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Clustering of health behaviours in adult survivors of childhood cancer and the general population

CE Rebholz[1], CS Rueegg[1], G Michel[1], RA Ammann[2], NX von der Weid[3], CE Kuehni[*,1,4] and BD Spycher[1,4] for the Swiss Paediatric Oncology Group (SPOG)[5]

[1]Institute of Social and Preventive Medicine, Swiss Childhood Cancer Registry, University of Bern, Bern, Switzerland; [2]Department of Paediatrics, University of Bern, Bern, Switzerland; [3]Paediatric Hematology-Oncology Unit, Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland

BACKGROUND: Little is known about engagement in multiple health behaviours in childhood cancer survivors.

METHODS: Using latent class analysis, we identified health behaviour patterns in 835 adult survivors of childhood cancer (age 20–35 years) and 1670 age- and sex-matched controls from the general population. Behaviour groups were determined from replies to questions on smoking, drinking, cannabis use, sporting activities, diet, sun protection and skin examination.

RESULTS: The model identified four health behaviour patterns: 'risk-avoidance', with a generally healthy behaviour; 'moderate drinking', with higher levels of sporting activities, but moderate alcohol-consumption; 'risk-taking', engaging in several risk behaviours; and 'smoking', smoking but not drinking. Similar proportions of survivors and controls fell into the 'risk-avoiding' (42% *vs* 44%) and the 'risk-taking' cluster (14% *vs* 12%), but more survivors were in the 'moderate drinking' (39% *vs* 28%) and fewer in the 'smoking' cluster (5% *vs* 16%). Determinants of health behaviour clusters were gender, migration background, income and therapy.

CONCLUSION: A comparable proportion of childhood cancer survivors as in the general population engage in multiple health-compromising behaviours. Because of increased vulnerability of survivors, multiple risk behaviours should be addressed in targeted health interventions.

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Engagement in health protective behaviour is important for preventing chronic diseases and early mortality (Centers for Disease Control and Prevention, 2004; Khaw *et al*, 2008) and is of particular importance for childhood cancer survivors (White *et al*, 2005; Children's Oncology Group, 2008; Demark-Wahnefried and Jones, 2008; Gritz and Demark-Wahnefried, 2009). Although about 80% are cured from cancer (Horner *et al*, 2009), survivors are at increased risk for second malignancies and early mortality (Armstrong *et al*, 2009; Meadows *et al*, 2009), and two thirds suffer from chronic conditions, such as endocrine disorders, heart problems, neurocognitive impairment and musculoskeletal disorders (von der Weid *et al*, 1996; Hewitt *et al*, 2003; Oeffinger *et al*, 2006).

Only few studies have investigated health behaviours in young adult survivors of childhood cancer (Mulhern *et al*, 1995; Larcombe *et al*, 2002; Butterfield *et al*, 2004; Bauld *et al*, 2005; Clarke and Eiser, 2007). In general, these studies reported a lower or similar level of engagement in single risk behaviours compared with the general population and controls (Mulhern *et al*, 1995; Larcombe *et al*, 2002; Bauld *et al*, 2005; Clarke and Eiser, 2007). From a public health perspective, it is important to know whether there are groups of individuals who engage in multiple health behaviours simultaneously, and whether such behaviour patterns differ between survivors and controls. Answers to these questions could provide a basis for targeted interventions, using a person-centred approach rather than focusing on single health behaviours. Clustering methods, including latent class analysis (LCA), have been used to identify and characterise health behaviour patterns in various populations (Schneider *et al*, 2009; Sutfin *et al*, 2009; Huh *et al*, 2011). In childhood cancer survivors, LCA has recently been used to classify them according to modifiable cognitive, affective and motivation indicators for future medical follow-up (Cox *et al*, 2011).

This study aimed to (i) identify and characterise different patterns of health behaviour in a mixed population of childhood cancer survivors and matched controls from the general population using LCA, (ii) assess differences in the prevalence of these behaviour patterns between survivors and controls, and (iii) identify risk factors for health-compromising behaviour patterns in survivors.

MATERIALS AND METHODS

This analysis included 835 adult survivors of childhood cancer from the Swiss Childhood Cancer Survivor Study (SCCSS) and 1670 controls from the Swiss Health Survey (SHS) matched on gender, age, language region and migration background; both surveys were conducted in 2007–2009.

*Correspondence: Professor CE Kuehni; E-mail: kuehni@ispm.unibe.ch
[4]These authors shared the last authorship.
[5]See Appendix.
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Swiss Childhood Cancer Survivor Study

The SCCSS is a nationwide population-based long-term follow-up study of all childhood cancer patients registered in the Swiss Childhood Cancer Registry (Michel *et al*, 2007; Kuehni *et al*, 2011), who were diagnosed with cancer between 1976 and 2003 before age 16 years, and who survived at least 5 years since diagnosis.

Study participants received an extensive questionnaire in German, French or Italian. Non-responders were sent a reminder questionnaire after 2 months and subsequently contacted by phone to encourage them to participate. Ethics approval was provided through the general cancer registry permission of the Swiss Childhood Cancer Registry (The Swiss Federal Commission of Experts for Professional Secrecy in Medical Research) and a statement of no objections was obtained from the ethics committee of the Canton of Bern.

Of 1699 eligible survivors, 1497 could be contacted and 1067 responded (response rate 63% of eligible, 72% of contacted survivors). We included participants aged 20–35 years at the time of survey. Of the 860 eligible respondents, we dropped 10 because of missing values in the question on alcohol consumption—the model required complete data for this variable, because information on frequency of drinking and binge drinking were conditional to a positive reply to this question—and another 15 because of missing information on migration background, which was required for matching controls, leaving 835 survivors for the analysis (Supplementary Figure S1).

Swiss Health Survey

The SHS is a national representative health survey repeated in 5-year intervals. The 2007 survey included a random sample of 30,179 Swiss households with a telephone landline. A stratified (by region) and stepwise (first selection of households, then of an individual within each household) sampling procedure was applied, with oversampling of households in the French- and Italian-speaking regions of Switzerland. Within each household, one person aged $\geqslant 15$ years was randomly chosen for the interview. The response rate was 66% (Bundesamt für Statistik, 2008). For each survivor, two controls from the SHS were matched for gender, age, language, region and migration background, resulting in 1670 controls.

Health behaviours

The SCCSS used a questionnaire similar to that of childhood cancer survivor studies in the US and the UK (Robison *et al*, 2002; Hawkins *et al*, 2008). For comparison with the Swiss population, health behaviours were assessed with standardised questions of the SHS. The following health-compromising and protective behaviours were assessed in both populations and included in the LCA to identify health behaviour patterns: smoking, alcohol consumption including binge drinking, cannabis use, skin examination, sun protection, sporting activities and vegetable/fruit consumption (Table 1).

