90 % (0.076–0.104, $p < 0.001$), with one exception in the chi-square test that was significant. The internal consistency obtained through Cronbach's alpha for the PCQ was $\alpha = .92$ and for its subtests it was: $\alpha = 0.87$, $\alpha = 0.90$ and $\alpha = 0.85$. It also showed good test-retest reliability (ICC = 0.80, ICC = 0.82, ICC = 0.78 for its dimensions) and showed convergent validity when associating its scores with anxious, depressive and parental stress symptoms, as well as quality of life. Finally, the PCQ adequately differentiated parents with and without depressive symptoms[44]. In this context, 15 instruments used to measure parental stress among parents with young children have been identified; of these, four are generic stress scales and eleven are self-administered instruments specific to parents[45].

Previous validation studies of the Parental Stress Scale

The PSS describes the relationship between parents and children and how parents feel about it. It has 4 factors (Parental Rewards, Parental Stressors, Lack of Control and Parental Satisfaction) and its validity is demonstrated by correlations with relevant emotions and role satisfaction, also discriminates between mothers of children in treatment for emotional/behavioral problems and developmental disabilities versus mothers of children who do not receive treatment.

Regarding the advantages of this instrument, we can point out that it is a scale that can be used with any type of parent, since its creators used a heterogeneous sample that included mothers and fathers of children with normal development, children with emotional problems and children with behavioral problems. It is also a brief and easy to apply instrument.

In a review study, Louie et al.[46] points out the translation of the PSS into 5 languages and its use in 8 countries. Its systematization reveals 21 studies, among which 13 use the instrument as it was created. Of these 13 studies, an experimental study in children from 3 to 6 years old with behavioral difficulties stands out, since the highest scores were observed in the PSS[47], as well as a study carried out with mothers of children between 6 weeks and 15 months with sleep disturbances, where the lowest pre-intervention scores on the PSS are observed[48]. In addition to these 13 studies, three others described in this systematic review point out the modification of the PSS for use with samples that contained special characteristics[49,50,51], and finally, the remaining 5 studies described in this article evaluate the psychometric properties of the scale and its modification for various reasons.

Among the studies that explore the psychometric properties of the PSS, we find the one carried out by Cheung[52], who evaluated the psychometric properties of the PSS in the Chinese population and reported having eliminated item 2 due to an unexpected correlation with the rest of the scale (r = .06), likewise preferred to use a scale with only 4 response options, to eliminate the midpoint, thus the modified scale of 17 items showed internal consistency α = 0.89, and correlated significantly with the Index of Parental Attitudes that was able to discriminate between adjusted and non-adjusted respondents. Regarding its factor structure, Cheung[52] through an exploratory factor analysis (EFA), detected only 2 factors: parental strain and parental satisfaction, which explained 53.46% of the variance. Another study is carried out by Leung & Tsang[53], who validated the PSS with parents recruited in primary schools and parents with children with attention deficit hyperactivity disorder (ADHD). These authors worked with a Rasch analysis that indicated that two items were outside the accepted adjustment range, which is why a 16-item scale was identified, with a single dimension and a reliability of .86. Subsequently, Baker et al.[54] shows a validation study in which they translate the original scale into spanish, eliminating item 2 and reporting a reliability of 0.72. Oronoz et al.[55] also translated the 18 items of the original scale into spanish and obtained psychometric properties with parents of spanish nationality, eliminating item 16 as it was considered ambiguous and carrying out an EFA to examine the dimensionality of the questionnaire, through generalized least squares estimation with oblimin rotation. Thus, 12 items organized into two factors are retained: Baby's Rewards and Stressors, with an internal consistency α = 0.77 and α = 0.76 respectively. In this same study, criterion validity was obtained by detecting correlations between the test scores and anxious and depressive symptoms measured using the Beck Depression Inventory (BDI) and the State-Trait Anxiety Inventory (STAI).

