

Effects of cognitive behavioral therapy on psychological adjustment in Chinese pediatric cancer patients receiving chemotherapy

A randomized trial

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Abstract

Background: Cognitive behavioral therapy (CBT) has been widely used in pediatric cancer patients to promote psychological adjustment (PA). Considering the diversity of region and culture in China, its effect in Chinese population is not well defined. Therefore, our study is to explore the effect of CBT on improving PA in Chinese pediatric cancer patients receiving chemotherapy.

Methods: One hundred four Chinese pediatric cancer patients receiving chemotherapy were divided into CBT group and control group randomly and equally. The resilience and negative mood were applied to evaluate the ability of psychological adjustment (PA). The Conner-Davidson Resilience Scale (CD-RISC) and depression anxiety stress scale (DASS) were employed to measure resilience and negative mood before and after intervention. The SPSS 22.0 software was used to analyze data.

Results: Prior to the intervention, the ability of psychological adjustment between 2 groups showed no significant difference ($P > .05$ for all). After intervention, the total CD-RISC score was significantly higher (56.09 ± 7.29 vs 44.75 ± 5.40), whereas the scores of depression (4.57 ± 2.94 vs 7.25 ± 4.25), anxiety (5.83 ± 3.07 vs 8.66 ± 4.92), stress (7.51 ± 4.33 vs 11.17 ± 4.25) were obviously lower in CBT group than those in the control group ($P < .05$ for all). Moreover, the decline of negative mood score in Yolk sac tumor children was the most evident in CBT group. While the resilience changes of cancer children in stage III was most obvious.

Conclusions: CBT can effectively help Chinese pediatric cancer patients modify distorted cognition to have a positive attitude towards cancer and chemotherapy. This treatment enhances resilience and relieves negative mood, which results in good psychological adjustment ability, especially in Yolk sac tumor and stage III. It has a beneficial effect on better treatment cooperation and high long-term quality of life.

Abbreviations: CBT = cognitive behavioral therapy, CD-RISC = Conner-Davidson resilience scale, DASS = depression anxiety stress scale, M = mean, PA = psychological adjustment, SD = standard deviation.

Keywords: pediatric, cancer, cognitive behavioral therapy, psychology

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1. Introduction

The mortality rate and 5 years long-term survival rate of pediatric cancer in China has improved significantly from 50% to 72%, but the psychological trauma caused by treatment has not been alleviated.^[1] Chemotherapy is an aggressive cancer treatment that not only can cause physiological side effects, but it also has a negative impact on cognitive function, mood control and ability to confront disease processes adequately.^[2] This subsequently has a negative effect on PA of children diagnosed with cancer. Additionally, their psychological mood is unstable and rebellious particularly in older teenagers during the special transition period from childhood to adulthood. It is common that pediatric cancer patients tend to be observed mood disorders when confronting cancer and its treatment, and this results in inefficient PA.^[3]

There are at least 5 key elements of adequate PA to cancer diagnosis including the successful adaptive tasks, the absence of psychological disorders, the presence of low negative affect, adequate functional status, and the satisfaction in various life domains.^[4] The resilience and negative mood were 2 of the most important indicators based on these elements. A resilience presenting a good PA is defined by baseline characteristic or traits, which are usually identified at the first interactions after cancer diagnosis and this enables cancer patients to thrive better in confronting the diagnosis, treatment, and related symptoms

burden.^[5–7] However, negative mood is a type of mental depression that indicates worse PA and this not only results in poor adherence to therapy and suicide tendencies but also causes endocrine disturbances and immunity decline.^[8]

Recent studies show that cognitive distortion in cancer events chemotherapy is one of the main reason for affected PA in pediatric cancer patients.^[9,10] Moreover, the Chinese traditional culture affects PA. Chinese cancer children tend to conceal their feelings and pretend to be strong, which lead to some misunderstanding on cancer events and treatment.^[11] CBT is a psychotherapy that can correct cognitive distortion to eliminate negative mood and behavior by means of cognitive reconstruction effectively. Meanwhile, CBT has been widely used in pediatric cancer patients to promote PA.^[12–14] However, due to the diversity of region and culture, the effects of CBT in Chinese population is not well defined. Therefore, our study is to explore the effect of CBT on improving PA including resilience and negative mood in Chinese pediatric cancer patients receiving chemotherapy.

2. Methods

2.1. Participants

The study was approved by the Ethics Commission of the Affiliated Children's Hospital of Chongqing Medical University (no. 2017044). Children and adolescents presenting malignant tumors between April 2017 and September 2018 were recruited for the study from the Department of Oncology and Hematology, Children's Hospital of Chongqing Medical University, Chongqing, China.

Inclusion criteria are as follows:

- (1) children with a clinical and pathological diagnosis of malignant tumors;
- (2) children aged from 8 to 18 years old;
- (3) children undergoing chemotherapy;
- (4) children with no communication and hearing disorders or mental and emotional disorders or cognitive impairment;
- (5) signed informed consent obtained from the patient's parents or legal guardians.

Exclusion criteria are as follows:

- (1) children with traumatic brain injury or intelligence deficiencies;
- (2) children with serious mental stress or diseases;
- (3) pediatric cancer patients who demised during the study period.

3. Sample

Sample volume calculation: through expert consultation and literature review, determine the mean (M) and standard deviation (SD) of CBT on negative emotion and resilience, set a class of type I error probability $\alpha = 0.05$, test efficacy $1 - \beta = 0.8$, according to the following formula:

$$N = 2 \times \left[\frac{(z_{\alpha} + z_{\beta})\sigma}{\delta} \right]^2$$

the sample volume of experimental group and control group was 53 cases.