Potential determinants of health-behaviour patterns

In both populations, we examined the following potential determinants of health behaviour: gender, age, marital status, parenthood and socio-economic variables, including income, educational attainment and migration background (one or both parents originating from another country; Table 2). For survivors, we additionally included parents' education and disease-related information, including age at diagnosis, ICCC-3 code of diagnosis (Steliarova-Foucher *et al*, 2005), treatment and relapse history. Treatment was categorised into four categories: surgery only, chemotherapy (without radiotherapy, irrespective of surgery), radiotherapy (irrespective of surgery and chemotherapy) and bone marrow transplantation (BMT; irrespective of other therapies).

Statistical analysis

We first identified different patterns of health behaviour in the combined population of survivors and controls, and subsequently assessed the prevalence and determinants of these behaviours separately in each population. To identify behaviour patterns, we used LCA (Lazarsfeld and Henry, 1968; Skrondal and Rabe-Hesketh, 2008), a clustering method that is based on a statistical model and is particularly suited for data collected through questionnaire surveys, because it can appropriately treat categorical data and missing values. Latent class analysis assumes that the population consists of distinct subpopulations (latent classes), which cannot be observed directly, but are inferred from the observed variables. After fitting the model, posterior probabilities of belonging to the identified classes can be computed for each subject (McLachlan and Peel, 2000). We applied LCA to the combined data from survivors and controls ($n = 2505$) on the health behaviours described in Table 1. After fitting the model, subjects were then allocated to the behaviour patterns for which they had the largest membership probability. We refer to the groups thus formed as 'health-behaviour clusters'. We fitted the models with 1–6 classes and used the Bayesian Information Criterion (BIC) to select the final model (McLachlan and Peel, 2000). Selecting the model with lowest BIC optimises model fit while at the same time avoiding over-fitting.

We compared proportions of survivors and controls allocated to the identified health behaviour patterns using χ^2-tests. We then assessed associations of potential determinants (demographic, socio-economic and disease related) with health-behaviour patterns using χ^2-tests. We subsequently included all variables with significant associations ($P < 0.05$) in the first step in a multinomial logistic regression model with health behaviour clusters as the outcome levels. We investigated whether income and educational attainment (assessed at the time of survey) lie on the causal pathway between potential determinants assessed in childhood (demographic- and disease-related variables, and parents' education) and health-behaviour patterns by comparing multinomial regression models with and without income and educational attainment.

The Mplus software version 6 (Muthén & Muthén, Los Angeles, CA, USA) was used for LCA and Stata version 10 (StataCorp, College Station, TX, USA) for all other analyses.

RESULTS

Characteristics of study population

Mean age was 26.1 years (s.d. = 4.1 years; range 20.0–35.0 years) and 53% were male in both study populations (because of matching; Table 2). Fewer survivors were married (12% *vs* 23%), had children (12% *vs* 21%), or had a university degree (8% *vs* 12%). Among survivors, mean age at diagnosis was 7.9 years (s.d. = 4.7 years; range 0.0–16.0 years) and mean time since diagnosis was 18.1 years (s.d. = 5.8 years; range 5.8–32.5 years); 36% were treated with radiotherapy and 10% had surgery only. A relapse of their primary cancer occurred in 15% of the survivors (Table 2).

Prevalence of health behaviours in survivors and controls

More survivors than controls were non-smokers (76% *vs* 65% in controls) and had preventive skin examinations by a physician (46% *vs* 35%; Table 1). In contrast, fewer survivors than controls reported protecting themselves from sun exposure (78% *vs* 87%)

Table 1 Questions used to assess behaviours and prevalence of behaviours among survivors and controls

			Survivors ($n=835$)		Controls ($n=1670$)		
Behaviour	**Measurement**	**Recoded categories**	***n***	**%[a]**	***n***	**%[a]**	***P*-value[b]**
Smoking	Do you smoke? If yes, how many cigarettes a day?	None	634	76	987	65	<0.001
		Up to 9 cigarettes a day	106	13	289	17	
		10–19 cigarettes a day	50	6	200	12	
		One or more packs a day	40	5	141	8	
Cannabis use	Have you ever consumed marijuana?	No, never	469	56	988	59	0.309
		Previously	275	33	512	31	
		Currently	74	9	167	10	
Drinking	Do you drink alcohol?	No alcohol consumption	86	10	177	11	0.818
		Alcohol consumption	749	90	1493	89	
	How frequently do you usually consume alcoholic drinks (such as wine, beer, schnapps or any other hard liquor)?[c]	Rarely	299	36	517	31	<0.001
		1–2 times a week	270	33	784	47	
		>2 times a week	126	15	138	8	
		1 or more drinks a day	51	6	54	3	
	How many times have you drunk more than 8 units (males)/ 6 units (females) at a time in the past year?[c]	No binge drinking	273	33	986	59	<0.001
		Less than once a month	272	33	321	19	
		Once a month or more	170	20	144	9	
Sporting activities	Do you engage in physical exercise or sporting activities? If yes, how intensively do you pursue these activities?	None	290	35	556	33	0.001
		Low to moderate intensity	269	32	480	29	
		Quite intensively	198	24	417	25	
		Very intensively	63	8	217	13	
Diet	How many portions[d] of fruit do you eat a day on average? How many portions of vegetables do you eat a day on average?	None (0 to <1 portion a day)	63	8	118	7	0.187
		Vegetable or fruit consumption (⩾1 portion a day)	156	19	358	21	
		Vegetable and fruit consumption (⩾1 portion a day each)	604	72	1140	68	
Skin protection	Do you protect yourself from sun exposure?	No	188	23	214	13	<0.001
		Yes	647	78	1455	87	
	Have you ever had your skin or moles examined by a physician?	No, never	429	51	1046	63	<0.001
		Yes, more than 12 months ago	275	33	442	27	
		Yes, in the last 12 months	112	13	127	8	

[a]Percentages don't always add up to 100% due to missing values. [b]χ^2-test. [c]Asked only to those with alcohol consumption (percentages don't add up to 100%). [d]1 portion = size of your fist.

and fewer intensively pursued sporting activities (8% *vs* 13%). More survivors engaged in binge drinking (20% *vs* 9%).

Identification of health-behaviour clusters

We fitted LCA models with 1–6 classes (Figure 1). The 2-class model distinguished between a 'low-risk' group (B1) and a 'high-risk' group that engaged in smoking and alcohol use (B2). In the 3-class model, the high-risk group was separated into two new groups, the first characterised by sporting activities and moderate to frequent drinking (C2), and the second by frequent drinking and smoking (C3). In the 4-class model, a new group emerged characterised by frequent smoking, but low alcohol consumption (D4). According to the BIC, the models including 3 and 4 classes were optimal, with BIC values: 36 007 and 36 008 for the 3 and 4, compared with 36 203 and 36 062 for the models with 2 and 5 classes, respectively.