Years later, other relevant validations were performed, such as the one carried out with Brazilian parents, in which the scale was first translated into Portuguese to subsequently carry through an EFA using the maximum likelihood factor extraction method and an oblique rotation method, which allows the factors to correlate with each other and which indicated a final structure of 16 items divided into two subscales that explained 37% of the variance (items 2 and 4 were eliminated). Internal consistency was acceptable for the global measure α = 0.81, as well as for its factors: α = 0.69 for parental satisfaction and α = 0.79 for parental stressors[56]. Algarvio et al.[57] for their part, also worked with 3842 Portuguese parents of children between 3 and 10 years old, but in this case they detected a 4-dimensional structure from a CFA ($\chi2$ = 805.725, $\chi2$ /df = 11.348, CFI = 0.944, GFI = 0.969, RMSEA = 0.052) also reported divergent validity with the Parental Concerns Scale, convergent validity using the AVE, and discriminant validity for the scale factors. Regarding the internal consistency of the general scale and its subscales, α = 0.78 was obtained for the general scale and from α = 0.57 to α = 0.78 for the factors. Pontoppidan et al.[58] carried out validation in Danish mothers using Rasch models, eliminating items 2 and 11 and leaving two subscales, one with 9 items that measures parental stress and one with 7 that measured satisfaction. The local dependence of 4 pairs of items was evident in the first scale, as well as 2 that function differentially, and for the satisfaction scale there was dependence between two pairs of items but no differential functioning. Both subscales were fitted to graphical loglinear Rasch models adjusting for local dependence and differential functioning of the items[58]. A further validation was the one devised in Canada by Zelman & Ferro[59], who confirmed the structure of the PSS for parents of children with chronic illnesses. In this case the data were adjusted to the original model $\chi2$ = 123.5, CFI = 0.965, TLI = 0.956, RMSEA = 0.080, WRMR = 0.764, and the internal consistency for the global score was α= 0.84 and for each subscale ranged from α = 0.61 to α = 0.85, in addition, convergent validity was evaluated with the family functioning, parental anxiety, parental depression, and the parenting and autonomy subscales of the KIDSCREEN. Finally, discriminant validity was confirmed through correlations between the parenting stress scale and the remaining KIDSCREEN subscales. These same authors validated the scale with foster and kinship caregivers in Australia using an EFA and CFA that supported a moderately correlated two-dimensional model measuring parental stress and satisfaction. The model had 16 items with an adequate fit $\chi2$ = 230.8, CFI = 0.937, RMSEA = 0.06.

The scale has also been validated in Norway using EFA and CFA and the results reveal a two-dimensional structure (parental stressors and lack of rewards) with 13 items and a satisfactory fit: $\chi2$ = 258.70, RMSEA = 0.059, CFI = 0.92, TLI = 0.90, SRMR = 0.039). Regarding internal consistency, it was obtained using Cronbach's alpha (α) and McDonald's omega (ω) and for the total scale they were α = .74, □ = .79, and for the subdimensions: α = 0.70 (□ = 0.76) for Parental Rewards, α = 0.75 (□ = 0.76) for Parental Stressors, α = 0.33 (□ = .54) for Lack of Control, and α = .44 (□ = .66) for Parental Satisfaction[60]. A final important validation study is the one carried out by Ramanandi et al.[61] in which the original version of 18 items was validated in parents of children with cerebral palsy in its Gujarati version. In this case, the test-retest reliability was equal to 0.987.

A study validated the 12-item Spanish version of the PSS among parents seeking care at a hospital pediatric emergency department. The scale demonstrated adequate internal consistency across the different factors (0.80 for the "Stressors" factor and 0.78 for the "Infant Rewards" factor) and optimal model fit (chi-square = 107.686; df = 53; CFI = 0.99; TLI = 0.98; RMSEA = 0.028; 90% CI = 0.00–0.05)[62]. Kotsis et al.[63] examined the psychometric properties of the PSS among Greek-speaking parents of preschool-aged children with language disorders; they found that the original four-factor structure (parental rewards, parental stressors, lack of control, and parental satisfaction) was valid for this population and reported high reliability (ω = 0.78). Another study involving Russian mothers of children aged 9 to 10 years demonstrated a two-factor model with acceptable fit; confirmatory factor analysis (CFA) indicated a good model fit: $\chi^2(103) = 236.04$, $p < 0.000$, CFI = 0.99, TLI = 0.99, RMSEA = 0.05, SRMR = 0.06[64].

Problem Statement

Parental stress can be defined as a repulsive reaction to parental obligations[4], several scales have been developed for its study and measurement[45]. One such instrument is the Parenting Stress Scale (PSS)[65], which has been validated in Spanish[54,55]. However, it should be noted that this scale was validated for use with Latino immigrants[54] and the Spanish population[55]. To the best of our knowledge, there is no validated Spanish-language instrument for measuring parenting stress in family caregivers of children with cancer; therefore, using it with other populations would compromise the validity and reliability of the results due to the lack of psychometric data. Based on the aforementioned evidence, the objective of this study was to evaluate the psychometric properties of the Parental Stress Scale in a sample of parent caregivers of pediatric oncology patients. In this regard, the confirmatory factor structure was initially evaluated based on the structure previously proposed by Oronoz et al.[55], as well as its factorial invariance according to the sex of the parent caregivers and the sex of the pediatric patients. Subsequently, its internal consistency was evaluated, as well as its convergent and divergent validity with the Zarit Caregiver Burden Interview. A two-factor structure (rewards and stressors) is expected to be confirmed, as well as excellent or good reliability for the scale and reliability ranging from excellent to acceptable for its factors[52,55,56,60,62,64].

