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Childhood cancer survivors' perceptions of the barriers and facilitators to physical activity: a systematic review and thematic synthesis of qualitative evidence using the theoretical domains framework

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ABSTRACT

Physical activity (PA) is recommended for childhood cancer survivors (CCSs). However, many CCSs have low levels of activity. This review aimed to systematically identify, appraise and synthesise qualitative research evidence on the barriers and facilitators to PA from the perspective of CCSs. Six databases (MEDLINE, Embase, PsycINFO, CINAHL, SPORTDiscus, and Scopus) were searched to identify qualitative data on PA gathered from CCSs diagnosed ≤ 18 years of age and who had completed active treatment. An inductive thematic synthesis was undertaken to identify descriptive themes relating to barriers and facilitators to PA, before mapping these onto the Theoretical Domains Framework (TDF). Methodological quality was assessed using CASP, and confidence in review findings was assessed using the GRADE-CERQual approach. Eight original studies were eligible. A total of 45 descriptive themes (29 facilitators and 16 barriers) were mapped onto nine domains of the TDF; they were most commonly mapped onto the Environmental Context and Resources ($n = 13$ descriptive themes) and the Social Influences ($n = 13$) domains. Study quality was variable and overall confidence in review findings was low. Conclusive/strong evidence for the barriers and facilitators to PA is lacking, highlighting the need for further research on the perceived influences on PA in CCSs. PROSPERO Registration: CRD42019147829.

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Systematic review; qualitative; childhood cancer; survivorship; physical activity

Introduction

There are almost 500,000 childhood cancer survivors (CCSs) in the United States (Howlader et al., 2021), and a similar number across Europe (Vassal et al., 2016). Improved cancer therapies have increased both survival rates and life expectancy for CCSs (Yeh et al., 2020); therefore, this expanding survivor population is also ageing. By early-to-mid adulthood, the majority of CCSs will develop at least one

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chronic health condition (known as late effects) related to their cancer treatment (Geenen et al., 2007; Hudson et al., 2013; Phillips et al., 2015). In this population, cardiovascular disease (CVD) is the leading cause of non-cancer mortality; survivors are up to 7-times more likely to die from CVD than the general population (Armstrong et al., 2009; Fidler et al., 2017; Winther et al., 2018). Although this increased risk is primarily due cardio-toxic therapies (e.g., anthracycline, radiotherapy to fields exposing the heart), traditional risk factors, including obesity, dyslipidemia, and hypertension, further increase CCSs' risk of developing, and dying from, CVD (Armstrong et al., 2013; Winther et al., 2018).

Physical activity (PA) is defined as any bodily movement produced by skeletal muscles that requires energy expenditure and encompasses exercise and movement for leisure, transport, work and play (World Health Organization, 2020). In adults, PA has been negatively correlated with the risk of cardiovascular mortality (Cheng et al., 2018) and, in children, is strongly related to indicators of physical health, including cardio-metabolic markers such as cholesterol and blood pressure (Poitras et al., 2016). Among CCSs, being less physically active has been associated with metabolic syndrome, cardio-metabolic risk factors (e.g., larger waist circumference), and cardiovascular events (Jones et al., 2014; Slater et al., 2015; Smith et al., 2014). In addition, in those who have received cardio-toxic therapies, better physical fitness has been associated with the presence of fewer cardio-metabolic risk factors (Schindera et al., 2021).

However, CCSs are often stated to be insufficiently active. A large proportion do not meet national physical activity recommendations (Mizrahi et al., 2019; Zhang et al., 2012). They also engage in less PA (Antwi et al., 2019; Zhang et al., 2012) and have lower levels of physical fitness than non-cancer controls (Antwi et al., 2019; Kabak et al., 2019). CCSs report a decline in activity and fitness during treatment and a significant proportion do not return to their pre-diagnosis level of PA post-treatment (Keats et al., 2006; Stössel et al., 2020).

