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Do problem-solving skills help mitigate emotional distress through perceived control and self-efficacy in parents of children with cancer?

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Abstract

Introduction. Parents of children with cancer face psychological challenges that can result in significant distress. It has been found that problem-solving (PS) could mitigate emotional distress (ED) in this population, but mechanisms of this relation are poorly understood. This study aimed to assess whether there is a link between PS and ED through perceived control and self-efficacy.

Methods. We included 119 parents (67 mothers, 52 fathers, including 50 couples) whose child was diagnosed with cancer. We evaluated whether PS was associated with ED through perceived control and self-efficacy in couples of parents.

Results. We found no direct association between PS and ED (β=-0.01, p=0.92). Our results indicated a significant indirect effect between ED and PS with perceived control as the intermediary variable (β=-0.24, p<0.001, 95% CI[-0.41, -0.11]). However, there was no indirect association between ED and PS with self-efficacy as the intermediary variable (β=-0.04, p=0.26, 95% CI[-0.11, 0.09]). The effect size was large in magnitude (R^2=0.59 for ED).

Conclusion. The mitigating role of PS on ED is better explained by an enhanced experience of control than by improved self-efficacy. Future interventions should directly target the action mechanism behind PS and ED in both mothers and fathers by targeting their perceived control.

Keywords. Pediatric cancer, parents, problem solving, distress, control, self-efficacy, cancer, oncology, psycho-oncology

Background

Each year, approximately 1,500 children and adolescents are diagnosed with cancer in Canada (1). Parents of these patients face short- and long-term psychological challenges with repercussions on them and their families (2). Emotional distress (ED) in parents of childhood cancer patients is characterized by stress, anxiety, depression, and uncertainty (2-4). A previous review supported that even 5 years postdiagnosis, ED symptoms such as uncertainty and anxiety can persist in parents (3). Furthermore, acute emotional reactions have been found to predict difficulties in long-term adjustment for both parents and children (4).

Helping parents manage the stressors resulting from having a child with cancer is essential to reduce the long-term burden of the illness on the parent and the child. Efforts to better understand ED in parents of children with cancer have led to the potential explanation that following their child's diagnosis, parents might lack or fail to deploy their problem-solving skills (PS), which can appear for example as having difficulties in making important decisions (e.g., regarding treatments) or as feeling overwhelmed (e.g., with taking care of other children, financial aspects) (5). PS has been defined as, "a process, used to obtain a best answer to an unknown, or a decision subject to some constraints" (6). This has led researchers and clinicians to select PS abilities as a concrete target to help parents of children with cancer (7).

One approach to targeting PS is problem-solving skills training (PSST), an intervention based on the principles of cognitive-behavior therapy that is aimed at individuals experiencing distress following a challenging life event (8). This therapeutic approach requires progressive training to select problems, define them, generate potential solutions, make decisions, and put in place these decisions while evaluating their efficacy (9). PSST interventions specifically targeting parents of children with cancer have been developed and have been found to be effective to improve PS skills and affect, especially in mothers (10, 11). Studies have further suggested that PSST relies on both taking back control and feeling able to engage in the PS process (12). In line with theory (13), there is evidence that training parents with PS psychotherapy helps improve their ED (9-11). Still, we do not know if the beneficial effect of PS is on taking control of the situation or feeling more competent in dealing with problematic situations.

Perceived control, defined by Wallston et al. (14) as, "the belief that one can determine one's own internal states and behavior, influence one's environment, and/or bring about desired

outcomes", is a construct that has been found to be linked to both ED and PS (7). A previous study conducted in adult oncology found that PS could facilitate cognitive reframing of events as more controllable and less threatening, as well as better identify factors that could be controlled (15). It has also been found that individuals report higher perceived control and less ED when they consider themselves as having good PS abilities (13). Consequently, there are arguments to consider perceived control as an intermediary variable in the link between PS and ED in parents of children with cancer.

Self-efficacy, or the perception of one's ability to deal with a problem, is also theoretically linked to PS and ED (16). Indeed, self-efficacy allows an individual to believe in their ability to engage in PS and to elaborate successful action plans to reach a given goal. In parents of children with cancer, higher perceived self-efficacy has been associated with higher psychological well-being and better psychosocial functioning in parents, and a higher quality of life for the child with cancer (17). Studies in other populations have also shown that individuals with higher self-efficacy generally have a lower vulnerability to stress and depression, two symptoms of global ED (18). To our knowledge, no studies in parents of children with cancer have documented the role of self-efficacy in relation to PS and ED.

To better select targets for interventions offered to parents of children with cancer, and to more adequately frame techniques used within the interventions, it is essential to clarify possible mechanisms underlying the association between PS and ED. Although a basic assumption of the effect of PS for most researchers, perceived control has not been evidenced as an intermediary variable in this effect. Similarly, major arguments point to the role of self-efficacy in the association between PS and ED, but no such demonstration is available to date. Our study aimed to evaluate whether PS was associated with ED through perceived control and self-efficacy in couples of parents. In line with theory, we hypothesized that when placed in the same model, both perceived control and self-efficacy would emerge as intermediary variables in the relationship between PS and ED (13, 17).

Methods

Participants

We included a total of 119 participants (67 mothers and 52 fathers, with 50 full couples)

whose children had been diagnosed and treated at the Sainte-Justine University Health Center (SJUHC) in Montreal (Quebec), Canada (**Figure 1**). The participants were recruited to be part of a non-interventional comparison group of an overarching project called VIE (Valorization, Implication, Education), a multidisciplinary family lifestyle intervention with nutrition, physical activity, and psychological support components ([19]). Data from the comparison group was collected independently and consecutively (participation rate was of 57.5%, **Figure 1**). The control group completed a cross-sectional self-report survey. Parents had a child who was diagnosed with cancer between 2013 and 2015. Parents were approached by a clinical coordinator during their regularly scheduled appointments. To be eligible, participants had to be parents of children meeting the following criteria: (1) be under 21 years of age at diagnosis; (2) have been treated with chemotherapy or radiotherapy; (3) be able to provide informed consent (by parents or legal guardians); (4) be 1.5 to 3.5 years post-diagnosis; and (5) had not been exposed to the VIE intervention. The participants also had to be able to read, speak, and understand French or English. Participants were excluded if their child: (1) had not received chemotherapy or radiotherapy and (2) had advanced cancer with a prognosis of less than twelve months. The sample description is available in **Table 1**.

