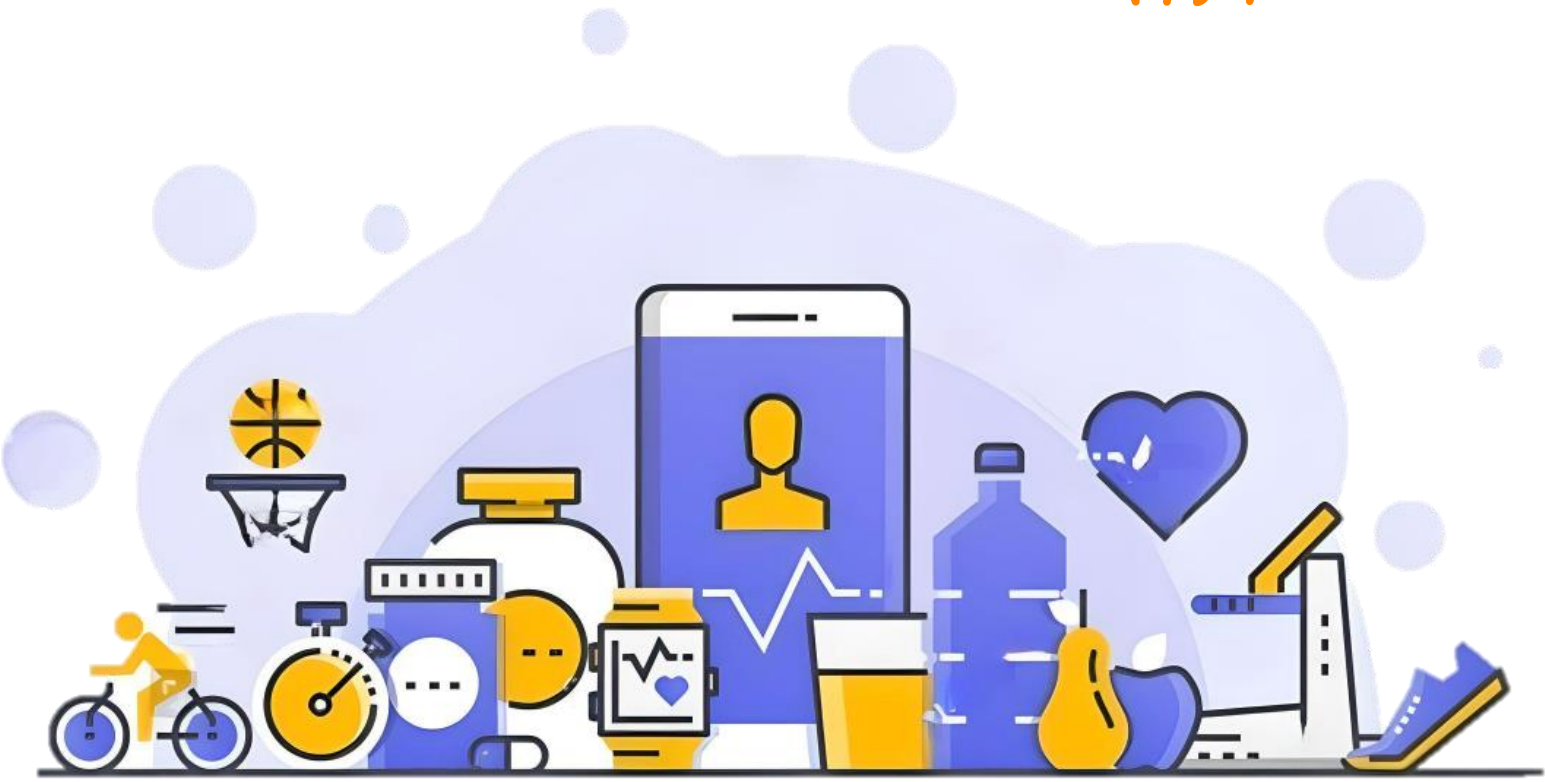
Lifestyle interventions in child, adolescent or young adult cancer survivors.

A systematic review



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Abstract

Background: Childhood cancer survivors (CCS) are at an increased risk of developing chronic diseases later in life due to toxic cancer treatments they received at the time. The risk of developing these chronic diseases is extravagated even further by unhealthy lifestyle habits. It is key for CCS to adopt a healthy lifestyle.

Aim: The aim of this systematic review is to summarize literature on the effects of lifestyle interventions on morbidity, mortality and quality of life of CCS.

Methods: Abstracts were selected from the online database MEDLINE (PubMed) with the search terms "Childhood cancer", "Children and young adults", "Survivors" and "Health behaviour interventions" and reviewed by two independent reviewers. Only randomized controlled trials were included.

Results: Fifteen papers out of 366 were found eligible. Participant numbers ranged from n=50 to n=784. Of the twelve different lifestyle interventions, seven showed significant results. Studied lifestyle behaviours were: n=3 smoking cessation, n=1 physical activity, n=1 diet-related bone health, n=1 sun exposure behaviour, n=1 health-risk/-protective behaviour. Programmed educational days had a significant effect on improving physical activity, sun exposure behaviour and diet-related bone health. Expert-to-patient health training sessions showed positive effects on smoking rates, breast-/testicular self-examination and junk food consumption. Peer-to-peer counselling sessions improved smoking cessation rates. Additionally, we found that peer-group approaches were more often effective in changing lifestyle behaviour as compared to interventions with a remote online environment. Moreover, we found that interventions were more successful if participants were allowed to set a personal goal beforehand.

Conclusion: Combined lifestyle interventions in CCS are shown to be effective in changing lifestyle behaviours such as, physical activity, sun exposure behaviour, diet-related bone health and smoking cessation. Future lifestyle interventions should embrace personal goal-setting with room for peer-group interactions.

Layman's summary

Children that survive cancer have had to undergo series of aggressive treatments and surgeries when they were young. Since children are in full physical development, these treatments can have a serious impact on their health on the long term. Some of these late effects could be heart failure or lung complications, diabetes or other psychosocial problems. By the age of 45, 95% of childhood cancer survivors (CCS) have at least one chronic health condition.

Adopting a healthy lifestyle, including a good diet, sufficient physical activity, no smoking etc., may lower the change of being affected by late effects. However, just like in the general population, maintaining a healthy lifestyle can be challenging. Lifestyle interventions, where CCS are educated about their increased risk of disease, and trained and supported by health care practitioners into adopting healthy lifestyle habits, may prevent or delay these late effects.

Systematic reviews are needed in science to recap what has been studied and what has been found to be effective. Moreover, it is important for the translation and implementation of research into the clinic. That is why we performed a systematic review on all the literature about CCS and lifestyle interventions, to better understand how lifestyle interventions could help CCS.

From our systematic search we found fifteen eligible papers that described twelve different lifestyle interventions. Lifestyle interventions that we saw were, for example: programmed interactive educational days or the use of digital/mobile tools such as e-modules or mobile-health apps in combination with Fitbits. Lifestyle behaviours that were studied were either physical activity, smoking, diet-related bone health, sun exposure behaviour, substance use or general health-risk/-protective behaviour. Five of the twelve lifestyle interventions that were found, showed a significant result in changing lifestyle behaviour of the participants. A programmed interactive educational day showed to be effective in changing physical activity, sun exposure behaviour and diet-related bone health. Additionally, interactive expert-to-patient health behaviour trainings showed positive effects on health-protective behaviours such as lowering junk food consumption, breast-/testicular self-examination or smoking intention rates. Moreover, a peer-to-peer counselling intervention showed great effects on smoking cessation rates among CCS.

Interestingly, from the trials that showed positive effects two general findings stood out. Frist, trials that facilitated a peer-group feeling among the CCS were more effective than the ones that had an online or digital design. Second, interventions where participants could set their personal health goals were more effective than trials where a health goal was assigned to them.

This review shows a summary of the current state of research about lifestyle interventions in CCS, published in the last two decades. The interest in lifestyle interventions in the general population is growing. In the right form, childhood cancer survivors could also benefit from them to decrease their chance of late effects.

Introduction

In the Netherlands, 600 children per year get diagnosed with cancer, of which neuroblastoma and acute lymphatic leukaemia (ALL) are most common.[1] Luckily, childhood cancer treatment has much improved in the last decade which has led to 5-year survival rates rising up to 80%. Meaning that 80% of children who get diagnosed with cancer will survive in the next 5 years. Currently there are about 16.000 childhood cancer survivors (CCS) in the Netherlands.[2]

This large and growing group calls for studies on long term health consequences, since treatments such as chemotherapy, radiation or stem cell transplantation can cause many physical and mental long-term late effects.[3] Examples of late effects could be heart failure,[4] pulmonary complications,[5] thyroid abnormalities,[6] impaired cognition,[7] posttraumatic stress disorder,[8] obesity,[9] osteoporosis or subsequent malignant neoplasms.[10] Type, onset and severity of the late effect depends on the therapeutical exposure at the time of treatment.

However, by the age of 45, 95% of CCS have at least one chronic health condition and 80% even has a serious disabling, or life-threatening chronic health condition.[11] This is twice the burden of disease compared to the general population at age 45.[12] Moreover, CCS are at an 8-fold increased risk of premature death when compared to the general population.[13] A second tumor, heart or lung problems are the most common causes of pre-mature death in CCS. So, sadly, surviving cancer does not stop at the cure. Long-term follow-up care is of utmost importance to maintain a healthy life for CCS.

Since CCS are already at an increased risk of serious health issues it is extra important for this population to maintain a healthy lifestyle. In the general population, poor lifestyle behaviour such as low level of physical activity, unhealthy diet, smoking and excess alcohol consumption are known to increase an individual's risk of disease.[14] As CCS already have an elevated health risk, a risky lifestyle behaviour will only aggravate this further. For example, Hodgkin's lymphoma survivors who received a chest radiation therapy have an increased risk of lung cancer. Smoking increases this risk by more than 20-fold.[15] Other studies showed that survivors of ALL are at an increased risk of developing obesity and insulin resistance later in life. A physically active lifestyle and healthy nutrition could lower this risk. [16,17]

Unfortunately, CCS generally engage in risky health behaviours in similar or only slightly lower rates as their siblings or peers.[18] Therefore, proper guidance from health care professionals to support CCS in adopting and sustaining a healthy lifestyle after cancer treatment completion, including not smoking and no or few alcohol consumptions, is important to prevent or delay late effects.[19]

Lifestyle or health behaviour interventions have been developed, but not much is yet known about the effectiveness of these interventions in this population. That is why in this review we will perform a

systematic analysis on all relevant and high quality published articles about health behaviour interventions in CCS. Determining the effectiveness of health behaviour interventions in this population could help CCS maintain a healthy life and reduce the burden of disease that late effects bring along.

The aim of this study is to determine the effectiveness of lifestyle interventions on physical health and mental health, including quality of life, in CCS.

Methods

We performed our methodological review according to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA).

Criteria for considering studies for this review

Types of studies

Studies that examined the association between the effectiveness of health behaviour interventions and the health of child, adolescent and young adult (CAYA) cancer survivors were considered. Interventional studies, including randomized controlled trial (RCT) with n≥50 were included. Case reports, case series or qualitative studies were excluded. Studies were filtered for original articles (no letters, editorials, commentaries, abstracts etc.), peer-review, English language and publication year after 1990.

Types of participants

Participant had to be CAYA cancer survivors who were 100% off active treatment. More than 75% of the study population had to be diagnosed with cancer before the age of 25, and more than 50% of the study population had to be either ≥5 years after diagnosis or ≥2 years after treatment completion.

Types of outcomes

Study outcomes had to be concerned with the effectiveness on change in health behaviours, including: levels of physical activity, diet/nutrition/body weight, smoking, alcohol use, drug use, sleep, and/or sun exposure and relaxation, as well as health outcomes, such as quality of life, morbidity or mortality.

Types of interventions

Lifestyle interventions included interventions focused on change in levels of physical activity, diet/nutrition/body weight, smoking, alcohol use, drug use, sleep, and/or sun exposure and relaxation. Interventions could focus on a single health behaviour or on combined health behaviours.

Search methods for identification of studies

Electronic searches

The online database MEDLINE (PubMed) was used in the period of April 2023. Search queries included the terms “Childhood cancer”, “Children and young adults”, “Survivors” and “Health behaviour interventions”. The full search strategy and search terms are provided in Appendix A. Papers were filtered for RCTs, English language, publication date after 1990 and humans.

Data collection and analysis

Selection of studies and data extraction

After performing the search strategies described above, two review authors independently selected studies based on abstract and full text that met the inclusion criteria. This was done by the use of an intelligent research collaboration platform Rayyan. Discrepancies between review authors were resolved by consensus. We obtained the full text of any study seemingly meeting the inclusion criteria for closer inspection. The study flow diagram is shown in Figure 1. Results from the studies were collected, categorized and summarized by one author.

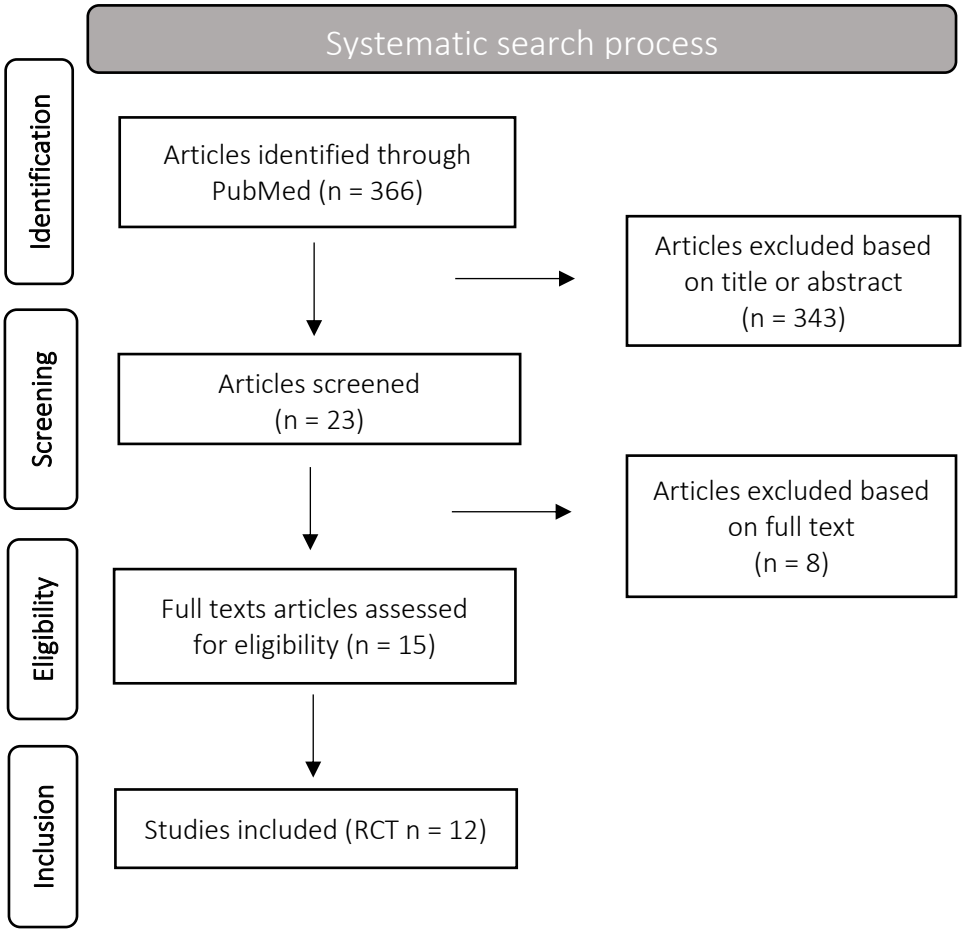

Figure 1 - PRISMA flow chart of search process. (RCT = randomized controlled trial)

Results

A total of 366 articles were collected from PubMed. After abstract/title and full text screening, n=15 papers were found eligible and 12 different lifestyle interventions were included for analysis. Evidence tables of all the RCTs are provided in Appendix B.

Type of lifestyle behaviours

Lifestyle behaviours that were studied were: physical activity (n=4); smoking cessation (n= 4); substance use (n=1); sun exposure behaviour (n= 1); diet-related bone health (n= 1); and health-risk/-protective behaviour (n=1). Furthermore, a variety of lifestyle interventions was seen among these studies (see Table 1).