A statistical program was used to determine group assignment, conceal the sequence by secret files until interventions were

assigned, allocation ratio is 1:1, and all participants were randomly divided into either CBT or control groups (n = 54 cases per group), 1 in CBT group was lost to follow-up because of transferring treatment and 1 in control group was death without discontinuing intervention (Fig. 1).

4. Interventions

For the control group, routine psychological care was as follows:

- (1) informed participants and their families of the disease including the diagnostic stage and advancement of the disease, and provide answers to their queries;
- (2) provided detailed information on the advantages, disadvantages, effects and costs of the current routine treatment plan and respected their rights in the selection of the treatment plans;
- (3) objectively informed possible complications during and after treatment including side effects and prognosis to enable them to develop psychological identity to the potential physiological changes;
- (4) informed them that negative mood may have negative effect on their health and encouraged children to express family members and other patients their inner feelings and sought more support;
- (5) shared their experiences of fighting cancer in children from the same ward, and received more psychological support from their peers.

The treatment group was based on routine psychological intervention and also implemented CBT. First of all, we built up the children and family-centered CBT model and psychotherapist, doctors, nurses, children, and families collaborative group. The director of the department, head nurse, psychotherapist, and volunteers participated in the implementation of the CBT interventions. Furthermore, all staff were involved in the same professional training and obtained a qualification certificate.

The CBT consist of cognitive therapy, relaxation training, and effect evaluation, which last for 5 weeks. The contents of intervention are as follows:

- (1) First week: established trust relationships with children and parents through interviews, and explained the purpose of CBT in a simple and comprehensible manner. They were invited to join the "Home of Children and Adolescent CBT" Wechat platform to communicate with each other.
- (2) Second week: psychotherapist revealed the negative mood and cognitive distortions of the children through direct and open questioning, and cognition diaries. According to cognition diaries, cognitive distortions were analyzed qualitatively. Children completed their personal cognition diary under the supervision of parents once a day. Its content includes the scene, intensity and concomitant idea or imagination of negative mood. Common cognitive distortions included "black or white", "exaggerated", "filtered", "bargain", "disaster", "mind reading", "feeling is the fact", "labelling" and "self-blame".^[15]
- (3) Third week: psychotherapist correct cognitive distortion and reconstruct cognition. According to the types of cognitive distortion the children were instructed to conduct specific cognitive training to establish correct cognition. Children with the participation of parents became aware of their cognitive distortion through suggestions, role playing, and role imitation. Then semantic analysis technology was

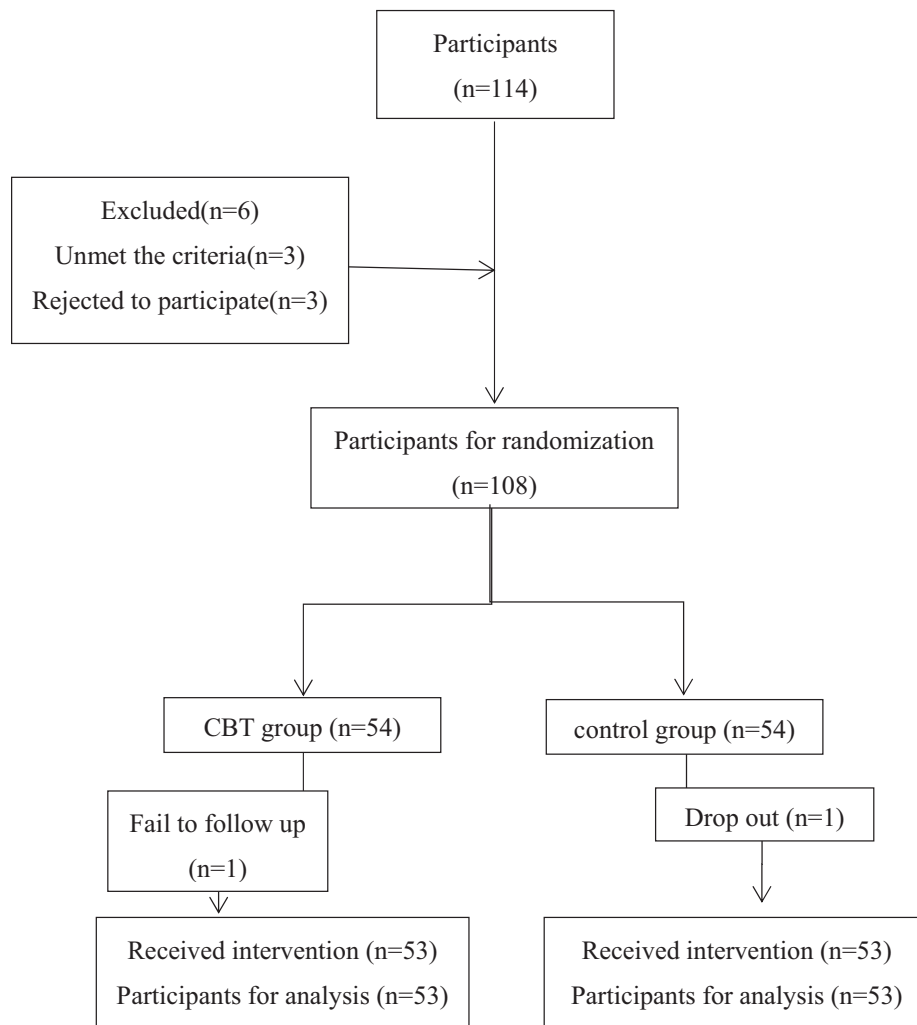


Figure 1. Study process flowchart.

applied to make the children realize the nature of cognition distortion, which is negative evaluation when there is dissatisfaction with their condition. Finally, reconstructed cognition was reviewed to verify correct cognition.