Modification of health behaviours such as PA offer a preventative strategy to the increased cardio-metabolic risk in CCSs, and there is growing interest in developing and testing PA interventions for these survivors. A critical step in developing behaviour change interventions is to identify factors that the user group (in this case CCSs post-treatment) perceive to make it more likely that they will carry out the behaviour (facilitators), or which hinder their performance of the behaviour (barriers) (Bartholomew Eldredge et al., 2016; O'Cathain et al., 2019). Qualitative methods such as interviews and focus groups are of particular value in developing an understanding of the influences on behaviour (Atkins et al., 2017). Synthesising existing research is a key step in intervention design (Bartholomew Eldredge et al., 2016; O'Cathain et al., 2019), and bringing together the findings from qualitative research can assist in arriving at new or enhanced understandings in order to inform decisions on health interventions (Flemming & Noyes, 2021).

To our knowledge, no such review exists that brings together qualitative evidence from studies with CCSs regarding their views of PA. Therefore, to inform the development of future PA interventions in CCSs, we aimed to systematically identify, appraise and synthesise qualitative research evidence regarding the barriers and facilitators to PA as reported by CCSs who have completed active treatment. In line with recommendations for interventions to be theoretically informed (Bartholomew Eldredge et al., 2016; Michie et al., 2011; O'Cathain et al., 2019), we mapped barriers and facilitators onto the Theoretical Domains Framework (TDF) – a comprehensive framework synthesised from 128 theoretical constructs from 33 theories – which can guide the identification of theoretical constructs which influence behaviour (Cane et al., 2012; Michie et al., 2005). The TDF consists of 14 domains (examples of domains include knowledge, skills, beliefs about capabilities) and has been used to inform intervention design in various healthcare settings and target populations (Cheung et al., 2019; Flannery et al., 2018; Kolehmainen et al., 2011; Nicholson et al., 2014), but as yet has not been used to explore PA behaviours in CCSs.

Methods

The review was prospectively registered with PROSPERO, the international prospective register of systematic reviews (registration number CRD42019147829).

Design

A thematic synthesis of qualitative studies was undertaken following the steps of Thomas and Harden (2008). The review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) and the Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ) statements (Page et al., 2021; Tong et al., 2012) (see Supplementary Materials 1 and 2).

Search strategy

A search of the following six electronic databases was conducted to identify relevant published studies: MEDLINE, Embase, PsycINFO, CINAHL, SPORTDiscus, and Scopus. With assistance from a medical librarian, a comprehensive search strategy based on the five components of the PICOS search strategy tool for qualitative research was designed, adapted for use with specific databases, and piloted (Methley et al., 2014). The PICOS components and the accompanying searches are presented in Supplementary Materials 3 and 4. The searches were run from database inception until 1 February 2021 and limited to articles published in English. Reference lists of systematic reviews identified in database searches were screened. Forward and backward citation searches were conducted for all included studies.

Article selection criteria

To be included, studies had to include qualitative data pertaining to PA, as defined above (World Health Organization, 2020), in CCSs (Table 1). This could be either wholly qualitative studies or mixed-method studies with a distinct qualitative component (e.g., a survey followed by an interview). Studies that presented only quantitative data from structured interviews, and studies that used surveys with open-ended questions, were not included due to a lack of depth and detail. Studies had to explore PA from the perspective of CCSs themselves. Although the views of others (e.g., family members, healthcare professionals) may have been contained within the papers, these data were not extracted for this review.

For this review, we defined CCSs to be individuals currently of any age who had received a diagnosis of any cancer or a brain tumour in childhood (aged ≤ 18 years old) and who had completed active hospital-based cancer treatment. Studies which included individuals on maintenance therapy were eligible since these patients are treated as outpatients and are typically able to

Table 1. Inclusion and exclusion criteria for systematic review.

	Inclusion criteria
Publication type	Full papers published in a peer-reviewed journal
Study type	Studies which reports a qualitative study or a mixed methods study which reports qualitative data
Participants	Studies which include childhood cancer survivors (CCSs) who: were diagnosed with a haematological malignancy, solid tumour or central nervous system tumour were diagnosed up to and including 18 years of age ^a had completed initial active cancer treatment ^b
Focus of studies	Studies which present data on the views and experiences of CCSs regarding the barriers and facilitators to physical activity
Publication date	Full papers published up until 1 February 2021
Language	Full text of papers available in English
Exclusion criteria	Quantitative studies, including those which present free text data from questionnaires Studies which present only quantitative data from structured interviews Qualitative studies which only include the views of others (e.g., parents) and not the survivor themselves Grey literature

^aIn studies where there is a heterogeneous sample, at least 50% of participants should be aged 18 years or under at diagnosis.