We obtained written informed consent from each participant in this study. The VIE project was conducted in accordance with the Declaration of Helsinki and the protocol was approved by the Ethics Review Committee of SJUHC (#2017-1413).

Assessment tools

Profile of Mood States (POMS-SF). We measured participants' ED using the shortened version of the Profile of Mood States (POMS-SF) ([20]). The POMS-SF includes 37 items indicating different emotional state adjectives along five subscales: Tension-Anxiety (normative data from adults >25 years M=7.0, SD=5.5), Depression-Rejection (normative M=7.1, SD=8.4), Anger-Hostility (normative M=6.6, SD=6.7), Fatigue-Inertia (normative M=7.3, SD=5.7), and Vigor-Activity (normative M=20.2, SD=6.2) ([21]). The items in each subscale are scored on a five-point Likert scale ranging "not at all" to "extremely" to measure the extent to which the adjectives describe the participants' emotional state over the past seven days. Here, we used the total score, (total mood disturbance score, TMD) ranging from -24 to 124, with higher scores indicating a higher level of ED ([20]), and an internal consistency of α=0.96 in the total sample, α=0.96 in

mothers α=0.96 in fathers. A previous study found that the POMS-SF had good psychometric properties, with an internal consistency ranging from 0.80 to 0.91 for all subscales ([22]).

Social Problem-Solving Inventory – Revised (SPSI-R). We measured participants' PS abilities using the shortened version of the Social Problem-Solving Inventory – Revised (SPSI-R) ([9]). This instrument is designed to assess participants' strengths and weaknesses regarding PS. The SPSI-R includes 25 items along the following five domains: positive problem orientation, negative problem orientation, rational PS style, impulsive PS style, avoidant PS. The PS styles refer to the strategy employed to effectively solve a problem. Each subscale of SPSI-R is made up of 5 items, each scored on a five-point Likert scale ranging "not at all" to "extremely true". In the present report we used, the total SPSI-R score ranging from 32 to 127, with higher scores indicating better PS abilities ([9]). Scores between 86 and 114 are considered normative, scores below 85 are considered below the norm group average, and scores above 115 are considered above the norm group average ([23]). In our sample, the SPSI-R score had an internal consistency of α=0.83 in the total sample, α=0.81 in mothers, and α=0.86 in fathers. A previous study found that the SPSI-R had good psychometric properties, with an internal consistency >0.85 for all subscales ([24]).

Perceived Stress Scale (PSS). We measured participants' perceived control using the Perceived Stress Scale (PSS) ([25]). This instrument was originally designed to measure the extent to which participants appraise situations that occur in their life as stressful, but it was found as an appropriate measure of perceived control ([26]). With support from the literature, among the original 14 items, we selected items 4, 5, 6, 7, 9, 10, and 13 as measures of perceived control ([26], [27]). We then led an exploratory principal component analysis (PCA) on the 7 perceived control items of the PSS (**Table S1)** to confirm that they adequately loaded onto a single factor in our total sample ([26], [27]). This allowed us to confirm the existence of 1 factor within the perceived control items of the PSS (see full preliminary psychometric analyses from PCA in **Table S2**). Items are scored on a five-point Likert scale, ranging from "never" to "very often". We found appropriate reliability of this perceived control index, with α=0.88 in the total sample, α=0.90 in mothers, and α=0.85 in fathers for the control items. A previous study found that the complete PSS had good psychometric properties, with an internal consistency of 0.89 ([28]).

Perceived Competence Scale (PCS). We measured participants' self-efficacy using the Perceived Competence Scale (PCS) ([29]). This instrument is designed to assess participants' sense

of competence to engage in various behaviors. The PCS originally contained 4 items, to which we added 2 additional items (PCS-6) developed by the team to grasp the idea of self-efficacy in the context of parents with ill children (**Table S3**). All items were also adapted to the pediatric cancer setting. We found that all items of the PCS-6 adequately loaded onto one component (see full preliminary psychometric analyses from PCA in **Table S4**). Items are scored on a seven-point Likert scale ranging from "not at all true" to "very true" ([29]). In this study, the total PCS-6 score ranged from 0 to 42, with higher scores indicating better self-efficacy, with a reliability of $\alpha=0.93$ for the total sample, $\alpha=0.92$ for mothers and $\alpha=0.93$ for fathers. A previous study found that the PCS had good psychometric properties, with an internal consistency of 0.89 ([30]).

Data analysis

For the statistical analyses on couples and for the other analyses, we used IBM SPSS Statistics, version 27.0.

In couples, following the Actor-Partner Interdependence model (APIM), we conducted path analyses using 95% confidence intervals estimated on 10,000 bootstrapping samples, allowing us to test for indirect effects. These analyses allowed us to investigate whether in our model, there were associations between PS and ED through perceived control and self-efficacy as intermediary variables in both mothers and fathers, while considering the non-independence of the dyadic data from mothers and fathers. Perceived control and self-efficacy were considered simultaneously as potential intermediary variables. To note that the term "intermediary variable" was favored over "mediator" because data was collected cross-sectionally. Hence, we first determined whether mothers and fathers should be considered as indistinguishable dyad partners by performing a within-dyad test of distinguishability ([31]). To perform this test, we constrained the paths to be equal for mothers and fathers, and we compared the constrained model to a non-constrained model in which all parameters were freely estimated using a chi-square difference test. To assess the fit of the model to the data, we followed the recommendations of Kline ([32]) by evaluating whether the chi-square was non-significant, the Comparative Fit Index (CFI) was higher than 0.95, and the Root Mean Square Error of Approximation (RMSEA) was lower than 0.8. These analyses in couples were conducted with Mplus, version 8.7.

Since data were collected cross-sectionally, we also examined the fit of an alternative model where problem-solving was the intermediary variable and perceived control/self-efficacy the independent variables. To do so, we used the same methods as for the main analyses.

In families where only one parent participated, we explored associations between variables of interest using bivariate Pearson correlation. These analyses, as well as all descriptive analyses, were conducted with IBM SPSS Statistics, version 27.0. In all analyses, the alpha level was set at 0.05 for statistical significance.

