Pediatric rheumatology

Improved factor structure for self-efficacy scales for children with JIA (CASE) and their parents (PASE)

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Abstract

Objective

Self-efficacy is an important factor in helping children to cope with a chronic disease. In order to study it, we have to be able to develop a valid and reliable scale. We validated and further developed the CASE (Children's Arthritis Self-Efficacy) and PASE (Parent's Arthritis Self-Efficacy) scales in a Finnish juvenile idiopathic arthritis (JIA) patient and parent population.

Methods

One hundred and twenty JIA children and their parents completed the CASE and PASE assessments, respectively. Exploratory Factor Analysis (EFA) applying the Principal Axis Factoring method was conducted and extended by the use of Confirmatory Factor Analysis (CFA) to allow a theory-driven approach to determine the latent dimensions for both CASE and PASE scales. Construct validity was analysed by measuring the extent to which the CASE and PASE variables correlated with variables of children's and parents' depression scales and with the clinical parameters of the child in a way that can be explained theoretically.

Results

A two-factor solution in PASE corresponding to Barlow's factor solution did not fit the sample of Finnish parents. Instead, a three-factor model similar to that of the CASE scale fitted the data for the PASE scale with self-efficacy in somatic symptoms and psychological and social functioning as subscales. Construct validity was confirmed for both scales.

Conclusion

The refined three-factor structure of the PASE scale and the slightly modified three-dimensional CASE scale were found to be robust scales enabling disease-specific analysis of somatic, psychological and social self-efficacy and comparisons between the patients and parents.

Key words

Juvenile idiopathic arthritis, self-efficacy, Confirmatory Factor Analysis, construct validity.

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Introduction

Family plays an active role in the modern rehabilitation of juvenile idiopathic arthritis (JIA) (1). The success of rehabilitation depends on the dynamic balance between the parents' ability to cope (2) and the child's often rapidly changing somatic symptoms (inflammatory pain), psychological factors (mood) and social situations (age-dependent social roles) (3). It would be useful to have reliable tools to measure and monitor a child's and his/her parents' adaptation to JIA. Self-efficacy, which refers to the confidence in one's ability to influence the forces affecting one's life [”mastery” or” perceived control”; (4)] has been acknowledged as one of the key factors in improving the family's quality of life (5, 6, 7). In general, self-efficacy beliefs determine how obstacles are viewed and attributed: the stronger the self-efficacy, the higher the goals people set for themselves and the firmer their commitment to overcoming obstacles (4). Self-efficacy in JIA is defined as children's and their parents' perceived ability to control or manage salient aspects of life with the disease (7). However, only a few studies have been published on this subject in paediatric rheumatology.

A three-dimensional structure comprising physical, emotional and social dimensions is typical for health-related quality of life scales in both adults and children (8, 9, 10). Barlow (6, 7) developed scales to measure self-efficacy both in children (CASE) and in parents (PASE). The original structure of “the CASE scale was three-dimensional. However, for the PASE scale, a two-factor solution was confirmed (6). We tested the factor structures and validated both scales in a Finnish sample of patients with JIA and their parents. The CASE and PASE self-efficacy scales were compared to obtain a comparable tool to investigate adaptation and coping among parents and children.

Patients and methods

Translation of the questionnaires

The translation of the original CASE and PASE scales was done in three steps. An interdisciplinary team comprising a certified translator, a psychologist, a physiotherapist, a paediatric rheumatologist and a professional, senior researcher translated the original questionnaires from English to Finnish. This translated version was back-translated to English by an independent certified translator, who did not participate in the first translation session. The final consensus version in Finnish was created in a joint session in which all of the above participated, with access to the original, translated and back-translated versions of the CASE and PASE scales.

PASE

The original PASE scale includes 14 questions about parental management of their child (6). The parents are asked to rate how confident they were of their ability to control their child's adjustment (e.g. pain, sadness and joint stiffness) using a 7-point scale from 1 (= very uncertain) to 7 (= very certain). According to Barlow and her co-workers (6), these 14 items measure two different aspects of parent's self-efficacy in the management of their child's JIA. Barlow called these two aspects “symptom subscale” (items 1 – 7) and “psychosocial subscale” (items 8 – 14). The list of the original 14 items is presented in Figure 1.

