

Social, emotional, and behavioral functioning in young childhood cancer survivors with chronic health conditions

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Abstract

Background: The cancer diagnosis and its intensive treatment may affect the long-term psycho-social adjustment of childhood cancer survivors. We aimed to describe social, emotional, and behavioral functioning and their determinants in young childhood cancer survivors.

Procedure: The nationwide Swiss Childhood Cancer Survivor Study sends questionnaires to parents of survivors aged 5–15 years, who have survived at least 5 years after diagnosis. We assessed social, emotional, and behavioral functioning using the Strengths and Difficulties Questionnaire (SDQ). The SDQ includes four difficulties scales (emotional, conduct, hyperactivity, peer problems), a total difficulties indicator, and one strength scale (prosocial). We compared the proportion of survivors with borderline and abnormal scores to reference values and used multivariable logistic regression to identify determinants.

Results: Our study included 756 families (response rate of 72%). Thirteen percent of survivors had abnormal scores for the total difficulties indicator compared to 10% in the general population. The proportion of survivors with abnormal scores was highest for the emotional scale (15% vs. 8% in the general population), followed by the peer problems scale (14% vs. 7%), hyperactivity (8% vs. 10%), and conduct scale (6% vs. 7%). Few survivors (4% vs. 7%) had abnormal scores on the prosocial scale. Children with chronic health conditions had a higher risk of borderline and abnormal scores on all difficulties scales (all $p < 0.05$).

Conclusion: Most childhood cancer survivors do well in social, emotional, and behavioral life domains, but children with chronic health conditions experience difficulties. Therefore, healthcare professionals should offer specific psycho-social support to these survivors.

Abbreviations: CHC, Chronic Health Conditions; CI, Confidence Interval; CNS, Central Nervous System; CS, Conduct Scale; ES, Emotional Scale; HS, Hyperactivity Scale; ICCC-3, International Classification of Childhood Cancer – Third Edition; IQR, Interquartile Range; MAR, Missing at Random; MICE, Multiple Imputation by Chained Equations; OR, Odds Ratio; PPS, Peer Problem Scale; PSS, Prosocial Scale; SCCR, Swiss Childhood Cancer Registry; SCCSS, Swiss Childhood Cancer Survivor Study; SDQ, Strengths and Difficulties Questionnaire.

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KEYWORDS

behavior, childhood cancer, cohort, difficulties, strengths, survivorship

1 | INTRODUCTION

Childhood cancer and its intensive treatment can raise a broad range of medical and psycho-social challenges for patients, their families, and society.¹ The steadily improving survival rates reaching 85% in Switzerland result in a growing population of long-term childhood cancer survivors.² However, the costs of cure include a lifelong increased risk of chronic health conditions^{3,4} and socioeconomic challenges^{5,6} that may interfere with the survivor's long-term psycho-social well-being. Research on psycho-social and behavioral functioning in adult childhood cancer survivors is extensive.⁷ Many adult survivors report good psycho-social well-being, but certain subgroups, such as survivors of central nervous system (CNS) tumors, experience some difficulties.⁸ Reports from the North American childhood cancer survivor study including adolescent survivors with an average age of 15 years revealed that those diagnosed with leukemia, CNS tumor, or neuroblastoma are at increased risk for adverse behavioral and social outcomes.^{9,10}

Children and young adolescents who survived cancer are rarely included in large representative and nationwide childhood cancer survivor studies. While there may be some commonalities between older adolescents and adult survivors, evidence on the psycho-social and behavioral functioning of children and young adolescents is limited. They are faced with unique developmental challenges such as gaining independence, establishing peer relationships, and navigating through the educational system. A widely used clinical screening tool for children's and young adolescents' behaviors, emotions, and relationships is the Strengths and Difficulties Questionnaire (SDQ).^{11–13} To date, the SDQ has rarely been used among young childhood cancer survivors. Existing studies lacked population-based sampling approaches and had conflicting findings.^{14–18} Based on findings among adult survivors,⁷ we would expect a CNS tumor diagnosis and a higher burden of physical health conditions to be associated with poor functioning also among young survivors. In this study, we aimed to (i) describe the social, emotional, and behavioral functioning in a representative and nationwide sample of young childhood cancer survivors aged 5–15 years based on the SDQ and (ii) evaluate whether sociodemographic characteristics, clinical characteristics, and cancer-related chronic health conditions are associated with poor functioning.