Results

Sample characteristics and preliminary analyses

A total of 120 families were contacted to participate in this study and members of 69 families agreed and were included in our analyses. The final study sample was composed of 119 participants (67 mothers and 52 fathers, including 50 couples) (**Figure 1**). The participants' children had a mean age at time of the study of 10.71 years (SD=5.43, range: 1-21 years), a mean age at diagnosis of 7.97 years (SD=5.33, range: 1-17 years), and a mean time since diagnosis of 2.39 years (SD=0.73, range: 1.5-3.5 years). The participants' children were 1.5-3.5 years post-diagnosis at the time of the study, with 95.7% (n=66) off-treatment and 4.3% (n=3) three months before the end of treatment at the time of recruitment. Participants' characteristics are presented in **Table 1**. Mothers had a mean emotional distress score of 12.73 (SD=21.77) and a mean problem-solving score of 107.97 (SD=11.61). Fathers had a mean emotional distress score of 14.38 (SD=25.17) and a mean problem-solving score of 107.62 (SD=11.81) (**Table 2**). We conducted preliminary Pearson correlations to ensure that there were minimal correlations between the partners for problem-solving, emotional distress, perceived control, and self-efficacy. We found that mothers' and fathers' perceived control were significantly correlated (p=0.045) (**Table 2**).

Associations between PS and ED

We found a significant medium-sized negative correlation between PS and ED in mothers (r=-0.40, p<0.01, r^2=0.16) and in fathers (r=-0.28, p=0.048, r^2=0.08). The correlations for mothers and fathers did not significantly differ (z=-0.72, p=0.47) ([33]).

Analysis in couples

The within-dyad test of distinguishability showed that there were no significant gender differences in the direct effects between mothers and fathers ($\Delta\chi^2[5]=1.52$, $p=0.91$). The final model constraining the effects to be equal for mothers and fathers ($\chi^2[20]=11.97$, $p=0.91$, CFI=1.00, RMSEA=0.00, 95% CI[0.00, 0.06]) showed an adequate fit to the data.

Figure 2 illustrates the results of the model. We found no direct association between PS and ED ($\beta=-0.01$, $p=0.92$). We found that participants' PS was positively associated with their perceived control, which was in turn negatively associated with their ED. These results indicate that higher PS was associated with higher perceived control, which was in turn associated with lower ED, for mothers and for fathers. We also found that participants' PS was positively associated with their self-efficacy, but their self-efficacy was not associated with their ED. These results indicate that higher PS was associated with higher self-efficacy, which in turn was not associated with ED.

Our results indicated a significant indirect effect between ED and PS with perceived control as the intermediary variable ($\beta=-0.24$, $p<0.001$, 95% CI[-0.41, -0.11]). However, there was no indirect association between ED and PS with self-efficacy as the intermediary variable ($\beta=-0.04$, $p=0.26$, 95% CI[-0.11, 0.09]). The effect size was large in magnitude ($R^2=0.59$ for ED) ([27](27)).

When exploring the alternative test model, with perceived control and self-efficacy being associated with ED through PS, this model had an adequate fit ($\chi^2[21]=19.50$, $p=0.55$, CFI=1.00, RMSEA = 0.00, 95% CI[0.00, 0.11]). However, we found that none of the indirect effects of the alternative model were statistically significant (**Table S5**). This allowed us to conclude that although its fit was adequate, the hypothesized model was a better fit than the alternate model (**Figure S1**).

Complementary analysis

In the subsample of the 19 participants whose partner did not participate in this study, we found a significant medium-sized negative correlation between PS and ED ($r=-0.62$, $p<0.01$, $r^2=0.38$). We found a significant large correlation between PS and perceived control ($r=0.59$, $p<0.01$, $r^2=0.35$), and between perceived control and ED ($r=-0.88$, $p<0.01$, $r^2=0.77$). We also found a significant medium-sized correlation between PS and self-efficacy ($r=0.65$, $p<0.01$, $r^2=0.42$), and between self-efficacy and ED ($r=-0.63$, $p<0.01$, $r^2=0.40$). These associations are compatible with observations made in the dyadic analysis.

Discussion

In this study, we aimed to explore the action mechanism underlying the association between PS and ED in parents of children with cancer. We found that this association went through perceived control for mothers and fathers. However, we found little argument for such an intermediary role of self-efficacy to explain the association of PS with ED. These results could allow to identify important targets for the development and refinement of interventions in parents of children with cancer.

As to the relation between PS and ED, we found a similar association in both mothers and fathers, suggesting that both could indeed benefit from improving their PS skills. This is at odds with the traditional focus of problem-solving interventions on mothers (3). Mothers are oftentimes considered more vulnerable in the context of pediatric cancer (34). The present results suggest that improving PS could benefit both members of the couple to the same degree since the association between PS and ED did not significantly differ between both parents.

Our main results suggest that one potential factor to explain the association between PS and ED is perceived control. Indeed, we found a consistent pattern across analyses showing that perceived control acts as an intermediary variable in this association. It could be that perceived control plays a key role by allowing PS skills to reframe events as more controllable and less threatening, as shown in previous studies in adult cancer research (15). Perceived control has also been shown as an actionable target in supportive interventions. Indeed, previous studies in other populations have used a wide array of tactics to improve participants' perceived control, such as providing individuals with information, giving them more responsibilities and providing them with the opportunity to make more choices (35). Other interventions have been found that promoting acceptance or using tools such as mind maps were useful to improve participants' perceived control (36, 37), which have resulted in improved levels of ED. Perceived control has been explored as an intervention target associated with outcomes related to distress, such as depression and anxiety (2, 3). However, these studies did not assess the precise mechanistic role of perceived control. Hence, our study is the first to evidence the intermediary role of perceived control in the relationship between PS and ED. Our study is also the first to identify the action mechanism of the relationship between PS and ED in parents of children with cancer.