This manuscript reports results for the 4-class model, which highlights differences in behaviour patterns between survivors and controls that are less evident from the 3-class model. Results of the 3-class model are shown in the online supplement (Supplementary Table 1).

Description of health-behaviour clusters

We labelled the four behaviour clusters as: D1 'risk-avoiding' (number of individuals allocated $n=1089$, 44% of sample), D2 'moderate drinking' ($n=797$, 32%), D3 'risk-taking' ($n=316$, 13%) and D4 'smoking' ($n=303$, 12%).

Cluster D1: 'risk-avoiding' This cluster includes individuals who did not, or only to a minor extent, engage in risk behaviours, and who reported health-protective behaviours (sporting activities, vegetable and fruit consumption, sun protection and skin examination; Figure 2, green dashed).

Cluster D2: 'moderate drinking' This cluster had a similar tendency for health-protective behaviours as the 'risk-avoiders', but engaged more frequently in sporting activities and in alcohol consumption, including binge drinking (Figure 2, blue).

Cluster D3: 'risk-taking' These individuals tended to engage in all assessed risk behaviours: smoking, marijuana consumption and alcohol use, including binge drinking. In addition, they reported lower engagement in health-protective behaviours compared with the 'risk-avoiding' Cluster D1 and 'moderate-drinking' Cluster D2 (Figure 2, red).

Cluster D4: 'smoking' These individuals had low engagement in health-protective behaviours and were likely to smoke, but not to drink (Figure 2, yellow dashed).

The clusters varied little with respect to sun protection and skin examination (Figure 2; Supplementary Table 2).

Table 2 Socio-demographic and clinical characteristics of the two study populations, survivors and controls

	Survivors ($n=835$)		Controls ($n=1670$)		
	n	**%**	***n***	**%**	***P*-value[a]**
Socio-demographic characteristics					
Age (years)					
20–25	373	44.7	746	44.7	n.a.[b]
26–30	285	34.1	570	34.1	
31–35	177	21.2	354	21.2	
Gender					
Male	441	52.8	882	52.8	n.a.[b]
Female	394	47.2	788	47.2	
Language					
German	633	75.8	1266	75.8	n.a.[b]
French/Italian	202	24.2	404	24.2	
Migration background[c]					
No	648	77.6	1296	77.6	na[b]
Yes	187	22.4	374	22.4	
Civil status					
Single, divorced or widowed	732	88.5	1284	76.9	<0.001
Married	95	11.5	385	23.1	
Education					
Compulsory schooling	70	8.0	69	4.1	<0.001
Vocational training	379	46.0	945	56.6	
Higher secondary[d]	304	36.4	449	26.9	
University	63	7.5	200	12.0	
Income					
Unemployed	110	13.2	43	2.6	<0.001
0–3000 CHF	239	28.6	573	34.3	
3001–6000 CHF	402	48.1	819	49.0	
>6000 CHF	45	5.4	235	14.1	
Number of children					
None	708	84.8	1325	79.3	<0.001
One	63	7.5	169	10.1	
Two or more	41	4.9	176	10.5	
Body mass index ($kg\,m^2$)					
<25	606	72.6	1266	75.8	0.372
⩾25	203	24.3	388	23.2	
Clinical characteristics					
Age at diagnosis (years)					
⩽ 4	228	27.3			
5–8	205	24.6			
9–12	183	21.9			
>12	219	26.2			
Diagnosis					
Leukaemia	310	37.1			
Hodgkin lymphoma	73	8.7			
Non-Hodgkin lymphoma	83	9.9			
CNS tumours	101	12.1			
Embryonal tumours[e]	127	15.2			
Bone tumours and soft tissue sarcomas	87	10.4			
Other[f]	54	6.5			
Therapy					
Surgery only	81	9.7			
Chemotherapy, but no radiotherapy	394	47.2			
Any radiotherapy	257	30.8			
BMT	95	11.4			
Relapse					
No	710	85.0			
Yes	125	15.0			

Abbreviations: CHF = Swiss Francs; CNS = central nervous system; n.a. = not applicable; BMT = bone marrow transplantation. Numbers do not always sum up to the total because of missing values. [a]χ^2-test. [b]Population matched for gender, age, language, region and migration background. [c]Does not have a Swiss passport or has received the Swiss passport after date of birth or parents originate from another country. [d]Higher secondary education includes high school, teachers training colleges, technical colleges and higher vocational education. [e]Includes neuroblastoma, retinoblastoma, Wilms tumour, liver tumour and germ cell tumour. [f]Includes epithelial neoplasms, malignant melanomas, unspecified malignant tumours and Langerhans cell histiocytosis.

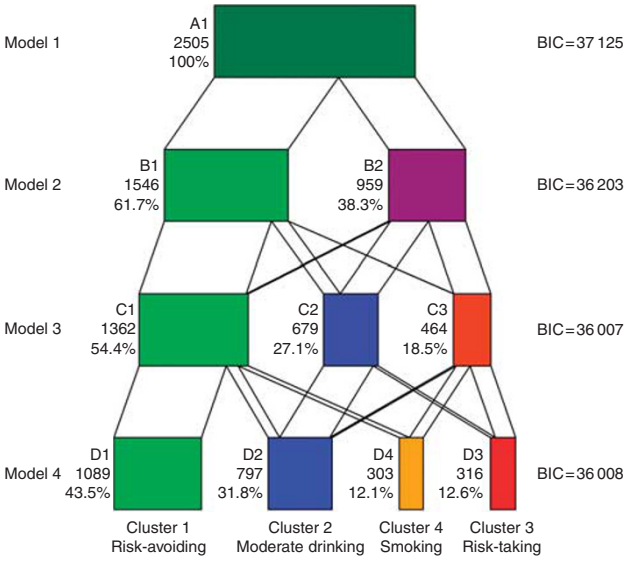

Figure 1 Illustration of behaviour groups identified by LCA as the number of classes was increased. The boxes in a given layer represent the behaviour groups identified in that model. Numbers of individuals and percentage of sample allocated to the group are reported next to the boxes.

Prevalence of health-behaviour clusters in survivors and controls

The prevalence of the four health-behaviour clusters differed between survivors and controls (*P*-value for χ^2-test < 0.001). Similar proportions of survivors and controls were allocated to the 'risk-avoiding' Cluster D1 (42% of survivors and 44% of controls) and 'risk-taking' Cluster D3 (14% of survivors and 12% of controls), a higher proportion of survivors was allocated to the 'moderate drinking' Cluster D2 (39% of survivors and 28% of controls) and a smaller proportion to the 'smoking' Cluster D4 (5% of survivors and 16% of controls).

The membership probabilities tended to be high for the groups to which subjects were allocated. Mean membership probabilities were 0.89, 0.76, 0.82 and 0.78, for Cluster D1 ('risk-avoiding'), Cluster D2 ('moderate drinking'), Cluster D3 ('risk-taking') and Cluster D4 ('smoking'), respectively, and did not differ substantially between survivors and controls.