Type of lifestyle intervention

N=3 interventions examined the benefits of a programmed interactive lifestyle education day with workshops and talks, whereas n=3 interventions examined the effects of digital- or mobile interventions. In addition, eight intervention used counselling sessions, either expert-to-patient (n=4) or peer-to-peer (n=2).

Summary of the included studies by type of lifestyle intervention

1. Programmed interactive lifestyle education days

A Hong Kong Chinese randomized clinical trial studied the effects of a 4-day integrated adventure-based training and health education programme in which 71 participants were randomized either into the intervention group (n=34) that received the adventure-training days or the control group (n=37) that did not receive the adventure-based training days but rather standard medical care follow-up.[20,21] The participants had an average age of 12.7. The main outcome was to improve the physical activity. The participants in the intervention arm were divided into groups of twelve at a day camp training centre were they participated in activities, such as educational talks, workshops to develop a feasible individual action plan for regular physical activity, and adventure-based training activities. These days were planned over a period of 6 months and follow-up was done at 9 months by Li et al.[20], and later at 12 and 18 months by Chung et al.[22] Adventure-based learning is a method where participants are exposed to a (physical) challenge that needs to be solved solely alone first. When succeeded, the experience participants had during the challenge is discussed with the trainers. In addition, improvements and encouragement to think of similar situations in daily life are reviewed. Examples of activities are rock climbing, trampoline jumping, shuttle runs or climbing across single-log bridges. After completion of the whole programme, at 9-month follow-up, the researchers found that participants in the intervention arm had significantly higher levels of physical activity (mean difference T1-T4

intervention group: -2.6 vs. control group -0.2), self-efficacy (mean difference T1-T4 intervention group: -2.0 vs. control group -0.3) and quality of life (mean difference T1-T4 intervention group: -4.3 vs. control group -0.1) as compared to baseline measures ($p<0.001$). When follow-up was done at 12 months and 18 months, this effect was sustained and effect sizes were even greater, especially that of quality of life. Moreover, this intervention was found to be both feasible and acceptable to the CCS after process evaluation.

Like-wise, the Lombardi Comprehensive Cancer Centre at the Georgetown University Medical Centre in Washington DC studied the effects of a programmed interactive lifestyle education (half-)day on the health of CCS. Mays and colleagues designed a programme called SHARE: Survivor Health and Resilience Education; a manualized, health education and multiple health behaviour change intervention. This intervention was used in two different randomized controlled trials, one on bone-health behaviour and one on sun safety behaviour.[23,24] In the bone-health behaviour trial, the SHARE programme consisted of a half-day interactive behavioural workshop. The workshops had a strong emphasis on nutrition and bone health-promoting behaviours such as calcium consumption. Components of the workshop were didactic presentations of bone health, demonstrations of healthy and unhealthy bone and discussion of meeting the recommended daily calcium consumption level of 1.300 mg per day. Moreover, nutritional aspects such as reading and understanding food labels, taste-testing calcium-rich foods and role playing of making calcium-rich food choices, were discussed. The 75 participants (average age of 14.2) were split into an intervention group (n=38) that received the SHARE programme and the control group (n=37) that received standard care. The researchers found that at 1-month follow-up, participants in the intervention group had a higher and more frequent milk consumption (intervention group (M=3.36, SD=0.72) vs. control group (M=2.93, SD=0.88)) and calcium-supplement consumption in their diet (intervention group (M=14.45, SD=10.97) vs. control group (M=3.03 SD=7.86)), as compared to the control group.

The effect of the SHARE programme on sun safety behaviour among CCS was studied in a different RCT by Mays and colleagues. 75 Participants (average age of 14.2) were split into an intervention group (n=38) that received the SHARE programme and the control group (n=37) that received standard care. The average age of all the participants was 14.2. Here, the programme focused on limiting sun exposure, using sunscreen with SPF-15 and wearing protective clothing. The workshops consisted of didactic presentations of sun exposure and sun protection, demonstrations of sun safety practices, and reviewing action plans regarding sun safety and other health-promoting behaviours. In addition, participants received a gift pack including samples of sunscreen. Post-intervention, at 1-month

Table 1. Evidence table of lifestyle interventions.

	First author	Intervention	Lifestyle behaviour	Results
Programmed interactive lifestyle education days	Li et al.[21]	Adventure-based training and health education programme.	Physical activity	Participants in the intervention group reported significant difference in physical activity stages of change ($p<0.001$), higher levels of physical activity ($p<0.001$) and self-efficacy($p=0.04$) than those in the control group. There was also a significant mean differences ($p<0.001$) in physical activity levels (-2.6), self-efficacy (-2.0), and quality of life (-4.3) of participants in the experimental group from baseline to 9 months after starting the intervention.
	Chung et al.[22]	Same study as above; follow up at 12 and 18 months.	Physical activity	Significant ($p<0.001$) main effect for intervention on physical activity levels (-2.3), self-efficacy (-1.9) and quality of life (-6.1). Improvement of quality of life statistically increased when follow-up extended to 12 or 18 months.
	Mays et al.[23]	Survivor Health and Resilience Education (SHARE) programme.	Diet-related bone health	At 1-mont post-intervention, participants in the intervention group reported higher and more frequent milk consumption (I (M=3.36, SD=0.72) vs. C (M=2.93, SD=0.88)) and calcium supplement consumption (I M=14.45, SD=10.97) vs. C (M=3.03 SD=7.86)).
	Mays et al.[25]	Survivor Health and Resilience Education (SHARE) programme.	Sun exposure behaviour	Participants in the intervention group reported significantly greater sun safety behaviours (I (M = 26.8, SD = 5.7) vs. C (M = 23.8, SD = 4.4)) at 1-month post-intervention than the control group did.
Digital or mobile interactive interventions	Howell et al.[26]	Interactive web-based educational materials.	Physical activity	At 6-monhts follow-up, participants who received the intervention treatment did not show difference in mean MVPA, fitness, neurocognitive outcomes or HRQoL in comparison with the control group.
	Mendoza et al.[27]	mHealth apps, Fitbit and social media.	Physical activity	Intervention- and control group participants had no significant difference in MVPA or sedentary behaviour.
	Hollen et al.[28]	Web-based online modules.	Substance use	There was no significance difference in quality decision making and risk motivation between participants that were in the intervention group and participants that were in the control group after 12 months.
One-on-one expert-counselling	Tyc et al.[29]	Risk counselling with expert.	Smoking	Compared with the SCC group, patients who received intervention had significantly higher knowledge scores (7.2% I vs. 4.4% C), higher perceived vulnerability scores (11.3% I vs.4.1% C), and lower intention to smoke scores at 12 months (-2.5% I vs. -1.7% C).
	Klesges et al.[30]	Telephone proactive quitline and nicotine replacement therapy.	Smoking	Neither the intervention group or the control group showed significantly impacted long-term smoking cessation rates.
	Salchow et al.[31]	Sport-scientist counselling.	Physical activity	There was no difference in MVPA between intervention and control group.
	Hudson et al.[32] Cox et al.*[33]	Multi-component behavioural intervention.	Health-risk/health-protective behaviour	Secondary-analysis by Cox et al. showed that in the intervention group BSE and TSE was increased ((t=-5.098, df=143, P=0.0001) and (t=3.049, df=108, P=0.003) resp.); junk food consumption was lowered (F(1,246)=3.80, P=0.052) and smoking abstinence remained consistent in the intervention arm while decreased in the control arm (F(1, 223)=2.936, P=0.088.),1 year post-baseline.
Peer-counselling	Emmons et al.[34]	Telephone-based peer-delivered counselling .	Smoking	The quit rate was significantly higher in the peer counselling condition vs the self-help condition at 8 (16.8% v 8.5%) and 12 months (15% v 9%).
	Emmons et al.[35]	Same study as above; follow up at 2 to 6 years.	Smoking	Quit rates at long-term follow-up (2-6 years) were significantly higher in the peer counselling condition vs the self-help condition (20.6% v 17.6%).
	Emmons et al.[36]	Web-based peer-delivered counselling.	Smoking	Equivalent rates of cessation were reported for both groups (16%) at the 15-month follow-up.

Abbreviations: I = intervention group; C=control group; MVPA = moderate-to-vigorous activity; HRQoL = health-related quality of life; BSE = breast self-examination; TSE = testicular self-examination; SSC = standard care control; *secondary-analysis.)

follow-up, participants in the intervention group reported significantly greater sun safety behaviour as compared with the participants in the control group ((M = 26.8, SD = 5.7) intervention group vs. (M = 23.8, SD = 4.4) control group). This could indicate that if CCS follow the SHARE programme it will increase their sun safety behaviour, decreasing their risk of melanoma's as late effect.

However a limitation of the SHARE studies was that the outcomes were based on self-reported measures, so an objective measure such as bone density to truly examine bone health outcomes or UV-exposure for sun safety practices, in this case, are lacking. Moreover, the effects found were rather short-term since follow-up was merely done at 1 month post-intervention. Nevertheless, an interim assessment of SHARE showed it to be relevant, understandable, beneficial and acceptable, advocating feasibility of yet to be performed trials with the SHARE programme with longer follow-up durations in the future.

2. Digital or mobile interactive lifestyle interventions

At the St. Jude Children's Research Hospital in Tennessee in 2019, the research group of Dr. Howell and colleagues was interested in the effect of a web-based behavioural intervention on the physical activity of CCS.[26] The 78 participants (mean age 12.6) were split into an intervention group (n= 53) and a control group (n=25) (2:1 randomization). By means of an interactive website and a wrist activity monitor, participants in the intervention arm of the trial could upload their individual physical activity data from their monitor to the website, accumulating points based on daily activities. The online avatar that the participants created at the start of the trial had to progress through various levels using the points earned. These point could also be used to redeem small prizes such as t-shirts or stickers. Additionally, educational materials were provided. Control group participants received an activity monitor as well as the educational materials, but had no access to the interactive website. After 24 weeks participants were assessed for moderate-to-vigorous physical activity (MVPA), fitness, neurocognitive outcomes and health-related quality of life (HRQoL). However, no statistical results on these outcomes were found. This might have been caused by the heterogeneity of the participants or the high variability within the activity monitors. That is why the researchers decided to repeat the trial and consider this RCT as a pilot study to gather preliminary data for a new larger trial. In this new trail, the researchers will perform the same interventional design but will focus solely on childhood ALL survivors (ClinicalTrials.gov Trial Number: NCT03223753). Moreover, outcome measures will be more specified to cardiopulmonary fitness, muscle strength, cardiovascular disease risk factors (blood pressure, obesity, lipids, insulin and glucose), fatigue, QoL and school attendance. The trial is now open for recruitment.

Similarly, Mendoza and his colleagues studied the effect of a wrist activity monitor, but not in combination with an interactive website, but with an interactive Facebook group for fellow participants.[27] In this trail, participants in the intervention arm (n=29; mean age 16.9) received a Fitbit Flex wearable wristband and a Fitbit mHealth app on their smartphone. Additionally, they were added to the online Facebook group where participants could earn badges and participation achievements but could also discuss their experience and encourage others. Daily step goals were set per week and gradually increased over the period of 10 weeks. Control group participants (n=30; mean age 16.3) received usual standard clinical care on physical activity by brief discussions or handouts. Despite the popular tracking device and easy accessible Facebook group, no significant differences in moderate-to-vigorous physical activity (MVPA) or sedentary behaviour were found between the intervention group and the control group at 10 weeks post-intervention. Nonetheless, participants were rather positive about the intervention. The Fitbit Flex and Fitbit app were found useful for goal setting, easy to use and motivational. But despite participants finding the Facebook group helpful for making connections and peer support effective, participants felt that it would be better to use a more preferred social media network such as Instagram or Snapchat, as Facebook is more thought to be for older people. Moreover, the small sample size (N=59) and short period of follow-up time (10 weeks) may have contributed to the non-significant results. A different trial design could provide promising results. So, this study showed mostly preliminary results for community-based mHealth interventions to promote physical activity.

Lastly, Hollen and colleagues also deployed the use of digital interventions for health practices in CCS.[28] In this trial, the researchers looked at the engagement of CCS in substance-use, such as smoking, alcohol consumption or drug use. 213 participants (average age 16.3) were split into an intervention group (n=102) and a control group (n=111). The intervention comprised of a decision aid with five interactive modules: decision-making module, smoking module, alcohol/drug-use module, interactive substance-use module and a health status module. All modules were delivered on a CD-ROM, except the health status module which was delivered by a health care professional. Decision making skills, risk motivation and risk behavioural status were assessed at three timepoints within 12 months. Despite that the majority of the participants rated the programme as positive (90%), there were no significant differences in quality decision making or risk motivation on substance-use between participants that were in the intervention group and participants that were in the control group at 12 months. However, the number of participants having cognitive problems due to late effects was high (66%) so this type of digital intervention might be challenging in this group. Especially because 90% of household members modelled substance use of some type, as well as 56% of their closest friends. This intervention might be more effective in a different target population.

3. One-on-one expert-counselling lifestyle interventions

A study from 2023 in the St. Jude's Children Research Hospital by Tyc and colleagues studied the effects of expert risk counselling on smoking cessation of adolescent CCS.[29] 103 participants (average age 14.2) were split into an intervention group (n=53) and a control group (n=50). The intervention consisted of a single session where participants were shown an educational video that discussed the long- and short-term physical and social consequences of tobacco use. In addition, a master's level psychologist discussed with them the late effect risks and potential chemotherapy and radiation treatment-related toxicities which can be exacerbated by smoking, and set a goal for tobacco abstinence or cessation. A physician feedback letter that reinforced the antitobacco message and tobacco literature was provided as well. Then, follow-up counselling was done at 1 and 3 months to reinforce the goals set by the participants. The control group did not receive personal follow-up counselling, but were briefly advised about the health risks associated with tobacco use. Interestingly, after 12 months, participants that had received the intervention did show a higher score in knowledge about the adverse consequences of tobacco use (T1-T3 7.2% increase from the intervention group compared to 4.4% increase in the control group) and a higher perceived susceptibility of tobacco-related risks (T1-T3 11.3% increase from the intervention group compared to 4.1% increase in the control group). Most importantly, this group showed a lower intention to smoke (T1-T3 2.5% decrease in the intervention group compared to 1.7% increase in the control group). This suggests that this design of tobacco risk counselling could be effective to decrease tobacco usage in adolescent CCS.

In addition, an earlier study in 2015 by Klesges and colleagues from the St. Jude's children Research Hospital was done on the effectiveness of multiple expert counselling sessions in adult CCS who smoked (average age unknown).[30] Participants in the intervention group (n=260) received six counselling sessions with an expert over a period of 8 weeks. During these sessions topics such as preparing to quit, the quitting process itself and short- and long-term relapse prevention, were discussed. Participants in the control group (n=259) received the same intervention sessions, but had to make the appointment themselves, while participants from the intervention group were directly contacted by the members of the staff to set appointments for the counselling sessions. Both groups were able to use nicotine-replacement therapy during the trial, if desirable. Outcomes that were measured after 12-months were point prevalence abstinence and continues abstinence, measured firstly by cotinine levels in urine or saliva and secondly by self-reported abstinence. The researchers found that there was no significant difference in effectiveness between the intervention group and the control group. This might by because 80% of all the participants who claimed abstinence from cigarettes failed the cotinine test, indicating that they were falsifying their tobacco status. Adjusting for this, the rates of smoking cessation in both conditions at 12 month were less than 2%, indicating that there was

no effect of the intervention what so ever. A reason for this low percentage might be the framing of the question whether the participants smoked or not. The could have made the participants uncomfortable when they had to admit they did not quit smoking and might explain why participants lied about their smoking status. Moreover, smoking cessation interventions might be more challenging in a group of adults who have been smoking for a long period of their life. In conclusion, this lifestyle intervention in this design is not effective.

A different expert-counselling approach was used by Salchow and colleagues in 2021 at the University Medical Center Hamburg-Eppendorf in Germany. They tried to study the effect of counselling sessions with a sport scientist on the physical activity levels of CCS.[31] Participants were split into an intervention group (n=36, mean age 16.5) and a control group (n=33, mean age 16.0). Individual needs were assessed and a personalized plan with goals of adopting and maintaining physically active behaviour was developed. Therapy-induced side-effects and current guidelines were dealt with as well. Consultations were done by phone on week 1, 3 and 12; follow-up was at 12-months. Control group participants only received physical activity guidelines by their physician during medical survivorship care. The main outcome was to increase the rate of MVPA. However, the intervention did not yield higher MVPA in the intervention group at 12-months post-baseline compared to the control group. These insignificant results may be the consequence of the control group having a very high mean MVPA at baseline and the small sample size (n=69). The researchers suggest to repeat the trial with a larger sample size.