CASE

The original CASE questionnaire includes 11 questions concerning the child's own management of his/her JIA (7). The children are asked to rate how certain, on a 5-point scale from 1 (= very uncertain) to 5 (= very certain), they are being able to manage physical and psychosocial issues related to their disease. These 11 items measure, according to Barlow and her co-workers (7), three different aspects of the child's self-efficacy – the “symptom subscale” (items 1 – 4), the “emotion subscale” (items 5-7) and the “activity subscale” (items 8-11). The list of the original 11 items is presented in Figure 2.

BDI II and CDI

Depression and mood disturbance of the parents was assessed by the Beck Depression Inventory (BDI II) (11), which has 21 items and has established

reliability and validity. Scores range from 0 to 63, with higher scores indicating greater depression. Depression/mood disturbance of the patients was assessed by the Children's Depression Inventory (CDI) (12), which has 28 items assessing a variety of depression symptoms. Scores range from 0 to 56. The scale is internationally the most widely used and validated measure of childhood depression in children aged 8-17 years (12).

Functional disability

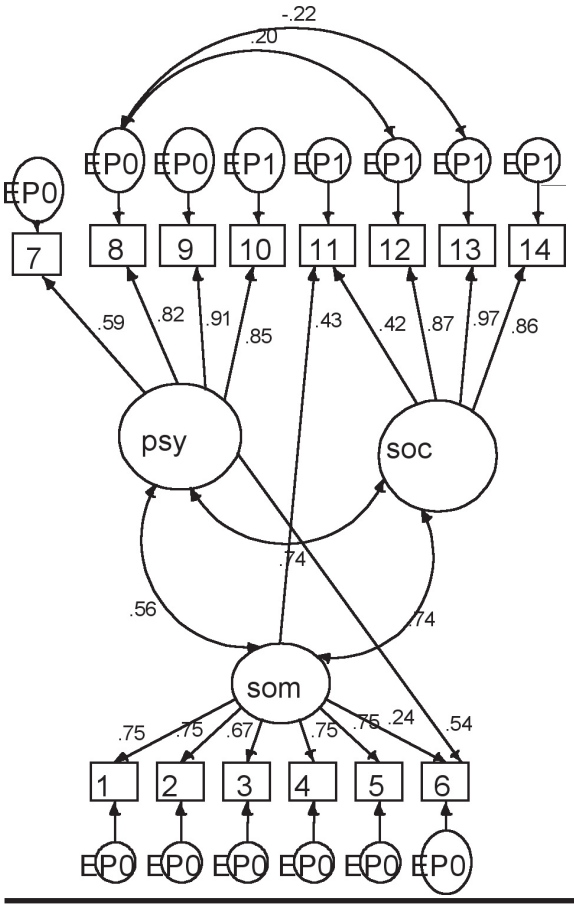
The Childhood Health Assessment Questionnaire (CHAQ) was used to measure children's functional status. The scale assesses performance in eight areas, but in this study the total score was used. Scores range from 0 to 3, with higher scores indicating greater functional impairment. The CHAQ is reported to be reliable and sensitive and it has been validated in a Finnish sample (13).

Pain

To measure pain in the children a structured pain questionnaire (14), with a 5-level frequency classification of pain was used (pain seldom or never, once a month, once a week, more than once a week, almost daily). Each of the seven pain areas was scored 0-5 with the total score ranging 0-28. The internal consistency of the scale was good (α= 0.745).