2 | METHODS

2.1 | Design, study population, and research setting

The Swiss Childhood Cancer Survivor Study (SCCSS) is a nationwide follow-up study of all patients registered in the Swiss Childhood Can-

cer Registry (SCCR),^{19,20} who were diagnosed with cancer between 1976 and 2010 before the age of 21 years, and who survived at least 5 years after diagnosis.²¹ The youngest survivors, those diagnosed as infants, are thus aged 5–6 years when their parents received the first questionnaire. All parents, whose children were eligible for the SCCSS, received a baseline questionnaire between 2007 and 2017. The SCCSS questionnaires were developed based on the questionnaires used in the North American and British childhood cancer survivor studies to increase international comparability.^{22,23} We added questions on socioeconomic measures adapted to the Swiss context.^{24,25} We developed a specific version for children aged 5–15 years with age-appropriate questionnaire instruments for this age group.^{26,27} Ethical approval of the SCCR and the SCCSS was granted by the Ethics Committee of the Canton of Bern (166/2014; 2021-01462).

2.2 | Social, emotional, and behavioral functioning

We assessed social, emotional, and behavioral functioning with the parent version of the SDQ.^{11,13} The SDQ consists of 25 items equally divided across four scales measuring difficulties (emotional, conduct, hyperactivity, and peer problem scale) and one strength scale (prosocial scale). Each scale consists of five items where parents indicate their level of agreement with each item using a 3-point Likert scale (0 = not true; 1 = somewhat true; 2 = certainly true). We calculated a sum score for each scale (range 0–10) and a total difficulties indicator by summing up the four difficulties scales (range 0–40). We used German reference values^{28,29} to classify survivors as *normal* (0–12 points for total difficulties indicator; 0–3 for emotional, conduct, peer problem scale; 0–5 for hyperactivity scale; 10–6 for prosocial scale), *borderline* (13–15 points for total difficulties indicator; 4 for emotional, conduct, peer problem scale; 6 for hyperactivity scale; 5 for prosocial scale), and *abnormal* (16–40 points for total difficulties indicator; 5–10 for emotional, conduct, peer problem scale; 7–10 for hyperactivity scale; 4–0 for prosocial scale).

2.3 | Sociodemographic characteristics

We obtained the following sociodemographic characteristics from the questionnaire: age at study, sex, language region in Switzerland, migration background, number of siblings, living situation, highest parental education, and net monthly household income. We classified survivors as having a migration background if they were not Swiss citizens at birth, not born in Switzerland or had at least one parent who was not a Swiss citizen. We divided the highest parental education into three categories: primary education (compulsory schooling only [≤ 9 years]),

secondary education (vocational training [10–13 years]; higher vocational training or college), and tertiary education (university degree).³⁰

2.4 | Chronic health conditions and clinical characteristics

Chronic health conditions were asked using questions from the North American²² and British²³ Childhood Cancer Survivor Studies with some adaptations because of the younger age of our cohort. Parents reported whether their child suffered from symptoms/diseases involving cardiovascular, pulmonary, and endocrine systems, hearing, vision, musculoskeletal, or neurological conditions (Table S1). Survivors were classified as having the chronic health condition if at least one of the respective symptoms/diseases was reported. We then created a sum score of the number of different chronic health conditions for each survivor.

We extracted the following characteristics from the SCCR: age at diagnosis, cancer diagnosis, type of treatment, time since diagnosis, and history of relapse. Cancer diagnoses were classified according to the International Classification of Childhood Cancer – Third Edition (ICCC-3).³¹ For analyses, we categorized cancer diagnoses into leukemia, lymphoma, CNS tumor, bone tumor/soft tissue sarcoma, and other tumors. We coded treatment hierarchically into surgery only, chemotherapy (may have had surgery), radiotherapy (may have had surgery or chemotherapy), and hematopoietic stem cell transplantation (may have had surgery, chemotherapy, or radiotherapy).