A clinical trial by Hudson et al. and Cox et al. was done in 2002 and 2005 at the St. Jude Children's Research Hospital After Completion of Therapy (ACT) Clinic.[33,37] Survivors receive annual care in the ACT clinic for 10 year after diagnosis or at least until they have reached the age of 18. In this trial, participants in the intervention group (n=131, mean age 15.1) received the usual standard care plus a multi-behavioural intervention. The control group participants (n=135, mean age 15.0) only received the standard care. The multi-behavioural intervention consisted of (1) the distribution and discussion of a written ACT clinical summary; (2) health behaviour training in a health goal chosen by the survivor ; (3) health goal commitment to practice chosen behaviour during ensuing year; (4) and telephone follow-up at 3 and 6 months from the clinic visit to reinforce the behavioural training. Outcomes were assessed at 1 year post baseline. The first analysis by Hudson et al. in 2002 did not yield significant results, but Cox et al. did a secondary analysis in 2005. In this analysis the researches split the data of the health behaviour outcomes into health-risk behaviours (current smoking status, alcohol use, driving under the influence of alcohol, use of smokeless tobacco products, and junk food consumption) and health-protective behaviours (dental hygiene, nutrition, seatbelt use, sunscreen use, hours slept each night, exercise, and BSE/TSE). Interestingly, after this re-analysis Cox et al. found that the multi-behaviour

intervention did have an effect on health behaviours of the participants. In the intervention group, the frequency of breast self-examination (BSE) and testicular self-examination (TSE) was increased ((t=-5.098, df=143, P=0.0001) and (t=3.049, df=108, P=0.003) resp.), junk food consumption was lowered (F(1,246)=3.80, P=0.052) and smoking abstinence was remained consistent (F(1, 223)=2.936, P=0.088.), as compared to the control group. Because patients could choose their own health goal, motivation to change within the intervention group was high. This indicates that a multi-behavioural intervention in CCS that focusses on a personal health goal, could be effective.

4. Peer-counselling lifestyle intervention

Another form of intervention that was seen, was a peer-to-peer counselling intervention used in smoking cessation trials in CCS. Emmons et al. performed a randomized clinical trial in 2000 and a follow-up in 2005 on smoking cessation in CCS.[34,35] The 784 participants (mean age 31) were split into an intervention group (n=386) and a control group (n=398). The intervention (Partnership for Health) consisted of a peer-delivered telephone counselling whereby each participant was assigned to a peer counsellor who also was a CCS. Six calls were provided in a period of 7 months. The sessions were based on the principles of motivational interviewing and emphasized the smoker's choice, personal responsibility for change and enhancement of self-efficacy. The calls were tailored to the participant's stage of readiness to quit smoking. Participants in the control group received a letter from the study physicians, highlighting the importance of smoking cessation to reduce the risk of secondary cancers. After 8 and 12 months, health outcomes such as smoking status, self-efficacy and readiness to quit, were assessed. At 8-months follow-up, the quit rate in the intervention group was 16.8% and 8.5% in the control group ($p<0.0003$), whereas at 12-month follow-up quit rates in the intervention group were 15% and 9% in the control group ($p<0.01$). So, the peer-counselling intervention almost doubled the smoking cessation rates compared to the passive self-help smoking cessation intervention.

A longer follow-up study was conducted to assess the long-term effects of the Partnership for Health intervention at 2 years and 6 years post-baseline. They found that quit rates were still significantly higher in the peer-counselling group than in the control group (20.6% v 17.6% $p<0.0003$). This suggest that the Partnership for Health intervention has a great long-lasting effect on the participants regarding smoking cessation.

To see whether the success of the Partnership for Health studies could also be sustained in a more mobile or online design, Emmons and colleagues performed the Partnership for Health-2 study, where the same intervention was performed but now either via a web-intervention or via a print-materials format.[38] 374 participants were split into 201 intervention group participants (mean age 32.5) and 128 control group participants (mean age 33.59). To parallel the original PFH study, seven discrete

tailored session were made for the web intervention. The content was dynamically tailored, matching the participant's stage of readiness and participants could see their progress from session to session. The discussion forum on the website was moderated by a peer counsellor who served for a resource for questions. The control group received print materials that focused on readiness to change, participant-specific barriers, and other survivor-related topics. The materials were designed to be as interactive as possible and testimonials and stories of other survivors were included to provide peer-peer connection. The intervention period went on for 6 months and follow-up was done at 15 months. Surprisingly, there was no significant difference between the intervention group and the control group in terms of smoking status after 15 months (16% in the web-intervention and 15.5% in the print-intervention were abstinent for 30 days). However, these quit rates are similar to the quit rates of the PFH-1 (15.0%). This suggests that either the web-format or the print-format intervention could be recommended to CCS, besides the telephone-format PFH. Especially since 87.0% of the web-participants and 92.1% of the print-material-participants rated the intervention as satisfied. Either way, both PFH-1 and PFH-2 show that peer-delivered counselling has high potential in smoking cessations interventions in CCS.

Summary lifestyle interventions

In summary, from these twelve lifestyle interventions we saw that interventions with a programmed interactive lifestyle education day or lifestyle interventions with peer-counselling sessions had the most potential and significant results (n=5). In contrast, none of the three studies on digital or mobile interactive interventions had significant results (n=3). One-on-one expert counselling showed varying results, depending on the health behaviour target. For example, in smoking cessation, on-on-one expert counselling was helpful in adolescents (n=1) but not in adults (n=1). One-on-one expert counselling on physical activity with a sport scientist did not seem to be effective either (n=1). However, a multi-component risk behaviour intervention showed promising results for a range of health-risk behaviours and health-protective behaviours (n=1).

Lifestyle interventions per lifestyle behaviour

Lifestyle interventions for physical activity seemed to be most effective in a programmed interactive lifestyle education day format. One-on-one expert counselling or mobile/digital interactive interventions did not show results in this category.

Likewise, diet-related bone health and sun safety practices both seem to benefit from programmed interactive lifestyle education days, such as the SHARE programme.

In addition, substance-use intervention did not seem to profit from a mobile/digital interactive intervention such as the CD-ROM modules.

For smoking cessation interventions, peer-counselling programme PFH seemed to be the most effective, since actual quit rates, not just intention to smoke, were affected. The participants in the PFH-1 intervention group showed a 16.8% cessation rate. Whereas, participants in the Tyc et al. trial showed a 2.5% decrease merely in smoking intention. This design of lifestyle intervention would be more suited for risk counselling sessions.

And lastly, the multi-component behavioural intervention in addition to the annual standard care from the St. Jude Children's Research Hospital After Completion of Therapy (ACT) Clinic, showed potential for different kinds of health-risk and health-protective behaviours in CCS such as BSE and TSE; junk food consumption and smoking abstinence.

Discussion

In this systematic search about the effectiveness of lifestyle interventions in CAYA cancer survivors, we found fifteen eligible papers, describing twelve lifestyle interventions. Seven of these RCTs were significantly successful in changing health behaviours in the participants. Programmed interactive educational days, such as the trial by Li et al. about adventure-based training and health education programme or the SHARE programme by Mays et al., showed to be effective in changing physical activity, sun exposure behaviour and diet-related bone health (n=3)[20,23,24]. Interactive expert-to-patient coaching sessions, such as the multi-behavioural training by Hudson et al. or the risk counselling sessions by Tyc et al., showed positive effects on health-protective behaviours such as lowering junk food consumption, breast-/testicular self-examination or smoking intention rates (n=2)[37,39]. Moreover, peer-to-peer counselling interventions, such as the Partnership for Health 1 and -2 by Emmons et al., showed great effects on smoking cessation rates among the participants (n=2)[38,40].

What might explain why the adventure-based training and health education programme, the SHARE programme and the Partnership for Health 1 and -2 were effective, is the present of a peer-to-peer component. In all these interventions, participants were part of a group (or duo in the PFH) with other CAYA cancer survivors. A study by Basset et al. showed that in adolescents in the general population, positive peer-group influence is connected to positive protective behaviour.[41] Moreover, a study by Tomé et al. showed that peer-groups significantly influence academic performances of secondary school students. Since CAYA cancer survivors have such an unique health situation, a strong fellow peer-bond between survivors could be expected. An emphasis on this within lifestyle interventions could be of strong use to adopt a new protective health behaviour for them.

This might furthermore explain why in the online lifestyle interventions (Howell et al., Mendoza et al. and Hollen et al.) no significant effects were found; there were no peer-to-peer interactions.[26–28]

However, the trial by Mendoza et al. did implement a peer-to-peer component via an online-community on Facebook, but this was not successful because Facebook might not be the most popular social media platform among youngsters (but other platforms might be). Nevertheless, one could speculate that, if compensated for the lack of peer-to-peer feeling that online interventions often have, online lifestyle interventions could play a big role in the future, since these types of intervention are more practical, accessible and faster than on-site sessions.

In addition, expert-to-patient coaching sessions were seen to be successful in the trial by Tyc et al. and the trial by Hudson et al.[37,39] A strong feature of these interventions might be related to the fact that participants were able to set their own health goal, instead of having an assigned goal, as in the smoking abstinence trail by Klesges et al. that did not show results.[30] Psychology studies show that in the general population personal goal setting and self-efficacy is highly important to attain a certain personal goal.[42] Implementing a personal-goal setting in lifestyle interventions would increase intrinsic motivation of the participants and make the intervention even more effective. This aspect lays at the base of the Partnership for Health programmes, where participants are asked to set a personal goal.[38,40] In contrast, personal goal setting was a feature of the lifestyle intervention by Salchow et al., where they studied the effects of coaching sessions with a sport-scientist on physical activity, but no significant results were found there.[31] However, this might be caused by the high outcome measures of the control group.

The key strength of this systematic review is the unbiased clear methodology of evidence collection that provides a summary of current literature. Moreover, only RCTs, powerful scientific study designs, were used in this study, strengthening our conclusions. Nevertheless, some limitations should be considered when interpreting the results. Firstly, the inclusion criteria only allowed for participants that were more than two years post-treatment (or five years post-diagnosis) and 100% off-treatment, meaning no conclusions can be made about CCS that are not covered by these criteria. Second, merely the online database MEDLINE PubMed was used during the systematic search.

Moreover, a portion of trails described in this review could be seen as pilot studies since no results were found due to impaired research design (n=5 (12)).[26,28,30,31,43] Some factors that should be considered are, for example: the high heterogeneity among CCS participants; the size of the participant group to prevent attrition bias; variability within outcome measures such as activity monitors like the Fitbit Flex or self-reported smoking cessation; and follow-up time periods that should be long since some outcome measures such as quality of life are not shown until years later. As well as the age of the participants; adult participants might be less impressionable compared to children or young-adults. This was shown by the difference in results between the Tyc et al. study on adolescents

and the Klesges et al. study on adults.[29,44] Nevertheless, feasibility of the intervention and acceptance by the participants was high, so these pilot studies could be re-considered if trial designs are improved.

What is lacking from this systematic review should be researched further. Health behaviours that did not come up from our search were obesity-related diet and nutrition; alcohol-consumption; mindfulness and mental-health (stress-levels, meditation, yoga etc.) or sleep. More defined research questions into the different aspects of lifestyle would be highly interesting to study.

Regarding the clinical point of view, the findings of this review could contribute to the implementation of renewed guidelines concerning lifestyle interventions on CAYA cancer survivors. From this review we can speculate that peer-group feeling and personal goal-setting contribute to the success of a lifestyle intervention. This could be manifested in the clinic as multi-component health behaviour and -education trainings with personal guidance by an expert, and additionally, a component of community-based peer-to-peer interaction. This peer-to-peer interaction could comprise simple group meetings or more interactive action groups (online platforms or in real life) where health goals are set together and CCS can support each other in order to achieve this. In the Netherlands, a combined lifestyle intervention called *Gecombineerde Leefstijlinterventie* is subsidised by the government.[45] People with overweight can sign up for this two-year programme where healthy nutrition an physical activity is supported via personal guidance but also via group sessions and activities. This could easily be implemented in the clinic for CAYA cancer survivors.

Concluding, we reviewed all the current literature on lifestyle interventions in CAYA cancer survivors and its effectiveness. Of 366 screened papers we found fifteen eligible papers describing twelve different lifestyle interventions on different lifestyle behaviours. Seven of them were successful, the other papers can be seen as pilot studies for future research. We found that interventions were more successful when peer-group feeling and personal goal-setting were part of the intervention. Future clinical implications could consider these findings in the design of lifestyle interventions for CCS. The first paper on lifestyle intervention in CCS we found was only published 21 years ago, but the interest in lifestyle behaviour in the general population as well as in the CCS population, is rising rapidly. With this review we aim to contribute to this growing interesting field of research.

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Appendix

A. Search strategy - search terms

1. Population: Childhood cancer	leukemia OR leukemi* OR leukaemi* OR "childhood ALL" OR AML OR (leukemia, lymphocytic, acute[mh]) OR (leukemia, lymphocytic, acute*) OR lymphoma OR lymphom* OR hodgkin OR hodgkin* OR T-cell OR B-cell OR non-hodgkin OR non-hodgkin* OR sarcoma OR sarcom* OR sarcoma, Ewing's OR Ewing* OR osteosarcoma OR osteosarcom* OR wilms tumor OR wilms* OR nephroblastom* OR neuroblastoma OR neuroblastom* OR rhabdomyosarcoma OR rhabdomyosarcom* OR teratoma OR teratom* OR hepatoma OR hepatom* OR hepatoblastoma OR hepatoblastom* OR PNET OR medulloblastoma OR medulloblastom* OR PNET* OR neuroectodermal tumors, primitive OR retinoblastoma OR retinoblastom* OR meningioma OR meningiom* OR glioma OR gliom* OR brain tumor OR brain tumor* OR brain tumour* OR brain cancer* OR brain neoplasm* OR intracranial neoplasm* OR brain neoplasms OR central nervous system neoplasm OR central nervous system neoplasms OR central nervous system neoplasm* OR central nervous system tumor OR central nervous system tumour OR central nervous system tumor* OR central nervous system tumour* OR pediatric oncology OR paediatric oncology OR childhood cancer OR childhood tumor OR childhood tumors
2. Population: Children and young adults	infan* OR newborn* OR new-born* OR perinat* OR neonat* OR baby OR baby* OR babies OR toddler* OR minors OR minors* OR boy OR boys OR boyfriend OR boyhood OR girl* OR kid OR kids OR child OR child* OR children* OR schoolchild* OR schoolchild OR school child[tiab] OR school child*[tiab] OR adolescen* OR juvenil* OR youth* OR teen* OR under*age* OR pubescen* OR pediatrics[mh] OR pediatric* OR paediatric* OR peadiatric* OR school [tiab] OR school*[tiab] OR prematur* OR preterm* OR young adult OR young adults
3. Population: Survivors	Survivor OR survivors OR long term survivor OR long term survivors OR long term survivo* OR survivo* OR long term survival OR survival[mh] OR long-term survivor OR long-term survivors OR long-term survivo* OR childhood cancer survivor OR childhood cancer survivors OR childhood cancer survivo* OR cancer survivors[mh]
4. Intervention: General terms health behaviour	lifestyle intervention OR lifestyle interventions OR lifestyle interven* OR life style OR life styles OR life styl* OR lifestyle OR lifestyles OR lifestyl* OR healthy lifestyle OR health promotion Or health promotions OR health promot* OR "promotion of health" OR health campaign OR health campaigns OR health campaign* OR health counseling OR health councel* OR health coaching OR health coach OR health coach* OR health behavior intervention OR health behavior interventions OR health behavior interven* OR health behaviour intervention OR health behaviour interventions OR health behaviour interven* OR health behavior change intervention OR health behavior change interventions OR health behavior change interven* OR health behaviour change intervention OR health behaviour change interventions OR health behaviour change interven* OR modifiable lifestyle intervention OR modifiable lifestyle interventions OR modifiable lifestyle interven* OR self-management intervention OR self-management interventions OR self-management interven* OR weight loss intervention OR weight loss interventions OR weight loss interven* OR BMI change intervention OR BMI change interventions OR BMI interven* OR weight control intervention OR weight control interventions OR weight control interven* OR weight management intervention OR weight management interventions OR weight management interven* OR obesity intervention OR obesity interventions OR obesity interven* OR weight reduction programs OR weight reduction program OR weight reduction program*