Methods

Participants

Using a non-random convenience sampling technique, a sample of 633 family caregivers of children with cancer treated in the oncology service of the Hospital Infantil de México Federico Gómez was recruited. They were 515 (81.4%) women and 118 (18.6%) men between 18 and 52 years old (M = 31.70; SD = 7.57), caregivers of 302 (47.7%) girls and 331 (52.3%) boys between 1 and 17 years (M = 5.75; SD = 4.91). Other sociodemographic aspects of the caregivers and clinical characteristics of pediatric patients are shown in Table 1. The inclusion criteria were being of legal age, speaking spanish, and being recognized as the patient's primary caregiver. The exclusion criterion was not knowing how to read and write. The only exclusion criterion was leaving two or more items of the psychological evaluation instruments used without a response (i.e., Parental Stress Scale and Zarit Caregiver Burden Interview). The sample size exceeded the a priori estimate of n = 200 to obtain a structural equation model for 2 latent factors and 12 observed variables with an effect size = 0.5 and statistical power = 0.8.

Table 1. Sociodemographic variables of caregivers and clinical variables of pediatric cancer patients. CNS: Central nervous system.

Caregivers		
	n	%
Parental role		
Mother	521	82.3
Father	112	17.7
Civil status		
Married/Free union	501	79.1
Divorced/Separated	71	11.2
Other	61	9.7
Familiar structure		
Nuclear	323	51
Single parent	100	15.8
Other	210	33.2
Occupation		
Housewife	413	65.2
Worker	26	4.1
Businessman	58	9.2
Employee	87	13.7
Student	5	0.8
Unemployed	44	7
Scholarship		
No schooling	18	2.8
Basic	406	64.1
upper secondary	163	25.8
Professional	46	7.3
Religion		
Catholic	512	80.9
Christian	75	11.8
None	46	7.3
Residence		
Mexico City	140	22.1
Mexico State	316	49.9
Other	177	28
Support networks		
Family	517	81.7
Friends	13	2.1
Religion	3	0.5
Government	21	3.3
Institutions	79	12.5
Pediatric patient		
Diagnosis		
Leukemia	280	44.2
CNS tumors	83	13.1
Bone tumors	3	0.5

Retinoblastoma	13	2.1
Lymphoma	157	24.8
Neuroblastoma	33	5.2
Rhabdomyosarcoma	44	7.0
Wilms tumor	20	3.2
Time since diagnosis		
≤ 3 months	234	37
≤ 1 year	200	31.5
> 1 year	199	31.5
Hospitalized time		
≤ 1 month	540	85.4
≤ 6 months	50	10.1
> 6 months	43	4.5

Instruments

Sociodemographic Variables Questionnaire. The sociodemographic variables questionnaire (Q-SV) is a questionnaire specifically developed and validated to collect sociodemographic variables of caregivers of pediatric patients diagnosed with chronic diseases, as well as clinical variables of the latter[66].

Parental Stress Scale. Originally developed by Berry & Jones[65], for this study the Parental Stress Scale (PSS) was used in its version validated in spanish by Oronoz et al.[55] It comprises 12 items on a Likert scale with 5 response options ranging from 1 (Completely disagree) to 5 (Completely agree) organized into two factors: Rewards (Cronbach's α = 0.77) and Stressors (Cronbach's α = 0.76), that explain 33.5% of the variance. Your qualification, after reversing the score of the Rewards factor items (i.e., 1, 3, 4, 11, 12), is obtained by adding the score obtained in each item. The higher the score, the greater the possession of the attribute.

*Zarit Caregiver Burden Interview***.** Originally developed by Zarit et al.[67] for this study the Zarit Caregiver Burden Interview (ZCBS) was used in its version by Alpuche et al.[68] validated with the Mexican population. It comprises 22 items on a Likert scale with 5 response options ranging from 0 (Never) to 4 (Always) organized into three factors: impact of care on the caregiver (ImC; α = 0.88), caregiver-patient interpersonal relationship (IRe; α = 0.77) and self-efficacy expectations (SEx; α = 0.64), which explain 50.4% of the variance. The grade is obtained by adding the score obtained in each item per factor and estimating the overall score, which requires the sum of all items. A higher score indicates greater possession of the attribute. For the present study, the psychometric properties of the ZCBS were: $\chi2 = 1259.58$ ($p < 0.05$); $\chi2/df = 6.11$; RMSEA = 0.090 (90% CI 0.085 to 0.095); WRMR = 1.99; CFI = 0.94; TLI = 0.94; with an internal consistency McDonald's ω = 0.80, CI 95% 0.77 to 0.83 (ImC); 0.70, CI 95% 0.62 to 0.77 (IRe); 0.72, IC 95% 0.69 to 0.76 (SEx).

Design

It was an instrumental design[69]. Based on classical measurement theory, the construct validity of the PSS was evaluated through exploratory and confirmatory factor analysis, its internal consistency was obtained through Cronbach's α and McDonald's ω. Divergent and convergent validity by estimating a structural model with the ZCBS factors.