- (4) Fourth week: with the cooperation of parents and children, deep breathing and progressive muscle relaxation training is carried out through repeated induction by psychotherapist. The implementation steps are as follows: slow inhalation through nose, fill the lungs with air and sustain a moment, then slowly exhale the air, and then relax the hands, forearms, biceps, forehead, eyes, neck, throat, shoulder, back, chest, abdomen, buttock, thigh, calf and feet to achieve complete relaxation of all muscles. Relaxation training lasted for 30 minutes at one time and at least once a day.
- (5) Fifth week: the effect of CBT outside hospital was evaluated by telephone interviews, follow-up visits. The resilience and negative mood were re-evaluated by CD-RISC and DASS.

5. Data collection

We used CD-RISC and DASS to evaluate PA. CD-RISC was developed by Conner and Davidson in 2003 to assess the level of resilience, which was sinicized by Yu et al^[16] and its validity and

reliability are 0.86 and 0.69, respectively. It contains 25 items including a total of 3 dimensions of tenacity, strength, and optimism. The CD-RISC comprises of 25 items, and each rated on a 5-point scale (0–4) with higher scores reflecting greater resilience. The DASS was used to assess the negative mood of Chinese children.^[17] The reliability and validity of the scale were 0.911 and 0.774, respectively. It contains 3 dimensions of depression, anxiety, and stress. After the interventions, the CD-RISC and DASS of the participants were tested and scored on the basis of the performance of the children's PA by trained professionals who were not involved in the assessment or intervention and were blinded to the treatment assigned. The lower the DASS score, the better the PA cancer children demonstrated. On the basis of the total score, there were five levels of negative mood:

- (1) normal: depression (≤ 9), anxiety (≤ 7), stress (≤ 14);
- (2) mildly abnormal: depression (10–13), anxiety (8–9), stress (15–18);
- (3) moderately abnormal: depression (14–20), anxiety (10–14), stress (19–25);
- (4) severe abnormal: depression (21–27), anxiety (15–19), stress (26–33);

(5) extremely severe abnormal: depression (≥ 28), anxiety (≥ 20), stress (≥ 34).

The questionnaire was collected immediately, and the integrity of the questionnaire was checked in time to ensure the validity of the information. One hundred eight questionnaires were sent out before intervention. One hundred six questionnaires were distributed after intervention. All questionnaires were gathered before and after intervention, and the effective response rate was 100%.

6. Statistical analysis

EpiData3.0 (The Epidate Association, Odense Denmark) was used for data input by 2 investigators and they verified that data were entered correctly. SPSS (SPSS Inc, 233 South Wacker Drive, IL) 22 were used for statistical analyses, and the mean (M), standard deviation (SD), and frequency, respectively, were applied to statistical description. The *t* test, analysis of variance

for repeated measurement data, chi-square and Mann-Whitney U rank sum tests were used to compare the 2 groups as necessary. $P < .05$ was considered statistically significant.

7. Results

A total of 106 children with malignant tumors were recruited with 52 (49.06%) boys and 54 (50.94%) girls, respectively. 53 cases were from the children aged from 8 to 12 years old and 46 cases from 13 to 18 years old. Among these, 2 (1.89%) cases were neuroblastoma; 23 (21.70%) cases were osteosarcoma; 17 (16.04%) cases were Ewing sarcoma; 17 (16.04%) cases were lymphoma; 14 (13.21%) cases were oophoroma; 19 (17.92%) cases were leukemia; 4 (3.77%) cases were yolk sac tumor; 6 (5.66%) cases were rhabdomyosarcoma; and 4 (3.77%) cases were germinoma. All the children were randomly divided into either the control group or the CBT group (53 cases per group). No statistical differences existed regarding age, gender, types of disease, stages, chemotherapy times, education levels of mother, living areas, and economic burden between 2 groups (Table 1).

No significant differences in psychological resilience and negative mood between 2 groups at baseline were observed ($P > .05$ for all). Following intervention, the CD-RISC and DASS in the CBT group was improved over baseline. However, no differences in the score of CD-RISC and DASS were found before and after intervention in the control group. Furthermore, total scores of CD-RISC including the scores of Tenacity, Strength, and Optimism in the CBT group were higher than the control group ($P < .05$ for all categories). Similarly, the DASS scores including depression, anxiety and stress in CBT group were lower than those in the control group ($P < .05$ for all; Table 2). Comparative analysis between the 2 age groups before and after intervention, showed no significant difference in the psychological resilience and negative mood scores in the group of 8 to 12 years and 13 to 18 years in both the CBT group and control group ($P > .05$ for all; Table 3). There were no significant changes on the scores of negative mood and resilience among different cancer types and stages in CBT group after intervention ($P > .05$ for all; Table 4). However, the intervening time had a certain influence on the change of negative mood scores of different types of cancer patients, and the most obvious decline was found in yolk sac tumors after intervention. Besides, psychological resilience scores gradually increased with the change of intervention time, and the most obvious improvement was found in children with stage III ($P < .05$; Table 5, Fig. 2).

Table 1

General characteristics of the participants (n%).