	OR weight loss program OR weight loss programs OR weight loss program* OR obesity management OR obesity manag* OR health behavior adherence OR health behaviour adherence OR health behaviour adher* OR health behavior adher* OR multiple health behavior change interventions OR multiple health behavior change interven* OR multiple health behaviour change interventions OR multiple health behaviour change interven* OR health education OR health educations OR health educat* OR behavior change technique OR behaviour change technique OR behavior change techniques OR behaviour change techniques OR behavior change techniq* OR behaviour change techniq* OR mindfulness OR mindful* OR meditation OR meditat* OR relaxation OR relaxation* OR "progressive relaxation" OR yoga OR "lifestyle coach" OR "lifestyle coaches" OR "lifestyle coaching" OR lifestyle coach* OR "combined lifestyle intervention" OR "combined lifestyle interventions" OR "health behaviour change support" OR "health behavior change support" OR Ehealth lifestyle intervention OR Ehealth lifestyle interventions OR Ehealth lifestyle interven* OR E-health lifestyle intervention OR E-health lifestyle interventions OR E-health lifestyle interven* OR Mhealth lifestyle intervention OR Mhealth lifestyle interventions OR Mhealth lifestyle interven* OR M-health lifestyle intervention OR M-health lifestyle interventions OR M-health lifestyle interven*	
5. Filter: (Randomized) controlled trials	(Randomized controlled trial[pt] OR controlled clinical trial[pt] OR randomized[tiab] OR placebo[tiab] OR randomly[tiab] OR trial[tiab]) NOT (animals [mh] NOT humans [mh])	
Limits:	From 01-01-1990 English Language Humans	
Combined:	1 AND 2 AND 3 AND 4 AND 5	= 366 hits

B. Evidence tables of included papers

Health behaviour interventions – Physical Activity (1/5)

William Li et al. Effectiveness of an integrated adventure-based training and health education program in promoting regular physical activity among childhood cancer survivors.
Psycho-Oncology (2013) 22, 2601-2610

Study design	Participants	Intervention	Main outcomes	Additional remarks
Study design RCT Treatment era Not reported Follow-up duration 50,70% of participants were ≥ 2 years post treatment	Eligible participants: (a) Hong Kong Chinese childhood cancer survivors who had completed treatment at least 6 months previously, (b) aged between 9 and 16 years, (c) able to speak Cantonese and read Chinese, and (d) had not engaged in regular physical activity for the past 6 months. Non eligible participants: Childhood cancer survivors with evidence of re-current or second malignancies and those with physical impairment or cognitive and learning problems identified from their medical records. Type and number of non-participants: N=107; type not reported Type and number of participants: N=71; N=37 male (52.1%) Intervention group N=34; N=19 male (55.9%) Control intervention N=37; N=18 male (48.6%) Cancer diagnosis: Intervention group: - Leukaemia: N=15 (44.1%) - Lymphoma: N=8 (23.5%) - Brain tumor: N=3 (8.8%) - Bone tumor: N=4 (11.8%) - Neuroblastoma: N=4 (11.8%) Control group: - Leukaemia: N=20 (54.1%) - Lymphoma: N=10 (27.0%) - Brain tumor: N=1 (2.7%) - Bone tumor: N=4 (10.8%)	Health behaviour intervention 4-day integrated adventure-based training and health education program with activities such as educational talks, a workshop to develop a feasible individual action plan for regular physical activity, and adventure-based training activities. The program was implemented in small groups with a maximum of 12 participants per group and in a day camp training centre on 4 days over a 6-month period. Health education talks and work-shops took place between the adventure-based training activities in the day camp centre and were conducted by healthcare professionals working in a local university. The adventure-based training activities were led by two qualified adventure-based training instructors with extensive experience and professional knowledge of conducting such training for children. Determinants were measured at T1 (baseline), T2 (3 months), T3 (6 months) and T4 (9 months). Control intervention Received medical follow-up care according to the schedules of their respective oncology units. They received the same amount of time and attention as the intervention group but not in such way as to have any specific effect on the outcome measures. The children were invited to attend 4 days of leisure activities over a 6-month period, for example, at 2 weeks, 2 months, 4 months, and 6 months after the day of recruitment. Leisure activities were organized by a community centre, which included cartoon film shows, handicraft workshops, chess games, health talks on the prevention of influenza and eating a healthy diet, and a day visit to	Outcomes and definitions - CUHK-PARCY: Chinese University of Hong Kong: Physical Activity Rating for Children and Youth; 11-point scoring system to grade levels of physical activity. - PASCQ: Physical Activity Stages of Change Questionnaire; identifies different exercise patterns to the five stages: pre-contemplation, contemplation, preparation, action, and maintenance. - PA-SE: The Physical Activity Self-Efficacy; measures the children's self-confidence in their ability to participate in various age-appropriate physical activities. - PedsQL: The Paediatric Quality of Life Inventory; to measure the participants' quality of life. Effect of intervention 1. Participants in the experimental group reported statistically significant differences in physical activity stages of change ($p<0.001$), higher levels of physical activity ($p<0.001$) and self-efficacy($p=0.04$) than those in the control group. 2. Statistically significant mean differences ($p<0.001$) in physical activity levels (-2.6), self-efficacy (-2.0), and quality of life (-4.3) of participants in the experimental group from baseline to 9 months after starting the intervention. 3. Increase in the number of survivors in the experimental group progressing from the pre-contemplation stage to the contemplation stage and from the preparation stage to the action stage at a later date 4. Intervention effect size on the levels of levels of physical activity, self-efficacy, and quality of life were large, moderate, and small respectively. Other results	Risk of bias A. Selection bias: Low risk Reason: A parent of each child was asked to draw an envelope from the box to indicate the group assignment. The envelope was then put back into the box to be drawn by the next parent. B. Attrition bias: High risk Reason: 8,8% of the participants and 13,5% of the participants dropped out of the study. C. Detection bias: Unclear Reason: Not reported. D. Performance bias: Low risk Reason: A single-blind technique was used whereby the person collecting the data was ignorant of the intervention allocation of the study participants. Additional remarks (if applicable) Overlap

	- Neuroblastoma: N=2 (5.4%) <u>Age at diagnosis:</u> Not reported. <u>Age at follow-up:</u> Intervention group: 12.5 yrs (M) Control group: 12.8 yrs (M) <u>Cancer treatment:</u> Intervention group: - Surgery: N=4 (11.8%) - Chemotherapy: N=22 (64.7%) - Radiotherapy: N=2 (5.9%) - Mixed method: N=6 (17.6%) Control group: - Surgery: N=2 (5.4%) - Chemotherapy: N=27 (73.0%) - Radiotherapy: N=1 (2.7%) - Mixed method: N=7 (18.9%) <u>Comorbidities (if applicable)</u> Not reported <u>Additional participant characteristics (if applicable)</u> Not reported	a museum and theme park. Determinants were measured at T1 (baseline), T2 (3 months), T3 (6 months) and T4 (9 months).	<u>Feasibility</u> Feasibility and appropriateness of implementation appeared to be acceptable to the children en parents concerned. <u>Study adherence</u> N=3 participants in the intervention group and N=5 in the control group did not complete the study.	

Health behaviour interventions – Physical Activity (2/5)

Chung et al. Sustainability of an Integrated Adventure-Based Training and Health Education Program to Enhance Quality of Life among Chinese Childhood Cancer Survivors: A RCT.
Cancer Nursing (2015) 38, 366-374

Study design	Participants	Intervention	Main outcomes	Additional remarks
Study design RCT follow-up William Li et al 2013 Treatment era not reported Follow-up duration 50,70% of participants were ≥ 2 years post treatment, at the time of original study	Eligible participants: (a) Hong Kong Chinese childhood cancer survivors who had completed treatment at least 6 months previously, (b) aged between 9 and 16 years, (c) able to speak Cantonese and read Chinese, and (d) had not engaged in regular physical activity for the past 6 months. Non eligible participants: Childhood cancer survivors with evidence of re-current or second malignancies and those with physical impairment or cognitive and learning problems identified from their medical records. Type and number of non-participants: N=107; type not reported Type and number of participants: N=71; N=37 male (52.1%) Intervention group N=33; type not reported Control intervention N=36; type not reported Cancer diagnosis: Not reported per group, total population: - Leukaemia: 49.3% - Lymphoma: 25.4% Age at diagnosis: Not reported Age at follow-up: Not reported per group, total population: Average age of 12.6 yrs (2.1 SD).	Health behaviour intervention 4-day integrated adventure-based training and health education program with activities such as educational talks, a workshop to develop a feasible individual action plan for regular physical activity, and adventure-based training activities. The program was implemented in small groups with a maximum of 12 participants per group and in a day camp training center on 4 days over a 6-month period. Health education talks and work-shops took place between the adventure-based training activities in the day camp center and were conducted by healthcare professionals working in a local university. The adventure-based training activities were led by two qualified adventure-based training instructors with extensive experience and professional knowledge of conducting such training for children. Determinants were measured T1 (baseline), T2 (12 months) and T3 (18 months) Control intervention Received medical follow-up care according to the schedules of their respective oncology units. They received the same amount of time and attention as the intervention group but not in such way as to have any specific effect on the outcome measures. The children were invited to attend 4 days of leisure activities over a 6-month period, for example, at 2 weeks, 2 months, 4 months, and 6 months after the day of recruitment. Leisure activities were organized by a community center, which included cartoon film shows, handicraft workshops, chess games, health talks on the prevention of influenza and eating a healthy diet, and a day visit to a museum and theme park. Determinants were measured T1 (baseline), T2 (12 months) and T3 (18 months)	Outcomes and definitions - CUHK-PARCY: Chinese University of Hong Kong: Physical Activity Rating for Children and Youth; 11-point scoring system to grade levels of physical activity. - PASCQ: Physical Activity Stages of Change Questionnaire; identifies different exercise patterns to the five stages: pre-contemplation, contemplation, preparation, action, and maintenance. - PA-SE: The Physical Activity Self-Efficacy; measures the children's self-confidence in their ability to participate in various age-appropriate physical activities. PedsQL: The Paediatric Quality of Life Inventory; to measure the participants' quality of life. - Process evaluation: Short one-to-one semi-structured interview conducted at 18 months with 5 childhood cancer survivors and their parents, randomly selected from the experimental group. Determinants were measured T1 (baseline), T2 (12 months) and T3 (18 months) Effect of intervention 1. Statistically significant main effect for intervention on physical activity levels, self-efficacy, and quality of life. 2. The effect sizes for the integrated program on the levels of physical activity and self-efficacy were large and on quality of life were about moderate. 3. No statistically significant change in levels of physical activity and self-efficacy from T2 to T3. 4. There was a statistically significant difference in the stages of change of the experimental group but not of the control group across the 3 time periods. 5. Improvement of quality of life statistically increased when follow-up extended to 12 or 18 months.	Risk of bias A. Selection bias: Low risk Reason: A parent of each child was asked to draw an envelope from the box to indicate the group assignment. The envelope was then put back into the box to be drawn by the next parent. B. Attrition bias: High risk Reason: N=8 participants dropped out in the original study, N=2 more in the follow-up C. Detection bias: Unclear Reason: Not reported. D. Performance bias: High risk Reason: Process evaluation interviews was done only in the intervention group. Additional remarks (if applicable) Overlap

	Cancer treatment: Not reported per group. - Chemotherapy: 69.1% - More than 1 treatment: 18.3% Comorbidities (if applicable) Not reported Additional participant characteristics (if applicable) Not reported		Other results Feasibility The results of process evaluation revealed that the program was both feasible and acceptable to childhood cancer survivors. Study adherence Excluded N=2 participants, one from the experimental group who had been readmitted to hospital for a recurrence of cancer to be investigated, and another from the control group who declared that he was no longer interested in participating.	

Health behaviour interventions – Physical Activity (3/5)

Howell et al. Randomized web-based physical activity intervention in adolescent survivors of childhood cancer
Paediatric Blood and Cancer (2019) 65

Study design	Participants	Intervention	Main outcomes	Additional remarks
Study design RCT Treatment era Not reported Follow-up duration Survival time median 9.3 years (range 2.4-14.3)	Eligible participants: Survivors (of any diagnosis) who were treated at St. Jude Children's Research Hospital (SJCRH); were 11 to < 15 years of age; were in active follow-up (not currently undergoing active treatment for cancer); did not meet the Centres for Disease Control and Prevention's (CDC) physical activity guidelines at enrolment (e.g. 60 minutes of activity a day, seven days a week); and had internet access and a computer with software compatible with the study activity monitor. Non Eligible participants: Not reported Type and number of non-participants: N=95; Type not reported Type and number of participants: N=78; N=35 male (44.87%) Intervention group N=53; N=24 male (42.6%) Control intervention N=25; N=11 male (44.0%) Cancer diagnosis: Intervention group: - Acute lymphoblastic leukaemia: N=12 (22.6%) - Acute myeloid leukaemia: N=0 (0.0%) - CNS Tumours: N=14 (26.4%) - Ewing Sarcoma: N=1 (1.9%) - Germ cell tumor: N=1 (1.9%) - Hodgkin lymphoma: N=1 (1.9%) - Neuroblastoma: N=3 (5.7%) - Non-Hodgkin lymphoma: N=3 (5.7%)	Health behaviour intervention Educational materials, an activity monitor and access to an interactive website designed to encourage physical activity via rewards. When participants first logged into the website, they created an avatar (a character used to represent the participant). Participants uploaded individual physical activity data from their monitor to the website, accumulating points based on daily activity levels. The goal was to progress the avatar through various levels on the website using the points earned. Points could also be redeemed for small prizes (e.g. t-shirts, stickers) and/or gift cards. Outcomes were measured at baseline and 24 weeks. Control intervention Participants in the control group received an activity monitor and educational materials only. Outcomes were measured at baseline and 24 weeks.	Outcomes and definitions - Physical activity (PA): measured using a accelerometer for 24 weeks in moderate-to-vigorous activity (MVPA) - Fitness: handgrip strength, sit-ups and push-ups were assessed at baseline and 24-weeks only. - Neurocognitive: assessed using Wechsler Abbreviated Scale of Intelligence (WASI), which provides a Full Scale Intelligence Quotient (IQ). - Cognitive flexibility was assessed using the Delis-Kaplan Executive Function System (D-KEFS). Both measured at baseline and 24-weeks. - Health-related Quality of Life (HRQoL): measured using the Paediatric Quality of Life Inventory (PedsQL) v4.0, collected at baseline and 24-weeks. Effect of intervention 1. Survivors who were enrolled in the intervention increased their MVPA and maintained that increase over time, while survivors in the control group steadily decreased their weekly MVPA. But there was no statistical difference between groups for mean change in weekly MVPA after 24-weeks (4.7 (SD 119.9) minutes intervention group, −24.3 (SD 89.7) control group, p=0.30). 2. Mean change in fitness, neurocognitive outcomes and HRQoL did not differ statistically at 6 months follow-up. 3. Intervention efficacy did not differ by level of avatar advancement in intervention group. Other results	Risk of bias A. Selection bias: Unclear Reason: Not reported. B. Attrition bias: High risk Reason: Intervention group study completion rate was 84.2% and control group completion rate was 80.6% for all outcomes. C. Detection bias: Unclear Reason: Not reported. D. Performance bias: Unclear Reason: Not reported. Additional remarks (if applicable) Overlap

	- Retinoblastoma: N=9 (17.0%) - Rhabdomyosarcoma: N=3 (5.7%) - Soft tissue sarcoma: N=1 (1.9%) - Wilms tumor: N=4 (7.6%) - Other malignancy: N=1 (1.9%) Control group: - Acute lymphoblastic leukaemia: N=6 (24.0%) - Acute myeloid leukaemia: N=1 (4.0%) - CNS tumor: N=3 (12.0%) - Ewing sarcoma: N=0 (0.0%) - Germ cell tumor: N=0 (0.0%) - Hodgkin lymphoma: N=1 (4.0%) - Neuroblastoma: N=3 (12.0%) - Non-Hodgkin lymphoma: N=3 (12.0%) - Retinoblastoma: N=2 (8.0%) - Rhabdomyosarcoma: N=1 (4.0%) - Soft tissue sarcoma: N=0 (0.0%) - Wilms tumor: N=2 (8.0%) - Other malignancy: N=3 (12.0%) <u>Age at diagnosis:</u> Intervention group: 2.5 yrs M (0.0-11.3 range) Control group: 3.1 yrs M (0.3-9.4 range) <u>Age at follow-up:</u> Intervention group: 12.8 yrs M (11.1-14.9 range) Control group: 12.4 yrs M (11.0-15.0 range) <u>Cancer treatment:</u> Intervention group: - Surgery: N=49 (92.5%) - Chemotherapy: N=43 (81.1%) - Radiation: N=19 (35.9%) Control group: - Surgery: N= 24 (96.0%) - Chemotherapy: N=20 (80.0%)		<u>Feasibility</u> <u>Study adherence</u> N=10 participants from intervention group (completion rate 84.2%) and N=6 participants from control group (completion rate 80.6%) dropped out.	