Procedure

During a preliminary phase, the spanish version of the PSS was culturally adapted to the Spanish used by the Mexican population. During this phase, 30 caregivers participated, different from those described above, who received a form with the 12 items of the instrument. They were asked to read each one of them and mark the adjacent box “Yes” or “No” if they understood or did not understand what the item in question was investigating. In case of a negative answer, they were required to write down the word or words that were difficult to understand in a box. The level of understanding of 9 items was ≥ 90%, so it was decided to present their translation as presented by Oronoz et al.[55] The remaining 3 items had to be modified as follows: Item 4, original: “I enjoy spending time with my child (ren)”, modified: “I enjoy the time I spend with my children”; Item 6, original: “Having children leaves little time and flexibility in my life”, modified: “Having a child takes up time and space in my life”; Item 7, original: “Having children has been a financial burden”, modified: “Having a child means a financial burden”.

Data collection was carried out by two collaborators trained for this task. It was carried out in the waiting room of the Oncology Department of the Hospital Infantil de México Federico Gómez. The collaborators personally approached the caregivers and after introducing themselves and verifying the inclusion and exclusion criteria, they invited them to participate in the study. The objectives of this and its benefits were explained, in addition to resolving any questions that arose from the caregiver. Those who agreed to participate were given a printed booklet containing the informed consent letter, which they

had to read and sign, as well as the instruments. Informed consent was obtained from all parents or legal guardians. Caregivers who agreed to participate were required to sign an informed consent form. The instruments were applied individually, with subjects answering questions on their own in a single session.

Answering in a booklet took between 5 and 10 minutes, after which the collaborators checked that there were no unanswered items, thanked the participant and said goodbye. Participants did not receive any incentive for their collaboration.

Data Analysis

Data analysis was performed with the R program[70] and its visual interface RStudio[71]. The libraries MVN v.5.9[72], knitr v.1.44[73], lavaan v.0.6-16[74], dplyr v.1.1.2[75], semPlot v. 1.1.6[76], semTools v.0.5-6[77], MBESS v.4.9.3[78] and psych v.2.3.9[79] were used.

Analysis of the items. For each item of the PSS, the mean, standard deviation, skewness and kurtosis were estimated. Likewise, univariate and multivariate normality was estimated using the Anderson-Darling test[80] and the Mardia skewness and kurtosis coefficients[81], respectively.

Confirmatory factor analysis. A confirmatory factor model was fitted for the PSS with its two factors: "Rewards" and "Stressors". The estimation method employed was weighted least squares means and variance adjusted (WLSMV) estimator with data from the polychoric correlation and asymptotic covariance matrix[82,83]. The fit was evaluated by estimating its $\chi 2$, $\chi 2/df$, root mean square error of approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), comparative fit index (CFI) and Tucker–Lewis index (TLI). The following fit values were considered acceptable: $\chi 2/df \leq 5$, RMSEA ≤ 0.08 (90% CI < 0.10), CFI ≥ 0.90, TLI ≥ 0.90; and excellent fit: $\chi 2/df \leq 2$, RMSEA ≤ 0.05, CFI ≥ 0.95, TLI ≥ 0.95 [100]. Goodness-of-fit indices were evaluated sequentially. In case of unacceptable values, appropriate specifications were made. For each respecification, statistical criteria (modification indices and factorial saturation of each item) and theoretical criteria (item-factor and factor-construct conceptual coherence) were considered to maintain the conceptual value of the instrument. Residual covariances were considered when theoretically justified by similarities in item content and the possibility of shared specific variance beyond the latent construct. Once a model with at least acceptable fits was identified, the R^2 for each factor loading (λ) and the average of λ were estimated. The internal convergent validity was evaluated by estimating the average variance extracted (AVE). An AVE value ≥ .50 indicates adequate internal convergent validity[84]. Discriminant validity was examined using the Fornell–Larcker criterion (FL) by verifying that the square root of the average variance extracted (AVE) for each construct exceeded its correlations with the remaining constructs[85]. Additionally, the heterotrait–monotrait ratio of correlations (HTMT) was estimated as a robust alternative for assessing discriminant validity. An HTMT value below 0.85 was considered indicative of excellent evidence of discriminant validity[86].

Multigroup analysis. Two multigroup analysis were conducted for evaluate the factorial invariance between caregiver and pediatric patient sex. However, given the presence of sparse response categories in some items across groups, measurement invariance analyses were conducted using robust maximum likelihood estimation (MLR), treating Likert-type indicators as continuous variables[82,87]. These analyses were conduct using a progressive constraint strategy[88] in that four models were estimate: configural, metric, scalar and strict invariance model. The configural model is the reference model and estimates factor loadings, intercepts and residuals. The metric model restricts factor loading equally across groups, the scalar model does the same for factor loading and intercepts and strict model equals factor loading, intercepts and residuals. Factorial invariance was established when the $\chi 2$ test identified the absence of significant differences ($p > 0.05$), the change (Δ) in the CFI was ≤ 0.01, the Δ in the RMSEA was ≤ 0.015 between a model with fewer restrictions to a stricter one[89]; also, Δ the SRMR ≤ .030 for metric invariance and Δ the SRMR ≤ .015 for scalar invariance were considered[90].