Somatic complaints

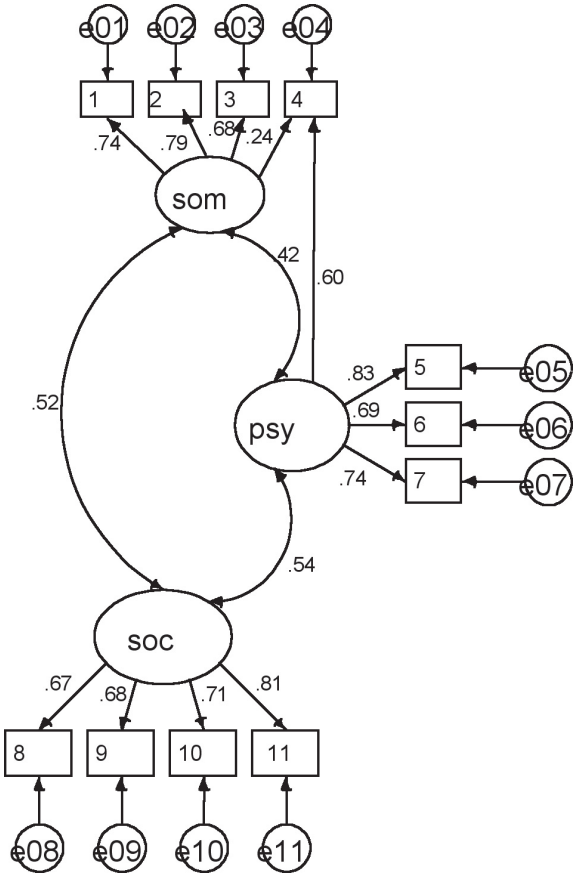
To measure the somatic symptoms of the children, the Child Behaviour Checklist (CBCL) (15) was used. It consists of 118 questions, each scored 0-2, from which one total behaviour problem score is summed. The scale also consists of eight subscales: anxious/depressed, withdrawn/depressed, somatic complaints, social problems, thought problems, attention problems, rule-breaking problems and aggressive behaviour. The reliability and validity of the scale has been documented in Finland (16) as well as widely in many other countries. The somatic complaints factor includes the following items: nightmares, constipation, dizziness, tiredness, pain, headaches,



The numbers in the boxes refer to the items in the PASE scale.

1. Pain
2. Joint stiffness
3. Joint swelling
4. Sleep
5. Non-medical treatment of pain
6. Fatigue
7. Activity
8. Sadness
9. Loneliness
10. Frustration
11. Pleasure
12. School activities
13. Activities with friends
14. Family activities

Fig. 1. Diagram showing the three-factor model of the PASE scale with three latent dimensions (som= self-efficacy with somatic symptoms, psy= self-efficacy in psychological functioning, soc= self-efficacy in social functioning). All three factors are correlated and items 8 and 11 and items 8 and 13 have a correlated measurement error.



The numbers in the boxes refer to the items in the CASE scale.

1. Pain
2. Joint stiffness
3. Fatigue
4. Joint swelling/relief
5. Sadness
6. Loneliness
7. Frustration
8. School
9. School games
10. Leisure activities with friends
11. Family leisure time

Fig. 2. Diagram showing the three-factor model of the CASE scale with three latent dimensions (som= self-efficacy with somatic symptoms, psy= self-efficacy in psychological functioning, soc= self-efficacy in social functioning). All three factors are correlated.

nausea, eye problems, skin problems, stomach problems, vomiting. The total score of the factor is 0-22.

Patients and parents

The inclusion criteria were a JIA diagnosis (17) established at least one year prior to the study and that the child was aged between 8 and 15 years at the start of the study. One hundred and twenty patients were recruited over a 6-month period during routine clinical visits. The parent attending with the child was also invited to participate. Four parents and/or children refused to participate. Patients were recruited from the Rheumatism Foundation Hospital in Heinola (N = 106), with a catchment area covering the whole country, except for the Metropolitan Helsinki area, which participated by recruiting patients (N = 14) from the Paediatric Rheumatology Clinic of the Helsinki University Hospital. All patients and parents signed an informed study consent form. The mean age of the patients was 12 years with the diagnosis having been made 6.2 (1-14) years before enrolment. Sixty (45%) patients had a polyarticular, 24 (18%) an extended oligoarticular and 36 (27%) an oligoarticular disease. The CHAQ (13) function score mean was M = 0.28 (SD = 0.43), the number of active joints mean was M = 1.84 (SD = 3.38), the number of somatic problems (15,16) mean was M = 3.9 (SD = 2.68) and the frequency of pain (14) mean was M = 4.07 (SD = 4.6). Of the parents, 25 (20%) were fathers and 95 (80%) mothers. The mean age of the fathers was M = 43.3 (34-60) years and mothers M = 41.4 (27-59) years. The CASE and PASE questionnaires were given to the 120 recruited JIA patients and their parents, who filled them in independently (separately) during the clinical visit.

