1 Physical activity and screen time in children who survived cancer – A report
2 from the Swiss Childhood Cancer Survivor Study

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39

40 Abbreviation table:

41 AAP American Academy of Pediatrics

42 BMI Body mass index

43 CCS Childhood cancer survivor

44 CI Confidence Interval

45 ICC-3 International Classification of Childhood Cancer, third edition

46	IQR	Interquartile range
47	MICE	Multivariate imputation by chained equations
48	OR	Odds ratio
49	TBI	Total body irradiation
50	WHO	World Health Organization

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57

58 **ABSTRACT (249/250)**

59 **Background:** Physical activity (PA) can reduce the risk of chronic adverse health
60 conditions in childhood cancer survivors. We examined physical activity and
61 sedentary screen time behavior in a nationwide study in Switzerland.

62 **Procedures:** The Swiss Childhood Cancer Survivor Study sent questionnaires to
63 parents of all Swiss resident ≥ 5 year-survivors diagnosed 1995–2010. We assessed
64 physical activity including compulsory school sport, recreational sport, commuting to
65 school, and time spent with screen media in those aged 5–15 years, and compared
66 results to international recommendations.

67 **Results:** We included 766 survivors with a median age at diagnosis of 2.8
68 (interquartile range 1.4–5.0) years and a median age at study of 12.5 (10.0–14.3)
69 years. Median PA time was 7.3 (4.8–10.0) hours/week and median screen time 1.4
70 (0.8–2.0) hours/day. Compulsory school sport hours and walking or cycling to school
71 contributed significantly to total PA. 55% of survivors met PA and 68% screen time
72 recommendations. PA was lower for children living in regions of Switzerland
73 speaking French or Italian compared to German, and for those who had a relapse or
74 musculoskeletal/neurological conditions. Screen time was higher in males, and
75 children with lower parental education and a migration background.

76 **Conclusions:** PA and sedentary screen watching were associated with social factors
77 and PA also with clinical risk factors. Structural preventions that afford active
78 commuting to school and sufficient school sport are essential, as is counselling
79 vulnerable survivor groups such as those with musculoskeletal and neurological
80 problems, and those who have had a relapse.

81 Introduction

82 Adult childhood cancer survivors have an elevated risk of poor health^{1,2} and early
83 death³: almost 75% suffer from a chronic adverse health condition² and their
84 cumulative mortality reaches nearly 10% 30 years after cancer diagnosis³. Physical
85 activity can reduce the risk of cancer and inhibit chronic health conditions like
86 diabetes and hypertension in the general population⁴, while among adult childhood
87 cancer survivors (CCS) physical activity has been associated with reduced risk
88 factors for cardiovascular disease⁵ and cardiovascular disease itself⁶, and with lower
89 overall mortality⁷. Yet while physical activity can mitigate many health hazards^{6,7}, only
90 half of adult CCS meet physical activity recommendations⁸⁻¹⁰.

91 An active lifestyle might be even more important for young children and
92 teenage survivors, but only a few studies, usually at single centers or with low
93 participant numbers, have been performed in this age group¹¹⁻¹⁴. Their results vary,
94 with 31 to 74% meeting recommendations for physical activity¹¹⁻¹⁵ and 28 to 46%
95 meeting those for screen time behavior^{11,14}. Research also has neither distinguished
96 between different types of physical activities nor described how school sports or an
97 active daily commute to school might contribute to overall physical activity. Better
98 knowledge of screen time behavior and physical activity and the factors influencing
99 both could inform recommendations for structured prevention and identify risk groups
100 that could profit from counselling or focused interventions.

101 This nationwide, population-based prospective cohort study in Switzerland
102 investigated activities in the daily life of young CCS and the factors associated with
103 physical activity and screen time.