When exploring the role of self-efficacy, previous research has supported the beneficial role of self-efficacy for psychosocial functioning in parents of children with cancer (17). However, this was not supported by the present data, both in mothers and fathers. Our results are at odds with the theory stipulating that when an individual aims to change their behavior, such as their approach to PS, their beliefs about their self-efficacy play a role in their ability to make the desired changes, since individuals only take action when they perceive having the skills and abilities (38). It could be that in the specific population of couples of parents of children with cancer, PS acts on ED in a specific way, by going entirely through perceived control rather than by going through self-efficacy. This could be because in the context of childhood cancer, parents completely lose control over the situation, which might be a major source of ED. Hence, it is possible that self-efficacy did not emerge as an intermediary variable because we placed perceived control and self-efficacy in the same model. It is also possible that for both mothers and fathers, the mean self-efficacy score was high, thereby inducing a ceiling effect that limited the evaluation of self-efficacy as an intermediary variable.

Clinical implications

Several interventions that make use of PS skills training to improve parents' well-being in the context of pediatric cancer have been developed, with some being supported by high level evidence like Sahler et al. (11). Our findings have important implications for such interventional strategies. First, our results highlight that PS could reduce ED equally in both parents. Consequently, it would be beneficial to find ways to address PS in fathers in the future, especially considering that fathers' experience during their child's cancer is largely influenced by the gendered organisation of support systems (39). Notably, fathers can be confronted with the gendered role pressure of continuing to go to work following their child's cancer diagnosis. It has been noted that a child's cancer diagnosis might engage a reorganization of the division of household labor, and some fathers face the need to learn new skills in order to engage in more active caretaking (39). An important outcome of this study is that perceived control emerges as a central intermediary target when working on PS skills. Strategies to influence the perception of control over the stressful situation, such as reframing or focusing on attainable goals would

probably be more beneficial than indiscriminately improving the arsenal of coping skills to increase capability. This could lead to future program refinement.

Study limitations

First, the study was performed in families with a child that was at later stages of their cancer trajectory. It is possible that associations found are reflective of the moment of the illness trajectory. Future studies should replicate the results to extend them to all stages of treatment. Second, this study was cross-sectional making it impossible to conclude causal effects. Nevertheless, we tested an alternative model, and the best fit was found in the model with problem-solving and self-efficacy as intermediary variables. Third, it is possible that the parents who agreed to participate felt that they had more control, higher self-efficacy, and more problem-solving skills than parents who did not agree to participate in this study. Indeed, recent research demonstrated that couples in which both versus one partner agree to participate in research differ in significant ways (40). Hence, self-selection to participate in this study might have impacted our results. Nonetheless, the fact that the results were similar in parents who participated with their partner and those who participated alone increases our confidence in the findings reported in this study. Fourth, parents who participated in this study had a relatively high socio-economic status, which could have limited variability in problem-solving skills and emotional distress in the sample. Future studies conducted on a socio-economically diverse sample could provide additional information regarding these parameters.

Conclusion

In a sample of couples of parents of children with cancer, we found that the negative association between PS and ED could be accounted for by higher perceived control but not by higher self-efficacy. If this result was to be replicated longitudinally, supportive interventions should aim to implement tactics to improve perceived control. As associative patterns were not significantly different between both parents, the results point to improving the inclusion of fathers in addition to the traditional focus on mothers in PS skills training. The present findings could lead to adopting more effective tactics to mitigate the ED of parents confronted with their child's cancer.

Data availability statement: Data is available upon request to the authors

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Tables

Table 1. Participant characteristics

	Participants (n=119) M (SD) or n (%)
Child's sex	
Male	32(46.37)
Female	37(53.62)
Child's age at time of study (years)	10.71(5.43)
Parents	
Mother	67(56.30)
Father	52(43.70)
Marital status	
Couple	100(84.03)
Not a couple	19(15.97)
Parental highest education	
Unfinished high school	7 (5.88)
High school	32 (26.89)
College	23 (19.33)
Baccalaureate	35 (29.41)
Master's degree	15 (12.61)
PhD	1 (0.84)
Other	3 (2.52)
Missing data	3 (2.52)
Income	
Less than 15 000$	20 (16.81)
15 000 to 29 999$	6 (5.04)
30 000 to 49 999$	26 (21.85)
50 000 to 69 999$	20 (16.81)
70 000 to 89 999$	20 (16.81)
90 000 to 109 999$	8 (6.72)
110 000 to 149 999$	6 (5.04)
More than 150 000$	5 (4.20)
Do not want to answer	1 (0.84)
Missing data	7 (5.88)
Child's clinical characteristics	
Age at diagnosis (years)	7.97(5.33)
Time since diagnosis (years)	2.39(0.73)
Diagnosis	
Acute lymphoblastic leukemia	32(46.38)
Lymphoblastic lymphoma	3(4.35)
Anaplastic lymphoma	2(2.90)
Hodgkin's lymphoma	9(13.04)
Burkitt's lymphoma	1(1.45)
B-cell leukemia	1(1.45)
Grey zone lymphoma	1(1.45)
Other	20(28.98)
Risk status (leukemia/lymphoma, n = 49)	
Standard risk	22(44.90)
High risk	9(18.37)
Very high risk	4(8.16)

Intermediate risk	3(6.12)
Not determined	11(22.45)
Stage (other cancers, n = 20)	
1	1(5.00)
2	3(15.00)
3	6(30.00)
4	4(20.00)
Not determined	5(25.00)
Missing (Synovialosarcoma)	1(5.00)
Radiotherapy	
Yes	23(33.33)
No	46(66.67)

Table 2. Correlation between problem-solving, emotional distress, perceived control, and self-efficacy in a sample of 119 participants

	Emotional distress M	Problem-solving M	Perceived control M	Self-efficacy M	Emotional distress F	Problem-solving F	Perceived control F	Self-efficacy F
Emotional distress M	1.00							
Problem solving M	-0.40**	1.00						
Perceived control M	-0.75**	0.47**	1.00					
Self-efficacy M	-0.59**	0.41**	0.67**	1.00				
Emotional distress F	0.26	-0.01	-0.12	0.08	1.00			
Problem-solving F	-0.05	0.17	0.02	-0.12	-0.28*	1.00		
Perceived control F	-0.25	-0.11	0.29*	-0.02	-0.63**	0.43**	1.00	
Self-efficacy F	-0.21	-0.03	0.12	0.04	-0.38**	0.22	0.52**	1.00
Mean	12.73	107.97	18.63	33.07	14.38	107.62	19.67	31.75
SD	21.77	11.61	4.91	6.94	25.17	11.81	4.38	8.41

Note. M, Mothers (N = 67); F, Fathers (N = 52); **$p < 0.01$, *$p < 0.05$. Emotional distress scores range from -24 to 124, with higher scores indicating a higher level of emotional distress. Problem-solving scores range from 32 to 127, with higher scores indicating better PS abilities. Perceived control scores range from 0 to 28, with higher scores indicating lower perceived control. Self-efficacy scores range from 6 to 42, with higher scores indicating higher self-efficacy.