2.5 | Statistical analysis

First, we evaluated data completeness, floor and ceiling effects, and internal consistency of the SDQ³² and visualized responses to individual SDQ items. We then calculated summary statistics (mean, median, interquartile range [IQR], range) and proportions with 95% confidence intervals (95% CI) of survivors classified as borderline and abnormal for the four difficulties scales, the total difficulties indicator, and the strength scale. We descriptively compared proportions of survivors classified as borderline and abnormal to a German reference population of 930 healthy children aged 6–16 years.²⁸ We also graphically displayed the proportions of survivors classified as borderline and abnormal stratified by the number of chronic health conditions.

We performed multiple imputations by chained equations (MICE) to complete missing values in sociodemographic and clinical characteristics assuming missing at random (MAR). Missing values of the variables number of siblings, highest parental education, monthly household income, and treatment were imputed with multinomial logistic regression models using all other sociodemographic and clinical characteristics without missing values as predictors. We generated 10 imputed datasets and pooled the results of subsequent analyses according to Rubin's rules.³³

We then fitted univariable and multivariable logistic regression models to identify associations between SDQ scores and sociodemo-

graphic characteristics, clinical characteristics, and chronic health conditions. We dichotomized SDQ scores into borderline or abnormal and normal for all regression analyses. We included characteristics associated with borderline or abnormal scores on the respective difficulties or strength scale at $p < 0.05$ in the multivariable analysis for this scale. We used Wald tests to calculate global P-values. We a priori decided to include age at study and sex in all multivariable analyses independent of the strength of the association. We evaluated the robustness of associations between SDQ scores and chronic health conditions in the respective univariable regression models by performing a sensitivity analysis excluding CNS tumor survivors, the most vulnerable group to experience such conditions.⁴ All analyses were performed using Stata version 15.1 (StataCorp LP, College Station, TX).

3 | RESULTS

Of 1176 families with eligible survivors aged 5–15 years, 1065 received the questionnaire (Figure S1). Of those, 766 (72%) completed it and 756 (71%) were included in the analysis. At the time of the survey, most survivors lived with both parents (82%; Table 1). The median age at diagnosis was 2.8 years (interquartile range [IQR] 1.4–5.1), the median time since diagnosis was 8.5 years (IQR 7.0–10.2), and the median age at study was 12.5 years (IQR 10.1–14.3). The most frequent cancer diagnoses were leukemia (37%) and CNS tumors (17%). Chronic health conditions were reported by 405 (54%) survivors with 204 (27%) reporting one condition and 201 (27%) at least two conditions. Neurological conditions (26%), musculoskeletal conditions (20%), and vision impairments (20%) were most frequent (Table S1). Clinical characteristics were similar between participating and nonparticipating survivors (Table S2).

3.1 | Social, emotional, and behavioral functioning: SDQ questionnaire scores

Internal consistency of the SDQ scales was satisfactory with Cronbach's alpha of >0.70 except for the conduct scale ($\alpha = 0.58$; Table S3). We observed only a few missing values (2% for all scales), but relatively large floor effects for the difficulties scales (19–34%) and ceiling effects for the strength (prosocial) scale (31%). Figure 1 shows the responses of survivors' parents to individual items of the SDQ. The median total difficulties indicator was 8 (IQR 4–12); 10% (95% CI: 8–12) of survivors had borderline and 13% (95% CI: 11–15) abnormal scores compared to 8% and 10% in the reference population (Table 2). The proportion of survivors with abnormal scores compared to the reference population was higher for the emotional scale (15% [95% CI: 13–18] vs. 8%) and the peer problems scale (14% [95% CI: 11–16] vs. 7%), and similar for the hyperactivity (8% [95% CI: 6–10] vs. 10%) and conduct scale (6% [95% CI: 4–8] vs. 7%). For the strength (prosocial) scale, the median score was 9 (IQR 7–10); 4% (95% CI: 2–5) of survivors had abnormal scores compared to 7% in the reference population.