Internal consistency. We use two approaches to evaluate internal consistency. First, we use Cronbach's alpha (α) to obtain a typical parameter estimate in multiples previous studies[55] and to compare the obtained values. Second, we estimate McDonald's ω for to be a more accurately parameter to evaluate internal consistency[91]. For Cronbach's α coefficient, a value ≥ 0.70 was considered acceptable[92], and for McDonald's ω, a value ≥ 0.80[93] and ≤ 0.94[94] were considered acceptable. Additionally, the H coefficient[95] was estimated to evaluate the replicability of the latent construct. Specifically, it assesses the extent to which a set of items is useful for consistently defining a latent factor that could be reproduced in samples other than the one used to estimate the model. H values > 0.80 are considered evidence of adequate construct replicability[96].

Convergent and divergent validity. For estimate the convergent and divergent validity between PSS and the factors of ZCBS we estimate a structural model based on the measurement model of both instruments. This approach permits to obtain more precise estimates by considering multiple relationships between the variables and underlying factors[97].

Ethical considerations

The conduct of this study adhered to the Declaration of Helsinki updated in 2013[98], as well as national[99] and international[100] regulations for research with humans. It must be considered research with minimal risk for the participants in accordance with the Reglamento de la Ley General de Salud en Materia de Investigación para la Salud[101] (Art. 3 Fracc. I, Art. 4, Art. 6, Título II Cap. I, Art. 17 Fracc. II) and its update published in the Diario Oficial de la Federación (2

April 2014) and based on the Norma Oficial Mexicana NOM-012-SSA3-2012[102] (Section 5 numerals 5.3 to 5.13 and 5.15), which establishes the criteria for the execution of research projects for health in human beings. Likewise, this study was approved by the Research Ethics and Biosafety Committee of the Hospital Infantil de México Federico Gómez National Institute of Health, research project HIM/2015/017/SSA.1207, "Effects of mindfulness training on psychological distress and quality of life of the family caregiver"

Results

Analysis of the items

Table 2
shows the descriptive statistics for the items on the Parental Stress Scale. There was no evidence of univariate ($p < 0.05$) or multivariate normality (Mardia Skewness = 8399.33; Mardia Kurtosis = 104.70, $p < 0.05$).

1	**Reactivo**	**M**	**SD**	**S**	**K**	**A-D**
	I am happy in my role as a parent	**4.54**	**0.76**	**-2.18**	**5.84**	**92.93***
2	Caring for my child(ren) sometimes takes more time and energy than I have to give	2.15	1.27	0.79	-0.61	45.62*
3	I feel close to my child (ren)	4.55	0.63	-1.94	6.69	87.81*
4	I enjoy spending time with my child (ren)	4.70	0.53	-2.04	5.65	126.29*
5	The major source of stress in my life is my child (ren)	1.98	1.27	1.07	-0.07	62.61*
6	Having children leaves little time and flexibility in my life	1.55	0.90	1.85	3.24	89.24*
7	Having children has been a financial burden	1.54	0.90	1.66	1.89	98.37*
8	It is difficult to balance different responsibilities because of my child (ren)	1.87	1.05	0.95	-0.07	55.14*
9	The behavior of my child(ren) is often embarrassing or stressful to me	1.78	1.02	1.11	0.15	64.98*
10	I feel overwhelmed by the responsibility of being a parent	1.59	0.98	1.89	3.12	90.06*
11	I am satisfied as a parent	4.54	0.82	-2.27	5.64	99.14*
12	I find my child (ren) enjoyable	4.74	0.62	-3.37	14.14	143.39*

Table 2. Descriptive statistics for the items of the Parental Stress Scale.

M: mean; SD; standard deviation; S: skewness; K: kurtosis; A-D: Anderson-Darling test; $p < 0.05$.

Confirmatory factor analysis

The originally estimated model showed acceptable ($\chi 2/df = 4.95$; RMSEA = 0.079 [0.070 to 0.089]; SRMR = 0.052) and excellent fit (CFI = 0.97; TLI = 0.96). In a second model, a residual covariance between items R3 and R4 was specified due to their conceptual similarity, as both items refer to positive emotional experiences within the parent–child relationship (feeling close to the child and enjoying time spent together). This second estimated model showed acceptable ($\chi 2/df = 3.37$; RMSEA = 0.061 [0.052 to 0.071]; SRMR = 0.044) and excellent fit (CFI = 0.98; TLI = 0.98). The factor loadings of the model ranged between 0.60 and 0.86 for the "Stressors" factor and between 0.66 and 0.93 for the "Rewards" factor, with a correlation between both of -0.72 (Fig. 1). The R^2 for items are shown in Table 3. The mean λ was 0.74 and 0.76 and the AVE 0.59 and 0.69 for the factors "Stressors" and "Rewards" respectively. Additionally, evidence of discriminant validity was found between factors (FL = 0.77 and FL = 0.83 for "Stressors" and "Rewards" respectively; HTMT = 0.70).