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Methods

The Swiss Childhood Cancer Survivor Study

The Swiss Childhood Cancer Survivor Study is a population-based, long-term cohort study of all children registered in the Swiss Childhood Cancer Registry who have been diagnosed since 1976, survived ≥ 5 years after initial diagnosis, and were alive at the time of the study¹⁶. The registry includes all patients in Switzerland who were diagnosed at age < 21 years with leukemia, lymphoma, central nervous system tumors, malignant solid tumors, or Langerhans cell histiocytosis¹⁷. Recent estimates indicate that the registry includes 95% of those diagnosed below age 16 since 1995 in Switzerland¹⁸. We included survivors aged 5–15 years at survey who had been diagnosed between 1995 and 2010. From 2010 to 2016, we traced addresses and sent a questionnaire to parents. We mailed the questionnaire a second time to those who did not respond, and further lack of response included an attempt to reach parents by phone. Among 1068 survivors whose parents were contacted, we received responses from parents of 766 (72%) (Supporting Information TABLE S1, FIGURE S1).

Ethics approval was granted by the Ethics Committee of the Canton of Bern, Switzerland, to the Swiss Childhood Cancer Registry and the Swiss Childhood Cancer Survivor Study (KeK-BE: 166/2014), and the Swiss Childhood Cancer Survivor Study is registered at ClinicalTrials.gov (identifier: NCT03297034).

Outcomes: physical activity and screen time

We examined physical activity as compulsory school sport, recreational sport, and commuting to school. We derived the time for compulsory school sport, 2.3 hours/week (3 x 45 minutes), from the Swiss school curriculum. Information on recreational sport activities and the commute to school were obtained via

questionnaire. Parents were asked about types of recreational sports and how many hours per week CCS devoted to each (Supporting Information FIGURE S2, question 1), and we categorized answers into 16 different types of sports. We also asked how the child usually went to school: on foot or by bike/kickboard, by bus/streetcar, or by car), and the time required (<10 minutes, 10–20 minutes, or >20 minutes); Supporting Information FIGURE S2, questions 2–3); the durations observed in the analysis were 5, 15, and 30 minutes. We considered only transit by foot or bike/kickboard as active. To obtain weekly estimates, we multiplied the times reported for one way to school by 15 to account for five school days per week, and an average of three trips to school per day because there are 2–4 afternoon school sessions per week at Swiss schools, with most children going home for lunch.

We used the World Health Organization (WHO) recommendations to characterize whether a child had sufficient physical activity (≥ 7 hours/week or ≥ 60 minutes/day of any physical activity for children aged 5–17 years)¹⁹. We created the binary outcome of those who had “sufficient” physical activity and those who did not.

Screen time was assessed by asking parents how much time their child spent on average each day interacting with screen media including television, computer games, game boys, PlayStation, or Nintendo (Supporting Information FIGURE S2, question 4). We used the American Academy of Pediatrics (AAP) recommendations for screen-based media exposure to determine acceptable screen time, less than two hours per day²⁰. We created the binary outcome of those who had media exposure that was “acceptable” screen time and those who those who did not.

Clinical characteristics

We extracted the following clinical characteristics from the cancer registry: age at cancer diagnosis, cancer diagnosis, year of cancer diagnosis, treatment protocol,

chemotherapy, radiotherapy, surgery, and hematopoietic stem cell transplantation. We classified cancer diagnoses in terms of 12 main groups and Langerhans cell histiocytosis according to the International Classification of Childhood Cancer, third edition (ICCC-3)²¹. We assessed whether children had been treated with anthracyclines. Thoracic radiation included the mantle field, mediastinum, thoracic spine, and total body irradiation (TBI); abdominal radiation included the pelvis, testis, and TBI; and radiation to the head/neck included TBI. We went back to medical records when registry treatment information was incomplete. The questionnaire collected information on chronic health conditions involving the cardiopulmonary and endocrine systems, problems affecting ears and eyes, and musculoskeletal/neurological conditions (Supporting Information TABLE S2).