TABLE 1 Sociodemographic and clinical characteristics of childhood cancer survivors

Survivors (n = 756)		
Sociodemographic characteristics	n	% ^a
Age at study		
< 10 years	183	24
10–13 years	257	34
>13 years	316	42
Sex		
Male	423	56
Female	333	44
Language region		
German	525	69
French or Italian	231	31
Migration background		
No	547	72
Yes	209	28
Number of siblings		
0	86	11
1	371	49
≥ 2	293	39
Missing	6	< 1
Living situation		
With both parents	622	82
With one parent ^b	123	16
Other ^c	11	2
Highest parental education		
Primary education	59	8
Secondary education	461	61
Tertiary education	218	29
Missing	18	2
Monthly household income (in CHF)		
<4500	77	10
4500–6000	128	17
6000–9000	227	30
>9000	222	30
Missing	102	13
Clinical characteristics	n	%
Age at diagnosis		
<1 year	145	19
1–4 years	344	46
>4 years	267	35
Diagnosis (ICCC-3)		
I Leukaemia	281	37
II Lymphoma	51	7
III CNS tumor	125	17

(Continues)

TABLE 1 (Continued)

Clinical characteristics	n	%
IV Neuroblastoma	72	10
V Retinoblastoma	48	6
VI Renal tumor	61	8
VII Hepatic tumor	13	2
VIII Bone tumor	12	2
IX Soft tissue sarcoma	49	7
X Germ cell tumor	17	2
XI, XII Other tumor ^d	2	<1
Langerhans cell histiocytosis	25	3
Treatment ^e		
Surgery only	120	16
Chemotherapy	454	60
Radiotherapy	126	17
HSCT	48	6
Missing	8	1
Time since diagnosis		
<8 years	318	42
8–11 years	318	42
>11 years	120	16
History of relapse		
No	666	88
Yes	90	12
Chronic health conditions		
0	351	46
1	204	27
≥2	201	27

^aPercentages are based upon available data for each variable.^bIncludes single parents and parents living with a new partner.^cIncludes children living with relatives, with an adoptive family, in an institution, and children with unknown living situation.^dOther malignant epithelial neoplasms, malignant melanomas, and other or unspecified malignant neoplasms.^eTreatment was coded hierarchically into surgery only, chemotherapy (may have had surgery), radiotherapy (may have had surgery or chemotherapy), and haematopoietic stem cell transplantation (may have had surgery, chemotherapy, or radiotherapy).

Abbreviations: CHF, Swiss francs; CNS, central nervous system; HSCT, haematopoietic stem cell transplantation; ICC-3, International Classification of Childhood Cancer - Third Edition; n, number.

3.2 | Determinants of abnormal scores on the difficulties and strengths scales of the SDQ

Survivors with chronic health conditions were more likely to have borderline or abnormal scores in all difficulties scales and in the total difficulties indicator compared to survivors without chronic health conditions (all $p < 0.05$). These associations from unadjusted regression



FIGURE 1 Responses of childhood cancer survivors' parents to individual items of the Strengths and Difficulties Questionnaire. Abbreviations: ES, emotional scale; CS, conduct scale; HS, hyperactivity scale; PPS, peer problem scale; PSS, prosocial scale. *Original responses to item recorded

TABLE 2 Summary statistics and proportion of childhood cancer survivors with borderline and abnormal scores for the four difficulties scales, the total difficulties indicator, and the strengths scale of the Strengths and Difficulties Questionnaire

	n	Mean (SD)	Median (IQR)	Range	Borderline ^a			Abnormal ^a		
					n _{survivor}	% _{survivor} (95% CI)	% _{reference} ^b	n _{survivor}	% _{survivor} (95% CI)	% _{reference} ^b
Emotional scale	754	2.3 (2.1)	2 (0–3)	0–10	65	9 (7–11)	6	116	15 (13–18)	8
Conduct scale	754	1.6 (1.6)	1 (0–2)	0–9	48	6 (5–8)	9	43	6 (4–8)	7
Hyperactivity scale	754	2.9 (2.3)	3 (1–4)	0–10	25	3 (2–5)	5	60	8 (6–10)	10
Peer problems scale	754	2.0 (2.1)	1 (0–3)	0–10	62	8 (6–10)	6	103	14 (11–16)	7
Total difficulties indicator	754	8.7 (5.9)	8 (4–12)	0–33	72	10 (8–12)	8	97	13 (11–15)	10
Prosocial scale	753	8.2 (1.8)	9 (7–10)	1–10	40	5 (4–7)	9	28	4 (2–5)	7