Socio-demographic characteristics of health-behaviour clusters in survivors and controls

In both populations, gender, education, income and migration background were significantly associated with health-behaviour clusters (Table 3; Supplementary Table S3). Female gender was common in the 'risk-avoiding' Cluster D1 (64% of survivors, 62% of controls) and less frequent in the 'moderate drinking' Cluster D2 (38% of survivors and 34% of controls) and 'risk-taking' Cluster D3 (25% of survivors and 24% of controls). The proportion of individuals with a university degree was highest in the 'moderate drinking' Cluster D2 (10% of survivors and 17% of controls). Members of Cluster D2 ('moderate drinking') and Cluster D3 ('risk-taking') tended to have a higher income than those in other clusters, whereas the percentage of individuals with a migration background was highest in the 'smoking' Cluster D4 (45% of survivors and 38% of controls). These associations remained similar in multinomial logistic regression models (Supplementary Table 3).

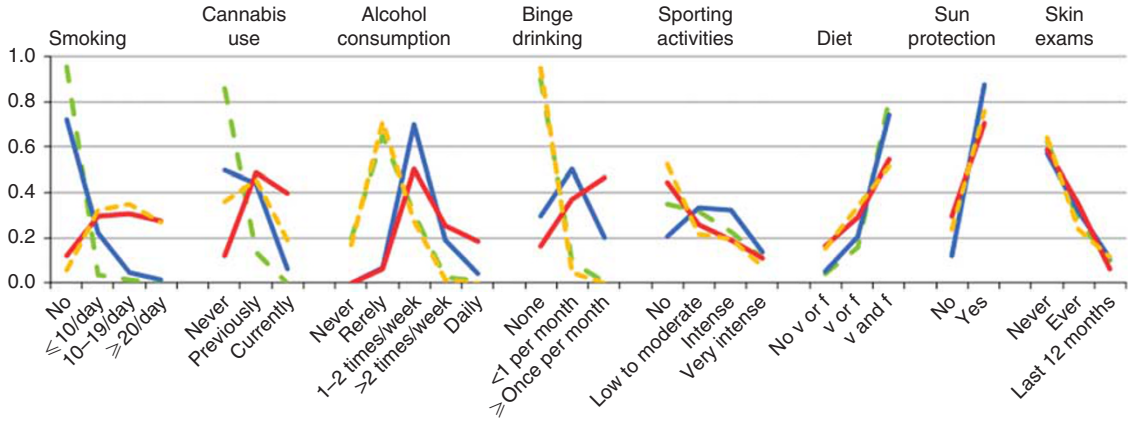

Figure 2 Prevalence of health behaviours within the four health-behaviour patterns identified. The prevalence of the response categories of a given variable are connected with lines to better visualise differences between the behaviour patterns. ▬▬, Cluster D1: risk-avaiding; ——, Cluster D2: moderate drinking; ——, Cluster D3: risk-taking; ·····, Cluster D4: smoking. Abbreviations: v = vegetables; f = fruits.

Clinical characteristics of health-behaviour clusters in survivors

In survivors, determinants of health-behaviour clusters in adjusted multinomial logistic regression were gender, diagnosis, therapy, relapse, having a migration background and income (Table 4). In females, the odds for having a behaviour pattern other than 'risk-avoiding' (Cluster D1) was a third or less of that in males (odds ratio (OR) 0.33 for 'moderate drinking' Cluster D2; 0.17 for 'risk taking' Cluster D3; 0.33 for 'smoking' Cluster D4). Compared with survivors of leukaemia, survivors of a central nervous system tumour were less likely to belong to the 'moderate drinking' Cluster D2 (OR 0.38) and 'risk-taking' Cluster D3 (0.26). Individuals treated by surgery only were more likely to belong to one of the three risk behaviour clusters D2, D3 and D4 (OR > 2) than those treated with chemotherapy, but no radiotherapy, and BMT was associated with the 'smoking' Cluster D4 (OR 3.60). Survivors who had a relapse were less likely to belong to a risk cluster (ORs < 0.6 for D2, D3 and D4). A migration background was associated with an increased risk for the 'smoking' Cluster D4 (OR 2.60).

In additional analysis (Supplementary Table 4), we investigated whether potential effects of diagnosis and treatment were mediated via education and income (assessed at time of survey) by excluding the latter variables from the regression models. Estimated associations did not change substantially, suggesting that associations between health-behaviour patterns and diagnosis or therapy were not mediated by educational attainment and income.

DISCUSSION

This study used LCA to determine how health behaviours cluster in young adult childhood cancer survivors and controls from the general population. Four health-behaviour clusters were identified: (i) 'risk-avoiding' with a healthy behaviour throughout, (ii) 'moderate drinking' with a similar profile, but engaging in more exercise and binge drinking, (iii) 'risk-taking' engaging in all risk behaviours and (iv) 'smoking' with a risk profile comparable with 'risk-taking', but low alcohol consumption. Fewer survivors than controls were part of the 'smoking' cluster, but more fell into the 'moderate-drinking' cluster. A considerable proportion, comparable to that in the general population (14%), engaged in multiple health-compromising behaviours.

Comparison with other health behaviour studies in the general population

Several authors have reported evidence for the clustering of health behaviour in the general population, including in children, adults and the elderly (Karvonen *et al*, 2000; Chiolero *et al*, 2006; Poortinga, 2007; Schneider *et al*, 2009; Sutfin *et al*, 2009; Huh *et al*, 2011). Our results are consistent with findings of a previous analysis of risk behaviours in the general Swiss population showing that, with increasing number of cigarettes, smokers engage less in leisure time physical activity, eat less fruits/vegetables and drink more alcohol (Chiolero *et al*, 2006). Determinants of multiple-risk behaviours in these studies were male gender and lower social class (Chiolero *et al*, 2006; Poortinga, 2007; Schneider *et al*, 2009). In agreement with these findings, we found that male gender was also associated with all three clusters involving risk behaviours. As in a previous study using data from the SCCSS (Rebholz *et al*, 2012), we found that high income and education were associated with alcohol consumption patterns. In student populations, increased alcohol use has previously been reported (O'Malley and Johnston, 2002), particularly among better-off students (Wicki *et al*, 2010). Students consume alcohol mostly for social and enhancement motives during social gatherings (Wicki *et al*, 2010). These may include gatherings in connection with sporting activities. Pupils engaging in a lot of sports more often reported episodes of drunkenness in Switzerland (Annaheim *et al*, 2006). In agreement with a study of Schneider *et al*, 2009 in a population 50 years plus, we found that the 'smoking' cluster contained many individuals with lower education and a migration background.