Items	Control group (n=53)	CBT group (n=53)
Gender*		
Boys	25 (47.17%)	27 (50.94%)
Girls	28 (52.83%)	26 (49.06%)
Age (years)*		
8–12	29 (54.72%)	31 (58.49%)
13–18	24 (45.28%)	22 (41.51%)
Education levels of children*		
Primary school	36 (67.92%)	36 (67.92%)
Junior high school	17 (32.08%)	15 (28.31%)
Senior high school	0 (0%)	2 (3.77%)
Disease stage*		
Stage I	7 (13.21%)	3 (5.66%)
Stage II	21 (39.62%)	17 (32.08%)
Stage III	19 (35.85%)	24 (45.28%)
Stage IV	6 (11.32%)	9 (16.98%)
Cancer types*		
Neuroblastoma	1 (1.89%)	1 (1.89%)
Osteosarcoma	8 (15.09%)	15 (28.30%)
Ewing's sarcoma	7 (13.21%)	10 (18.87%)
Lymphoma	10 (18.87%)	7 (13.21%)
Oophoroma	7 (13.21%)	7 (13.21%)
Leukemia	14 (26.42%)	5 (9.43%)
Yolk sac tumor	3 (5.66%)	1 (1.89%)
Rhabdomyosarcoma	2 (3.76%)	4 (7.54%)
Germinoma	1 (1.89%)	3 (5.66%)
Chemotherapy times*		
0–3	22 (41.51%)	19 (35.85%)
4–6	20 (37.73%)	16 (30.19%)
7–12	8 (15.09%)	14 (26.42%)
>12	3 (5.67%)	4 (7.54%)
Areas*		
City	27 (50.94%)	25 (47.17%)
Rural	26 (49.06%)	28 (52.83%)
Economic burden*		
No	12 (22.64%)	6 (11.32%)
Yes	41 (77.36%)	47 (88.68%)
Education levels of mother*		
Primary school	20 (37.74%)	23 (43.40%)
Junior high school	27 (50.94%)	22 (41.51%)
Senior high school	3 (5.66%)	3 (5.66%)
University and above	3 (5.66%)	5 (9.43%)

CBT group vs control group.

* $P > .05$.

Table 2

Comparison of psychological resilience and negative mood scores (M ± SD).

Items	Control group (n=53)		CBT group (n=53)	
	Baseline	After intervention	Baseline	After intervention
Psychological resilience				
Total score	45.43 ± 4.96	44.75 ± 5.40	46.21 ± 8.83	56.09 ± 7.29 ^{*,†}
Tenacity	26.00 ± 2.98	26.26 ± 2.70	26.62 ± 4.06	30.70 ± 3.53 ^{*,†}
Strength	14.38 ± 1.92	13.79 ± 1.32	15.08 ± 2.57	17.66 ± 2.90 ^{*,†}
Optimistic	5.60 ± 0.96	4.77 ± 1.32	5.74 ± 2.32	7.94 ± 2.03 ^{*,†}
Negative mood				
Depression	7.40 ± 5.42	7.25 ± 4.25	9.00 ± 5.19	4.57 ± 2.94 ^{*,†}
Anxiety	9.49 ± 4.61	8.66 ± 4.92	11.53 ± 7.52	5.83 ± 3.07 ^{*,†}
Stress	11.89 ± 6.65	11.17 ± 5.73	13.43 ± 4.40	7.51 ± 4.33 ^{*,†}

* $P < .01$, vs control group.

† $P < .05$, vs baseline.

Table 3
Comparison of psychological resilience and negative mood scores between younger and older cancer children (M ± SD).

Items	times	Control group (n = 53)		CBT group (n = 53)	
		8–12 (n = 31)	13–18 (n = 22)	8–12 (n = 29)	13–18 (n = 24)
Psychological resilience					
Total score	Before*	45.03 ± 5.31	45.92 ± 4.57	46.65 ± 8.68	48.00 ± 9.18
	After*	44.83 ± 5.35	45.13 ± 4.95	55.81 ± 7.05	56.50 ± 7.76
Tenacity	Before*	25.90 ± 3.28	26.13 ± 2.64	26.48 ± 4.17	26.82 ± 3.99
	After*	26.10 ± 3.05	26.38 ± 2.46	30.55 ± 3.51	30.91 ± 3.63
Strength	Before*	14.10 ± 1.76	14.71 ± 2.09	14.77 ± 2.53	15.50 ± 2.61
	After*	13.90 ± 1.91	14.04 ± 2.11	17.68 ± 3.03	17.64 ± 2.77
Optimistic	Before*	5.00 ± 0.96	5.13 ± 0.99	5.55 ± 2.20	6.00 ± 2.60
	After*	4.83 ± 1.28	4.88 ± 1.32	7.94 ± 1.98	7.95 ± 2.14
Negative mood					
Depression	Before*	7.72 ± 6.67	7.00 ± 3.48	8.45 ± 6.42	9.77 ± 5.34
	After*	7.45 ± 5.50	7.00 ± 3.06	4.39 ± 3.20	4.82 ± 2.59
Anxiety	Before*	10.41 ± 5.54	8.38 ± 2.90	11.45 ± 7.47	11.64 ± 7.76
	After*	9.24 ± 5.64	8.46 ± 4.02	5.77 ± 3.84	5.91 ± 4.25
Stress	Before*	12.55 ± 7.99	11.00 ± 4.49	13.16 ± 8.19	13.82 ± 7.27
	After*	11.93 ± 6.83	10.42 ± 3.95	7.35 ± 4.63	7.73 ± 3.96

* P > .05, 8–12 years old cancer children compared with the 13–18 years old ones.

Table 4
Comparison of psychological resilience and negative mood scores of various cancer types and stages in CBT group after intervention (M ± SD).