^aScale scores were classified as *borderline* (13–15 points for total difficulties indicator, 4 for emotional, conduct and peer problem scale, 6 for hyperactivity scale, 5 for prosocial scale) and *abnormal* (16–40 points for total difficulties indicator, 5–10 for emotional, conduct and peer problem scale, 7–10 for hyperactivity scale, 0–4 for prosocial scale) according to German reference values.^{28,29}

^bReference data according to Woerner et al.^{28,29}

Abbreviations: IQR, interquartile range; n, number.

models (Table S4) remained significant after adjusting for covariates (Table 3) and excluding CNS tumor survivors in a sensitivity analysis. While 14% of children without chronic health conditions had borderline or abnormal scores in the total difficulties indicator, this increased to 22% in those with one condition, and 38% in those with two or more conditions (Figure 2). A similar increase by number of chronic health condition was seen for the emotional scale (17%, 23%, 38%), peer problem scale (16%, 20%, 34%), conduct scale (9%, 11%, 19%), and hyperactivity scale (8%, 11%, 18%). Adjusting for chronic health conditions, being diagnosed with a CNS tumor was independently associated with borderline or abnormal scores on the peer problem scale compared to leukemia (Table 3; OR = 1.8, 95% CI: 1.1–2.9). The prosocial scale results were not associated with clinical characteristics.

Associations with sociodemographic characteristics differed across scales. Survivors living with only one parent had more borderline or abnormal scores on the conduct scale (OR = 2.1, 95% CI: 1.2–3.6; Table 3). Females were less likely than males to have borderline or abnormal scores on the peer problem scale (OR = 0.6, 95% CI: 0.4–0.8), the total difficulties indicator (OR = 0.5, 95% CI: 0.4–0.8), and the prosocial scale (OR = 0.5, 95% CI: 0.3–0.8). Survivors with at least two siblings (OR = 0.4, 95% CI: 0.2–0.9) and whose parents had tertiary education (OR_{tertiary education} = 0.3, 95% CI: 0.1–0.7) had a lower risk for the hyperactivity scale.

4 | DISCUSSION

This nationwide population-based study showed that most young childhood cancer survivors did well in social, emotional, and behavioral life domains. However, children with chronic health conditions and those with a CNS tumor experienced clinically significant difficulties. The proportion of survivors with difficulties increased from 14% among children without chronic health conditions to 22% in those with one condition and 38% in those with two or more conditions. This was especially pronounced for emotional difficulties and peer problems.

Overall, only a few children aged 5–15 years experienced problems and mainly on the emotional and peer problem scale of the SDQ. When compared to a German reference population of 930 healthy children aged 6–16 years,²⁸ the proportion of survivors with abnormal scores in our sample was twice as high as expected for the emotional scale (15% vs. 8%) and the peer problem scale (14% vs. 7%). In contrast, differences between survivors and the reference population were small for hyperactivity (8% vs. 10%) and conduct (6% vs. 7%).

Studies using the SDQ in young childhood cancer survivors are few.^{14–18} Comparability is limited by varying age ranges and diagnostic groups included, and methodological concerns related to small sample sizes or low response rates (Table S5). In line with our findings, a Norwegian study of 50 survivors aged 6–20 years found more emotional problems in survivors compared to controls.¹⁴ Emotional problems may arise from the psychological strain of having suffered from a potentially fatal disease, frequent hospitalizations, cancer-related absences from social activities, and fear of late effects and relapse.¹⁴ Peer problems were only increased in the parent-reported SDQ version but not

in the questionnaires completed by survivors. In contrast, in a study from New Zealand, 170 survivors aged 12–18 years themselves did not report more emotional and peer problems than controls.¹⁵ Reinjell and colleagues included only acute lymphoblastic leukemia patients aged 9–15 years and showed no difference from healthy controls on any scale.¹⁶ Neu and colleagues reported that 13% of pre-school survivors aged 5–6 years had abnormal scores on the total difficulties indicator,¹⁷ which is similar to our study.