Comparison with health-behaviour studies in childhood cancer survivors

Several authors have compared single behaviours between survivors and healthy adults. They usually found less engagement in health-compromising behaviour among survivors, particularly smoking (Emmons *et al*, 2002; Carswell *et al*, 2008; Frobisher *et al*, 2008) and alcohol consumption (Carswell *et al*, 2008; Lown *et al*, 2008; Frobisher *et al*, 2010; Rebholz *et al*, 2012). Rather than focusing on single behaviours, we chose a multiple behaviour approach. This allowed, for instance, to identify the group of 'risk-takers', who engage in various unhealthy activities while neglecting healthy behaviours, and to show that this group is as prevalent

Table 3 Socio-demographic and clinical characteristics of health behaviour clusters in survivors and controls

	Cluster D1 'risk-avoiding'		Cluster D2 'moderate drinking'		Cluster D3 'risk-taking'		Cluster D4 'smoking'			
	Survivors ($n=352$)	Controls ($n=737$)	Survivors ($n=327$)	Controls ($n=470$)	Survivors ($n=114$)	Controls ($n=202$)	Survivors ($n=42$)	Controls ($n=261$)	*P*-value[a] survivors	*P*-value[a] controls
Socio-demographic characteristics										
Age (years)										
20–25	46.6	40.7	41.6	44.3	49.1	53.0	40.5	50.2	0.414	0.006
26–30	32.1	34.7	36.1	34.7	36.0	31.7	31.0	33.3		
31–35	21.3	24.6	22.3	21.1	14.9	15.4	28.6	16.5		
Gender										
Male	36.1	38.5	62.1	66.4	74.6	75.7	61.9	51.0	<0.001	<0.001
Female	63.9	61.5	37.9	33.6	25.4	24.3	38.1	49.0		
Language										
German	77.8	76.4	76.2	79.6	69.3	71.8	73.8	70.5	0.316	0.023
French/Italian	22.2	23.6	23.9	20.4	30.7	28.2	26.2	29.5		
Marital status										
Single, divorced or widowed	86.1	68.9	87.7	81.9	87.7	93.6	87.7	77.4	0.796	<0.001
Married	13.1	30.9	11.4	18.1	10.5	6.4	11.9	22.6		
Education										
Compulsory schooling	11.4	5.4	4.0	1.5	8.8	3.5	16.7	8.4	0.002	<0.001
Vocational training	44.0	55.4	45.0	50.0	47.4	60.9	54.8	68.6		
Higher secondary[b]	34.4	26.5	39.8	31.9	37.7	27.2	23.8	18.8		
University	6.5	12.8	10.1	16.6	5.3	8.4	2.4	4.2		
Income										
Unemployed	19.9	2.3	9.2	2.1	7.0	1.5	4.8	5.0	<0.001	0.001
0–3000 CHF	33.0	36.5	23.9	31.7	27.2	33.2	33.3	33.7		
3001–6000 CHF	40.9	46.8	54.1	47.5	51.8	55.9	52.4	52.9		
>6000 CHF	2.3	14.4	8.6	18.7	7.0	9.4	2.4	8.4		
Number of children										
None	75.0	72.7	82.6	86.0	83.3	91.1	83.3	77.0	0.265	<0.001
One	8.8	12.9	5.2	7.9	8.8	5.0	7.1	10.3		
Two or more	5.4	14.4	4.6	6.2	3.5	4.0	4.8	12.6		
Migration background[c]										
No	75.9	79.4	81.4	82.1	80.7	81.2	54.8	61.7	0.001	<0.001
Yes	24.2	20.6	18.7	17.9	19.3	18.8	45.2	38.3		
Body mass index (kgm^2)										
<25	72.6	74.6	77.5	77.0	69.6	77.7	85.1	75.5	0.142	0.143
⩾25	27.4	24.3	22.5	22.8	30.4	19.8	14.9	23.8		
Parent's education[d]										
Compulsory schooling	8.6		8.0		4.4		25.0		0.009	
Vocational training	47.3		43.3		47.8		29.2			
Higher secondary[b]	29.1		32.5		30.4		31.3			
University	9.4		12.9		13.9		4.2			
Clinical characteristics										
Age at diagnosis (years)										
≤ 4	29.6		26.3		25.4		21.4		0.209	
5–8	21.9		28.1		21.9		26.2			
9–12	21.3		22.3		26.3		11.9			
>12	27.3		23.2		26.3		40.5			
Diagnosis										
Leukaemia	33.2		40.7		40.0		35.7		0.024	
Lymphoma	17.9		17.7		24.6		16.7			
CNS tumour	16.8		8.3		7.0		16.7			
Other solid tumour[e]	32.1		33.3		29.0		31.0			
Therapy										
Surgery only	8.2		9.8		11.4		16.7		0.007	
Chemotherapy, but no radiotherapy	42.6		51.4		57.0		26.2			
Any radiotherapy	36.7		26.9		22.8		33.3			
BMT	11.9		10.7		7.9		21.4			
Relapse										
No	80.1		89.3		89.5		81.0		0.003	
Yes	19.9		10.7		10.5		19.1			

Abbreviations: CHF = Swiss Francs; CNS = central nervous system; BMT = bone marrow transplantation. [a]χ^2-test for differences in prevalence of characteristics between clusters. [b]Higher secondary education includes high school, teachers training colleges, technical colleges and higher vocational education. [c]Does not have a Swiss passport or has received the Swiss passport after date of birth or parents originate from another country. [d]The highest level of education of either father or mother. [e]Includes neuroblastoma, retinoblastoma, Wilms tumour, liver tumour, germ cell tumour, epithelial neoplasms, malignant melanomas, unspecified malignant tumours and Langerhans cell histiocytosis. Data are prevalence in %

Table 4 Determinants of health behaviour clusters in survivors only (adjusted multinomial logistic regression model)