^bIn studies where there is a heterogeneous sample, at least 50% of participants should be have completed initial active cancer treatment. Studies which include participants on maintenance therapy will be included.

return to normal activities, such as PA (AboutKidsHealth, 2018). It was anticipated that relevant studies may include heterogeneous samples in terms of age at diagnosis and phase of cancer continuum. Therefore, it was stipulated that to be eligible, at least half (50% or more) of the participants should be aged ≤ 18 years at diagnosis and at least half should have completed active treatment.

Screening process and study selection

Following deduplication, references were imported into Rayyan software (Ouzzani et al., 2016) and two reviewers (MB and MP or LS) independently screened titles and abstracts to identify potentially eligible studies. To maximise sensitivity, any article considered potentially relevant by either reviewer was obtained in full-text before being independently assessed by two reviewers. Any discrepancy between reviewers was resolved in discussion with a third reviewer. Where required, the authors of papers were contacted to provide further details about their study sample to confirm eligibility.

Data extraction and synthesis

Data extraction was carried out by MP and cross-checked by MB. Characteristics of the study design and the participants were extracted. Findings were extracted from the results sections but also the abstract and discussion where these findings had not been presented elsewhere in the paper. Data to be synthesised included direct quotes from participants, and the primary study authors' interpretations of the findings regarding CCSs' perspectives on PA. Where studies included data on multiple health behaviours (e.g., diet, PA), only that relating specifically to PA was extracted. The PDFs of included papers were imported into NVivo 12 software to facilitate analysis (QSR International Pty Ltd, 2018).

Qualitative data synthesis

The three steps of thematic synthesis as described by Thomas and Harden (2008) were followed. First, inductive line-by-line coding was carried out by MP during which 'free' codes were assigned, which described the meaning and content of each line of text. Codes and the accompanying text were second-checked by MB (an experienced qualitative researcher) and reviewed with MP to ensure consistency. Next, the two reviewers organised and grouped the initial codes based on similarities and differences, to create descriptive themes. Descriptive themes were labelled based on the data and codes they were describing, thus remaining 'close' to the data (Thomas & Harden, 2008), and were at the level which reflected whether the theme was identified as a barrier or facilitator of PA. Lastly, to generate analytical themes which went 'beyond' the data (Thomas & Harden, 2008), we used the TDF, which consists of 14 domains of theoretical constructs which can influence behaviour (Cane et al., 2012; Michie et al., 2005). MB and MP organised and mapped the descriptive themes onto the TDF domains, before discussing with LS and VA-S (both experienced in using the TDF) to reach a consensus on the categorisation of the themes within the framework.

Quality assessment and transparency of reporting

The methodological quality of the included studies was assessed using the Critical Appraisal Skills Programme (CASP) Qualitative Checklist, which consists of 10 items assessing rigour, credibility and relevance (Critical Appraisal Skills Programme. CASP Qualitative Checklist, 2018). MB and MP independently appraised each study and any discordance was resolved through discussion.

An important determinant of any assessment of study quality is the quality of reporting (Carroll et al., 2012); therefore, the Consolidated Criteria for Reporting Qualitative Health Research (COREQ) checklist was also completed by MB to provide a comprehensive assessment of the transparency of reporting for each study (Tong et al., 2007). COREQ details 32 components of study design that

should be included in reports of qualitative research. As per established guidance (Noyes et al., 2018), no study was excluded on the basis of poor quality or reporting. Rather the results of CASP and COREQ were used to inform our assessment of confidence in each of the review findings.

Assessing confidence in the review findings

The GRADE-CERQual (Confidence in the Evidence from Reviews of Qualitative Research) approach was used to assess confidence in each of the findings of the review (Lewin et al., 2015), these being the barriers and facilitators (descriptive themes) which had been categorised to a TDF Domain. Assessment of the four components of methodological limitations; coherence; adequacy of data; and relevance informs an overall judgement of confidence in each finding – that is, the extent to which the finding is a reasonable representation of the phenomenon of interest (Lewin et al., 2015). As per CERQual guidance, the confidence level for all findings began at high and was downgraded to moderate, low or very low based on the assessment of each of the four components (Lewin et al., 2018).