Ethics

The principles of the Declaration of Helsinki were followed. All patients and their parents received both oral and written information on the study and gave their written informed consent. The study protocol and procedures were accepted by the Ethical Committee of the Paijat-Hame Hospital District.

Statistical analysis

The data were analysed using SPSS 14.0 for Windows (18). Confirmatory Factor Analysis (CFA) was conducted using AMOS software (19) and Prelis 2 was used for computing polychoric correlations (20). Exploratory Factor Analysis (EFA) was conducted by applying the Principal Axis Factoring method. The rotation was oblique. CFA was conducted without gender distinction. In our CFA model, the latent factors were free to covary. Regarding missing data, it was assumed that the data loss pattern was missing completely at random (MCAR). The missing score was replaced by the mean substitution method, which involves replacing a missing score with the overall sample average (21). AMOS software provides a number of goodness-of-fit statistics and experts generally recommend that a variety of fit indices should be used so that the weakness of a particular index is offset by the strength of another (22). A model provides a good fit with the data when the p-value associated with the χ^2-test is non-significant, because the researcher seeks to confirm the null hypothesis. The χ^2 goodness of fit is falling out of favour because it is greatly influenced by sample size and violations of multivariate normality (23). For this reason, the relative χ^2 has been used as an informal measure of fit (24). The relative χ^2 is the ratio of χ^2 to degrees of freedom (df). There is no consensus on what value constitutes a good fit but generally a relative χ^2 less than 2 is preferred (25). The Comparative Fit Index (CFI) is another commonly used fit statistic, with values greater than 0.90 indicating good fit. In addition, some researchers recommend this index because it is less influenced by sample size (25). The Root Mean Square Error of Approximation (RMSEA) is another measure of fit, which ranges from 0 to 1, but in contrast to CFI the closer it is to zero, the better the fit (23). The RMSEA attempts to correct for the number of parameters in the model. Values less than 0.05 indicate a good fit (26). The goodness of fit of the models in the current study was evaluated using (a) the χ^2-test, (b) the relative χ^2 (χ^2/df), (c) the CFI, and (d) the RMSEA. The reliability or the internal consistency of the subscales derived using CFA was tested by Cronbach's alpha. Descriptive statistics were used to describe the central tendency and the variability of the subscales. Student's t-test was applied to test the difference between groups (mothers and fathers). Pearson's correlation coefficient was used to measure the construct validity. Statistical significance was accepted with alpha < 0.05.

Results

PASE

Factor analyses were conducted to investigate whether the original two-factor loading pattern fits a sample from the Finnish population. EFA revealed that no meaningful factor structure emerged from a two-factor solution (6). In particular, the items 8-14 reflecting the psychosocial subscale did not emerge as one coherent factor. The items measuring somatic symptoms (items 1-7) loaded quite well into one coherent factor, although item 7 did not load into this factor at all. The analysis was continued by applying CFA. First, we attempted to confirm the somatic dimension, which EFA already had approved. The fit of item 6 (fatigue) to this dimension was tested, but the fit statistics showed a poorer fit with item 6 included in this dimension than without it (Table I). Secondly, we tested various factor models consisting of two or three latent dimensions – somatic, psychological and social. Finally, three three-factor models were tested to confirm their clustering into three domains, one somatically, one psychologically and one socially oriented (Table II). The fit statistics did not support the first of the three three-factor models (somatic dimension 1-6, psychological 7-10, and social 11-14) (Table II). In the second of the three-factor solutions, the fit statistics supported the model (df/χ^2 = 1.6, RMSEA = 0.078, CFI = 0.96). However, item number 7 was excluded and did not load onto any factor. In the third model, all items were included and fit statistics were good (df/χ^2 = 1.9, RMSEA = 0.089, CFI = 0.94) (Table II). This model was preferred for further analy-