Staged/types	Depression	Anxiety	Stress	Resilience	Tenacity	Strength	Optimistic
types							
Neuroblastoma (n = 1)	4.00 ± 0.00	4.00 ± 0.00	4.00 ± 0.00	54.00 ± 0.00	29.00 ± 0.00	18.00 ± 0.00	7.00 ± 0.00
Osteosarcoma (n = 15)	5.87 ± 3.50	7.87 ± 4.10	9.20 ± 3.27	53.13 ± 5.85	29.87 ± 2.82	16.53 ± 1.76	7.40 ± 1.80
Ewing's sarcoma (n = 10)	4.40 ± 2.63	4.40 ± 3.37	7.40 ± 4.90	57.60 ± 6.05	31.20 ± 2.82	18.30 ± 2.05	8.10 ± 1.91
Lymphoma (n = 7)	5.43 ± 2.50	6.86 ± 4.45	8.57 ± 4.99	54.14 ± 5.95	29.57 ± 2.37	17.29 ± 1.60	7.29 ± 2.21
Oophoroma (n = 7)	3.71 ± 2.92	4.86 ± 3.97	6.86 ± 5.01	62.71 ± 8.46	33.14 ± 5.27	18.57 ± 3.73	9.71 ± 2.43
Leukemia (n = 5)	3.60 ± 3.84	3.00 ± 2.44	4.40 ± 4.33	52.40 ± 8.32	29.40 ± 4.50	16.00 ± 2.55	7.00 ± 1.58
Yolk sac tumor (n = 1)	2.00 ± 0.00	4.00 ± 0.00	6.00 ± 0.00	56.00 ± 0.00	30.00 ± 0.00	17.00 ± 0.00	9.00 ± 0.00
Rhabdomyosarcoma (n = 4)	3.00 ± 1.15	3.50 ± 1.91	5.00 ± 4.76	61.75 ± 9.91	33.25 ± 4.78	21.75 ± 6.23	9.25 ± 2.21
Germinoma (n = 3)	3.33 ± 1.15	9.33 ± 4.16	8.67 ± 3.05	54.33 ± 4.61	29.67 ± 2.30	17.33 ± 1.15	7.33 ± 1.15
F value	0.875	1.787	0.968	1.856	1.057	1.879	1.419
P value	.545	.105	.473	.092	.410	.088	.216
Stages							
Stage I (n = 3)	1.00 ± 1.41	1.00 ± 1.41	1.00 ± 1.41	55.00 ± 7.07	31.00 ± 2.82	16.50 ± 2.12	7.50 ± 2.12
Stage II (n = 17)	4.24 ± 2.90	5.29 ± 3.53	7.53 ± 4.27	55.76 ± 7.33	30.88 ± 3.80	17.06 ± 2.27	7.94 ± 1.85
Stage III (n = 24)	4.92 ± 2.70	6.17 ± 4.20	8.17 ± 4.08	56.67 ± 6.19	30.62 ± 3.01	18.08 ± 3.33	7.92 ± 2.06
Stage IV (n = 9)	5.33 ± 3.60	7.44 ± 3.90	7.78 ± 4.63	55.44 ± 10.93	30.56 ± 4.97	17.89 ± 3.18	8.11 ± 2.66
F value	0.913	1.031	1.592	0.868	0.481	1.940	0.730
P value	.459	.395	.182	.486	.750	.110	.574

Table 5
Repeated measurement variance analysis for psychological adaptation in different cancer types and stages of CBT group.

Variation	SS	df	MS	F	p
Negative mood score					
Time	3906.556	1	3906.556	71.914	.000*
Time * cancer types	1419.215	8	177.402	3.266	.005*
Error	2390.200	44	54.323		
Resilience					
Time	982.028	1	982.028	78.912	.000*
Time * cancer types	154.096	8	19.262	1.548	.169
Error	547.564	44	12.445		
Negative mood score					
Time	2985.622	1	2985.622	42.253	.000*
Time * stages	347.041	3	115.680	1.637	.193
Error	3462.375	49	70.661		
Resilience					
Time	736.582	1	736.582	60.967	.000*
Time * stages	109.660	3	36.553	3.026	.038*
Error	592.000	49	12.082		

* P < .05.