	- Radiation: N=10 (40.0%) <u>Comorbidities (if applicable)</u> Not reported <u>Additional participant characteristics (if applicable)</u> - Not reported			

CNS = central nervous system;

Health behaviour interventions – Physical Activity (4/5)

Salchow et al. Effects of a structured counselling-based intervention to improve physical activity behaviour of adolescents and young adult cancer survivors – the randomized phase II Motivate AYA – MAYA trial
Clinical Rehabilitation (2021) 35, 1164-1174

Study design	Participants	Intervention	Main outcomes	Additional remarks
Study design Randomized controlled phase 2 trial (DRKS00009453) Treatment era Recruitment 2016-2017, with lasted follow-up 2018 Follow-up duration 7.0 ± 7.3 yrs (12.0 weeks to 33.1 years)	Eligible participants: Adolescent and young adult cancer survivors aged 15 to 39 years, with at least one treatment related (e.g. anthracycline based chemotherapy, chest radiation or cyclophosphamide and chest radiation), or non-treatment related risk factor (nicotine abuse, diabetes mellitus, dyslipoproteinemia or hypertension) for cardiovascular diseases. Non Eligible participants: Exclusion criteria included: ongoing cancer therapy, pre-existing severe cardiovascular disease or any contraindication for vigorous physical activity. Type and number of non-participants: N=26; type not reported Type and number of participants: N=69; N=29 male (42.0%) Intervention group N=36; N=13 male (36.1%) Control intervention N=33; N=16 male (48.5%) Cancer diagnosis: Intervention group: - Solid tumours: N=18 (50.0%) - Lymphoma: N=14 (38.89%) - Leukaemia: N=4 (11.11%) Control group: - Solid tumours: N=12 (36.36%) - Lymphoma: N=2 (36.36%) - Leukaemia: N=9 (27.27%)	Health behaviour intervention Individual physical activity counselling by a sports scientist, based on an adaption of the Transtheoretical Model. Individual needs were assessed and a personalized plan with the goals of adopting and maintaining physically active behaviour was developed. The sport scientists also provided information about therapy-induced side-effects and handed out current guidelines to the participants. After 1 and 3 weeks telephone consultation, a final consultation was done at week 12. Participants completed the questionnaires in weeks 0, 12 and 52. Questionnaires were given to all participants in person for the baseline data collection (week 0) and via post for the remainder for the trial. Control intervention Received a handout with the physical activity guidelines for cancer survivors at baseline by the physician during the medical survivorship care consultation. Participants completed the questionnaires in weeks 0, 12 and 52. Questionnaires were given to all participants in person for the baseline data collection (week 0) and via post for the remainder for the trial.	Outcomes and definitions Primary outcome: - Vigorous physical activity, defined as ≥ 9 MET-hours per week of vigorous activity, measured with short version of International Physical Activity Questionnaire (IPAQ) Secondary outcome: - Amount and intensity of physical activity behaviour (IPAQ) as well as the interest in and need for a clinical exercise programme (semi-structured interview), and overall quality of life (EORTC QLQ-C30). Effect of intervention 1. The rate of participants recording vigorous physical activity behaviour of ≥ 9 MET-hours per week was not doubled due to the intervention. 2. There was no significant difference within the inter-group comparison from baseline to post-intervention. Other results Feasibility Not reported. Study adherence N=15 participants in the intervention group and N=20 participants in the control group dropped out.	Risk of bias A. Selection bias: Low risk Reason: An uninvolved third- party researcher, who had no stake in the outcome of this study, was responsible for the allocation. Participants were designated based on the random drawing of a slip of paper from a sealed opaque envelope (#1 for control and #2 for intervention). B. Attrition bias: High risk Reason: 33.33% of intervention group and 45.45% of the control group dropped out C. Detection bias: Unclear Reason: Not reported. D. Performance bias: Unclear Reason: Not reported. Additional remarks (if applicable) Overlap

	<u>Age at diagnosis:</u> Intervention group: 16.5 yrs AV ± 5.8 SD Control group: 16.0 yrs AV ± 10.6 SD <u>Age at follow-up:</u> Intervention group: 23.4 yrs AV ± 5.8 SD Control group: 25.3 yrs AV ± 7.2 SD <u>Cancer treatment</u> Intervention group: - Chemotherapy: N=34 (94.44%) - Radiotherapy: N=15 (41.67%) - Surgery: N=17 (47.22%) Control group: - Chemotherapy: N=31 (93.94%) - Radiotherapy: N=18 (54.55%) - Surgery: N=10 (30.30%) <u>Comorbidities</u> Inclusion criteria were CAYAs with a treatment-related or non-treatment-related risk factor for cardiovascular diseases. Not further reported on. <u>Additional participant characteristics (if applicable)</u> Not reported			

AV = average; SD = standard deviation; MET = metabolic equivalent of task

Health behaviour interventions – Physical Activity (5/5)				
Mendoza et al. A Fitbit and Facebook mHealth intervention for promoting physical activity among adolescent and young adult childhood cancer survivors: A pilot study *Paediatric Blood and Cancer (2017) 64*				
Study design	**Participants**	**Intervention**	**Main outcomes**	**Additional remarks**
Study design Two-armed unblinded RCT (NCT02469727) Treatment era 2015-2016 Follow-up duration 10.3 years (IQR 7.5 – 13.0)	Eligible participants: 14–18 years old, ≥1-year post cancer therapy, ambulatory (able to walk) and without medical contraindication to increasing PA, able to complete questionnaires in English, and no previous use of a wearable PA tracking device. Non Eligible participants: Not reported. Type and number of non-participants: N=182; type not reported Type and number of participants: N=59; 24 male (40.7%) Intervention group N=29; 12 male (41.4%) Control intervention N=30; 12 male (40.0%) Cancer diagnosis (per group): Intervention group: - Leukaemia (ALL, MLL): N=9 (31.0%) - Bone (Ewing, osteosarcomas): N=0 (0.0%) - CNS: N=2 (6.9%) - Lymphoma (incl. Hodgkin and other types): N=4 (13.8%) - Other solid tumours: N=14 (48.3%) – Other: N=0 (0.0%) Control group: - Leukaemia (ALL, MLL): N=11 (36.7%) - Bone (Ewing, osteosarcomas): N=5 (16.7%) - CNS: N=3 (10.0%) - Lymphoma (incl. Hodgkin and other types): N=1 (3.3%) - Other solid tumours: N=9 (30.0%) – Other: N=1 (3.3%)	Health behaviour intervention (1) the Fitbit Flex wearable wristband and Fitbit mHealth app and (2) a Facebook group where participants could earn badges and participation achievements but could also discuss their experiences and encourage other participants. Starting in intervention week 2, research staff contacted participants via telephone or text message once per week to help set a daily step goal to increase it gradually over the coming weeks to meet population recommendations (10,000 steps/day); Research staff also sent affective text messages for PA every other day to encourage and remind intervention participants about their PA goals. The intervention period was 10 weeks. Time 1 measurements occurred in weeks 1–3 prior to randomization. Time 2 measurements occurred during weeks 8–10 of the intervention period. Control intervention Usual standard of clinical care advice on PA as per their providers' discretion; brief discussions and handouts. No active intervention. The intervention period was 10 weeks. Time 1 measurements occurred in weeks 1–3 prior to randomization. Time 2 measurements occurred during weeks 8–10 of the intervention period.	Outcomes and definitions - PA: measured by the Fitbit Flex expressed as moderate-to-vigorous physical activity (MVPA) and sedentary behaviour - Paediatric Quality of Life Inventory (PedsQL) 4.0 Generic Core: (1) physical functioning, (2) emotional functioning, (3) social functioning, and (4) school functioning. - Cancer Module Scales: (1) pain and hurt, (2) nausea, (3) procedural anxiety, (4) treatment anxiety, (5) worry, (6) cognitive problems, (7) perceived physical appearance, and (8) communication - Higher scores indicate higher Health Related Quality Of Life (HRQOL) - Facebook-engagement: measured by group posts "seen by" participants, participants' "likes", and participants' typed "comments". (descriptive variables) - Self-determination theory (SDT): measured by the Physiological Need Satisfaction in Exercise Scale - Continuum of PA: Behavioural Regulation in Exercise Questionnaire-2 and scales on 'amotivation' and integrated regulation. - Enjoyment of PA: Physical Activity Enjoyment Scale Effect of intervention 1. Intervention and control participants had no significant differences in MVPA or sedentary behaviour, all $p > 0.05$. 2. Significant difference at the social functioning scale of the PedsQL Generic Core ($p=0.04$).	Risk of bias A. Selection bias: Unclear Random: Participants were randomly assigned but not stated how this was done. B. Attrition bias: Low risk. Reason: N=0 participants dropped out. C. Detection bias: High risk Reason: Unblinded trial D. Performance bias: Unclear Reason: Not stated whether the participants or personnel were blinded from knowledge of which intervention was received. Additional remarks (if applicable) Overlap

	<u>Age at diagnosis</u> Not reported <u>Age at follow-up</u> Intervention group: 16.9 yrs M (1.5 SD) Control group: 16.3 yrs M (1,=.5 SD) <u>Cancer treatment</u> Intervention group: - Chemotherapy: N=26 (89.7%) - Radiation: N=8 (27.6%) - Lower extremity surgery: N=3 (10.3%) Control group: - Chemotherapy: N=24 (80.0%) - Radiation: N=8 (26.7%) - Lower extremity surgery: N=3 (10.0%) <u>Comorbidities (if applicable)</u> Not reported <u>Additional participant characteristics (if applicable)</u> Not reported		3. Significant difference for introjected motivation on the behavioural constructs of the SDT. (p=0.047). <u>Other results</u> <u>Feasibility</u> Acceptability and suggestions about the study were collected on a one-one-one interview (N=22) of the intervention group. Participants were mostly positive about the intervention. Many participants had recommendations for improving the intervention. <u>Study adherence (if applicable)</u>	

PA = Physical activity; ALL = acute lymphoid leukaemia; MLL = mixed lineage leukaemia; CNS = central nervous system;

Health behaviour interventions – Smoking (1/5)

Emmons et al. Peer-delivered smoking counselling for childhood cancer survivors increases rate of cessation: The Partnership for Health Study.
Journal of Clinical Oncology (2005) 23, 6515-6523

Study design	Participants	Intervention	Main outcomes	Additional remarks
Study design Randomized Controlled Trial Treatment era 1999-2000 Follow-up duration 5 years from the time of diagnosis	Eligible participants: From the Childhood Cancer Survivor Study (CCS) participants were recruited for the Partnership for Health (PFH) study. CCCS inclusion criteria were: diagnosis of leukaemia, CNS malignancies (all histology's), Hodgkin's disease, non-Hodgkin's lymphoma, kidney cancer, neuroblastoma, soft tissue sarcoma, or malignant bone tumor (1), diagnosis and initial treatment at one of the 27 collaborating CCSS institutions (2), diagnosis date between January 1, 1970, and December 31, 1986 (3), age younger than 21 years at the time of diagnosis (4), survival of at least 5 years from the time of diagnosis (5). Then, participants for the PFH were include if: age of at least 18 years (1), not currently in treatment for cancer (2), mentally able to provide informed consent (3), able to read and speak English (4), being a current smoker (5) Non Eligible participants: Not reported Type and number of non-participants: N=993; type not reported Type and number of participants: N=784; type not reported Intervention group N=386; type not reported Control intervention N=398; type not reported Cancer diagnosis (per group): Not reported per group, total participants: - Leukaemia: N=205 (26%) - Hodgkin's disease: N=144 (18%) - CNS malignancy: N=93 (12%) - Non-Hodgkin's lymphoma: N=90 (11%)	Health behaviour intervention Peer-delivered telephone counselling intervention. Each participant was assigned a peer counsellor (who was also a childhood cancer survivor) who worked with them throughout the intervention; up to six calls were provided within a 7-month period. The calls were tailored to the participants' stage of readiness to quit smoking and interest in other health topics and goals. Nicotine replacement therapy (NRT) was discussed and made available without costs to participants and their spouses who indicated that they were ready to make a serious quit attempt. A written report with tailored supplemental educational materials was provided before the first counselling call. Follow-up assessment were conducted 8 and 12 months after baseline survey. Control intervention Self-help intervention. Participants received a letter from the study physicians highlighting the importance of smoking cessation to reduce the risk of secondary cancers and the "Clearing the Air: How to Quit Smoking and Quit for Keeps" cessation manual. The manual discussed nicotine replacement therapy (NRT) as a treatment option, which is available over-the-counter for the participants to purchase and use if they wish. Follow-up assessment were conducted 8 and 12 months after baseline survey.	Outcomes and definitions Smoking status: - 7-day point-prevalence smoking status - Number of recent quit attempts - Smoking rate - Nicotine dependence (time from waking to first cigarette) - NRT use Psychosocial variables - Self-efficacy, defined by measures of confidence in one's ability to quit smoking using a 5-point Likert response scale. - Readiness to quit smoking, assessed by the Stages of Change algorithm Effect of intervention (1) The quit rate was significantly higher in the peer-counselling (PC) group when compared with the self-help (SH) group (16.8% vs 8.5%; P< .0003) at the 8-month follow-up. This difference was maintained at the 12-month follow-up (15% v 9%; P < .01) (2) Attempts to quit smoking were not significantly different between the two groups; by the 12-month follow-up, 20% of the SH group had made at least one serious quit attempt and 37% had made two or more attempts, compared with 18% and 43% of the PC group, respectively. (3) Controlling for baseline self-efficacy and depression, the PC group was likely to quit smoking by the 12-month follow-up, compared with the SH group (12-month OR = 1.99; 95% CI, 1.27 to 3.14).	**Risk of bias** A. Selection bias: Unclear Reason: No information on random sequence allocation and allocation concealment. B. Attrition bias: Low risk Reason: For all outcomes, more than 90% of both intervention and control group was assessed. C. Detection bias: Unclear Reason: No information whether the outcome assessors were blinded. D. Performance bias: Unclear Reason: No information whether participants and personnel were blinded. Additional remarks (if applicable) Self-help was used rather than a no-intervention control group, because of the ethical issues associated with failure to promote smoking cessation within this high-risk group. Overlap Follow-up study at 2 to 6 years was done by Emmons et al (2009)

	- Bone cancer: N=84 (11%) - Soft tissue sarcoma: N=75 (9%) - Kidney cancer: N=54 (7%) - Neuroblastoma: N=48 (6%) <u>Age at diagnosis (per group):</u> Not reported per group, total participants: 0-3 yrs: N=151 (19%) 4-9 yrs: N=231 (29%) 10-14 yrs: N=223 (28%) ≥ 15 yrs: N=191 (24%) <u>Age at follow-up (per group):</u> Not reported per group, total participants: 31 yrs M 6.66 yrs (SD) <u>Cancer treatment (per group):</u> Not reported per group, total participants: - Radiation, chemotherapy, or surgery only: N=92 (12%) - Radiation and surgery: N=113 (14%) - Radiation and chemotherapy: N=59 (7%) - Chemotherapy and surgery: N=120 (15%) - Radiation, chemotherapy, and surgery: N=259 (33%) - Data missing: N=153 (19%) <u>Comorbidities (if applicable)</u> Not reported <u>Additional participant characteristics (if applicable)</u> Not reported		(4) At the 8-month follow-up, 33% of participants in the PC condition reported that they had used NRT during the previous 6 months, compared with 8% of the SH participants. At the 12-month follow-up, 16% of the PC participants indicated that they had used NRT in the previous 4 months, compared with 6% of SH participants. (5) No significant interactions between NRT use and intervention group were found. <u>Other results</u> Not applicable. <u>Feasibility (if applicable)</u> Not applicable. <u>Study adherence (if applicable)</u> - 12 participants in the PC group did not complete the study - All participants in the SH group completed the study	