sis of the data. There were two cross-loadings in this final PASE-scale structure solution. Item 6 (fatigue) loaded into the psychological dimension with $\lambda = 0.54$ and into the somatic dimension with $\lambda = 0.24$ and was therefore included in the former. Item 11 (pleasure) loaded into the somatic and social dimensions with an equally strong coefficient. The decision to include it in the socially oriented dimension was based on the semantic properties of this particular item in the Finnish version of the PASE scale. The latent dimensions were named "PASEsom, self efficacy with somatic symptoms" (items 1-5), "PASEpsy, self-efficacy in psychological functioning" (items 6-10) and "PASEsoc self-efficacy in social functioning" (items 11-14). The naming of the factors was based on the original qualities of the items loaded into these dimensions. The reliability coefficient for these sum variables (dimensions), measured as the internal consistency, were $\alpha = 0.84$ for PASEsom $\alpha = 0.88$ for PASEpsy and $\alpha = 0.93$ for PASEsoc.

The final three-factor model composed of somatic, psychological and social dimensions was qualitatively and quantitatively satisfactory (Fig. 1). The model confirmed that the parental self-efficacy theory had three separate domains. These factors had fairly strong intercorrelations $\phi = 0.56 - 0.74$ indicating that the theoretical limits for factor intercorrelation $\phi = 0.90$ (16) were not violated. Two error-term correlations were found (Fig. 1). Items 12 and 13, included in the social dimension had correlated measurement error with item 8, included in the psychological dimension (r = -0.22 and r = 0.20 respectively). Construct validity was demonstrated through significant positive correlation between the PASE subscales and adult depression measured by BDI II: PASEsom (r = -0.189 $p < 0.05$), PASEpsy (r = -0.215, $p < 0.01$), PASEsoc (r = -0.193, $p < 0.05$). All correlations were in the expected direction.

CASE

Based on previous studies (7), CFA of the CASE scale was directly started by testing whether a three-factor model would fit the data. The final three-factor model with dimensions corresponding to the PASE scale reflecting self-efficacy in somatic, psychological and social functioning fitted the data quite well (Table III). However, item 4 (swollen joints/relief) had a stronger loading with the self-efficacy in psychological functioning ($\lambda = 0.60$) than with the self-efficacy in somatic functioning ($\lambda = 0.24$) and was included in the psychological dimension. This differs from Barlow's solution (7). This factor loading might be explained by the final wording of this particular item in the questionnaire.

The latent dimensions were termed "CASEsom, self-efficacy with somatic symptoms" (items 1-3), "CASEpsy self-efficacy in psychological functioning" (items 4-7) and "CASEsoc self-efficacy in social functioning"(items 8-11). The reliability coefficients for the sum variables (dimensions), measured as the internal consistency, were $\alpha = 0.77$ for CASEsom, $\alpha = 0.80$ for CASEpsy and $\alpha = 0.79$ for CASEsoc. The CASE factors intercorrelated $\phi = 0.54$-0.66, but these intercorrelations

Table I. Goodness of fit statistics for CFA of the somatic dimension of the Parent's Arthritis Self-Efficacy scale.

Dimensions (items)	df	χ^2	*p*-value	χ^2/df < 2	RMSEA < 0.10	CFI > 0.90
Somatic (1-5)	5	6.2	$p = 0.286$	1.2	0.046	0.99
Somatic (1-6)	9	16.6	$p = 0.055$	1.8	0.086	0.97

Table II. Goodness of fit statistics for three different three-factor solutions tested using CFA of the Parent's Arthritis Self-Efficacy scale.

Dimensions (items)	df	χ^2	*p*-value	χ^2/df < 2	RMSEA < 0.10	CFI > 0.90
Somatic (1-6) Psychological (7-10) Social (11-14)	72	179.0	$p < 0.0005$	2.4	0.114	0.90
Somatic (1-6+11) Psychological (6,8,9,10) Social (11-14)	58	98.4	$p < 0.01$	1.6	0.078	0.96
Somatic (1-6+11) Psychological (6-10) Social (11-14)	70	133.5	$p < 0.0005$	1.9	0.089	0.94

Table III. Goodness of fit statistics for confirmatory factor analyses of the models tested for the Children's Arthritis Self Efficacy (CASE) scale.