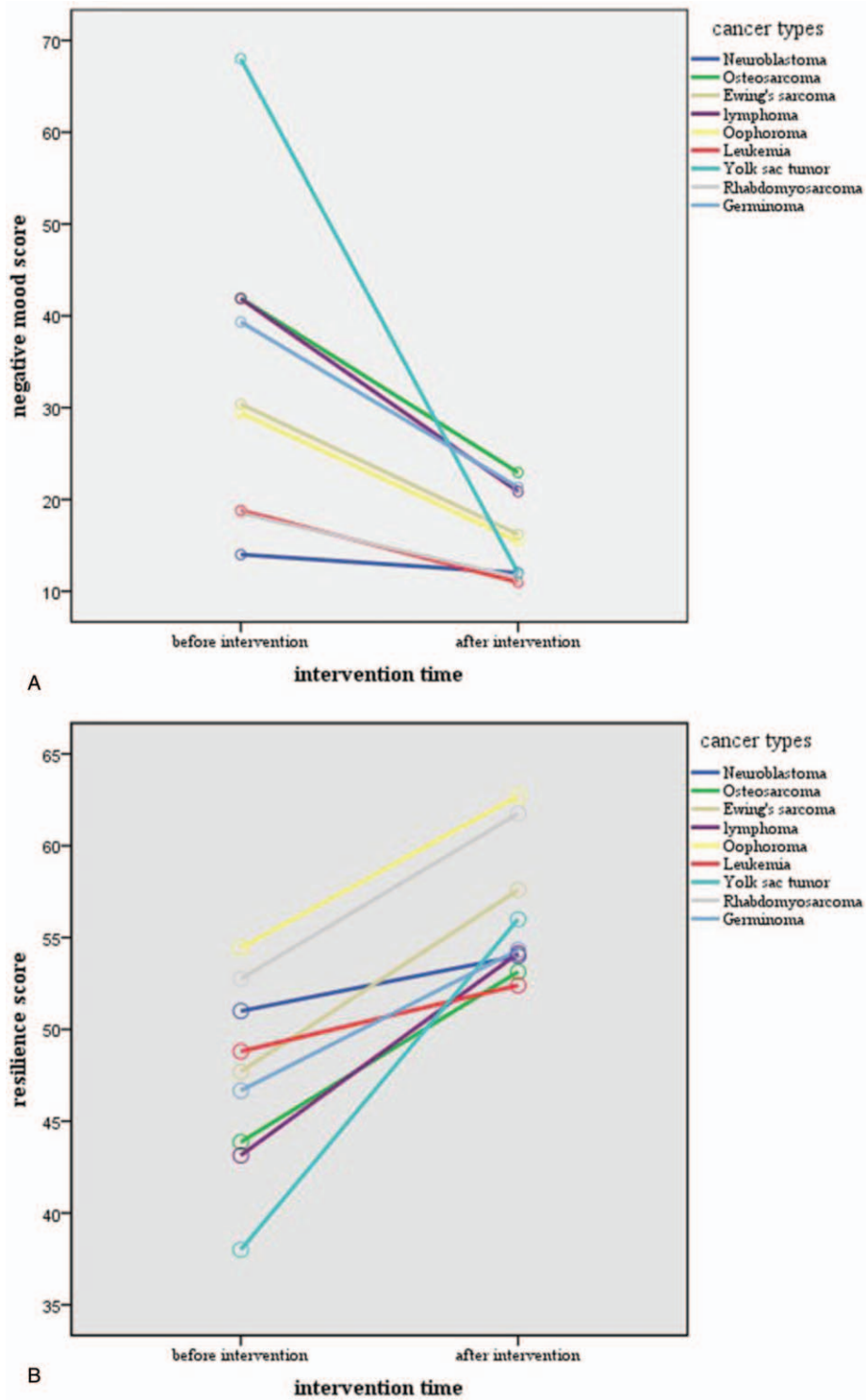


Figure 2. Comparison of psychological resilience and negative mood scores of various cancer types and stages in cognitive behavioral therapy (CBT) group during different intervention times. A: the changes of negative mood scores in various cancer types; B: the changes of resilience scores in various cancer types; C: the changes of negative mood scores in various cancer stages; D: the changes of resilience scores of various cancer stages.

8. Discussion

The present study compared the effects of 2 psychological intervention strategies on PA in children and adolescent presenting malignant tumors. It demonstrated that the family-children centered CBT model improved the PA of children with

cancer more effectively than routine psychological care. Moreover, there are no significant difference on the PA effects of CBT between younger and older cancer children. Besides, the improvement of negative emotions and resilience were most evident in children with yolk sac tumor and stage III, respectively.