Results

A total of 1729 hits were returned from the database searches. After screening by title and abstract, 61 full-text papers were reviewed, resulting in 8 eligible studies (Figure 1). A summary of the included studies is presented in Table 2. The studies were published between 2013 and 2021, with five originating from the United States of America (USA) (Kuntz et al., 2019; Lowe et al., 2016; Rokitka et al., 2021; Santa Maria et al., 2014; Wu et al., 2015), two from Canada (Price et al., 2020; Wright et al., 2013) and one from the United Kingdom (UK) (Burke et al., 2017). Only five of the eight studies focused specifically on PA (Burke et al., 2017; Price et al., 2020; Rokitka et al., 2021; Wright et al., 2013; Wu et al., 2015).

Five studies adopted a purely qualitative approach (Burke et al., 2017; Kuntz et al., 2019; Price et al., 2020; Santa Maria et al., 2014; Wu et al., 2015), whilst three reported qualitative data as part of a mixed-methods study (Lowe et al., 2016; Rokitka et al., 2021; Wright et al., 2013). Six collected data via one-to-one interviews (Burke et al., 2017; Kuntz et al., 2019; Lowe et al., 2016; Price et al., 2020; Rokitka et al., 2021; Wright et al., 2013). All studies were cross-sectional, apart from Burke et al. (2017), who interviewed their participants three times over a three-month period.

Included sample sizes varied from three participants to 30, and data were reported from a total of 126 participants. Studies included participants as young as eight years old (Burke et al., 2017), and as old as 52 years (Rokitka et al., 2021). One study included only survivors of central nervous system tumours (Santa Maria et al., 2014), whilst the remainder recruited patients with a range of diagnoses. Only four studies included samples in which all participants had been diagnosed aged 18 years and under (Burke et al., 2017; Lowe et al., 2016; Santa Maria et al., 2014; Wright et al., 2013). Although seven studies focused their recruitment on survivors who had completed active cancer treatment (Burke et al., 2017; Lowe et al., 2016; Price et al., 2020; Rokitka et al., 2021; Santa Maria et al., 2014; Wright et al., 2013; Wu et al., 2015), two of these also included survivors on maintenance therapy (Burke et al., 2017; Price et al., 2020). Whilst two studies did not state the time since completion of treatment for their sample (Wright et al., 2013; Wu et al., 2015), the remaining studies were split as to whether they included survivors nearer to the completion of their treatment, (Burke et al., 2017; Kuntz et al., 2019; Price et al., 2020) or longer-term survivors (those ≥ 5 years post-treatment) (Lowe et al., 2016; Rokitka et al., 2021; Santa Maria et al., 2014).

Quality assessment and transparency of reporting

Studies scored between four and eight (out of nine) on the CASP checklist. Several studies presented limited details regarding the recruitment strategy, data collection, relationship between researcher and participant, and data analysis. Transparency of reporting was variable, with studies reporting