Chronic health conditions were an important determinant of impaired social, emotional, and behavioral functioning in our study, similar to a study from North America including adolescent survivors.⁹ Even though we included mainly mild, not life-threatening chronic conditions, we found that the more medical problems a child had, the higher was the child's risk to experience social, emotional, and behavioral difficulties. This highlights the importance of medical follow-up care to detect and treat potential cancer-related conditions early.³⁴ In our study, we found a high prevalence of neurological conditions (26%). Intensive cancer treatments can lead to neurocognitive problems, such as impaired intelligence, processing speed, executive function, or deficits in memory and attention that may emerge throughout survivorship. This is particularly pronounced among survivors of CNS tumors.³⁵ Such neurocognitive impairments have been previously shown to interfere with peer interactions and social adjustment in older adolescent and adult survivors of CNS tumors^{36–38} and may as well explain the high prevalence of peer problems in our younger cohort.

This is the first study on the social, emotional, and behavioral functioning of childhood cancer survivors aged 5–15 years, which was based on a representative nationwide sample and a well-established and validated screening instrument. This age group is underrepresented in psycho-oncological research and representative studies are lacking. Our study is strengthened by its large national sample of 756 children and the excellent response rate of >70%. Selection bias and nonresponse are likely to play only a minor role.³⁹ We included all childhood cancer types and used high-quality clinical information based on medical records from the SCCR.

A limitation of our study may be that the strengths and difficulties of survivors were only reported by parents, and not also by children. Discrepancies between caregiver and child report may be of particular concern for peer interactions during late childhood and early adolescence. Indeed, a previous study showed that parents of children and adolescents surviving cancer reported more peer problems than the survivors themselves.¹⁴ We therefore may have overestimated peer problems in our study. However, the SDQ is a widely established instrument with generally satisfactory psychometric properties in different settings^{32,40} and generally high levels of parent–child and interparental agreement.^{41,42} However, the relatively high floor effects observed in our study may indicate a lack of sensitivity in survivors experiencing only few difficulties. Other limitations include the lack of information on survivors' social, emotional, and behavioral functioning before the cancer diagnosis and the cross-sectional design, which did not allow to establish causal relationships. Finally, we used German reference data for the SDQ as there are no such data available for

TABLE 3 Determinants of borderline or abnormal scores on the difficulties and strengths scales of the SDQ^a from multivariable logistic regression^b

	Emotional scale (n = 754)		Conduct scale (n = 754)		Hyperactivity scale (n = 754)		Peer problem scale (n = 754)		Total difficulties indicator (n = 754)		Prosocial scale (n = 753)	
	OR ^c (95% CI)	p-Value ^d	OR ^c (95% CI)	p-Value ^d	OR ^c (95% CI)	p-Value ^d	OR ^c (95% CI)	p-Value ^d	OR ^c (95% CI)	p-Value ^d	OR ^c (95% CI)	p-Value ^d
Sociodemographic determinants												
Age at study		0.322		0.221		0.013		0.396		0.105		0.920
<10 years	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
10–13 years	0.7 (0.5–1.2)		0.8 (0.4–1.4)		0.6 (0.3–1.1)		1.3 (0.8–2.1)		0.7 (0.4–1.1)		1.0 (0.5–1.9)	
>13 years	0.7 (0.5–1.1)		0.6 (0.3–1.1)		0.4 (0.2–0.7)		1.4 (0.9–2.3)		0.6 (0.4–1.0)		0.9 (0.5–1.7)	
Sex		0.861		0.065		0.069		0.004		0.002		0.006
Male	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
Female	1.0 (0.7–1.4)		0.6 (0.4–1.0)		0.6 (0.4–1.0)		0.6 (0.4–0.8)		0.5 (0.4–0.8)		0.5 (0.3–0.8)	
Migration background												0.148
No												
Yes												1.4 (0.9–2.0)
Number of siblings												0.047
0												
1												0.7 (0.4–1.4)
≥ 2												0.4 (0.2–0.9)
Living situation												0.032
With both parents												
With one parent												Ref.
Other												2.1 (1.2–3.6)
												1.9 (0.4–9.6)
Highest parental education												0.013
Primary education												
Secondary education												Ref.
Tertiary education												0.5 (0.2–1.0)
Monthly household income												0.198
< 4500												
4500–6000												Ref.
												1.1 (0.5–2.5)