Table 3
Determination coefficient for the items of the confirmatory model of the Parental Stress Scale

Rewards					**Stressors**						
R1	R3	R4	R11	R12	R2	R5	R6	R7	R8	R9	R10
0.44	0.46	0.60	0.61	0.86	0.36	0.40	0.73	0.68	0.59	0.53	0.63

Multigroup analysis

For the sex of pediatric patients, the PSS showed a completely factorial invariance (i.e., configural, metric, scalar and strict; Table 4). However, for the variable sex of caregiver the scalar invariance demonstrated was only configural, metric and scalar (Table 5).

Table 4
Multigroup analysis for the variable sex of the pediatric patient. RMSEA: root mean square error of approximation; ΔRMSEA: difference for root mean square error of approximation; CFI: comparative goodness-of-fit index; ΔCFI: difference for comparative goodness-of-fit index; ΔSRMR: difference for standardized root mean square residual.

Model	CFI	RMSEA	SRMR	ΔCFI	ΔRMSEA	ΔSRMR
Configural	0.937	0.068	0.049	—	—	—
Metric	0.93	0.068	0.057	-0.007	0.001	0.008
Scalar	0.931	0.065	0.058	0.001	-0.003	0.001
Strict	0.928	0.063	0.06	-0.003	-0.001	0.003

Table 5
Multigroup analysis for the variable sex of the caregiver.

Model	CFI	RMSEA	SRMR	ΔCFI	ΔRMSEA	ΔSRMR
Configural	0.933	0.071	0.046	—	—	—
Metric	0.924	0.072	0.055	-0.009	0.001	0.008
Scalar	0.919	0.071	0.056	-0.005	-0.001	0.002
Strict	0.897	0.077	0.061	-0.022‡	0.005	0.005

RMSEA: root mean square error of approximation; ΔRMSEA: difference for root mean square error of approximation; CFI: comparative goodness-of-fit index; ΔCFI: difference for comparative goodness-of-fit index; ΔSRMR: difference for standardized root mean square residual. ‡: Failure to meet the criterion

Internal consistency

The internal consistency evaluated by Cronbach's α and McDonald's ω was acceptable (Table 6). Both latent factors show good replicability of the construct that represents (Rewards: H = 0.88; Stressors: H = 0.89).

Table 6
Internal consistency of the factors of the Parental Stress Scale.

Rewards	Cronbach's α (CI 90%)	McDonald's ω
	0.74 (0.70 to 0.77)	**0.88**
Stressors	0.82 (0.80 to 0.84)	0.89

Convergent and divergent validity

Table 7
shows the correlation between the factors of the PSS (i.e., “Stressors” and “Rewards”) and those of the ZCBS (i.e., Impact of Care on the Caregiver, Caregiver-Patient Interpersonal Relationship, Self-Efficacy Expectations), obtained through a structural model.

Stressors	Impact of Care on the Caregiver	Caregiver-Patient Interpersonal Relationship	Self-Efficacy Expectations
	0.43**	**0.37****	**0.04**
Rewards	-0.25**	-0.26**	0.05

Table 7. Correlation between the factors of the Parental Stress Scale and the Zarit Caregiver Burden Interview.

** p < 0.01.

Discussion

The objective of this study was to evaluate the psychometric properties of the Parental Stress Scale in a sample of parent’s caregivers of oncological pediatric patients. The results showed a factorial structure with two negatively related factors (i.e., “Rewards” and “Stressors”), each with adequate internal convergent and discriminant validity among themselves. Its internal consistency was acceptable in both cases when measured using Cronbach's α and only that of one of them when measured using McDonald's ω. With the factors “Impact of Care on the Caregiver” and “Caregiver-Patient Interpersonal Relationship” from the Zarit Caregiver Burden Interview, the “Rewards” factor showed divergent validity, while the “Stressors” factor showed convergent validity. Previous studies carried out using exploratory factor analysis identified two factors for the parental stress scale[52,55,56,60]. The present results verify this structure through an approach of structural equations (i.e., confirmatory factor analysis), which allows conceptually and theoretically verifying the foundation of said scale, at least in the version evaluated here[55]. Furthermore, the fits of the reported model are consistent with previous studies that used

confirmatory factor analysis and verified a structure of 4[57,59] and 2 factors[60]. However, unlike this last work, the present one showed two negatively correlated factors (i.e., r = -0.72). This is because in the study by Nærde and Sommer[60], the factors were conceptualized as “Parental Stressors” and “Lack of Rewards”, both with a negative valence in the relationship between the parents and the child, as well as the “Stressors” factor in our model, while for the “Rewards” factor, this is positive.

The average λ of each factor indicates a high relationship between each observed variable (i.e., item) with its latent factor, while the value obtained for the AVE verifies the adequate conceptual representation of the latter. Furthermore, the evaluation of discriminant validity indicated that each factor in the presented model measures a different aspect on the scale. These results extend previous reports carried out with a structural equations approach, for which the behavior of these indices was not measured[59,60], or if it was, it was only partially (i.e., AVE[57]). It is also important to highlight the presence of a positive correlation between items 3: “I feel close to my child (ren)” and 4 “I enjoy spending time with my child (ren)”. The above may be because the respondents were able to perceive a conceptual similarity and therefore respond in a similar way to them.