	Cluster D1 'risk-avoiding' ($n=352$)	Cluster D2 'moderate drinking' ($n=327$)		Cluster D3 'risk-taking' ($n=114$)		Cluster D4 'smoking' ($n=42$)		
	Reference	OR[a]	95% CI	OR[a]	95% CI	OR[a]	95% CI	*P*-value[b]
Gender								
Male	1.00	1.00		1.00		1.00		<0.001
Female		0.33	(0.23–0.47)	0.17	(0.10–0.28)	0.33	(0.16–0.67)	
Diagnosis								
Leukaemia	1.00	1.00		1.00		1.00		0.122
Lymphoma		0.74	(0.46–1.19)	1.13	(0.61–2.09)	0.91	(0.33–2.51)	
CNS tumour		0.38	(0.20–0.77)	0.26	(0.09–0.76)	0.55	(0.16–1.96)	
Other solid tumours[c]		0.83	(0.55–1.25)	0.72	(0.40–1.31)	1.04	(0.42–2.54)	
Therapy								
Surgery only		2.08	(1.02–4.24)	2.94	(1.13–7.63)	5.77	(1.55–21.4)	0.003
Chemotherapy, but no radiotherapy	1.00	1.00		1.00		1.00		
Any radiotherapy		0.77	(0.51–1.16)	0.59	(0.33–1.06)	1.47	(0.60–3.62)	
BMT		0.85	(0.48–1.50)	0.55	(0.23–1.28)	3.60	(1.27–10.2)	
Relapse								
No	1.00	1.00		1.00		1.00		0.064
Yes		0.52	(0.32–0.87)	0.57	(0.27–1.18)	0.56	(0.21–1.47)	
Migration background								
No	1.00	1.00		1.00		1.00		0.009
Yes		0.71	(0.47–1.08)	0.76	(0.42–1.38)	2.60	(1.23–5.49)	
Income								
Unemployed		0.34	(0.22–0.66)	0.25	(0.10–0.60)	0.18	(0.04–0.85)	0.001
0–3000 CHF		0.72	(0.48–1.10)	0.86	(0.48–1.54)	0.92	(0.40–2.14)	
3001–6000 CHF	1.00	1.00		1.00		1.00		
>6000 CHF		2.02	(1.09–7.67)	1.89	(0.61–5.82)	0.94	(0.10–8.69)	
Education								
Compulsory schooling		0.43	(0.21–0.89)	0.74	(0.31–1.79)	1.69	(0.59–4.85)	0.102
Vocational training	1.00	1.00		1.00		1.00		
Upper secondary[d]		1.22	(0.83–1.80)	1.14	(0.67–1.96)	0.75	(0.31–1.80)	
University		1.44	(0.73–2.81)	0.76	(0.26–2.22)	0.33	(0.04–2.86)	
Parent's education[e]								
Compulsory schooling		1.08	(0.57–2.06)	0.73	(0.27–1.99)	2.51	(0.93–6.80)	0.483
Vocational training	1.00	1.00		1.00		1.00		
Higher secondary[d]		1.27	(0.86–1.87)	0.99	(0.57–1.71)	1.97	(0.84–4.64)	
University		1.76	(0.97–3.17)	1.83	(0.83–4.03)	1.05	(0.20–5.46)	

Abbreviations: BMT = bone marrow transplantation; CHF = Swiss Francs; CI = confidence interval; CNS = central nervous system; CHF = Swiss Francs; OR = odds ratio. [a]Adjusted for all factors listed and age at survey. Reference group for ORs is the 'risk-avoiding' Cluster D1, for example, the odds of belonging to Cluster D2 rather than to Cluster D1 (probability of Cluster D2/probability of Cluster D1) among females is 0.33 times that among males. [b]*P*-value of likelihood-ratio test. [c]Includes neuroblastoma, retinoblastoma, Wilms tumour, liver tumour, germ cell tumour, epithelial neoplasms, malignant melanomas, unspecified malignant tumours and Langerhans cell histiocytosis. [d]Higher secondary education includes high school, teachers training colleges, technical colleges and higher vocational education. [e]The highest level of education of either father or mother.

among survivors as in the general population. This would not have been evident from a simple univariate comparison of health behaviours between survivors and controls.

Few other studies have looked at engagement in multiple health behaviours of childhood cancer survivors, finding that behaviours were correlated with each other (Mulhern *et al*, 1995; Larcombe *et al*, 2002; Butterfield *et al*, 2004). Butterfield *et al*, 2004 created a risk factor variable out of five behaviours and found that the majority (92%) of survivors who were enroled in a smoking cessation trial engaged in other health-compromising behaviours. Larcombe *et al*, 2002 used principal component analysis to create a health-behaviour index based on smoking, drinking, recreational drug use, diet, exercise and sun care, ranging from 'most healthy' to 'least healthy'. The behaviour patterns 'risk-avoiding' and 'risk-taking' identified in our study may correspond to the ends of this spectrum. However, our approach using LCA identified two additional qualitatively distinct patterns 'moderate drinking' and 'smoking', which do not easily fit into a continuous spectrum.

Strengths and limitations

The SCCSS is a national population-based survey of childhood cancer survivors with a response rate of 72% that well represents young adult childhood cancer survivors in Switzerland. Questions on health behaviours originated from the SHS and were assessed in the SCCSS and SHS 2007 in the same study period. We used an objective method (LCA) to derive health-behaviour patterns from data on a set of pre-specified behaviour variables.

Several limitations should be considered. Health behaviours were based on self-report in both surveys and were, because of restrictions in length of the questionnaire, limited in detail. Differences in the survey methods (paper questionnaires in the

SCCSS and telephone interviews in the SHS) may have influenced replies. 'Wish bias', that is, the tendency to underreport health compromising or overreport socially desirable behaviours (Wynder *et al*, 1990), may have differentially affected replies in survivors and controls. Finally, results of the LCA depend on the selection of variables included in the models. A different selection of variables might have resulted in somewhat different patterns of health behaviours.

Implications for clinical practice

Our finding that the 'risk-avoiding' and 'risk-taking' behaviour patterns were equally prevalent in survivors and controls suggests that the experience of having had childhood cancer does not change future health behaviour in the majority of survivors. However, the higher proportion 'moderate drinkers' compared with 'smokers' in survivors might represent a shift away from smoking towards increased alcohol consumption in some. It is possible that survivors are more aware of the health-compromising effect of tobacco than of alcohol. In clinical guidelines on follow-up, care counselling against smoking is recommended (Hewitt *et al*, 2003; Scottish Intercollegiate Guidelines Network (SIGN), 2004; Hewitt *et al*, 2005; United Kingdom Children's Cancer Study Group, 2005), while whereas alcohol is rarely mentioned (Hewitt *et al*, 2003; Children's Oncology Group, 2008).

Few health interventions have yet been conducted in childhood cancer survivors (Clarke and Eiser, 2007; San Juan *et al*, 2011). Our study suggests that there is a need for targeted health interventions by showing that a significant proportion of cancer survivors readily engaged in multiple harmful activities. Given the increased vulnerability of childhood cancer survivors for chronic diseases and late mortality, this is a reason for concern (Hewitt *et al*, 2003; Oeffinger *et al*, 2006; Reulen *et al*, 2010). Engaging in multiple risk behaviours simultaneously can have synergistic detrimental effects on health (Mokdad *et al*, 2005), and health interventions should therefore primarily target survivors showing multiple-risk behaviour pattern. Multicomponent health interventions may help these survivors to adopt a healthy lifestyle (Prochaska, 2008). Conversely improvement of single behaviours may serve as a gateway: increasing physical activity and a healthier diet could, in turn, increase motivation and confidence for reducing smoking and alcohol consumption habits (Butterfield *et al*, 2004). Such an intervention might also benefit the small group of survivors who were allocated to the 'smoking' pattern, but not the 'moderate drinkers'.