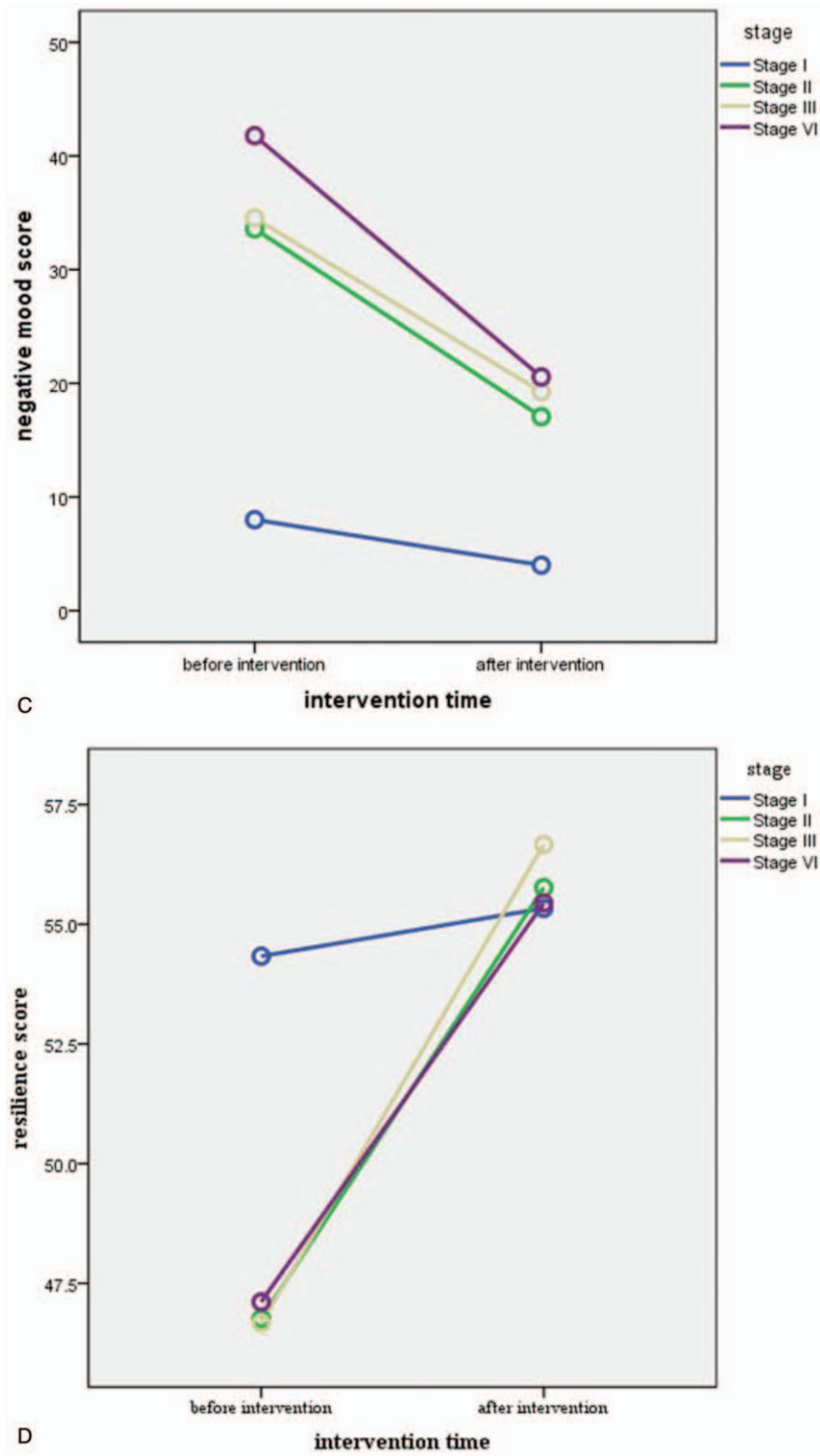


Figure 2. (Continued).

Resilience is the ability of an individual to resist stress by “self-adjusting mechanism” and successfully using both internal and external protective factors.^[18] The influencing factors are multi-dimensional, including individual, family, and society. Among them, individual factors include physical health, cognition and efficacy of self-coping mechanism.^[18] This study found that the total scores of resilience, tenacity, strength and optimism in

children with cancer before intervention were all below the average level, which was lower than the level of normal children in adolescents foreign countries, China and Taiwan district.^[19–21] This may be related to cognitive distortion caused by children’s immature cognition of disease, over protection by parents and public prejudice against cancer.^[22] Although the control group received only routine psychological care, the doctors, nurses, and

parents could not provide effective psychological intervention to correct their cognitive distortion and make pediatric cancer patients optimistically adjust to the chemotherapy. Because the qualifications, educational background of the doctors, nurses, and parents were not uniform and lacked inadequate professional psychology knowledge. In the CBT group, psychotherapist conducted one-to-one psychological counseling according to the cognitive ability and characteristics of the children, correct cognitive distortion such as “Cancer is death”, “Loss of hair, amputation of limbs, and a full moon’s face can ruin one’s life”, “Children with cancer are useless and burdensome” and established optimistic cognition such as “Children with cancer can live with a tumor for a long time”, “Damage caused by cancer treatment can lead to long-term survival”, “Family and society need them”. Finally, pediatric cancer patients strengthened their reasonable understanding of cancer events and took a positive coping style of chemotherapy.^[23,24] Essentially, these efforts help cancer children accept the physiological changes brought on by anticancer therapy, and then improve their psychological resilience, especially in stage III patients.

The determining factors of negative emotion in hospitalized children are mixed, but most are related to the physiological discomfort caused by cancer diagnosis and treatment.^[25] This study found that depression and stress were at normal level, but anxiety was higher than the normal level, which was consistent with previous studies and the causes may be associated with fear of chemotherapy’s adverse effects, and ineffective coping mechanism.^[26] However, the routine psychological care in the control group only provided them with psychological comfort by verbal consolation rather than an effective strategy to deal with the side effects of chemotherapy. In the CBT group, behavioral relaxation training was used, and chemotherapeutic children were induced repeatedly by psychotherapist to relax the whole body muscle through deep breathing and progressive muscle relaxation training with the objective to resist nausea, vomiting, and to perform bone marrow puncture in a relaxed state of mind and body.^[27,28] Physical relaxation can relieve the fear of venipuncture and blood sampling and enhance the ability of responding to anticipatory vomiting positively. Relaxation training enhances confidence in coping with side effects of chemotherapy, improves its self-coping efficacy, and relieves anxiety, tension and fear during treatment. Therefore, the anxiety score of CBT group decreased to the normal level after intervention especially in yolk sac tumor.

Recent study found that optimistic mood affected the immune function of cancer patients through the hypothalamus-pituitary-adrenal axis and sympathetic neuro-adrenomedullary axis, and increased the number of T lymphocytes and NK cells activity to promote their immunity.^[29] It may benefit immune function and prognosis of cancer patients.^[30] In addition, the improvement of negative mood and psychological resilience are beneficial to make cancer children cope with cancer symptoms optimistically, and improve their quality of life.^[31] Therefore, good psychological adjustment contribute to the recovery of physical and mental health of cancer children after CBT.

9. Conclusion

The effects of CBT on improving psychological adjustment are better than routine psychological care in Chinese pediatric cancer patients, which can help cancer children enhance the resilience and reduce negative mood especially in Yolk sac tumor and stage III, and then promote quality of life.

10. Limitations

Validity of the results might be limited by several biases. Because of the complexity of the intervention, we only tested the effect of CBT in 1 hospital. Thus, we cannot determine acceptability and feasibility in other settings. Though we found that negative mood scores were obvious improved in yolk sac tumor, the sample is so small and its validity is limited. Considering the various level of intelligence and reporting psychological feelings in children, we only explore the application effect of CBT in children above the age of 8 and its effect in children less than 8 years still remains unclear.