Demographic, socioeconomic, and lifestyle characteristics

The questionnaire included demographic (sex, age at study, Swiss language region), socioeconomic (migration background, parental education), and lifestyle characteristics (children's body mass index [BMI], maternal BMI). We used self-reported weight and heights and calculated children's BMI and corresponding z-scores²². BMI z-scores lower than -2 were classified as underweight, -2 to 1 as normal weight, >1 to 2 as overweight, and >2 as obese²³. Self-reported maternal BMI was calculated and categorized according to the National Institutes of Health²⁴.

Statistical analyses

We compared characteristics of participating survivors and those in families from whom we received no response using chi-square tests. We used multivariate imputation by chained equations (MICE) to complete missing values in the outcome variables and demographic, socioeconomic, lifestyle, and clinical variables. Missing

values for hours of recreational sport were predicted by corresponding description of recreational sport. All other variables with missing values were imputed by using all other variables with the exception of the outcome variables (Supporting Information text). In an alternative approach, we determined physical activity and screen times using the original data before MICE (Supporting Information TABLE S3). Using multivariable logistic regression, we explored the association between the two binary outcomes, sufficient physical activity (meeting the WHO recommendations) and acceptable screen time (according to AAP recommendations), and demographic, socioeconomic, lifestyle, and clinical characteristics using an a priori selection of clinically important variables. We also investigated the correlation between physical activity and screen time using the pooled Spearman correlation coefficient. We used STATA software (Version 15.1, Stata Corporation, Austin, TX) and R (Version 3.5.2; R Foundation for Statistical Computing, Vienna, Austria)²⁵.

Results

Study population

The median age at diagnosis of the study population of 766 children (428 were male) was 2.8 years (interquartile range [IQR] 1.4–5.1), median age at survey 12.5 years (10.1–14.3), and median time since diagnosis 9.0 years (7.5–10.8) (TABLE 1). The two most frequent diagnoses were leukemia (37%) and central nervous system tumor (16%), and 51% received anthracyclines and 16% any radiation. Overall, 54% of children reported one or more adverse chronic health condition. At survey, the median BMI z-score in children was 0.08 (–0.7–0.9), and 59% of survivors were normal weight. Full demographic, socioeconomic, and clinical characteristics of CCS

are given in Table 1. Participants were comparable to surviving nonparticipants in most characteristics (Supporting Information TABLE S1).

Physical activity

Overall, the median time devoted to physical activity was 7.3 hours/week, with recreational sport contributing 3.0 hours/week (TABLE 2, FIGURE 1, Supporting Information FIGURE S3). The most common recreational sports were soccer (13%), gymnastics (12%), swimming (11%), cycling/driving a scooter (10%), and free outdoor/indoor play (10%). For male survivors, soccer (21%), scooter (11%), and free indoor/outdoor play (10%) were most relevant, and for female survivors, gymnastics (17%), swimming (13%), and dancing (12%) (FIGURE 2). Over one-half of CCS (55%) had sufficient physical activity according to the WHO recommendations. We found no important difference using the alternative analysis approach that assessed physical activity time and meeting the WHO recommendations using the original data before MICE (Supporting Information TABLE S3).

Screen time

Median screen time was 91 minutes/day, and 68% of children had acceptable screen time in accordance with AAP recommendations (TABLE 2, FIGURE 1). We found no important difference in the alternative analysis approach that assessed screen time and meeting AAP recommendations using the original data before MICE (TABLE S3).

Predictors for physical activity and screen time

Physical activity was lower for children who lived in the French and Italian language regions than it was in the German-speaking region of Switzerland. It also was lower

for those who had had a relapse or suffered from musculoskeletal/neurological conditions (TABLE 3, FIGURE 3). We observed no association between physical activity and sex, age at study, BMI of survivors and mothers, cancer diagnoses, cardiopulmonary conditions, and treatment exposures. Screen time was higher in male survivors and children with lower parental education and migration background (TABLE 3, FIGURE 3), but not associated with sex, age at study, parental education, endocrine and musculoskeletal/neurological problems, and all other clinical characteristics.