References

1.   Ellison LF, Xie L, Sung L. Trends in paediatric cancer survival in Canada, 1992, to 2017 2021 [cited 2021 November 20]. Available from: https://www150.statcan.gc.ca/n1/pub/82-003-x/2021002/article/00001-eng.htm.

2.   Ogez D, Péloquin K, Bertout L, Bourque C-J, Curnier D, Drouin S, et al. "Taking back control together": Definition of a new intervention designed to support parents confronted with childhood cancer. Cogent Medicine. 2021;8(1):1944476.

3.   Vrijmoet-Wiersma JC, van Klink JM, Kolk AM, Koopman HM, Ball LM, Maarten Egeler R. Assessment of parental psychological stress in pediatric cancer: A review. Journal of Pediatric Psychology. 2008;33(7):694-706.

4.   Sultan S, Leclair T, Rondeau E, Burns W, Abate C. A systematic review on factors and consequences of parental distress as related to childhood cancer. European journal of cancer care. 2016;25(4):616-37.

5.   Ogez D, Péloquin K, Bertout L, Bourque C-J, Curnier D, Drouin S, et al. Psychosocial intervention programs for parents of children with cancer: A systematic review and critical comparison of programs' models and development. Journal of Clinical Psychology in Medical Settings. 2019;26(4):550-74.

6.   Mourtos N, Okamoto N, Rhee J, editors. Defining, teaching, and assessing problem solving skills. 7th UICEE Annual Conference on Engineering Education; 2004.

7.   Varni JW, Sahler OJ, Katz ER, Mulhern RK, Copeland DR, Noll RB, et al. Maternal problem-solving therapy in pediatric cancer. Journal of Psychosocial Oncology. 1999;16(3-4):41-71.

8.   Nezu AM, Nezu CM, Friedman SH, Faddis S, Houts PS. Helping cancer patients cope: A problem-solving approach: American Psychological Association; 1998.

9.   D'Zurilla TJ, Goldfried MR. Problem solving and behavior modification. Journal of Abnormal Psychology. 1971;78(1):107-26.

10.   Dolgin MJ, Devine KA, Tzur-Bitan D, Askins MA, Fairclough DL, Katz ER, et al. Responsivity to problem-solving skills training in mothers of children with cancer. Journal of pediatric psychology. 2021;46(4):413-21.

11.   Sahler OJZ, Fairclough DL, Phipps S, Mulhern RK, Dolgin MJ, Noll RB, et al. Using problem-solving skills training to reduce negative affectivity in mothers of children with newly

diagnosed cancer: report of a multisite randomized trial. Journal of consulting and clinical psychology. 2005;73(2):272.

12.   Bell AC, D'Zurilla TJ. Problem-solving therapy for depression: a meta-analysis. Clinical psychology review. 2009;29(4):348-53.

13.   Nezu AM. Differences in psychological distress between effective and ineffective problem solvers. Journal of Counseling Psychology. 1985;32(1):135.

14.   Wallston KA, Wallston BS, Smith S, Dobbins CJ. Perceived control and health. Current Psychology. 1987;6(1):5-25.

15.   Mishel MH, Belyea M, Germino BB, Stewart JL, Bailey Jr DE, Robertson C, et al. Helping patients with localized prostate carcinoma manage uncertainty and treatment side effects: nurse-delivered psychoeducational intervention over the telephone. Cancer. 2002;94(6):1854-66.

16.   Eskin M. Problem solving therapy in the clinical practice: Newnes; 2012.

17.   Oktaviani I, Allenidekania A. Correlation between parents' self-efficacy and quality of life of children with cancer aged 8-12 years. Pediatric Reports. 2020;12(S1):52-6.

18.   Wood R, Bandura A. Impact of conceptions of ability on self-regulatory mechanisms and complex decision making. Journal of personality and social psychology. 1989;56(3):407.

19.   CHU Sainte-Justine. The VIE Project 2020 [Available from: https://www.chusj.org/en/soins-services/H/Hematologie/Projet-Vie.

20.   Shacham S. A shortened version of the Profile of Mood States. Journal of Personality Assessment. 1983;47(3):305-6.

21.   Nyenhuis DL, Yamamoto C, Luchetta T, Terrien A, Parmentier A. Adult and geriatric normative data and validation of the profile of mood states. Journal of clinical psychology. 1999;55(1):79-86.

22.   Curran SL, Andrykowski MA, Studts JL. Short form of the profile of mood states (POMS-SF): psychometric information. Psychol Assess. 1995;7(1):80.

23.   D'Zurilla TJ, Nezu AM, Maydeu-Olivares A. SPSI-R Social Problem-Solving Inventory-Revised. Toronto, Ontario: Multi-Health Systems 2018 September 22, 2022. 100 p.

24.   Hawkins D, Sofronoff K, Sheffield J. Psychometric properties of the social problem solving inventory-revised short-form: Is the short form a valid and reliable measure for young adults? Cognitive Therapy and Research. 2009;33(5):462-70.

25.   Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. Journal of Health and Social Behavior. 1983;24(4):385-96.

26.   Cerclé A, Gadea C, Hartmann A, Lourel M. Typological and factor analysis of the perceived stress measure by using the PSS scale. European review of applied psychology. 2008;58(4):227-39.

27.   Cohen S. Perceived stress in a probability sample of the United States. 1988.

28.   Mitchell AM, Crane PA, Kim Y. Perceived stress in survivors of suicide: psychometric properties of the Perceived Stress Scale. Research in nursing & health. 2008;31(6):576-85.

29.   Williams GC, Freedman ZR, Deci EL. Supporting autonomy to motivate patients with diabetes for glucose control. Diabetes Care. 1998;21(10):1644-51.