Routine assessment of health behaviours and targeted counselling should be included in long-term follow-up for childhood cancer survivors. In previous studies, survivors have expressed interest in receiving lifestyle counselling, in particular for diet and physical activity (Demark-Wahnefried *et al*, 2005b; Zebrack, 2008), and follow-up care appointments may provide opportunities for teachable moments (Demark-Wahnefried *et al*, 2005a). Special attention should be given to male patients, to survivors from immigrant families, who are at particular risk of smoking, but also to survivors with a high educational attainment, who are at greater risk of increased alcohol consumption including binge drinking. Because of their high risk of late effects, survivors after BMT should be regularly seen in follow-up appointments, and risky behaviours should be strongly discouraged.

In conclusion, although engaging in health protective behaviour is more common and smoking less common in childhood cancer survivors than among young adults from the general population, a comparable proportion of young adults in both populations engage in multiple health-compromising activities. As childhood cancer survivors remain a vulnerable population, targeted health interventions are needed for this multiple risk-taking group.

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Conflict of interest

The authors declare no conflict of interest.

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REFERENCES

Annaheim B, Schmid H, Kuntsche E (2006) *Sport und Bewegung von 11- bis 16 -jährigen Schülerinnen und Schülern in der Schweiz*. Schweizerische Fachstelle für Alkohol- und andere Drogenprobleme: Lausanne

Armstrong GT, Liu Q, Yasui Y, Neglia JP, Leisenring W, Robison LL, Mertens AC (2009) Late mortality among 5-year survivors of childhood cancer: a summary from the Childhood Cancer Survivor Study. *J Clin Oncol* **27**(14): 2328–2338

Bauld C, Toumbourou JW, Anderson V, Coffey C, Olsson CA (2005) Health-risk behaviours among adolescent survivors of childhood cancer. *Pediatr Blood Cancer* **45**(5): 706–715

Bundesamt für Statistik (2008) *Schweizerische Gesundheitsbefragung 2007—Erste Ergebnisse*. Bundesamt für Statistik: Neuchâtel

Butterfield RM, Park ER, Puleo E, Mertens A, Gritz ER, Li FP, Emmons K (2004) Multiple risk behaviors among smokers in the childhood cancer survivors study cohort. *Psychooncology* **13**(9): 619–629

Carswell K, Chen Y, Nair RC, Shaw AK, Speechley KN, Barrera M, Maunsell E (2008) Smoking and binge drinking among Canadian survivors of childhood and adolescent cancers: a comparative, population-based study. *Pediatr Blood Cancer* **51**(2): 280–287

Centers for Disease Control and Prevention (2004) *The Burden Of Chronic Diseases And Their Risk Factors: National And State Perspectives 2004*. US Department of Health and Human Services: Atlanta

Children's Oncology Group (2008) Long-Term Follow-Up Guidelines for Survivors of Childhood, Adolescent, and Young Adult Cancers. www.survivorshipguidelines.org (accessed 21 March 2010)

Chiolero A, Wietlisbach V, Ruffieux C, Paccaud F, Cornuz J (2006) Clustering of risk behaviors with cigarette consumption: a population-based survey. *Prev Med* **42**(5): 348–353

Clarke SA, Eiser C (2007) Health behaviours in childhood cancer survivors: a systematic review. *Eur J Cancer* **43**(9): 1373–1384

Cox CL, Zhu L, Finnegan L, Steen BD, Hudson MM, Robison LL, Oeffinger KC (2011) Survivor profiles predict health behavior intent: the Childhood Cancer Survivor Study. *Psychooncology* **21**(5): 469–478

Demark-Wahnefried W, Aziz NM, Rowland JH, Pinto BM (2005a) Riding the crest of the teachable moment: promoting long-term health after the diagnosis of cancer. *J Clin Oncol* **23**(24): 5814–5830

Demark-Wahnefried W, Jones LW (2008) Promoting a healthy lifestyle among cancer survivors. *Hematol Oncol Clin North Am* **22**(2): 319–342

Demark-Wahnefried W, Werner C, Clipp EC, Guill AB, Bonner M, Jones LW, Rosoff PM (2005b) Survivors of childhood cancer and their guardians. *Cancer* **103**(10): 2171–2180

Emmons K, Li FP, Whitton J, Mertens AC, Hutchinson R, Diller L, Robison LL. for the Childhood Cancer Survivor Study (2002) Predictors of smoking initiation and cessation among childhood cancer survivors: a report from the childhood cancer survivor study. *J Clin Oncol* **20**(6): 1608–1616

Frobisher C, Lancashire ER, Reulen RC, Winter DL, Stevens MC, Hawkins MM (2010) Extent of alcohol consumption among adult survivors of childhood cancer: the British childhood cancer survivor study. *Cancer Epidemiol Biomarkers Prev* **19**(5): 1174–1184

Frobisher C, Winter DL, Lancashire ER, Reulen RC, Taylor AJ, Eiser C, Stevens MC, Hawkins MM (2008) Extent of smoking and age at initiation