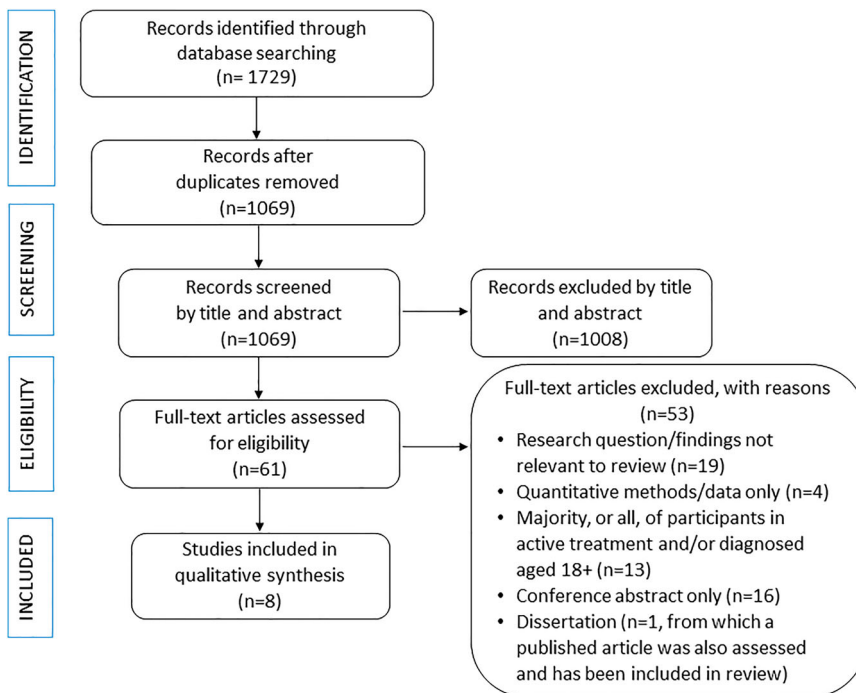


Figure 1. PRISMA flow diagram of study selection.

between seven and 25 of the 32 items in the COREQ checklist. Components relating to the personal characteristics of researcher, relationship with participants, data collection and data analysis were often not reported. Full details of the CASP and COREQ assessments can be found in Supplementary Materials 5 and 6.

Synthesis of findings

Inductive coding identified 45 descriptive themes which described individual barriers ($n = 16$) and facilitators ($n = 29$) to PA as perceived by CCSs. These descriptive themes mapped onto nine TDF domains (Table 3). The results are presented by TDF domain, with one or two quotes from participants or study authors' interpretations for illustrative purposes in the text. Further example quotes are presented in Supplementary Material 7.

Based on judgements of the four CERQual components, the majority of descriptive themes were assessed as being of low confidence ($n = 30$ descriptive themes), suggesting that it is only possible that they are a reasonable representation of the barriers and facilitators to PA in CCSs. The remainder of descriptive themes ($n = 15$) were judged as being of very low confidence, indicating that it is not clear whether the finding is a reasonable representation of the barriers and facilitators to PA in CCSs. This was mainly due to lack of adequacy as findings were not supported by sufficiently rich data or a sufficient number of participants or studies. There was also a lack of studies that were deemed directly relevant to the review question (e.g., study did not focus on survivors views of barriers and facilitators to PA; inclusion of survivors on active treatment; inclusion of survivors aged >18 years at diagnosis). Methodological concerns were also common. Definitions of both the CERQual components, and the levels of confidence are given in Supplementary Material 8. A summary of the CERQual confidence levels for each of the barriers and facilitators is summarised in Table 3, with the full CERQual evidence profile available in Supplementary Material 9.

Table 2. Key characteristics of included studies.

Author (Year) Country of study	Focus of study ^a	Study design	Qualitative data collection and data analysis method	Patient group, recruitment and sampling method	Sample size (n)	Participant demographics	Participant clinical characteristics
Burke et al. (2017) UK	To explore experiences of well- and ill-being among childhood cancer survivors who participated in recreational cycling over a 3-month period as a result of receiving a bicycle from a charity	Qualitative, longitudinal	Semi-structured interviews (individual) Inductive and deductive approaches	Patient group: Childhood cancer survivors Recruitment: Identified by charity from a list of 24 survivors who had applied to charity for a bike and who were scheduled to receive one Sampling method: Purposive	4	Mean age at study: 10.5 years; (range 8–13 years) Gender: 100% male Ethnicity: Not stated	Diagnosis: Medullablastoma (n = 1, 25%); acute lymphoblastic leukemia (n = 3, 75%) Mean age at diagnosis: 8.25 years (range 4–10 years) Treatment received: Chemotherapy (n = 4, 100%); radiotherapy and surgery (n = 1, 25%) Treatment status: Post-intensive treatment; 75% (n = 3) on maintenance therapy Time since treatment: At least 1 month post-intensive treatment
Kuntz et al. (2019) USA	To explore the self-reported experience of paediatric and adolescent cancer patients considering: (1) the cancer diagnosis and experience and what it means to them; (2) interventions and resources that help children during diagnosis and treatment; and (3) barriers that interfere with healing and coping with cancer	Qualitative, cross-sectional	Semi-structured interviews (individual) No stated method of data analysis	Patient group: Patients currently aged 10–25 years old, diagnosed with any cancer, and either receiving active treatment or completed treatment within the year prior, and fluent in either English or Spanish. Recruitment: At a children's hospital Sampling method: Convenience	30	Mean age at study: 16.5 years; (range 10–21 years) Gender: 27% (n = 8) female; 73% (n = 22) male Ethnicity: 63.3% (n = 19) Hispanic/Latino; 10% (n = 3) multiple races; 13% (n = 4) caucasian; 3% (n = 1) African-American; 7% (n = 2) Asian; 3% (n = 1) Middle Eastern	Diagnosis: Leukaemia (n = 24, 80%); solid tumour (n = 6, 20%) Mean age at diagnosis: Not stated, but 66% (n = 20) currently aged ≤18 years Treatment received: Not stated Treatment status: Completed treatment (n = 18, 60%), in active treatment (n = 12, 40%) Time since treatment: 60% (n = 18) completed treatment within past year
Lowe et al. (2016) USA	To qualitatively assess intrapersonal and interpersonal factors that influence health behaviours as described by survivors	Mixed methods, cross-sectional	Semi-structured interviews (individual) Grounded Theory	Patient group: Survivors diagnosed with cancer at age <18 years old, and currently between 18–34 years of age Recruitment: Via medical records at children's hospital and cancer centre; eligible	26	Mean age at study: 21.73 years (SD = 2.96) Gender: 53.8% (n = 14) female; 46.2% male Ethnicity: 100.0% (n = 26) non-Hispanic; 84.6% (n = 22) white	Diagnosis: Hodgkin's lymphoma (n = 7, 27%); non-hodgkin's lymphoma (n = 2, 8%); acute lymphoblastic leukemia (n = 4, 15%); sarcoma (n = 6, 23%); thyroid cancer (n = 3, 12%); other (n = 4, 15%)