Dimensions (items)	df	χ^2	*p*-value	χ^2/df < 2	RMSEA < 0.10	CFI > 0.90
Three-factor solution with somatic (1-4), psychological (4-7) and social (8-11) dimensions	40	64.4	$p < 0.01$	1.6	0.073	0.947
Three-factor solution with somatic (1-4), psychological (5-7) and social (8-11) dimensions	41	75.7	$p = 0.001$	1.8	0.086	0.925
The final three-factor solution with somatic (1-3), psychological (4-7) and social (8-11) dimensions	41	68	$p < 0.01$	1.66	0.076	0.942

Table IV. Correlations between self-efficacy factors and clinical parameters.

Variables	Csom	Cpsy	Csoc	Ctotal
Functional disability	-0.351**	-0.221*	-0.287**	-0.345**
Number of active joints	-0.288**	-0.111	-0.184*	-0.228*
Pain frequency	-0.127	-0.117	-0.299**	-0.225*
Somatic complaints	-0.168	-0.193*	-0.229*	-0.247**

*$p < 0.05$; **$p < 0.01$.

were acceptable and under 0.90 (23).

Construct validity for CASE was investigated by correlating CASE subscales and the CDI scale: CASEsom (r = -0.197, $p < 0.05$), CASEpsy (r = -0.357, $p < 0.01$), CASEsoc (r = -0.338, $p < 0.01$). The CDI scale was chosen because it was found to conceptually correspond to the self-efficacy concept. It was hypothesized that the interaction between these concepts would be negative. Criterion validity was studied correlating self-efficacy with clinical data (disease activity measures, functional disability, number of active joints, pain and somatic complaints) (Table IV). All correlations were in the expected direction.

Univariate statistics showed that the mean scores in all the subscales both in children's and parents' self-efficacy were fairly high, in particular the score in social self-efficacy. The parents and the children had a corresponding pattern. The mean scores (SD), measured on a scale of 1-7, for the parent's self-efficacy with somatic symptoms, in psychological functioning and social functioning were M = 4.7 (1.26), M = 4.9 (1.28) and M = 5.3 (1.14), respectively. The mean scores (SD), measured on a scale of 1-5, for the children's self-efficacy were M = 3.7(0.80), with somatic symptoms, in psychological functioning M = 3.7 (0.87) and in social functioning M = 4.2 (0.74). Mothers displayed stronger self-efficacy than fathers in the dimensions: in somatic symptoms M_m = 4.6, M_f = 3.9, in psychological functioning M_m = 4.9, M_f = 4.8 and in social functioning M_m = 5.4, M_f = 5.2 (0.87). In the somatic dimension, the difference was significant (df = 117, t = 2.29, $p < 0.05$), but not in the others.

Discussion

If we want to study and improve self-efficacy, we have to be able to develop a scale that is both valid and reliable. Validation is a process by which the properties of an assessment are formally evaluated (27). The OMERACT group has proposed a paradigm to capture the essential elements of validation. In this study, we have followed the guidelines suggested in the OMERACT filter (27, 28).

Our results inserted the PASE scale into the general three-dimensional structure of health-related quality of life measures and Barlow's preliminary work with the three-dimensional self-efficacy scale designed for children with JIA (7). The three-factor structure of the PASE scale, corresponding to the children's self-efficacy measure, was found to be statistically satisfactory and also appealing, because its structure enables comparisons of self-efficacy dimensions within the family.

CFA is a sophisticated tool for investigating the structure of a set of data. However, using CFA requires some presumptions to be made about the data. First, the most widely used estimations assume multivariate normality (22). Analysis of the CASE disclosed that, in contrast to Barlow's study (7), most but not all items were normally distributed, as often is the case in questionnaire studies. In particular, the social self-efficacy items were skewed. In the present study, various diagnostic subgroups (polyarticular, extended oligoarticular and oligoarticular diseases) were represented, with the intake area having practically nationwide coverage. Thus, the sample was representative. Furthermore, according to Chou and co-workers (26) the maximum likelihood method used in the present CFA is fairly robust to violation of multivariate normality when the sample size is large enough and when the model produced is not too complex (less than four factors), as in the present study (22). We also ran control analysis transforming the skewed variables to normally distributed. The results did not change from the original analysis. Second, the data should be continuous. In our case, the scales were ordinal data scales and therefore control analyses were conducted with Pearson's correlation coefficients being replaced by polychoric correlations. This also did not affect the results. Thus, the results of the CFA in this study can be considered robust.