of smoking among adult survivors of childhood cancer in Britain. *J Natl Cancer Inst* **100**(15): 1068–1081
Gritz ER, Demark-Wahnefried W (2009) Health behaviors influence cancer survival. *J Clin Oncol* **27**(12): 1930–1932
Hawkins MM, Lancashire ER, Winter DL, Frobisher C, Reulen RC, Taylor AJ, Stevens MC, Jenney M (2008) The British childhood cancer survivor study: objectives, methods, population structure, response rates and initial descriptive information. *Pediatr Blood Cancer* **50**: 1018–1025
Hewitt M, Greenfield S, Stovall EL (2005) *From Cancer Patient To Cancer Survivors: Lost In Transition*. National Academies Press: Washington, DC
Hewitt M, Weiner SL, Simone JV, National Research Council (2003) *Childhood Cancer Survivorship. Improving Care And Quality Of Life*. National Cancer Policy Board: Washington, DC
Horner MJ, Ries LAG, Krapcho M, Neyman N, Aminou R, Howlader N, Altekruse SF, Feuer EJ, Huang L, Mariotto A, Miller BA, Lewis DR, Eisner MP, Stinchcomb DG, Edwards BK (2009) *Seer Cancer Statistics Review* 1975–2006. National Cancer Institute: Bethesda, MD, USA
Huh J, Riggs NR, Spruijt-Metz D, Chou CP, Huang Z, Pentz M (2011) Identifying patterns of eating and physical activity in children: a latent class analysis of obesity risk. *Obesity (Silver Spring)* **19**(3): 652–658
Karvonen S, Abel T, Calmonte R, Rimpela A (2000) Patterns of health-related behaviour and their cross-cultural validity—a comparative study on two populations of young people. *Soz Praventivmed* **45**(1): 35–45
Khaw KT, Wareham N, Bingham S, Welch A, Luben R, Day N (2008) Combined impact of health behaviours and mortality in men and women: the EPIC-Norfolk prospective population study. *PLoS Med* **5**(1): 0039–0047
Kuehni CE, Rueegg CS, Michel G, Rebholz CE, Strippoli MP, Niggli FK, Egger M, von der Weid NX (2011) Cohort profile: The Swiss childhood cancer survivor study. *Int J Epidemiol*; doi:10.1093/ije/dyr142
Larcombe I, Mott M, Hunt L (2002) Lifestyle behaviours of young adult survivors of childhood cancer. *Br J Cancer* **87**(11): 1204–1209
Lazarsfeld PF, Henry NW (1968) *Latent Structure Analysis*. Houghton Mifflin: Boston
Lown EA, Goldsby R, Mertens AC, Greenfield T, Bond J, Whitton J, Korcha R, Robison LL, Zeltzer LK (2008) Alcohol consumption patterns and risk factors among childhood cancer survivors compared to siblings and general population peers. *Addiction* **103**(7): 1139–1148
McLachlan G, Peel D (2000) *Finite Mixture Models*. John Wiley & Sons: New York
Meadows AT, Friedman DL, Neglia JP, Mertens AC, Donaldson SS, Stovall M, Hammond S, Yasui Y, Inskip PD (2009) Second neoplasms in survivors of childhood cancer: findings from the Childhood Cancer Survivor Study cohort. *J Clin Oncol* **27**(14): 2356–2362
Michel G, von der Weid NX, Zwahlen M, Adam M, Rebholz CE, Kuehni CE (2007) The Swiss childhood cancer registry: rationale, organisation and results for the years 2001–2005. *Swiss Med Wkly* **137**(35-36): 502–509
Mokdad AH, Marks JS, Stroup DF, Gerberding JL (2005) Correction: actual causes of death in the United States, 2000. *J Am Med Assoc* 293(3): 293–294
Mulhern RK, Tyc VL, Phipps S, Crom D, Barclay D, Greenwald C, Hudson M, Thompson EI (1995) Health-related behaviors of survivors of childhood cancer. *Med Pediatr Oncol* **25**(3): 159–165
O'Malley PM, Johnston LD (2002) Epidemiology of alcohol and other drug use among American college students. *J Stud Alcohol Suppl* **14**: 23–39
Oeffinger KC, Mertens AC, Sklar CA, Kawashima T, Hudson MM, Meadows AT, Friedman DL, Marina N, Hobbie W, Kadan-Lottick NS, Schwartz CL, Leisenring W, Robison LL (2006) Chronic health conditions in adult survivors of childhood cancer. *N Engl J Med* **355**(15): 1572–1582
Poortinga W (2007) The prevalence and clustering of four major lifestyle risk factors in an English adult population. *Prev Med* **44**(2): 124–128
Prochaska JO (2008) Multiple health behavior research represents the future of preventive medicine. *Prev Med* **46**(3): 281–285
Rebholz CE, Kuehni CE, Strippoli MP, Rueegg CS, Michel G, Hengartner H, Bergstraesser E, von der Weid NX (2012) Alcohol consumption and binge drinking in young adult childhood cancer survivors. *Pediatr Blood Cancer* **58**(2): 256–264
Reulen RC, Winter DL, Frobisher C, Lancashire ER, Stiller CA, Jenney ME, Skinner R, Stevens MC, Hawkins MM (2010) Long-term cause-specific mortality among survivors of childhood cancer. *JAMA* **304**(2): 172–179
Robison LL, Mertens AC, Boice JD, Breslow NE, Donaldson SS, Green DM, Li FP, Meadows AT, Mulvihill JJ, Neglia JP, Nesbit ME, Packer RJ, Potter JD, Sklar CA, Smith MA, Stovall M, Strong LC, Yasui Y, Zeltzer LK (2002) Study design and cohort characteristics of the childhood cancer survivor study: a multi-institutional collaborative project. *Med Pediatr Oncol* **38**(4): 229–239
San Juan AF, Wolin K, Lucia A (2011) Physical activity and pediatric cancer survivorship. *Recent Results Cancer Res* **186**: 319–347
Schneider S, Huy C, Schuessler M, Diehl K, Schwarz S (2009) Optimising lifestyle interventions: identification of health behaviour patterns by cluster analysis in a German 50+ survey. *Eur J Public Health* **19**(3): 271–277
Scottish Intercollegiate Guidelines Network (SIGN) (2004) Long term follow-up of survivors of childhood cancer. A national clinical guideline. No. 76 Vol. http://www.sign.ac.uk/pdf/sign76.pdf (accessed 1 November 2010)
Skrondal A, Rabe-Hesketh S (2008) Latent variable modelling. *Stat Methods Med Res* **17**(1): 3–4
Steliarova-Foucher E, Stiller C, Lacour B, Kaatsch P (2005) International classification of childhood cancer. 3rd Edn. *Cancer* **103**(7): 1457–1467
Sutfin EL, Reboussin BA, McCoy TP, Wolfson M (2009) Are college student smokers really a homogeneous group? a latent class analysis of college student smokers. *Nicotine Tob Res* **11**(4): 444–454
United Kingdom Children's Cancer Study Group (2005) Therapy based long-term follow-up. In *A practice statement*, Skinner R, Wallace WH, Levitt GA (eds) 2nd Edition, United Kingdom children's cancer study group, Late effects group: UK
von der Weid N, Beck D, Caflisch U, Feldges A, Wyss M, Wagner HP (1996) Standardized assessment of late effects in long-term survivors of childhood cancer in Switzerland. *Int J Pediatr Hematol Oncol* **3**: 483–490
White J, Flohr JA, Winter SS, Vener J, Feinauer LR, Ransdell LB (2005) Potential benefits of physical activity for children with acute lymphoblastic leukaemia. *Pediatr Rehabil* **8**(1): 53–58
Wicki M, Kuntsche E, Gmel G (2010) Drinking at European Universities? A review of students' alcohol use. *Addict Behav* **35**(11): 913–924
Wynder EL, Higgins IT, Harris RE (1990) The wish bias. *J Clin Epidemiol* **43**(6): 619–621
Zebrack B (2008) Information and service needs for young adult cancer patients. *Support Care Cancer* **16**(12): 1353–1360

APPENDIX

The Swiss Paediatric Oncology Group (SPOG): Dr med R Angst, Aarau; Professor Dr med M Paulussen, Professor Dr med T Kühne, Basel; Professor Dr med A Hirt, Professor Dr med K Leibundgut, Bern; PD Dr med AH Ozsahin, Geneva; PD Dr med M Beck Popovic, Lausanne; Dr med L Nobile Buetti, Locarno; Dr med Pierluigi Brazzola, Bellinzona; Dr med U Caflisch, Lucerne; Dr med J Greiner, Dr med H Hengartner, St Gallen; Professor Dr med M Grotzer, Professor Dr med F Niggli, Zürich.