Correlation between low physical activity and high screen times

We found no correlation between physical activity and screen time in survivors (pooled Spearman correlation coefficient -0.05), and no correlation between time spent for recreational sports and an active way to school (pooled Spearman correlation coefficient 0.157) (Supporting Information FIGURE S4).

Discussion

This comprehensive survey of physical activity and screen time in children and adolescents who have survived cancer found that half of young survivors met the recommendation for physical activity and two-thirds did not exceed the maximum recommended for screen time. Having an active way to get to school and compulsory school sport greatly contributed to overall hours of physical activity.

Our results for physical activity are superior compared to those of a cohort study that included 1300 Swiss children and adolescents between 6–16 years of age, among whom only 39% of children aged 12-13 years met or exceeded physical activity recommendations assessed by accelerometer²⁶. Also in that study, children

who lived in the French and Italian linguistic regions of Switzerland were less active than those living in the German-speaking region²⁶. Young survivors in our study preferred recreational sports including soccer for males, and gymnastics, swimming, and dancing for females, and these preferences are similar to those of other school children²⁷. A study of screen time in healthy adolescent school children in Switzerland found higher median screen times of 122 minutes per day (compared to 82 minutes per day in our population), though screen time was assessed differently and focused on internet use²⁸.

Studies of physical activity and screen time in children after cancer are few and report variable results. A 2012 Australian study assessed 40 children in two centers after hematopoietic stem cell transplantation at a mean age of 12.5 years by questionnaire; 48% of the children met the physical activity recommendation and 28% that for screen time¹¹. Another single-center Australian study that used a three-day diary assessed 74 young survivors with a mean age of 15.0 years between 2012 and 2014 and reported that 74% adhered to physical activity and 46% to screen time recommendations¹⁴. Gilliam and colleagues performed phone interviews between 2010 and 2011 in 105 North American survivors aged 11.1 years who reported a mean physical activity time of 6.7 hours per week, which is lower than the mean 8.0 hours we observed¹², but times since diagnosis differed between the two cohorts (9.0 years in our study versus 4.6 years in the North American study). Another study from two North American centers reported a mean physical activity time of 47 minutes per day for 319 survivors aged 14.6 years, which corresponds to 5.5 hours per week and again is lower than in our cohort¹⁵. But that study used questionnaires that focused on past-year leisure-time physical activity, whereas our questionnaire also included the way to school and school sport. This could explain the difference.

Important predictors for physical activity in young survivors in other studies are social support from family and peers¹². Additional predictors reported for adolescent and adult survivors include female sex^{8,9}, low parental⁸ or survivor education^{9,13,29}, cranial radiation^{8,9,29}, overweight and obesity^{9,29}, physical limitations^{8,29}, and a diagnosis of central nervous system tumors and sarcomas^{29,30}. We also found that musculoskeletal/neurological problems are a predictor for physical activity and we also saw a trend for parental education, central nervous system tumors, and endocrine conditions.

Among our study's limitations is the reliance of the outcome variables physical activity and screen time on parental reporting. Parents might have overestimated physical activity and underestimated screen time because of both social desirability and recall biases. A second problem involves the questionnaire's having inquired about structured physical activities even though young children in particular are active mainly in an unstructured way with free inside and outside play²⁶. This differential misclassification bias could have led to underestimation of activity in younger survivors. However, parents did mention free outdoor and indoor play in 10% of boys and 9% of girls (FIGURE 2). Accelerometers and pedometers may overcome this problem^{26,31}, though worn only for study purposes and short periods their data might not be representative of daily life. A third limitation is that physical activity in Swiss school children differs between winter and summer²⁶, but we did not account for the season when parents filled out the questionnaire. Fourth, screen time questions assessed traditional screen activities such as watching television and computer games, and not use of social media and mobile phones; the average screen time we observed might be an underestimate. Finally, our study had no control group because too few siblings met our inclusion criteria.