CCS = Childhood Cancer Survivor Study, PFH = Partnership for Health, CNS = central nervous system, SD = standard deviation, NRT = Nicotine Replacement Therapy, SH = self-help, PC = peer-counselling

Health behaviour interventions – Smoking (2/5)

Emmons et al. Long-term smoking cessation outcomes among childhood cancer survivors in the Partnership for Health Study. (FU of Emmons et al 2005)
Journal of Clinical Oncology (2009) 27, 52-60

Study design	Participants	Intervention	Main outcomes	Additional remarks
Study design Randomized Controlled Trial Treatment era Original study 1999-2000 (Emmons et al 2005) Follow up 2 to 6 years later. Follow-up duration >5 years from the time of diagnosis	Eligible participants: *Emmons et al 2005:* From the Childhood Cancer Survivor Study (CCS) participants were recruited for the Partnership for Health (PFH) study. CCCS inclusion criteria were: diagnosis of leukaemia, CNS malignancies (all histology's), Hodgkin's disease, non-Hodgkin's lymphoma, kidney cancer, neuroblastoma, soft tissue sarcoma, or malignant bone tumor (1), diagnosis and initial treatment at one of the 27 collaborating CCSS institutions (2), diagnosis date between January 1, 1970, and December 31, 1986 (3), age younger than 21 years at the time of diagnosis (4), survival of at least 5 years from the time of diagnosis (5). Then, participants for the PFH were include if: age of at least 18 years (1), not currently in treatment for cancer (2), mentally able to provide informed consent (3), able to read and speak English (4), being a current smoker (5) Non Eligible participants: Not reported Type and number of non-participants: N=231; type not reported Type and number of participants: N=565; N=288 male (50.97%) Intervention group N=282; N=141 male (50.0%) Control intervention N=283; N=147 male (52%) Cancer diagnosis (per group): Not reported.	Health behaviour intervention Peer-delivered telephone counselling intervention. Each participant was assigned a peer counsellor (who was also a childhood cancer survivor) who worked with them throughout the intervention; up to six calls were provided within a 7-month period. The calls were tailored to the participants' stage of readiness to quit smoking and interest in other health topics and goals. Nicotine replacement therapy (NRT) was discussed and made available without costs to participants and their spouses who indicated that they were ready to make a serious quit attempt. A written report with tailored supplemental educational materials was provided before the first counselling call. Follow-up assessment were conducted 8 and 12 months after baseline survey. Long-term follow-up assessment was done at 2 to 6 years postbaseline. Control intervention Self-help intervention. Participants received a letter from the study physicians highlighting the importance of smoking cessation to reduce the risk of secondary cancers and the "Clearing the Air: How to Quit Smoking and Quit for Keeps" cessation manual. The manual discussed nicotine replacement therapy (NRT) as a treatment option, which is available over-the-counter for the participants to purchase and use if they wish. Follow-up assessment were conducted 8 and 12 months after baseline survey. Long-term follow-up assessment was done at 2 to 6 years postbaseline.	Outcomes and definitions - Smoking status: based on 7-day point-prevalence smoking status at the end of the PFH intervention and LT follow-up among the entire sample, including: continuous smoker (smoker at each assessment), relapser (non-smoker at the end of PFH and a smoker at LT follow-up), delayed quitter (smoker at the end of PFH and non-smoker at LT follow-up), and continuous quitter (non-smoker at both time points). - Nicotine dependence: measured as time from waking to first cigarette. - Self-efficacy: defined using single-item measures of confidence in one's ability to quit smoking in at 1 and 6 months, and confidence in not smoking in a variety of situations. - Readiness to quit smoking: assessed by the Stages of Change algorithm - Depressed mood: assessed using a single item reflecting feelings of being downhearted and blue in the previous 2 weeks. Effect of intervention 1) 19% of all participants report having quit smoking at the LT follow-up. Quit rates at LT follow-up were significantly higher in the PC condition compared to SH (20.6% v 17.6%; P < .0003). 2) SH participants were almost twice as likely to be continuous smokers at the LT follow-up versus continuous quitters, compared with those in the PC condition, although the difference did not reach statistical significance (odds ratio, 1.86; 95% CI, 0.975 to 3.55; P=.0591). 3) Although smoking cessation rates continued to be higher among the PC group than SH, relapse rates were also higher in PC (11% v 4%), but not significantly different when compared with continuous quitters.	**Risk of bias** A. Selection bias: Unclear Reason: No information on random sequence allocation and allocation concealment. B. Attrition bias: High risk Reason: 75% op population left at FU. C. Detection bias: Unclear Reason: No information whether the outcome assessors were blinded. D. Performance bias: Unclear Reason: No information whether participants and personnel were blinded. Additional remarks (if applicable) LT smoking outcomes and quit attempts were not associated with subsequent cancer diagnosis, although recurrence was common (32% reported a cancer or benign tumor at follow-up). Overlap

	<u>Age at diagnosis (per group):</u> Not reported. <u>Age at follow-up (per group):</u> Intervention group: 31 yrs (6.5 SD) Control group: 31 yrs (6.9 SD) <u>Cancer treatment (per group):</u> Not reported. <u>Comorbidities (if applicable)</u> Not reported <u>Additional participant characteristics (if applicable)</u> Not reported		4) There were no differences between conditions in the rate of quitting by the LT follow-up among those who reported being smokers at the 8-month follow-up (approximately 13% in both conditions). 5) Overall, intervention condition was significantly associated with LT outcomes in bivariate analyses (P< .01). 6) Among those who were still smoking at the LT follow-up (n= 392), attempts to quit were not different by condition (at least 1 attempt: 58.7% of SH and 54% PC; 3+ attempts: 30.35% SH and 26.7% PC). <u>Other results</u> Continuous quit rates were significantly higher in those who received five to six calls (11%) vs those who received 3 to 4 calls (5%) or 0 to 2 calls (3%; P< .0001). However, relapse rates among those who quit at 8 months were also higher among those with a higher intervention dose (17%, 11%, and 2%, respectively). <u>Feasibility (if applicable)</u> Not applicable. <u>Study adherence (if applicable)</u> The response rate at the 8-month PFH follow-up was 77% (n=590), and 74% at the CCSS LT follow-up (n =566).	

CCS = Childhood Cancer Survivor Study; CNS = central nervous system; SD = standard deviation; SH = Self-help; PC = Partner Counselling; LT = Long-term; PFH = Partner for Health;

Health behaviour interventions – Smoking (3/5)

Emmons et al. Partnership for health-2, a web-based versus print smoking cessation intervention for childhood and young adult cancer survivors: Randomized comparative effectiveness study
Journal of Medical Internet Research (2013) 15

Study design	Participants	Intervention	Main outcomes	Additional remarks
Study design RCT Treatment era December 2005 – October 2009 Follow-up duration Participants were all ≥2 years post cancer treatment	Eligible participants: Diagnosed with cancer before age 35, currently between ages 18-55, completed cancer treatment for ≥2 years, included: diagnosed with cancer before age 35, currently between ages 18-55, completed cancer treatment for ≥2 years, mentally able to provide informed consent, reachable by telephone, able to speak English, and a current smoker (defined as smoking within the previous 30 days). Non Eligible participants: Not current smoker. Type and number of non-participants: N=4025; type not reported Type and number of participants: N=374; N=192 (51.3%) male Intervention group N=201; N=93 (45.8%) male Control intervention N=128; N=70 (55.6%) male Cancer diagnosis (per group): Intervention group: - Leukaemia: N=45 (22.2%) - Hodgkin's disease: N=40 (19.7%) - CNS malignancy: N=17 (8.4%) - Non-Hodgkin's Lymphoma: N=14 (6.9%) - Bone cancer: N=15 (7.4%) - Other: N=70 (34.5%) Control group: - Leukaemia: N=34 (27.0%) - Hodgkin's disease: N=21 (16.7%)	Health behaviour intervention PFH-2 Web intervention (1) a letter encouraging smoking cessation from the site oncologist, developed based on the principles of the National Cancer Institute's "5 A's" smoking counselling guidelines, (2) free pharmacotherapy for participants and spouses/significant others who want to quit, and (3) tailored and targeted self-help content (Web or print) addressing participant-specific barriers to change and other survivor-related topics of interest. The Web intervention consisted of seven discrete tailored sessions designed to parallel the counselling sessions of the original PFH study and mirror the basic content of the PFH-2 print materials. Content was dynamically tailored and matched the participants' stage of readiness. Control intervention PFH-2 Print materials Intervention (1) a letter encouraging smoking cessation from the site oncologist, developed based on the principles of the National Cancer Institute's "5 A's" smoking counselling guidelines, (2) free pharmacotherapy for participants and spouses/significant others who want to quit, and (3) tailored and targeted self-help content (Web or print) addressing participant-specific barriers to change and other survivor-related topics of interest. Print materials were materials that were developed for the peer counsellor condition in PFH-1 (Emmons et al 2005). The material focused on readiness to change, participant-specific barriers and other survivor-related topics of interest. They were designed to be as interactive as possible and testimonials and stories of other	Outcomes and definitions Smoking behaviour: - Smoking status: self-reported assessment of smoking - Nicotine dependence: number of minutes after waking that participants smoked their first cigarette - Quit attempts: number of quits in the previous 12 months with at least 24 hours abstinence - Use of pharmacotherapy: assessed withing two questions about whether participants had ever use Zyban or nicotine replacement therapy to quit smoking Motivational variables: - Stages of change scale: assessed motivation to quit smoking according to four categories - Self-efficacy: assessed related to participants' level of confidence that they could quit smoking in the next 1 and 6 months Effect of intervention 1) There were no significant differences between the two interventions arms in terms of smoking status at follow-up. 16% of Web participants and 15.5% of print participants reported being abstinent for the previous 30 days. 2) Compared to quit rates in the original PFH peer-delivered telephone intervention (Emmons et al 2005), current Web and print conditions suggests PFH-2 interventions attained equivalent levels of cessation (PFH-1: 15% quit rates at 12 months follow-up) 3) Quit attempts among low and high users of intervention were (resp.); Print: 2.0 vs	Risk of bias A. Selection bias: Low risk Reason: The random allocation sequence was generated by the study biostatistician. Randomization was done by the survey team and supervised by the biostatistician, following completion of the baseline survey. B. Attrition bias: Low Reason: All outcomes were analysed for more than 90% of the control and intervention group at follow-up. C. Detection bias: Unclear Reason: No information whether participants and personnel were blinded. D. Performance bias: Unclear Reason: No information whether participants and personnel were blinded. Additional remarks (if applicable) Overlap

	- CNS malignancy: N=15 (11.9%) - Non-Hodgkin's Lymphoma: N=6 (4.8%) - Bone cancer: N=10 (7.9%) - Other : N=42 (33.3%) <u>Age at diagnosis (per group):</u> Not reported. <u>Age at follow-up (per group):</u> Intervention group: 32.50 yrs (LS means) Control group: 33.59 yrs (LS means) <u>Cancer treatment (per group):</u> Intervention group: - Radiation: N=122 (60.1%) - Chemotherapy: N=153 (75.4%) - Surgery: N=141 (69.5%) Control group: - Radiation: N=81 (64.3%) - Chemotherapy: N=96 (76.2%) - Surgery: N=93 (73.8%) <u>Comorbidities (if applicable)</u> Not reported <u>Additional participant characteristics (if applicable)</u> Not reported	survivors were included to provide survivor-survivor connection. The intervention period was 6 months and a follow-up survey was completed by telephone at 15 months after randomization.	4.45 and Web: 3.42 vs 6.47 (*P* not reported) 4) Smoking rates among low and high users of intervention were (resp.); Print: 13.7 vs 9.84 (cigs/day) Web: 9.8 vs 3.42 (cigs/day) (*P* not reported) 5) There were no significant differences in terms of quit attempts between the two arms. 6) There were no significant differences between the two arms in terms of impact on readiness to quit smoking. <u>Other results</u> Psychological variables: - Cancer-related distress: assessed with the Intrusive Thoughts subscale of the Impact of Events Scale (IES) - Perceived control: assessed with a 3-item scale that measured the degree to which participants felt they could control physical side effects, future health, and chance of a cancer recurrence - Perceived vulnerability: assessed with a question about the likelihood of experiencing serious health problems in the future <u>Feasibility (if applicable)</u> - Of the Web participants who logged in, 87.9% (116/132) reported being satisfied or very satisfied with the site. - Of the print condition participants, 92.1% (117/127) reported being satisfied or very satisfied with the materials. <u>Study adherence (if applicable)</u> Not reported	

CNS = central nervous system; LS = least-square; PFH = Partnership for Health

Health behaviour interventions – Smoking (4/5)

Tyc et al. Intervention to reduce intentions to use tobacco among paediatric cancer survivors
Journal of Clinical Oncology (2003) 21, 1366-1372

Study design	Participants	Intervention	Main outcomes	Additional remarks
Study design RCT Treatment era Not reported. Follow-up duration The median time from diagnosis was 6.3 years (range, 1.7 to 15.7 years).	Eligible participants: Preadolescents and adolescents who were previously treated for cancer at St. Jude Children's Research Hospital (SJCRH, Memphis, TN) who were currently disease-free and who were at least 1 year from completion of all antineoplastic therapy. Non Eligible participants: Patients with brain tumours were excluded because of the cognitive and functional impairments that are characteristic of many of these patients after treatment. Type and number of non-participants: N=16; type not reported Type and number of participants: N=103; N=53 males (51.5%) Intervention group N=53; N=28 males (52.8%) Control intervention N=50; N=25 males (50.5%) Cancer diagnosis (per group): Not reported per group, all participants: - 57.3% leukaemia - 42.7% solid tumours Age at diagnosis (per group): Not reported. Age at follow-up (per group): Intervention group: - 10-13 yrs: N=21 (39.6%) - 14-18 yrs: N=32 (60.4%) Control group: - 10-13 yrs: N=19 (38.0%)	Health behaviour intervention Tobacco intervention (TI) group. A single session with periodic reinforcement of tobacco goals by telephone. The intervention consisted of an educational video that discussed the short- and long-term physical and social consequences of tobacco use; late effects risk counselling focused on potential chemotherapy and radiation treatment-related toxicities that can be exacerbated by tobacco use and the survivors' increased vulnerability to tobacco-related health risks relative to their healthy peers; goal setting involving tobacco abstinence or cessation depending on the survivor's smoking status; a physician feedback letter that reinforced the antitobacco message delivered in the intervention; tobacco literature; and follow-up telephone counselling at 1 and 3 months after the intervention to reinforce previously established goals and address barriers to achieving goals of tobacco abstinence or cessation. Participants were assessed at baseline, 6 and 12 months following intervention Control intervention Standard care control (SCC) group. Patients in the SCC group were asked about their tobacco use and briefly advised about the health risks associated with tobacco use. All tobacco users were advised to stop and non-smokers were encouraged to continue to resist tobacco. Participants were assessed at baseline, 6 and 12 months following intervention.	Outcomes and definitions - Knowledge (K): The K scale consists of 25 true-false questions related to the adverse consequences associated with tobacco use. Several questions focus on the increased health risk of the youngster treated for cancer. - Perceived vulnerability (PV): Eight-item scale measures participants perceptions of their vulnerability to tobacco-related health risks secondary to cancer treatment. Individual responses were rated on a 5-point scale. Higher score represents higher PV. - Intentions to smoke (I): The I scale consists of six items that measure future intentions to use tobacco as rated on a 5-point scale ranging from very unlikely to very likely. - Perceived positive effects of tobacco use: 13-item scale assesses perceptions of the positive effects that accompany tobacco use. Effect of intervention 1) 7.2% increase in K for the TI group was obtained compared with a 4.4% increase in the SCC group at 12 months. 2) PV scores at 12 months increased 11.3% in the TI group relative to a 4.1% increase in the SCC group. 3) At 12 months, a 2.5% decrease in I scores for the TI group was found compared with a 1.7% increase in scores for the SCC group. 4) No significant difference between SCC and TI groups at 6 months, across all outcomes	Risk of bias A. Selection bias: Low risk Reason: The random assignment for all patients was stratified by age, sex, race, and self-reported smoking status using the randomization scheme proposed by Zelen. B. Attrition bias: High risk Reason: Every outcome was assessed for 39/50 (78%) participants in the control group and 42/50 (84%) participants in the intervention group at 12-month follow-up. Moreover, the outcome of perceived positive effects of tobacco use was only assessed for 40/53 (75.5%) participants at 12 month follow-up. C. Detection bias: Unclear Reason: No information whether participants and personnel were blinded. D. Performance bias: Unclear Reason: No information whether participants and personnel were blinded. Additional remarks (if applicable) Overlap

	- 14-18 yrs: N=31 (62.0%) <u>Cancer treatment (per group):</u> Not all demographics reported. Mantle radiotherapy (or bleomycin): - intervention group: N=3 - control group: N=5 <u>Comorbidities (if applicable)</u> Not reported. <u>Additional participant characteristics (if applicable)</u> Not reported.		<u>Other results</u> <u>Feasibility (if applicable)</u> Not reported. <u>Study adherence (if applicable)</u> ~ 70% and 78.6% of patients provided data at the 6- and 12-month assessment intervals, respectively.	