All the factors within the PASE scale and the CASE scale intercorrelated. Such intercorrelations between factors are not unusual in behavioural and human sciences. Disease-related functioning is a process where physiological, psychological and social factors interact so it is natural that correlations exist between them. However, there are individual differences regarding the influence of the separate domains in the process of coping with the disease. Therefore, it is important to study these factors separately. The intercorrelations are particularly understandable in the child's CASE scale because of their varying developmental statuses (29). In a child's mind, for instance, loneliness can represent a social, psychological or even somatic item depending on his/her level of conceptualization. The intercorrelations were clearly under ϕ = 0.90 and thus acceptable (26).

As PASE measures rather practical factors of self-efficacy from somatic, psychological and social perspectives, it enables the practitioner to use it as an indicator of improvement or regression in the rehabilitation process as well as in comparisons between groups. Our analyses revealed that the parents' perceived self-efficacy was fairly good. In concordance with Barlow's (7) findings, mothers had stronger self-efficacy than fathers in all the subscales. This stresses the importance of supporting the whole family, especially fathers during the rehabilitation process.

In the final factors solution of the PASE scale, two error-term correlations were found. These were correlations of "sadness and school activities" and "sad-

ness and activities with friends". A correlated measurement error occurs when a variable that is not measured directly or identified explicitly in the model is theorized to influence item responses (24). In the current study, correlation of the error terms might reflect a positive response bias. Measured in the hospital setting, in which the issue of the rehabilitation process is to enhance coping with JIA, for instance at school, the bias is understandable. Inevitably parents also want their child to manage with the disease (30, 31). Thus, this correlation of the error terms might reflect particular wishes as regards management. However, the correlation of the error terms was not very strong.

Exploratory and Confirmatory Factor Analyses of PASE revealed that no meaningful factor structure emerged upon use of a two-factor solution as conducted by Barlow and co-workers (6). Instead, the theoretically motivated three-factor model produced a very satisfactory factor solution with construct validity. PASE item 6 reflecting "fatigue" and PASE item 11 reflecting "pleasure" were somewhat problematic as they cross-loaded into two or more latent dimensions in the Finnish PASE. Loading of the "fatigue" item into both somatic symptoms and psychological functioning dimensions seems understandable from the idiomatic equivalence perspective. Cultural differences might explain the problems met with the "pleasure" item as its significance may differ in different societies and contexts. The present three-factor solutions for PASE and CASE scales are also in accordance with somewhat similar and qualitatively solid three-factor structures, which have been recently described for children's health-related questionnaires and quality-of-life measurements (8, 9, 32, 33).

Our solution of the CASE scale provided a very acceptable fit comparable to the factor structure proposed in the previous work confirming it (7). The three-factor model of the parental PASE, with latent dimensions corresponding to self-efficacy in somatic symptoms and psychological and social functioning, fitted the data very well. Also, construct validity was demonstrated for the final CASE subscales through significant correlations with the depression scale of the CDI. However, one of the items "joint swelling/relief" cross-loaded into two factors of which the dimension "psychological functioning" was chosen. This slight modification of the original CASE was based on the λ value, wording of that particular item and its semantic and idiomatic properties.

Good self-efficacy means that the person has belief in his/her efficacy to exercise control over health-related problems, such as JIA (4). Efficacy beliefs represent a pathway through which psychosocial influences affect health functioning (4, 34). Thus, self-efficacy is a relevant subject of study in families that have a child with a chronic, resource-demanding disease. In this study, both the PASE and CASE scales with a three-factor structure were found to reflect the self-efficacy in symptoms and psychological and social functioning in JIA children and their parents. These instruments were found to represent internally consistent measures of disease-specific self-efficacy in a Finnish JIA patient and parent sample. The present findings support the previous work indicating the adequate psychometric strength of the CASE scale (7). The factors structure of the parental PASE scale was reformulated to a three-dimensional solution analogous to the CASE scale based on a theory-based hypothesis to correspond to empirical findings.

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