Another novel aspect of the present study was the evaluation of factorial invariance through multigroup analysis. The data obtained showed strict invariance when comparing the structure of the Parental Stress Scale between the sex of the minor patient. This indicates its usefulness to compare the level of stress and rewards derived from the relationship between parents and child, regardless of the sex of the latter. When the comparison was made between the sex of the caregiving father, the factorial invariance was only configural, metric and scalar, suggesting that residual variances differed between female and male caregivers despite equivalent factor structure, loadings, and intercepts[89,90]. However, the failure to meet this final criterion does not imply that the Parental Stress Scale has a different factorial structure for men and women, as scalar invariance is sufficient to support meaningful comparisons of latent means across groups[103].

The internal consistency evaluated by Cronbach's α was acceptable for the two factors (> 0.70), but below what was acceptable for the “Rewards” factor when it was evaluated by McDonald's ω (< 0.80). It is worth mentioning that the minimum acceptable value is more strict for this last coefficient, compared to the first. Furthermore, the internal consistency for the factors of this scale has been variable in various validation studies. In those that used Cronbach's α, this has ranged between 0.33[60] to 0.89[52], depending on whether a global value or per factor is obtained and the number of these. When McDonald's ω was used, the value obtained ranged between 0.54 and 0.79[60]. The above implies that the values reported here are consistent with the literature.

Finally, the two-factor model for the Parenting Stress Scale showed adequate convergent and divergent validity with the Zarit Caregiver Burden Interview. With the factors “Impact of Care on the Caregiver” and “Caregiver-Patient Interpersonal Relationship”, the “Rewards” factor showed divergent validity (r = 0.43 and 0.37, respectively), while the “Stressors” factor showed convergent validity (r = -0.25 and − 0.26, respectively). The third factor of the overload Scale, “Self-efficacy expectations”, showed a null correlation with the factors of the Parental Stress Scale. This indicates that the stress or rewards generated by interaction with their children do not affect their expectation of self-efficacy in caring for them. An advantage of the present study over others that have also evaluated this type of validity for this scale is the use of a structural equations approach. The above allows us to obtain more precise estimates by considering multiple relationships between the variables and underlying factors[97].

Based on the findings described above, several practical implications can be considered. As already noted, having instruments that reliably assess parental stress could contribute to a timely intervention that could avoid the drift into inappropriate parenting styles[104,105] that in turn will generate mental health problems in children, as well as in their routines or habits[105,106,107,108]. At a social level, working with daily stress could reduce the levels of domestic violence, since Calvano et al.[109] points out the impact of parental stress levels on this variable, in addition to adding that it can impact the presence of verbal emotional abuse in the family. In this regard, it should be noted that one in three women in 108 countries suffer of violence at home[110], which impacts economic losses ranging from 1 to 2% of the Gross Domestic Product, in countries such as Brazil, the United Kingdom and Vietnam[111,112,113]. Finally, the use of validated instruments will allow us to study the effectiveness of interventions that reduce parental stress, in this case, of parents of Mexican children with cancer, such as those indicated by Hughes et al.[25] in their systematic review.

Considering these findings, some limitations of the present study should be acknowledged. The limitations of this study are related to aspects of the design and the instrument itself. For the first case, although the sample size is adequate, the selection technique, being non-random, compromises the generality of the data. Likewise, the sex variable showed an imbalance, with a greater number of mothers compared to the number of fathers. This is even though recent data indicate the increasing involvement of the latter in the care and upbringing of children[114]. Another neglected aspect was temporal stability, evaluated using a test-retest strategy. Future studies should address these aspects, seeking random sampling and balanced classes between the caregiver's sex, as well as the evaluation of other psychometric aspects of the scale. For the second case, the lack of cut-off points for each of the constructs measured in the Parental Stress Scale should be noted, which complicates the interpretation of its results. Furthermore, it was previously noted that the diversity of structures reported for it makes it difficult to adequately compare its results between various populations[60]. Another important aspect is that only one factor (i.e., “Stressors”) showed acceptable internal consistency, when evaluated by McDonald's ω, which is a more appropriate indicator when Likert scales are analyzed. This suggests caution when interpreting the Rewards factor score. However, Cronbach's α shows acceptable values for both factors, which indicates that the scale can be used with the sample used.

Overall, the findings of this study support the following conclusions. The Parental Stress Scale validated in parents caring for pediatric cancer patients showed adequate psychometric properties, with an acceptable to excellent fit for its two factors (i.e., “Stressors” and “Rewards”), each with adequate representation for its variables. observed (i.e., items) and acceptable discrimination between them. The Parental Stress Scale showed factorial invariance for the sex of the minor patient and for their caregivers. Internal consistency showed acceptable values for both factors when evaluated using Cronbach's α, although only the “Stressors” factor when evaluated using McDonald's ω. Furthermore, this scale showed convergent and divergent validity with the factors

“Impact of Care on the Caregiver” and “Caregiver-Patient Interpersonal Relationship”. In conclusion, the Parental Stress Scale is a useful tool, although with limitations, to evaluate emotional aspects in the interaction of the caregiver with their child oncology patient.