(Continues)

TABLE 3 (Continued)

	Emotional scale (n = 754)		Conduct scale (n = 754)		Hyperactivity scale (n = 754)		Peer problem scale (n = 754)		Total difficulties indicator (n = 754)		Prosocial scale (n = 753)	
	OR ^c (95% CI)	p-Value ^d	OR ^c (95% CI)	p-Value ^d	OR ^c (95% CI)	p-Value ^d	OR ^c (95% CI)	p-Value ^d	OR ^c (95% CI)	p-Value ^d	OR ^c (95% CI)	p-Value ^d
6000–9000			0.6 (0.3–1.3)						0.6 (0.3–1.2)			
>9000			0.7 (0.3–1.5)						0.7 (0.4–1.4)			
Clinical determinants												
Age at diagnosis						0.269						
<1 year			Ref.									
1–4 years			1.4 (0.7–2.6)									
>4 years			0.9 (0.4–1.9)									
Diagnosis (ICCC-3)				0.072						0.128		
Leukemia			Ref.						Ref.			
Lymphoma			1.0 (0.4–2.7)						0.5 (0.2–1.3)			
CNS tumor			1.7 (0.9–3.1)						1.8 (1.1–2.9)			
Bone tumor/soft tissue sarcoma			1.4 (0.6–3.1)						0.8 (0.4–1.7)			
Other tumor			0.6 (0.3–1.1)						0.9 (0.6–1.4)			
History of relapse										0.437		
No			Ref.						Ref.			
Yes			1.2 (0.7–2.1)						1.2 (0.7–2.1)			
Chronic health conditions				0.031						0.001		
0			Ref.						Ref.			
1			1.4 (0.9–2.2)						1.3 (0.8–2.0)			
≥2			2.9 (2.0–4.4)						2.3 (1.5–3.7)			
												<0.001

^aBorderline or abnormal scores were defined as 13–40 points for the total difficulties indicator, 4–10 for the emotional, conduct and peer problem scale, 6–10 for the hyperactivity scale, 0–5 for the prosocial scale) according to German reference values.^{28,29}

^bCharacteristics associated with borderline or abnormal scores on the respective difficulties or strengths scales at $p < 0.05$ were included in the multivariable analyses (separate models for each scale and the total difficulties indicator). Age at study and sex were included in all multivariable models independent of the strength of the association in the respective univariable model.

^cOdds ratio from multivariable logistic regression models: OR > 1 indicate a higher likelihood of borderline or abnormal scores on the emotional scale, conduct scale, hyperactivity scale, peer problems scale, total difficulties indicator, and prosocial scale of the Strengths and Difficulties Questionnaire (SDQ). OR < 1 indicate a lower likelihood of borderline/abnormal scores.

^dGlobal p -value calculated from Wald tests.

Abbreviations: CHF, Swiss francs; CNS, central nervous system; ICCC-3, International Classification of Childhood Cancer - Third Edition; Ref., reference group; SDQ, Strengths and Difficulties Questionnaire. p -Values <0.05 are indicated in bold.