This study is the first nationwide, population-based study of physical activity and screen time in children who survived cancer. Among its strengths is its relatively high response rate, 72%, which makes us confident that the results are representative for Swiss CCS. Also, being nested in the Swiss Childhood Cancer Registry provided us with important, comprehensive data on demographic, socioeconomic, lifestyle, and clinical characteristics.

Our results indicate that structural support via compulsory school sport and an active daily commute to school are important contributors to physical activity. Public health policy should at least preserve if not increase support for both compulsory and voluntary school sport. Further research should inquire into why physical activity is lower in the parts of Switzerland speaking French and Italian than in the German-speaking part, and how physical activity levels might be increased in all three. Also, it goes without saying that family and community support for actively commuting to school should be maintained or increased.

For individual prevention, clinicians should counsel young survivors and their families to pursue active lives. In a German study, only 25% of 83 young survivors with a median age of 14 years and 3.8 years after cancer diagnosis participated in school sport, and medical advisories against sports participation were frequent³². Parents also might overprotect their children during and after completion of cancer therapy. Physical activity not only is safe both during and after cancer therapy, it may positively influence evolving chronic health conditions. Pediatric oncologists therefore can and should assure families that physical activity is of particular importance to CCS and encourage participation in compulsory and voluntary school sports, and keep medical restrictions on activity to a minimum. Further research should include interventions that include social support as an important contributor to children's physical activity¹².

338 In summary, we found that half of young cancer survivors are not active
339 enough and one-third devote too much time to sedentary screen viewing.
340 Compulsory school sport and an active commute to school are important
341 components of an active lifestyle. Therefore, we need both individual-based
342 prevention such as better counselling of survivors and families, and structural
343 prevention addressed to all children in Switzerland, such as promotion of active
344 commuting to school and extended school sport lessons.

Conflict of Interest statement

The commercial funders of the Swiss Childhood Cancer Registry support the daily running of the registry and have not had and will not have any role in the design, conduct, interpretation or publication of the Swiss Childhood Cancer Registry itself as well as the related research projects.

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(www.kinderkrebshilfe.ch), the Federal Office of Public Health (FOPH) and the National Institute of Cancer Epidemiology and Registration (www.nicer.org).

Data availability statement

The Swiss Childhood Cancer Registry and Swiss Childhood Cancer Survivor Study are a collaborative project of the Swiss Pediatric Oncology Group (SPOG) and the Institute of Social and Preventive Medicine, University of Bern, Switzerland. Our homepage displays detailed information in methods, results and publications (www.childhoodcancerregistry.ch). Researchers interested in collaborative work can contact the corresponding author (Claudia Kuehni; claudia.kuehni@ispm.unibe.ch) to discuss planned projects or analyses of existing data. The final decision will be made upon presentation of the project to the Scientific Council of the Swiss Pediatric Oncology Group¹⁶.

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Legends

TABLE 1 Demographic, socioeconomic, lifestyle, and clinical characteristics of childhood cancer survivors included in the study, N=766

TABLE 2 Compulsory school sport, recreational sport, active way to school, total physical activity, screen time, and adherence to WHO/AAP recommendations in childhood cancer survivors, N=766, 56% males, median age 12.5 years

TABLE 3 Factors associated with a) sufficient physical activity (WHO recommendation) and b) acceptable screen time (AAP recommendation) in childhood cancer survivors, N=766, 56% males, median age 12.5 years

FIGURE 1 A, box plot and histogram of total physical activity in hours/week; B, box plot and histogram of screen time in minutes/day; reported in childhood cancer survivors (N=766, 56% males, median age 12.5 years)

FIGURE 2 Frequencies of the 16 different recreational sports in childhood cancer survivors (N=766, 56% males, median age 12.5 years), stratified by sex; there can be multiple (1-5) different recreational sports per child