30.   Matin H, Nadrian H, Sarbakhsh P, Shaghaghi A. Factorial structure and psychometric analysis of the persian version of perceived competence scale for diabetes (PCSD-P). Behavioral Sciences. 2019;9(5):50.

31.   Kenny D, Kashy D, Cook W. Dyadic data analysis: Guilford press. New York, NY, US. 2006.

32.   Kline RB. Principles and practice of structural equation modeling: Guilford publications; 2015.

33.   Cohen J. Statistical power analysis. Current directions in psychological science. 1992;1(3):98-101.

34.   Eyigor S, Karapolat H, Yesil H, Kantar M. The quality of life and psychological status of mothers of hospitalized pediatric oncology patients. Pediatric hematology and oncology. 2011;28(5):428-38.

35.   Kerr NL, Atkin RS, Stasser G, Meek D, Holt RW, Davis JH. Guilt beyond a reasonable doubt: Effects of concept definition and assigned decision rule on the judgments of mock jurors. Journal of Personality and Social Psychology. 1976;34(2):282.

36.   Tan X, Xiong H, Gui S, Wan Y, Yan W, Wang D, et al. Effects of cognitive education on the perceived control and symptom distress of lung cancer patients receiving chemotherapy: A randomised controlled trial. European Journal of Cancer Care. 2019;28(5):e13120.

37.   Wadsworth L, Hayes-Skelton S. Exploring perceived control, a low-control task, and a brief acceptance intervention in a low and high transdiagnostic anxiety sample. Neurology, Psychiatry and Brain Research. 2020;35:1-9.

38.   Aminuddin HB, Jiao N, Jiang Y, Hong J, Wang W. Effectiveness of smartphone-based self-management interventions on self-efficacy, self-care activities, health-related quality of life and clinical outcomes in patients with type 2 diabetes: A systematic review and meta-analysis. International journal of nursing studies. 2021;116:103286.

39.   Chesler MA, Parry C. Gender roles and/or styles in crisis: An integrative analysis of the experiences of fathers of children with cancer. Qualitative health research. 2001;11(3):363-84.