Declarations

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Data availability The raw data supporting the conclusions of this article will be made available by the authors on reasonable request.

Declarations

Competing interests The authors declare no competing interests.

Author Contribution

F.T.-T., D.L. conceptualization; methodology; writing—original draft and reviewing; project supervision. F.T.-T., D.L., R.P.F.-E., H.S., S.M.-V.: conceptualization; methodology; data analysis; data interpretation; writing—original draft and reviewing. D.L. and R.P.F.-E.: methodology; data analysis; data interpretation; writing—original draft and reviewing. S.H.-C., H.S., J.F.M.-R., M.A.N.-B., G.H.-S. and J.H.R.-C. writing—original draft and reviewing; funding acquisition. All authors read and approved the final manuscript.

Data Availability

The raw data supporting the conclusions of this article will be made available by the authors on reasonable request.

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Figures

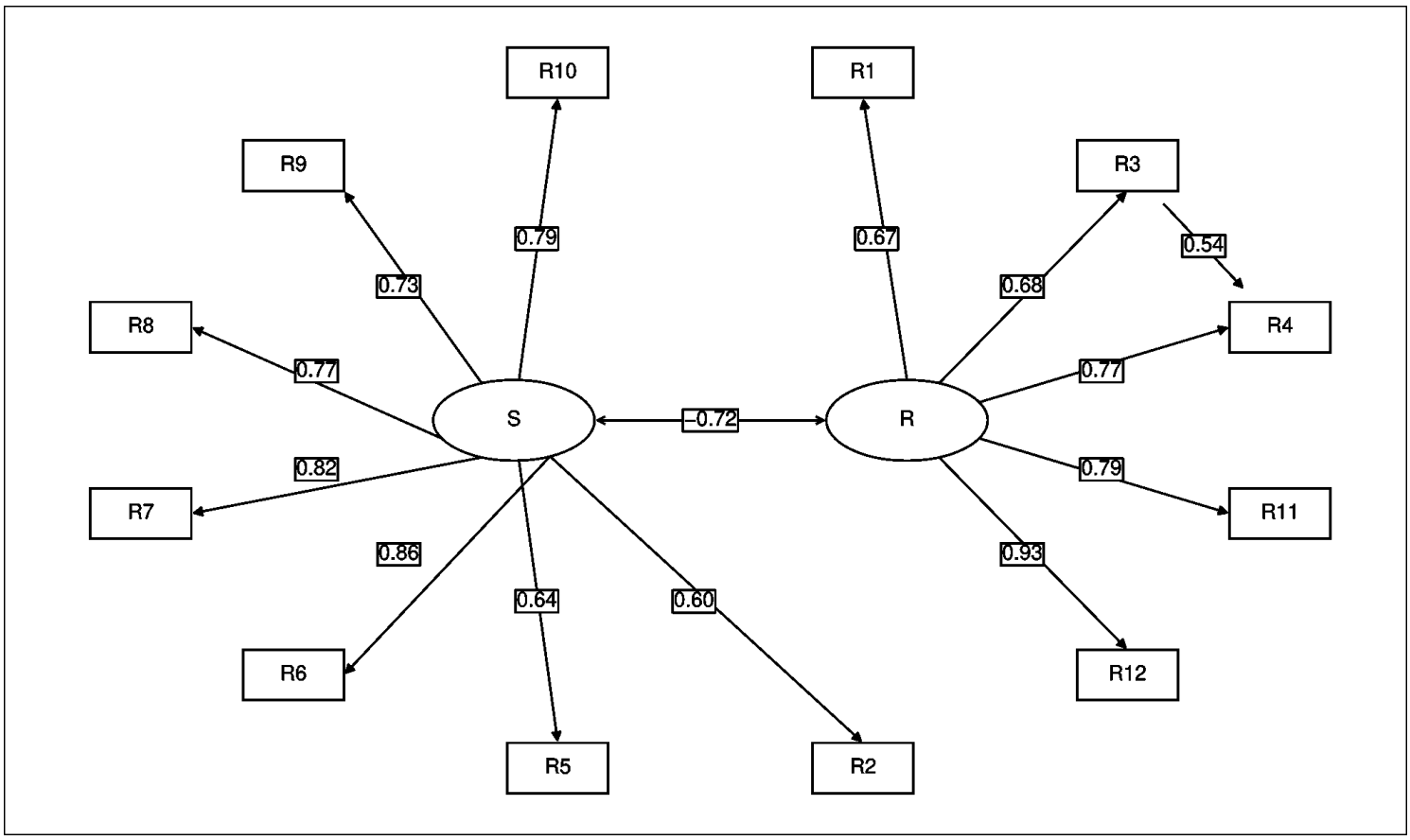


Figure 1

Confirmatory model of the Parental Stress Scale