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References

- [1] Ahmad SS, Reinius MA, Hatcher HM, et al. Anticancer chemotherapy in teenagers and young adults: managing long term side effects. *BMJ* 2016;354:i4567.
- [2] Wallace WH, Thompson L, Anderson RA. Long term follow-up of survivors of childhood cancer: summary of updated SIGN guidance. *BMJ* 2013;346:f1190.
- [3] Brotman MA, Kircanski K, Leibenluft E. Irritability in Children and Adolescents. *Annu Rev Clin Psychol* 2017;13:317.
- [4] Ridder DD, Geenen R, Kuijjer R, et al. Psychological adjustment to chronic disease. *Lancet* 2008;372:246–55.
- [5] Molina Y, Yi JC, Martinez-Gutierrez J, et al. Resilience among patients across the cancer continuum: diverse perspectives. *Clin J Oncol Nurs* 2014;18:93–101.
- [6] Eicher M, Ribí K. Interprofessional, psycho-social intervention to facilitate resilience and reduce supportive care needs for patients with cancer: Results of a noncomparative, randomized phase II trial. *Psycho-oncology* 2018;27:1833–9.
- [7] Wu X, Zhang X, Wang Q, et al. The research progress of cancer patient’s psychological resilience intervention. *Clin J Nurs* 2017;52: 316–20.
- [8] Shina KJ, Lee YJ, Suh PG, et al. Molecular mechanisms underlying psychological stress and cancer. *Curr Pharm Des* 2016;22:2389–2402.
- [9] Zhong X, Wang J. Research progress and prospect of psychological resilience in cancer patients. *Chin J Nurs* 2013;48:380–2.
- [10] Lu H, Zhu L, Shen N. Investigation of symptoms in children and teenagers with cancer. *J Nurs Sci* 2012;27:9–12.
- [11] Liu J, Yuan c. The element of Chinese culture in cancer care research and its implication. *Chin J Nurs* 2012;27:93–6.
- [12] Kichler JC, Kaugars AS. Topical review: applying positive development principles to group interventions for the promotion of family resilience in pediatric psychology. *J Pediatr Psychol* 2015;40:978–80.

- [13] Zhang P, Mo L, Li X, et al. Effect of different psychological interventions on negative emotion in children with malignant tumors: a network meta analysis. *J Chongqing Med Univ* 2017;42:1208–13.
- [14] Thompson RD, Delaney P, Flores I, et al. Cognitive-behavioral therapy for children with comorbid physical illness. *Child Adolesc Psychiatr Clin N Am* 2011;20:329–48.
- [15] Watson . *Handbook of Psychotherapy in Cancer Care*. Hoboken, New Jersey: John Wiley & Sons, Ltd; 2011.
- [16] Yu X, Lau JTF, Mak WWS, et al. Factor structure and psychometric properties of the Connor-Davidson Resilience Scale among Chinese adolescents. *Compr Psychiatry* 2011;52:218–24.
- [17] Zhang F, Liu Z, Ma z, et al. Application of the short version of depression-anxiety-stress assessment on students after earthquake. *Chin J Behav Med Brain Sci* 2016;25:82–5.
- [18] Ye Y. Research progress on psychological resilience of inpatient children. *J Qilu Nurs* 2017;23:74–7.
- [19] Wu LM, Sheen JM, Shu HL, et al. Predictors of anxiety and resilience in adolescents undergoing cancer treatment. *J Adv Nurs* 2013;69:158–66.
- [20] Wen Y, Liu Q, Zhang F, et al. Mental resilience tested with the Resilience Scale for Chinese Adolescents (RSCA) in Chinese children: a meta-analysis. *Chin Mental Health J* 2015;29:826–32.
- [21] Chen CM, Chen YC, Wong TT. Comparison of resilience in adolescent survivors of brain tumors and healthy adolescents. *Cancer Nurs* 2014;37:373–81.
- [22] Tillery R, Long A, Phipps S. Child perceptions of parental care and overprotection in children with cancer and healthy children. *J Clin Psychol Med Settings* 2014;21:165–72.
- [23] Mellblom AV, Ruud E, Loge JH, et al. Do negative emotions expressed during follow-up consultations with adolescent survivors of childhood cancer reflect late effects? *Patient Educ Couns* 2017;100:2098–101.
- [24] Yuan J, Liu Y, Yang M. The influences of emotional coping style and cognitive training on the adolescents' susceptibility to affective disturbances. *Adv Psychol Sci* 2014;22:1062–74.
- [25] Zhan Q, Li D. The mediating effect of regulatory emotional self-efficacy on family harmony and resilience in adolescent. *Chin Mental Health J* 2017;31:554–6.
- [26] Qiu X, Liu X. The moderating effect of psychological resilience between family structure and children's peer relationship. *Chin J Behav Med Brain Sci* 2017;26:450–3.
- [27] Dupuis LL, Sung L, Molassiotis A, et al. 2016 updated MASCC/ESMO consensus recommendations: prevention of acute chemotherapy-induced nausea and vomiting in children. *Support Care Cancer* 2017;25:323–31.
- [28] Totadri S. Prophylaxis and management of antineoplastic drug induced nausea and vomiting in children with cancer. *Pediatr Hematol Oncol J* 2016;1:50–5.
- [29] Yan Q. *Biological Rhythms and the HPA Axis in Psychoneuroimmunology*. Bern, Switzerland: Springer International Publishing; 2016.
- [30] Lutgendorf SK, Andersen BL. Biobehavioral approaches to cancer progression and survival: mechanisms and interventions. *Am Psychol* 2015;70:186–97.
- [31] Rosenberg AR, Bradford MC, Barton KS, et al. Hope and benefit finding: results from the PRISM randomized controlled trial. *Pediatr Blood Cancer* 2018;66:e27485.