FIGURE 3 Factors associated with A) sufficient physical activity, and B) acceptable screen time in childhood cancer survivors (N=766, 56% males, median age 12.5 years). Pooled odds ratios from multivariable logistic regression adjusted for demographic, socioeconomic, lifestyle, and clinical characteristics. CI, confidence interval. CNS, central nervous system

Supporting Information

TABLE S1 Demographic, socioeconomic, and clinical characteristics of responding and nonresponding childhood cancer survivors (N=1068)

TABLE S2 Selected chronic health conditions asked in the Swiss Childhood Cancer Survivor Study for survivors aged 5–15 years and included in this study

TABLE S3 Compulsory school sport, recreational sport, active way to school, total physical activity, screen time, and adherence to WHO and AAP recommendations in childhood cancer survivors, N=766, 56% males, median age 12.5 years; original data before multivariate imputation by chained equations (MICE)

FIGURE S1 Population tree of Swiss childhood cancer survivors eligible for the study, contacted and responding to the questionnaire of the Swiss Childhood Cancer Survivor Study

FIGURE S2 Physical activity and screen time, asked in the Swiss Childhood Cancer Survivor Study questionnaire: recreational sport (question 1), the way to school (questions 2 and 3), and screen time (question 4)

FIGURE S3 Pooled means of recreational sport, compulsory school sport, and active way to school by foot, bike/kickboard contributing to the total physical activity in hours/week in childhood cancer survivors (N=766, 56% males, median age at study 12.5 years)

FIGURE S4 Scatterplots of A) total physical activity and screen time, and B) recreational sport and active way to school, evaluated in childhood cancer survivors, N=766, 56% males, median age at study 12.5 years; no correlation between variables (pooled Spearman correlation coefficient for total physical activity and screen time -0.05; pooled Spearman correlation coefficient for recreational sport and active way to school 0.157)

Supporting information text S1: Description of number of missing values

TABLE 1 Demographic, socioeconomic, lifestyle, and clinical characteristics of childhood cancer survivors included in the study, N=766

	N = 766	
	n	% ^a
Demographic and socioeconomic characteristics		
Male sex	428	56
Age at survey, years		
5–7	65	8
8–10	196	26
11–13	282	37
14–15	223	29
Language region		
German	535	70
French	197	26
Italian	34	4
Migration background ^b	212	28
Parental education ^c		
Primary education	61	8
Secondary education	462	60
Tertiary education	219	29
Lifestyle characteristics		
Child's BMI (kg/m ²) z-scores		
Underweight	124	16
Normal	456	59
Overweight	89	12
Obese	23	3
Mother's BMI (kg/m ²)		
Underweight	29	4
Normal	486	64
Overweight	156	20
Obese	66	8
Clinical characteristics		
Age at diagnosis, years		
<1	149	20
1–4	423	55
5–10	194	25
Time since diagnosis, years		
5–10	607	79
11–15	159	21
ICCC3 cancer diagnoses		
I Leukemia	286	37
II Lymphoma	52	7
III Central nervous system tumor	125	16
IV Neuroblastoma	73	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	6
X Germ cell tumor	19	3
XI&XII Other rare tumors ^d	28	3
History of relapse	100	13
Time era of treatment		
1995–2000	147	19
2001–2005	319	42
2006–2010	300	39
Any chemotherapy	624	82
Anthracyclines	388	51
Any radiation	122	16

Thoracic ^e	30	4	N
Abdominal ^f	30	4	
Cranial and neck ^g	76	11	
Bone marrow transplantation	55	7	a n d
Chronic health conditions			
Cardiopulmonary	72	9	
Endocrine	82	11	n ,
Hearing and vision	210	27	
Musculoskeletal/neurological	275	36	
Number of chronic health conditions			n u m b e
None	354	46	
1	239	31	
≥2	173	23	

r; BMI, body mass index.

^a Column percentages are given.

^b Migration background: survivors who were not Swiss citizens at birth, not born in Switzerland, or had at least one parent who was not a Swiss citizen were defined as having a migration background.