TN = Tennessee; TI = tobacco intervention; SCC = standard care control;

Health behaviour interventions – Smoking (5/5)

Klesges et al. Efficacy of a tobacco quitline among adult survivors of childhood cancer.
Nicotine and Tobacco Research (2015) 17, 710-718

Study design	**Participants**	**Intervention**	**Main outcomes**	**Additional remarks**
Study design RCT Treatment era Not reported Follow-up duration In remission for at least 1 year	Eligible participants: Participants were CCSs diagnosed prior to 21 years of age and in remission for at least 1 year. Participants had to be at least 18 years and had to be smoking cigarettes regularly for a year or more (like a traditional QL, all individuals who perceived themselves as "regular smokers" were considered eligible without a minimum number of cigarettes smoked per day). Non Eligible participants: Not reported. Type and number of non-participants: Not reported. Type and number of participants: N=-519; N=285 male (45.1%) Intervention group N=260; N=150 male (57.7%) Control intervention N=259; N=135 male (52.1%) Cancer diagnosis (per group): Not reported. Age at diagnosis (per group): Not reported. Age at follow-up (per group): Not reported. Cancer treatment (per group): Not reported. Comorbidities (if applicable) Smokers.	Health behaviour intervention Proactive +4 weeks of medication quitline (QL) (counsellors call the participants) and nicotine replacement therapy (NRT). Participants in the Proactive + 4 weeks of medication intervention were contacted by study staff to schedule appointments for the intervention to be delivered. Upon successful contact by the project staff, survivors were scheduled for six counselling sessions over an 8-week period of time. In the event that the participant could not be reached for a scheduled counselling session, counsellors proactively contacted participants until the intervention was delivered. After three or more unsuccessful telephone attempts to reach a participant, a letter or e-mail was sent, encouraging participants to re-contact study staff. Participants in the Proactive condition were mailed a four-week supply of NRT in the form of the patch followed by another four week supply three weeks later if they had successfully stopped smoking on their quit date. Follow-up assessment was done 12-months after baseline measures. Control intervention Reactive +2 weeks of medication QL (participants initiate call to counsellors) and nicotine replacement therapy (NRT). In the Reactive + 2 weeks of medication intervention, participants were given a toll-free number and were told they could call for intervention sessions by trained counsellors any time during the hours of 8 a.m. and 8 p.m. CST. While some tobacco QLs are staffed 24 hr per day, a 12-hr period of time, including early morning and early evening hours, was perceived to be a good blend between high accessibility and the available	Outcomes and definitions Primary outcome: - Point prevalence abstinence: whether the participants had smoked in the past 7 days. > verified by a cotinine urine levels - Continuous abstinence: whether the participants had smoked since their quit date. > verified with salivary cotinine levels Secondary outcome: - Self-reports of point prevalence and continuous abstinence at end of treatment (8 weeks) and at 12-months follow-up. Effect of intervention 1. Primary: The cessation rates are 2.3% (n = 6) in the Proactive + 4 weeks of medication condition and 4.6% in the Reactive + 2 weeks of medication condition (n = 12), a nonsignificant difference (OR = 0.49, 95% CI = 0.15–1.43, p = .16). 2. Secondary: At the end of the intervention (8 weeks), 33.2% of those in the Proactive + 4 weeks of medication condition reported point prevalence abstinence, compared with 17.0% in the Reactive + 2 weeks of medication condition (p < .001). 3. Secondary: Those in the Proactive + 4 weeks of medication condition reported a significantly higher rate of continuous abstinence at end of treatment (20.8% vs. 12.0%, p = .009). 4. At 12-month follow-up, neither self-reported point prevalence	Risk of bias A. Selection bias: Unclear Reason: Not reported. B. Attrition bias: Low risk Reason: 16.11% attrition for all outcomes. C. Detection bias: Unclear Reason: Not reported D. Performance bias: Unclear Reason: Not reported. Additional remarks (if applicable) *Did not meet the inclusion criteria on participants >2 years off treatment, due to lack of information in the paper.* Overlap

	<u>Additional participant characteristics (if applicable)</u> Not reported.	resources for the study. After hours, there was a voice mail where participants could leave a message, and interventionists would contact them as soon as possible. Participants in the Reactive + 2 weeks of medication condition were told to call up to six times over an 8-week period. Participants in the Reactive condition received a starter package including two weeks' worth of NRT and a brochure detailing proper patch use to enhance safety of use. Subsequently, they were encouraged to purchase the patch for six additional weeks. Follow-up assessment was done 12-months after baseline measures.	(23.0% vs. 18.7%) nor continuous (11.5% vs. 9.7%) abstinence were significantly different for the Proactive + 4 weeks of medication versus Reactive + 2 weeks of medication conditions. <u>Other results</u> 1. Participants in the Proactive + 4 weeks of medication condition demonstrated a significantly higher total number of completed counselling sessions compared to participants in the Reactive + 2 weeks of medication condition among those who completed 12-month follow-up ($p < .0001$). <u>Feasibility (if applicable)</u> <u>Study adherence (if applicable)</u> N=72 did not complete study	

CCS = childhood cancer survivors; Ql = quitline; NRT = nicotine replacement therapy; CST = central standard time;

Health behaviour interventions – Diet (1/1)

Mays et al. Efficacy of the Survivor Health and Resilience Education (SHARE) program to improve bone health behaviours among adolescent survivors of childhood cancer.
Annals of Behavioural Medicine (2011) 42, 91-98

Study design	**Participants**	**Intervention**	**Main outcomes**	**Additional remarks**
Study design RCT Treatment era Not reported. Follow-up duration >2 years post treatment.	Eligible participants: adolescents aged 11–21 years who were treated for an oncologic malignancy, were one or more years post-cancer treatment, and one or more years cancer-free. Non Eligible participants: Not reported Type and number of non-participants: Not reported. Type and number of participants: N=75; N=36 male (48.0%) Intervention group N=38; N=17 male (44.7%) Control intervention N=37; N=19 male (51.4%) Cancer diagnosis (per group): Not reported. Age at diagnosis (per group): Not reported. Age at follow-up (per group): Intervention group: 14.2 yrs (M 2.0 SD) Control group: 14.2 yrs (M 2.8 SD) Cancer treatment (per group): Not reported. Comorbidities (if applicable) Not reported. Additional participant characteristics (if applicable) Not reported.	Health behaviour intervention The resulting intervention was comprised of a half-day interactive behavioural workshop that included messages and skill-building exercises addressing relevant risk-reducing and health-promoting behaviours for adolescent survivors of childhood cancer. The intervention had a strong emphasis on nutrition and bone health behaviours, including calcium consumption, with the goal of promoting good bone health habits and preventing bone-related morbidity. Intervention content that focused on promoting bone health included didactic presentations of bone health, demonstrations of healthy and unhealthy bone, and a discussion of meeting USDA-recommended daily calcium consumption level of 1,300 mg per day. Nutritional aspects of the intervention related to bone health focused on reading and understanding food labels, taste-testing calcium-rich foods, and role playing of making calcium-rich food choices. Intervention sessions were facilitated by a masters-level registered dietician who was a member of the research team. Participants completed a follow-up assessment via telephone approximately 1 month after the end of the intervention (median=41 days). Baseline assessment was done prior to random allocation. Control intervention The control condition was a standard care wait-list condition. Control participants were offered the intervention at the conclusion of the study. Participants completed a follow-up assessment via telephone approximately 1 month after the end of the intervention (median=41 days). Baseline assessment was done prior to random allocation.	Outcomes and definitions Theoretical Predictors of Bone Health Behaviour: - Bone health knowledge: six multiple choice items adapted from the U.S. Department of Health and Human Services (U.S.DHHS) National Bone Health Campaign for children and prior research. Bone health knowledge was operationalized using a continuous variable reflecting the proportion of items each participant answered correctly (range, 0–100%). - Calcium consumption self-efficacy: assessed using a 11-item scale adapted from earlier research [30]. Bone health behaviour: - Milk consumption frequency: single item adapted from the U.S. DHHS National Bone Health Campaign. The item asked participants "How often would you say you drink milk?" - Dietary calcium intake: assessed on the U.S. Department of Agriculture (USDA) five-step multiple pass 24-h recall method. This method asks participants to list everything that he or she ate/drank for a preceding 24-h period, and subsequently asks questions about when and where foods were eaten, details about each food, and then reviews information with participants. - Calcium supplementation: a single item asking "On how many of the past 30 days did you take a calcium supplement?" Effect of intervention 1. Average milk consumption frequency was significantly higher	Risk of bias A. Selection bias: Unclear Reason: Not reported. B. Attrition bias: Unclear Reason: Not reported. C. Detection bias: Low risk Reason: All telephone interviews were administered by a trained research assistant who was masked to trial condition. D. Performance bias: Unclear Reason: Not reported. Additional remarks (if applicable) - *Did not meet the inclusion criteria on participants >2 years off treatment, due to lack of information in the paper.* Overlap

			among intervention participants at 1-month post-intervention (M=3.36, SD=0.72) compared with control participants (M=2.93, SD=0.88; t(63)=2.16, p=0.03). 2. Intervention participants reported significantly more frequent milk consumption at 1-month follow-up compared with control participants (B=0.50, 95% confidence interval (CI)=0.08, 0.92, p=0.02). 3. At 1-month follow-up, a significantly greater proportion of intervention participants (82.9%) reported taking any calcium supplements in the past 30 days compared with control participants (24.1%; χ2 1 df=22.2, p<0.001). 4. The odds of reporting any calcium consumption in the past 30 days was significantly higher among intervention participants at 1-month follow-up (odds ratio=24.49, 95% CI=4.91, 143.05, p<0.001). 5. The mean number of days with calcium supplementation in the past month was significantly higher among intervention participants (M=14.45, SD=10.97) compared with control participants (M=3.03 SD=7.86, t(62)=4.74, p<0.001). 6. Regression analysis demonstrated that at 1-month follow-up, intervention participants reported taking calcium supplements on significantly more days within the past month than control participants (B=10.25, 95% CI=4.94, 15.55, p<0.001) after adjusting for	

			baseline calcium supplementation and theoretical predictors. 7. At the bivariate level, no significant difference existed between intervention (M=1,263.7 mg, SD=736.2 mg) and control (M=1,152.1 mg, SD=891.6 mg) participants in average dietary calcium intake at 1-month follow-up (t(64)=0.56, p=0.58). 8. Regression analysis revealed that, after adjusting for baseline calcium intake and changes in knowledge and self-efficacy, intervention participants evidenced significantly greater calcium consumption at 1-month follow-up (B=4.92, 95% CI=0.33, 9.52, p=0.04) compared with control participants, explaining 15% of the variance. <u>Other results</u> <u>Feasibility (if applicable)</u> Not reported. <u>Study adherence (if applicable)</u> Not reported.	

M = mean; SD = standard deviation; CI = confidence interval; df = degrees of freedom;

Health behaviour interventions – Substance use (1/1)

Hollen et al. A substance use decision aid for medically at-risk adolescents: Results of a RCT for cancer-surviving adolescents.
Cancer Nursing (2013), 355-367

Study design	Participants	Intervention	Main outcomes	Additional remarks
Study design RCT Treatment era 2009 Follow-up duration 5 years after disease free.	Eligible participants: Age 14–19 years, survivors of childhood cancer, diagnosed between birth and 12 years, disease-free for at least five years, and had no treatment during the previous two years. Non Eligible participants: Participants with physical or emotional concerns and/or known significant cognitive deficits. Type and number of non-participants: N=30; N=18 males (60.0%) Type and number of participants: N=213; N=115 males (47%) Intervention group N=102; type not reported Control intervention N=111; type not reported Cancer diagnosis (per group): Not reported per group, total: - Acute lymphoblastic leukaemia: N=98 (40%) - Acute myelogenous leukaemia: N=7 (3%) - Hodgkin lymphoma: N=7 (3%) - Non-Hodgkin lymphoma: N=15 (6%) - Sarcoma: N=21 (9%) - Embryonal: N=48 (20%) - Brain tumours: N=29 (12%) - Other: N=18 (7%) Age at diagnosis (per group): Not reported per group, all participants (M (range)): 5.1 yrs (0-14)	Health behaviour intervention Five modules on decision making, smoking, alcohol/drug use, an interactive substance use module, and a health status module. Tailored substance use risk behaviour counselling was delivered by nurse practitioners at baseline and again at 9- months for high riskers in the intervention group. CD-ROM components of the intervention, with live action videos delivered at baseline, were delivered as electronic "e-boosters" at 2-, 4-, 6-months, and a telephone booster at 9-months to maintain contact prior to the final study visit at 12 months. The intervention involved approximately 7.5 contact hours (including the battery of measures at three timepoints) with the teen over 12 months to complete the study. Control intervention Control group received standard care and a sham CD-ROM related to study skills. The intervention involved approximately 7.5 contact hours (including the battery of measures at three timepoints) with the teen over 12 months to complete the study.	Outcomes and definitions Decision making: - measured by the Decision Making Quality Scale (DMQS): a 7-item Likert scale developed to assess the degree to which a participant adheres to seven quality decision-making criteria during consequential decision making. Risk motivation: - measured by a Risk Motivation Questionnaire (RMQ): a 48-item survey that samples level of motivation for engaging in or avoiding three domains of risk behaviours: cigarette smoking, drinking alcohol and street drug use. Risk behaviour status: - measured by Periodic Assessment of Drug Use Among Youth (PADU): self-report 50-item survey to assess frequency and amount of risk behaviour. - Urine cotinine assessment for tobacco use was used to control for bias in self-reporting. Effect of intervention 1) For quality decision making, there was no effect between treatment groups for either follow-up timepoint of 6- and 12-months. 2) Examining immediate effects (within 6-months) for risk motivation, the intervention resulted in a significant effect (p=0.04) between treatment groups for the total score as well as for the alcohol (p=0.02) and illicit drugs (p=0.02) subscales. However, this was not sustained at 12-months. Other results	Risk of bias A. Selection bias: Low risk Reason: Teen cancer survivors were randomized to either an enhanced care or usual care treatment group by computer-based randomization. B. Attrition bias: Low risk Reason: There were 30 attrition cases (12%) over the 12-months follow-up period and 8 cases (3%) withdrew over the course of the study. C. Detection bias: Unclear Reason: No information whether participants and personnel were blinded. D. Performance bias: Unclear Reason: No information whether participants and personnel were blinded. Additional remarks (if applicable) Overlap

	<u>Age at follow-up (per group):</u> Not reported per group, all participants (M (SD)): 16.3 yrs (1.6) <u>Cancer treatment (per group):</u> Not reported per group, total: - Cranial irradiation (1800 Gy or more): N=39 (16%) - Methotrexate (intrathecal; high dose systemic): N=116 (48%) - Dexamethasone therapy: N=55 (23%) <u>Comorbidities (if applicable)</u> Not reported. <u>Additional participant characteristics (if applicable)</u> Not reported.		<u>Feasibility (if applicable)</u> The majority of the teens rated the program favourably, with almost all evaluation criteria above 90% (for the combined scores of "somewhat true" and "very true" response options). <u>Study adherence (if applicable</u>) There were 30 attrition cases (12%) over the 12-months follow-up period and 8 cases (3%) withdrew over the course of the study.	