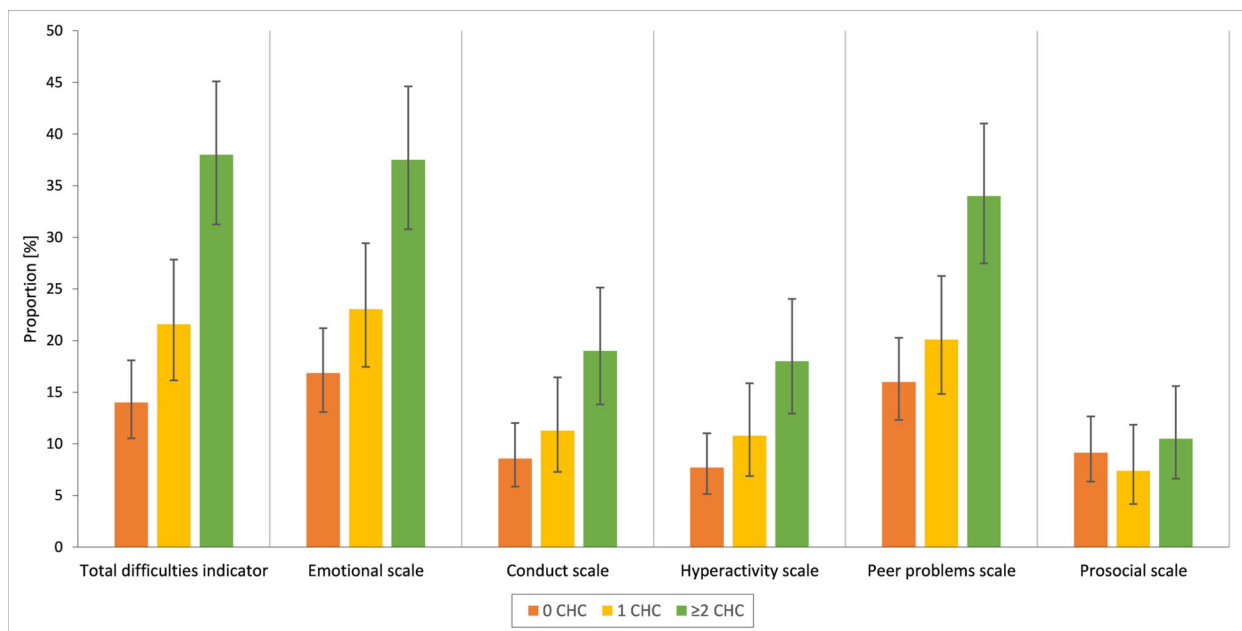


FIGURE 2 Proportions with 95% confidence intervals (95% CI) of survivors with borderline or abnormal on the difficulties and strength scales of the SDQ stratified by the number of chronic health conditions. Abbreviations: CHC, chronic health conditions; SDQ, Strengths and Difficulties Questionnaire

Switzerland. We expect that this may have only a modest impact on our findings due to the geographical proximity and similarities in societal structure, socioeconomic conditions, and healthcare systems.

Overall, our findings are reassuring. Only few children who were cured of cancer in Switzerland experienced social, emotional, and behavioral problems. Follow-up care is essential and generally well established in Switzerland for children until age 16–20 years. Chronic health conditions are usually well cared for in these clinics. However, not all cancer-related conditions can be prevented or cured, and the affected children and their families need to cope with the conditions they have.⁴³ Our results suggest that children with chronic health conditions might benefit from additional psycho-social care to support their social, emotional, and behavioral functioning. Psycho-social care services for children with cancer and their families have been recommended as part of the Psychosocial Standards of Care Project for Childhood Cancer.⁴⁴ These standards cover a broad range of psycho-social care in pediatric oncology, but implementation is challenging.⁴⁵ To date, few interventions focusing on social, emotional, and behavioral functioning in childhood cancer survivors have been developed. However, specific cognitive-behavioral therapy and cognitive mediation programs have been shown to improve psychological symptoms and behavioral problems in childhood cancer survivors.^{7,46} Interventional research related to social functioning largely focused on social skills training in young CNS tumor survivors. Effects were relatively modest and knowledge on the long-term benefits is limited.⁷ Childhood and adolescence are periods of transition and adjustment. Because of the many years of life ahead and potential lifelong benefits, more efforts are needed to support young childhood cancer survivors experiencing difficulties in social, emotional, or behavioral domains at an early stage.

In conclusion, most childhood cancer survivors do well in social, emotional, and behavioral life domains, but children with chronic health conditions experience difficulties. Therefore, healthcare professionals should offer specific support to these survivors.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the information of this manuscript were accessed on secured servers of the Institute of Social and Preventive Medicine at the University of Bern. Individual-level sensitive data can only be made available for researchers who fulfill the respective legal requirements. All data requests should be communicated to the corresponding author.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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