^c Parental education categorized by three categories: primary education (compulsory schooling only [≤9 years]), secondary education (vocational training [10–13 years]), and tertiary education (higher vocational training, college, or university degree). If parents achieved different levels of education, we selected the parent with the highest education.

^d Including Langerhans cell histiocytosis; other malignant epithelial neoplasms, malignant melanomas, and other or unspecified malignant neoplasms.

^e Thoracic radiation included mantle field, mediastinum, thoracic spine, and total body irradiation.

^f Abdominal radiation included the pelvis, testes, and total body irradiation.

^g Cranial/neck radiation included total body irradiation.

TABLE 2 Compulsory school sport, recreational sport, active way to school, total physical activity, screen time, and adherence to WHO/AAP recommendations in childhood cancer survivors, N=766, 56% males, median age 12.5 years

	N=766				
	Median ^a , IQR	Mean ^b , SD	10 th –90 th percentile	Range	Adherence ^c to WHO/AAP
Compulsory school sport (hours/week) ^d	2.3, NA	2.3, NA	NA	NA	
Recreational sport (hours/week) ^e	3.0, 1.0–5.0	3.7, 3.9	0–8.0	0–32	
Active way to school (hours/week) ^f	1.3, 0–3.8	2.0, 1.9	0–3.8	0–7.5	
Total physical activity (hours/week) ^g	7.3, 4.8–10.0	8.0, 4.5	3.3–13.5	2.3–35.5	55%
Screen time (minutes/day) ^h	82, 45–120	91, 66	15–180	0–480	68%

WHO, World Health Organization (recommending ≥ 7 hours of physical activity per week); AAP, American Academy of Pediatrics, (recommending < 120 minutes screen time per day); N, number; IQR, interquartile range; SD, standard deviation; NA, not applicable.

^a Pooled median over the complete imputed dataset.

^b Pooled mean over the complete imputed dataset.

^c Percent of adherence refers to the pooled medians.

^d Compulsory school sport defined as 3×0.75 hours/week=2.3 hours/week.

^e Recreational sport as asked in the questionnaire (question 1, FIGURE S2): Which types of sport does your child perform?

^f Active way to school by foot or bike/kickboard as asked in the questionnaire (questions 2 and 3, FIGURE S2): How does your child usually go to the kindergarten or to school? How long is your child's way to the kindergarten or school?

^g Total physical activity consisting of compulsory school sport, recreational sport, and an active way to school. Please indicate, how often your child performs different types of sports (hours per week).

^h Screen time as asked in the questionnaire (question 4, FIGURE S2): How much time does your child spend on average with the following activities per day? Watching television, computer games, game boy, PlayStation, Nintendo.

TABLE 3 Factors associated with a) sufficient physical activity (WHO recommendation) and b) acceptable screen time (AAP recommendation) in childhood cancer survivors, N=766, 56% males, median age 12.5 years