M= mean; SD = standard deviation

Health behaviour interventions – Sun exposure (1/1)

Mays et al. Improving short-term sun safety practices among adolescent survivors of childhood cancer: A randomized controlled efficacy trial.
Journal of Cancer Survivorship (2011) 5, 247-254

Study design	Participants	Intervention	Main outcomes	Additional remarks
Study design RCT Treatment era Not reported. Follow-up duration 7.1 yrs after end of treatment	Eligible participants: Male and female adolescents age 11 - 21 years who were previously treated for an oncologic malignancy, 1 or more years post-cancer treatment, and 1 or more years cancer free Non Eligible participants: Not reported. Type and number of non-participants: Not reported. Of patients who met eligibility criteria, trial consent rate was 49%. Type and number of participants: N=75; N=36 male (48.0%) Intervention group N=38; N=17 male (44.7%) Control intervention N=37; N=19 male (51.4%) Cancer diagnosis (per group): Intervention group: - Leukaemia: N=21 (55.3%) - Nervous System: N=12 (16.0%) - Kidney/Liver: N=9 (12.0%) - Lymphoma: N=7 (9.3%) - Sarcoma: N=5 (6.7%) - Other: N=3 (4.0%) Control group: - Leukaemia: N=18 (48.9%) - Nervous System: N=3 (8.1%) - Kidney/Liver: N=7 (18.9%) - Lymphoma: N=5 (13.5%) - Sarcoma: N=2 (5.3%) - Other: N=2 (5.3%)	Health behaviour intervention A half-day, group-based interactive workshop that included health promotion content addressing sun safety and other relevant health behaviours for adolescent survivors of childhood cancer. Aspects of the intervention that focused on promoting sun safety practices were included with content that targeted other health behaviours relevant to childhood cancer survivors, such as diet and physical activity. Examples of sun safety behaviours addressed by the intervention included limiting sun exposure, using sunscreen with SPF 15, and wearing protective clothing. The intervention addressed sun safety behaviours through didactic presentations of sun exposure and sun protection, demonstrations of sun safety practices, and reviewing action plans regarding sun safety and other health-promoting behaviours. Intervention participants received gift packs, which included samples of sunscreen (in accord with the intervention's main goals). Control intervention The control condition was a standard care wait-list condition. Control condition participants were offered the intervention at the conclusion of the study. Baseline assessment consisted of two telephone calls lasting approximately 30-40 minutes each. The participants submitted a behavioural record for several days as baseline assessment. After baseline assessment, participants were randomly allocated to either the intervention condition or a wait-list control condition. Participants completed an outcome assessment via telephone approximately 1-month post-intervention.	Outcomes and definitions Sun safety behaviours: - assessed using a scale consisting of 8 items with 5-point Likert-type response options ranging from 'Never' (1) tot 'Always' (5). (Apply sunscreen; Apply sunscreen 30 min before going outside; Use SPF1; Wear protective clothing; Reapply every 1.5-2 hours; Reapply after swimming/sweating; Use shade; Limit time outside) Effect of intervention Participants in the intervention group reported significantly greater sun safety behaviours at 1-month post-intervention (M = 26.8, SD = 5.7) compared with participants in the control group (M = 23.8, SD = 4.4) (B = 2.64, 95% CI = 1.02, 4.27, p = 0.002). Other results Not reported. Feasibility (if applicable) Not reported. Study adherence (if applicable) No drop-outs	Risk of bias A. Selection bias: Unclear Reason: No information about manner of random allocation. B. Attrition bias: Low risk Reason: No attrition. C. Detection bias: Low risk Reason: All telephone interviews were administered by a trained research assistant who was masked to participants' trial condition and was not involved in administering the intervention. Only the trial coordinator, who was not involved with data collection, was aware of participants' trial allocation status. D. Performance bias: Unclear Reason: Not reported whether participants or personnel was blinded. Additional remarks (if applicable) Overlap

	<u>Age at diagnosis (per group):</u> *Age at end of treatment Intervention group: 6.9 yrs (3.0 SD) Control group: 7.4 yrs (4.9 SD) <u>Age at follow-up (per group):</u> Intervention group: 14.2 yrs (2.0 SD) Control group: 14.2 yrs (2.8 SD) <u>Cancer treatment (per group):</u> Not reported. <u>Comorbidities (if applicable)</u> Not reported. <u>Additional participant characteristics (if applicable)</u> Not reported.			

M= mean; SD = standard deviation

Health behaviour interventions – Health related QoL & health behaviour (1/2)

Hudson et al. Multi-component behavioural intervention to promote health protective behaviours in childhood cancer survivors: The protect study
Medical and Paediatric Oncology (2002) 39, 2-11

Study design	Participants	Intervention	Main outcomes	Additional remarks
Study design RCT Treatment era July 1995 – July 1997 Follow-up duration 5 years from diagnosis, 2 years from end of treatment.	Eligible participants: (1) age 12–18 years; (2) in remission 2 or more years after completion of cancer therapy; (3) had cognitive functioning appropriate to understand the intervention counselling; and (4) English-speaking as a primary language. Non Eligible participants: Patients who were not U.S. residents or who did not speak English as their primary language were excluded because of communication problems and cultural differences in attitudes toward cancer and health behaviours. Type and number of non-participants: N=46; type not reported Type and number of participants: N=266; N=118 male (44.4%) Intervention group N=131; N=57 male (44%) Control intervention N=135; N=61 male (45%) Cancer diagnosis (per group): Intervention group: - Leukaemia/lymphoma: N=73 (56%) - Solid tumours: N=58 (44%) Control group: - Leukaemia/lymphoma: N=72 (53%) - Solid tumours: N=63 (47%) Age at diagnosis (per group): Not reported	Health behaviour intervention The survivors are evaluated annually in the ACT Clinic for at least 10 years from their diagnosis, or until they reach the age of 18 years. Participants in the intervention arm received this standard care plus the multi-behavioural intervention: Patients randomized to the Intervention Group received standard care plus the multi-behavioural intervention which included: (1) distribution and discussion of written ACT clinical summary; (2) health behaviour training in health goal chosen by the survivor; (3) health goal commitment to practice chosen behaviour during ensuing year; and (4) telephone follow-up at 3 and 6 months from the clinic visit to reinforce the behavioural training. Outcome assessments were done at baseline (T0) and one year later (T1) Control intervention The survivors are evaluated annually in the ACT Clinic for at least 10 years from their diagnosis, or until they reach the age of 18 years. Participants in the control arm received standard care. Standard care comprises breast or testicular self-examination teaching by a clinic nurse using a breast or testicular model; (2) targeted late effects screening based on clinical history and treatment exposures; (3) a thorough clinical assessment by a clinic physician or nurse practitioner; and (4) late effects risk counselling.	Outcomes and definitions - Health knowledge: A 30-item subscale assessing health knowledge primarily included ''yes/no'' response options to inquiries regarding treatment modalities and risk of given treatment sequelae. Accuracy of responses was verified by com- paring survivor report to health care provider report. Mismatches (both positive and negative) were considered in the scoring. Total scores could range from 0 to 37, with higher scores representing greater knowledge. - Perceived susceptibility: An 11-item subscale assessed perceived susceptibility by asking the survivor to indicate how likely it would be to experience a given health problem secondary to cancer treatment. Responses were rated on a 5-point scale, ranging from very unlikely (1) to very likely (5). Total scores could range from 11 to 55. - Perceived seriousness: Perceived seriousness was assessed by an 11-item subscale that asked the survivor to indicate how serious it would be to develop a given health problem because of cancer treatment. Responses were rated on a 1–4-point scale, ranging from not serious at all (1) to very serious (4). Total scores could range from 11 to 44. - Perceived benefits: A 9-item subscale assessed perceived benefits by asking the survivor to acknowledge the health benefits of a given health practice. Responses were rated on a 4-point scale, ranging from strongly agree (1) to strongly disagree (4). Total scores could range from 9 to 36. - Perceived barriers: Was assessed by asking the survivor to indicate the degree of difficulty imposed with adherence to the practice of protective behaviours. Responses were rated on a 4-point scale, ranging from strongly disagree (1) to strongly agree (4). Total scores could range from 2 to 8. - Health practices: A 12-item subscale assessed the frequency of a given health practice using a 4-point scale with responses appropriate for tobacco use, sun protection, self-examination, diet, and exercise. Total score could range from 12 to 48.	Risk of bias A. Selection bias: Low risk Reason: Randomization was performed according to the procedure suggested by Zelen. B. Attrition bias: Low risk Reason: 5.6% of the patients did not complete study. C. Detection bias: Low risk Reason: The team's responses were checked for reliability between two members and validity with the principal investigator. Disagreements occurred in <1% of cases and were resolved in consultation with the principal investigator. D. Performance bias: Unclear Reason: No information about blinding of participants or personnel. Additional remarks (if applicable) Re-examination of data by Cox et al 2005 Overlap

	Age at follow-up (per group): Intervention group: 15.09 yrs (1.90 SD) Control group: 14.96 yrs (1.97 SD) Cancer treatment (per group): Not reported Comorbidities. (if applicable) Not reported. Additional participant characteristics (if applicable) Not reported.	Outcome assessments were done at baseline (T0) and one year later (T1)	Effect of intervention 1) Results indicate that there were no significant differences in the change scores between the two groups for variables assessing health knowledge (P=0.89); health perceptions of susceptibility to health risks (P=0.69), barriers to (P=0.96), and benefits of (P=0.25) protective health actions; or practices (P=0.31). 2) There was a greater increase in the perceived seriousness score (P=0.09) at the 1-year assessment for the Intervention Group, although this improvement was not statistically significant at the level of alpha=0.05. 3) In order to assess if there was an impact of intervention with respect to gender, there was a statistically significant difference in change scores between males and females in health knowledge (P=0.0071). 4) There were no significant self-reported improvements in patient health practices related to chosen health goal for patients in other health goal subgroups (P>0.10). 5) However, patients who selected the health goal of self-examination improved their practice of BSE/TSE in the form of more frequent practice of self-examination, as indicated by higher BSE/TSE item scores (P=0.001). Other results Feasibility (if applicable) Not reported Study adherence (if applicable) Information was not available for 15 (5.6%) patients who were unwilling to complete forms (n=12) or who resumed active treatment for second malignancies (n=3).	

M= mean; SD = standard deviation

Health behaviour interventions – Health related QoL & Health behaviours (2/2)

Cox et al. Adolescent survivors: A secondary analysis of a clinical trial targeting behaviour change. Secondary analysis of Hudson et al (2002)
Paediatric Blood and Cancer (2005) 45, 144-154

Study design	Participants	Intervention	Main outcomes	Additional remarks
Study design RCT Treatment era July 1995 – July 1997 *Re-exam in 2005 Follow-up duration 5 years from diagnosis, 2 years from end of treatment.	Eligible participants: (1) age 12–18 years; (2) in remission 2 or more years after completion of cancer therapy; (3) had cognitive functioning appropriate to understand the intervention counselling; and (4) English-speaking as a primary language. Non Eligible participants: Patients who were not U.S. residents or who did not speak English as their primary language were excluded because of communication problems and cultural differences in attitudes toward cancer and health behaviours. Type and number of non-participants: N=46; type not reported Type and number of participants: N=266; N=118 male (44.4%) Intervention group N=131; N=57 male (44%) Control intervention N=135; N=61 male (45%) Cancer diagnosis (per group): Intervention group: - Leukaemia/lymphoma: N=73 (56%) - Solid tumours: N=58 (44%) Control group: - Leukaemia/lymphoma: N=72 (53%) - Solid tumours: N=63 (47%) Age at diagnosis (per group): Not reported	Health behaviour intervention The survivors are evaluated annually in the ACT Clinic for at least 10 years from their diagnosis, or until they reach the age of 18 years. Participants in the intervention arm received this standard care plus the multi-behavioural intervention: Patients randomized to the Intervention Group received standard care plus the multi-behavioural intervention which included: (1) distribution and discussion of written ACT clinical summary; (2) health behaviour training in health goal chosen by the survivor; (3) health goal commitment to practice chosen behaviour during ensuing year; and (4) telephone follow-up at 3 and 6 months from the clinic visit to reinforce the behavioural training. Outcome assessments were done at baseline (T0) and one year later (T1) Control intervention The survivors are evaluated annually in the ACT Clinic for at least 10 years from their diagnosis, or until they reach the age of 18 years. Participants in the control arm received standard care. Standard care comprises breast or testicular self-examination teaching by a clinic nurse using a breast or testicular model; (2) targeted late effects screening based on clinical history and treatment exposures; (3) a thorough clinical assessment by a clinic physician or nurse practitioner; and (4) late effects risk counselling. Outcome assessments were done at baseline (T0) and one year later (T1)	Outcomes and definitions Cognitive outcome measures: - Health knowledge: A 30-item subscale assessing health knowledge primarily included ''yes/no'' response options to inquiries regarding treatment modalities and risk of given treatment sequelae. Accuracy of responses was verified by comparing survivor report to health care provider report. Mismatches (both positive and negative) were considered in the scoring. Total scores could range from 0 to 37, with higher scores representing greater knowledge. - Perceived susceptibility (Perceived risk & Vulnerability): An 11-item subscale assessed perceived susceptibility by asking the survivor to indicate how likely it would be to experience a given health problem secondary to cancer treatment. Responses were rated on a 5-point scale, ranging from very unlikely (1) to very likely (5). Total scores could range from 11 to 55. - Perceived seriousness: Perceived seriousness was assessed by an 11-item subscale that asked the survivor to indicate how serious it would be to develop a given health problem because of cancer treatment. Responses were rated on a 1–4-point scale, ranging from not serious at all (1) to very serious (4). Total scores could range from 11 to 44. - Perceived benefits (Efficacy): A 9-item subscale assessed perceived benefits by asking the survivor to acknowledge the health benefits of a given health practice. Responses were rated on a 4-point scale, ranging from strongly agree (1) to strongly disagree (4). Total scores could range from 9 to 36. - Health motivation was assessed by four single questionnaire items and is examined for the first time in this secondary data analysis: the first two items had ''no/yes'' response options, two additional items were scored on a Likert scale	Risk of bias A. Selection bias: Low risk Reason: Randomization was performed according to the procedure suggested by Zelen. B. Attrition bias: Low risk Reason: 5.6% of the patients did not complete study. C. Detection bias: Low risk Reason: The team's responses were checked for reliability between two members and validity with the principal investigator. Disagreements occurred in <1% of cases and were resolved in consultation with the principal investigator. D. Performance bias: Unclear Reason: No information about blinding of participants or personnel. Additional remarks (if applicable) Overlap

	Age at follow-up (per group): Intervention group: 15.09 yrs (1.90 SD) Control group: 14.96 yrs (1.97 SD) Cancer treatment (per group): Not reported Comorbidities. (if applicable) Not reported. Additional participant characteristics (if applicable) Not reported.		ranging from 1 (strongly disagree) to 5 (strongly agree). Behavioural outcome measures: - Health-risk behaviours: comprised current smoking status, alcohol use, driving under the influence of alcohol, use of smokeless tobacco products, and junk food consumption - Health-protective behaviours: comprised dental hygiene, nutrition, seatbelt use, sunscreen use, hours slept each night, exercise, and BSE/TSE. Assessed both by using a 4-point Likert scale (never to always). Effect of intervention 1) Three of the eight cognitive variables (motivation to change behaviour, perception of risk, and knowledge about disease and treatment) changed significantly in the expected direction: perceived need to change behaviour increased (t=-2.910, df=248, P=0.004); perception that it was a lot of trouble to stay healthy changed significantly from disagree to agree (t=11.914, df=250, P=0.0001); and knowledge about the disease, risks, and treatment increased (t=2.091, df=250, P=0.038). 2) The frequency of both breast self-exam (t=-5.098, df=143, P=0.0001) and testicular self-exam (t=3.049, df=108, P=0.003) increased between T0 to T1. 3) The intervention had two main effects: junk food consumption significantly decreased in the intervention group: F(1,246)=3.80, P=0.052 and smoking abstinence remained consistent in the treatment group while decreasing in the control group: F(1, 223)=2.936, P=0.088.	

			4) There was significant interaction between treatment arm and gender in four of the T1 outcome measures: smoking F(1,246)=7.775, P=0.006; dental hygiene practices F(1,249)=3.337, P=0.069; healthy nutrition practices F(1,248)=4.797, P=0.029; and alcohol consumption F(1,245)=3.568, P=0.060. <u>Other results</u> 1) Within the ANCOVA models, age interacted significantly with several of the T1 outcome behaviours: exercise F(1,249)=8.550, P=0.004; use of sunscreen F(1,248)=4.369, P=0.038; and alcohol consumption F(1,245)=4.482, P=0.035. <u>Feasibility (if applicable)</u> Not reported <u>Study adherence (if applicable)</u> Information was not available for 15 (5.6%) patients who were unwilling to complete forms (n=12) or who resumed active treatment for second malignancies (n=3).	

M= mean; SD = standard deviation