40.   Park Y, Impett EA, MacDonald G. Generalizability of results from dyadic data: Participation of one versus two members of a romantic couple is associated with breakup likelihood. Personality and Social Psychology Bulletin. 2021;47(2):232-40.
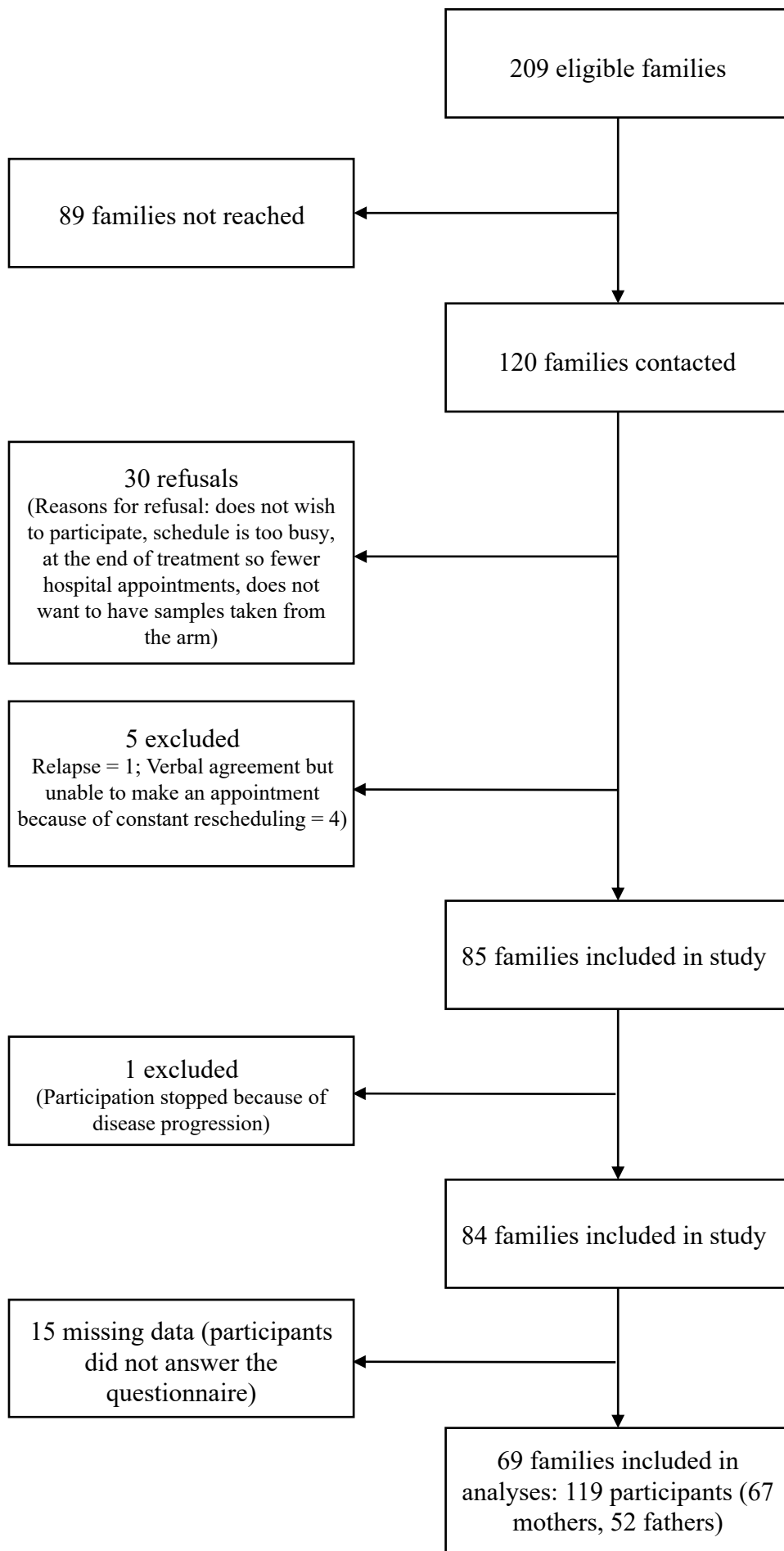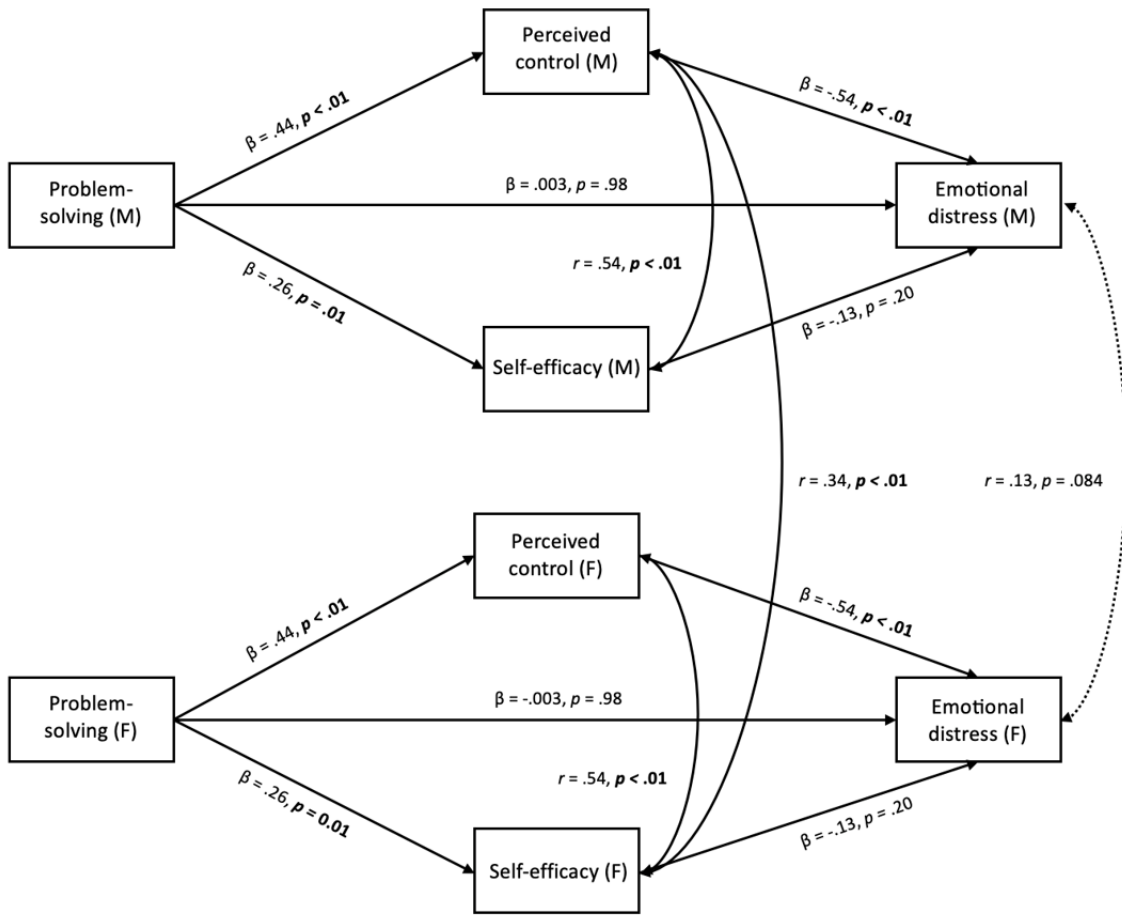
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                                        ┌─────────────────────────┐
                                        │   209 eligible families  │
                                        └─────────────────────────┘
                                                     │
┌─────────────────────────┐                         │
│ 89 families not reached  │ ◄───────────────────────┤
└─────────────────────────┘                         │
                                                     ▼
                                        ┌─────────────────────────┐
                                        │  120 families contacted  │
                                        └─────────────────────────┘
                                                     │
┌───────────────────────────────────┐               │
│ 30 refusals                        │               │
│ (Reasons for refusal: does not wish│               │
│ to participate, schedule is too busy,│ ◄───────────┤
│ at the end of treatment so fewer   │               │
│ hospital appointments, does not    │               │
│ want to have samples taken from    │               │
│ the arm)                           │               │
└───────────────────────────────────┘               │
                                                     │
┌───────────────────────────────────┐               │
│ 5 excluded                         │               │
│ Relapse = 1; Verbal agreement but  │ ◄───────────┤
│ unable to make an appointment      │               │
│ because of constant rescheduling = 4)│             │
└───────────────────────────────────┘               │
                                                     ▼
                                        ┌─────────────────────────┐
                                        │ 85 families included in  │
                                        │          study           │
                                        └─────────────────────────┘
                                                     │
┌───────────────────────────────────┐               │
│ 1 excluded                         │               │
│ (Participation stopped because of  │ ◄───────────┤
│ disease progression)               │               │
└───────────────────────────────────┘               │
                                                     ▼
                                        ┌─────────────────────────┐
                                        │ 84 families included in  │
                                        │          study           │
                                        └─────────────────────────┘
                                                     │
┌───────────────────────────────────┐               │
│ 15 missing data (participants      │               │
│ did not answer the                 │ ◄───────────┤
│ questionnaire)                     │               │
└───────────────────────────────────┘               │
                                                     ▼
                                        ┌─────────────────────────┐
                                        │ 69 families included in  │
                                        │ analyses: 119 participants (67│
                                        │ mothers, 52 fathers)     │
                                        └─────────────────────────┘
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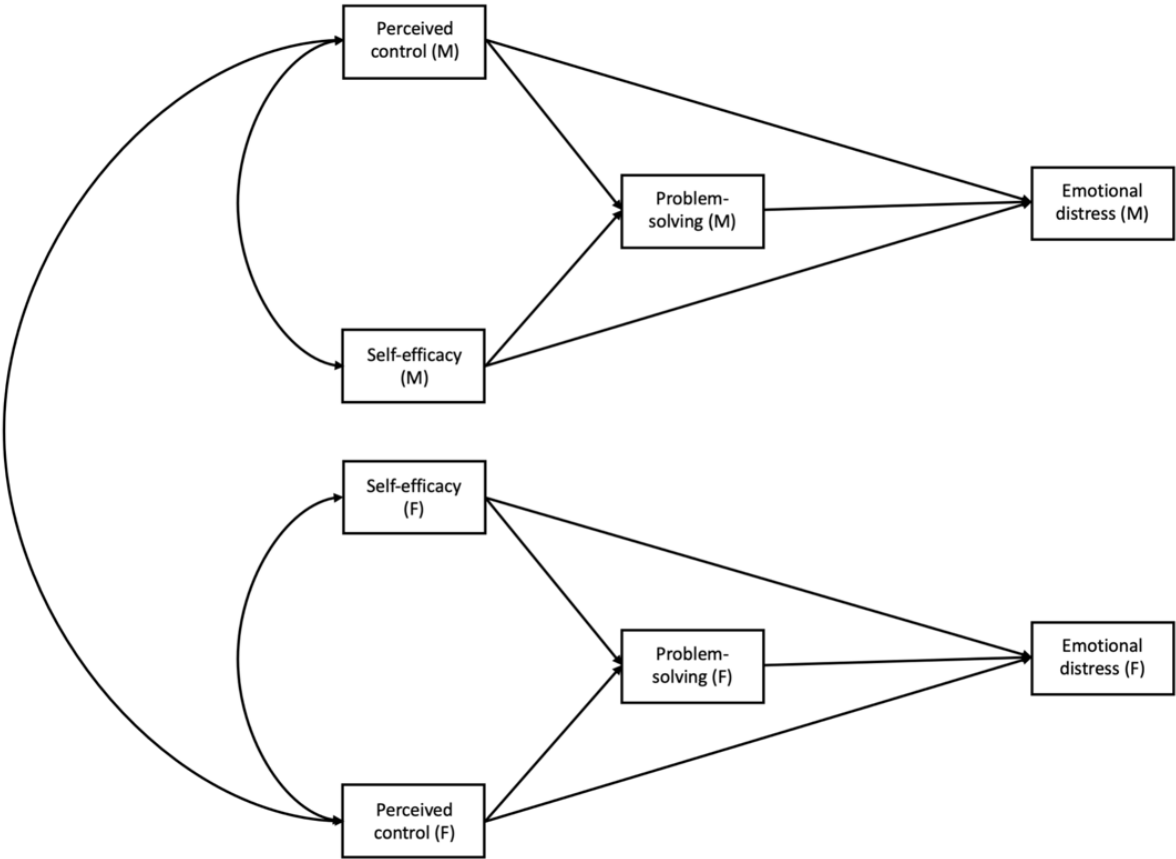
Figure 2.