	Multivariable logistic regression							
	a) Sufficient physical activity				b) Acceptable screen time			
	% ^a	Odds Ratio ^b	95% CI	p-value ^c	% ^a	Odds Ratio ^d	95% CI	p-value ^c
Demographic characteristics								
Sex								
Female	50	1.0			72	1.0		
Male	60	1.3	0.9-1.8	0.113	64	0.6	0.4-0.9	0.007
Age at study, years								
5–7	48	1.4	0.4–4.4		88	14.5	1.1–18.0	0.074
8–10	55	1.5	0.7–3.3		78	2.9	1.2–6.9	
11–13	60	1.6	1.0–2.6	0.306	68	2.0	1.1–3.4	
14–15	51	1.0			52	1.0		
Language region								
German	59	1.0			68	1.0		
French/Italian	48	0.6	0.4-0.9	0.005	65	0.8	0.6-1.2	0.354
Socioeconomic characteristics								
Migration background								
No	57	1.0			71	1.0		
Yes	51	0.9	0.6–1.3	0.473	59	0.6	0.4–0.9	0.018
Parental education								
Tertiary education	60	1.0			77	1.0		
Secondary education	54	0.8	0.6–1.1	0.218	65	0.5	0.3–0.8	0.004
Primary education	48	0.6	0.3–1.1		50	0.4	0.2–0.8	
Lifestyle characteristics								
Child's BMI (kg/m ²) z-scores								
Normal weight	43	1.0			66	1.0		
Underweight	50	0.8	0.5–1.2	0.409	74	1.2	0.7–2.1	0.803
Overweight/Obesity	45	1.0	0.7–1.7		64	0.8	0.6–1.6	
Maternal BMI (kg/m ²) (continuous)	NA	1.0	0.9–1.0	0.381	NA	1.0	0.9–1.0	0.247
Clinical characteristics								
Cancer diagnoses								
Leukemia	59	1.0			61	1.0		
Lymphoma	60	1.1	0.6–2.1	0.588	73	1.8	0.8–3.8	0.111
CNS tumor	46	0.7	0.4–1.3		71	2.2	1.1–4.7	

Other tumor	55	0.9	0.6–1.4		71	1.3	0.8–2.1	
Relapse								
No	58	1.0			67	1.0		
Yes	40	0.6	0.4–1.0	0.030	67	1.0	0.6–1.8	0.975
Cardiopulmonary conditions								
No	55	1.0			67	1.0		
Yes	56	1.1	0.7–1.9	0.642	68	1.1	0.6–1.9	0.805
Endocrine conditions								
No	57	1.0			68	1.0		
Yes	42	0.6	0.4–1.1	0.112	59	0.8	0.4–1.4	0.360
Hearing/vision chronic conditions								
No	56	1.0			66	1.0		
Yes	54	1.3	0.9–1.9	0.195	70	1.0	0.7–1.6	0.887
Musculoskeletal/neurological conditions								
No	59	1.0			67	1.0		
Yes	49	0.7	0.5–0.9	0.017	69	1.0	0.7–1.5	0.936
Anthracyclines								
No	53	1.0			68	1.0		
Yes	57	0.9	0.6–1.3	0.506	67	1.2	0.7–1.9	0.492
Radiotherapy								
No	55	1.0			68	1.0		
Yes	59	1.2	0.8–1.9	0.410	66	1.1	0.7–1.9	0.654
Stem cell transplantation								
No	55	1.0			68	1.0		
Yes	55	1.2	0.5–1.5	0.543	59	0.7	0.3–1.4	0.300

WHO, World Health Organization; AAP, American Academy of Pediatrics; N, number; CI, confidence interval; BMI, body mass index; NA, not applicable; CNS, central nervous system

^a Column percentages are given.

^b Pooled odds ratios comparing those with high physical activity to those with low physical activity, adjusted for sociodemographic, socioeconomic, and cancer characteristics.

^c p-value from likelihood ratio tests.

^d Pooled odds ratios comparing those with low screen time to those with high screen time, adjusted for sociodemographic, socioeconomic, and cancer characteristics.

A)

B)

FIGURE 1 A, box plot and histogram of total physical activity in hours/week; B, box plot and histogram of screen time in minutes/day; reported in childhood cancer survivors (N=766, 56% males, median age 12.5 years)

FIGURE 2 Frequencies of the 16 different recreational sports in childhood cancer survivors (N=766, 56% males, median age 12.5 years), stratified by sex; there can be multiple (1-5) different recreational sports per child

A) Sufficient physical activity

B) Acceptable screen time

FIGURE 3 Factors associated with A) sufficient physical activity, and B) acceptable screen time in childhood cancer survivors (N=766, 56% males, median age 12.5 years). Pooled odds ratios from multivariable logistic regression adjusted for demographic, socioeconomic, lifestyle, and clinical characteristics. CI, confidence interval. CNS, central nervous system