Figure S1.

Supplementary information, Table S1. Perceived Control Items of the Perceived Stress Scale

Item number	
Item 4	In the last month, how often have you dealt successfully with irritating life hassles?
Item 5	In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?
Item 6	In the last month, how often have you felt confident about your ability to handle your personal problems?
Item 7	In the last month, how often have you felt that things were going your way?
Item 9	In the last month, how often have you been able to control irritations in your life?
Item 10	In the last month, how often have you felt that you were on top of things?
Item 13	In the last month, how often have you been able to control the way you spend your time?

Supplementary information, Table S2. Communalities, total variance explained, and component matrix of a one-factor principal component analysis conducted on non-inversed perceived control items of the PSS

PSS item	Communalities		Total variance explained			Component matrix
	Initial	Extraction	Initial Eigenvalues	% of Variance	Cumulative %	Component 1
Item 4	1.00	0.55	4.19	59.86	59.86	0.85
Item 5	1.00	0.73	0.73	10.45	70.32	0.85
Item 6	1.00	0.72	0.66	9.46	79.77	0.80
Item 7	1.00	0.63	0.55	7.87	87.64	0.79
Item 9	1.00	0.54	0.35	4.97	92.61	0.74
Item 10	1.00	0.64	0.28	3.96	96.57	0.74
Item 13	1.00	0.38	0.24	3.43	100.00	0.61

Note. We found a high average inter-item correlation in mothers ($r = 0.57$), fathers ($r = 0.47$), and the total sample ($r = 0.53$). Average item-total correlations were also large in mothers ($r = 0.72$), fathers ($r = 0.63$), and the total sample ($r = 0.68$) (Streiner, 2003; https://doi.org/10.1207/S15327752JPA8001_18).

Supplementary information, Table S3. Items of the Perceived Competence Scale adapted to the specific context of pediatric cancer

Item number	
Item 1	I feel confident in my ability to deal with my child's illness.
Item 2	I am capable of dealing with the situation.
Item 3	I am able to organise myself, to determine my own routine to take care of my child's illness.
Item 4	I feel able to meet the challenge of dealing with the situation.
Item 5	I feel in control of the situation.
Item 6	I see clearly what I can do to manage the situation.

Supplementary information, Table S4. Communalities, total variance explained, and component matrix of a one-factor principal component analysis conducted on all items of the PCS-6

PCS-6	Communalities		Total variance explained			Component matrix
	Initial	Extraction	Initial Eigenvalues	% of Variance	Cumulative %	Component 1
Item 1	1.00	0.75	4.45	74.173	74.173	0.91
Item 2	1.00	0.83	0.54	8.916	83.089	0.90
Item 3	1.00	0.61	0.38	6.317	89.405	0.89
Item 4	1.00	0.82	0.26	4.33	93.735	0.87
Item 5	1.00	0.65	0.21	3.423	97.158	0.81
Item 6	1.00	0.79	0.17	2.842	100.00	0.78

Note. We found a high average inter-item correlation in mothers ($r = 0.67$), fathers ($r = 0.71$), and the total sample ($r = 0.69$). Average item-total correlations were also very large in mothers ($r = 0.85$), fathers ($r = 0.87$), and the total sample ($r = 0.86$) (Streiner, 2003; https://doi.org/10.1207/S15327752JPA8001_18).

Table S5. Indirect effect of problem-solving on emotional distress through perceived control and self-efficacy in the alternative model

Parent	Predictor	Outcome	Intermediary variable	ß	*p*
Mothers	Perceived control	Emotional distress	Problem-solving	0.00	0.93
	Self-efficacy			0.00	0.99
Fathers	Perceived control	Emotional distress	Problem-solving	0.00	0.93
	Self-efficacy			0.00	0.99