(Continued)

Table 2. Continued.

Author (Year) Country of study	Focus of study ^a	Study design	Qualitative data collection and data analysis method	Patient group, recruitment and sampling method	Sample size (n)	Participant demographics	Participant clinical characteristics
				patients sent survey and asked to indicate interest in interview; <i>n</i> = 64/106 (60.4%) provided permission Sampling method: Purposive			Mean age at diagnosis: Not stated Treatment received: 88.5% (<i>n</i> = 23) chemotherapy; 69.2% (<i>n</i> = 18) surgery; 57.7% (<i>n</i> = 15) radiation Treatment status: Off treatment Time since diagnosis: Mean 6.69 years (SD = 3.08)
Price et al. (2020) Canada	To explore survivors' experiences of parental support for physical activity received (and their parents' experiences of providing support)	Qualitative, cross-sectional	Semi-structured interviews (individual) Thematic analysis	Patient group: Survivors aged 15–25 years at the time of study who completed treatment <5 years ago Recruitment: Via healthcare provider referrals, community programs, websites for national organisations, and snowball sampling Sampling method: Snowball (no other sampling method cited by authors)	10	Mean age at study: 17.4 years (SD = 3.2) Gender: 30% (<i>n</i> = 3) female; 70% (<i>n</i> = 7) male Ethnicity: 90% (<i>n</i> = 9) caucasian; 10% (<i>n</i> = 1) other	Diagnosis: Lymphoma (<i>n</i> = 5, 50%); leukemia (<i>n</i> = 2, 20%); osteosarcoma (<i>n</i> = 1, 10%); synovial sarcoma (<i>n</i> = 1, 10%); brain tumour (<i>n</i> = 1, 10%) Mean age at diagnosis: Not stated, but 80% (<i>n</i> = 8) currently aged ≤18 years Treatment received: Chemotherapy (<i>n</i> = 9; 90%); surgery (<i>n</i> = 7, 70%); radiation (<i>n</i> = 5, 50%) Treatment status: Off primary treatment; <i>n</i> = 2, 20% on maintenance therapy Time since diagnosis: 4.5 years (SD = 2.9) Time since treatment: < 5 years ago
Rokitka et al. (2021) USA	To examine survivors' current self-reported health, physical activity levels, their interest, needs and preferences for exercise interventions, and barriers to physical activity	Mixed methods, cross-sectional	Structured interviews (individual, open question for perceived barriers to physical activity) No stated method of data analysis	Patient group: Survivors who were diagnosed with cancer at age ≤21 years old, currently aged 18–60 years old, were >5 years since diagnosis, had completed active cancer therapy, and had anticipated life expectancy of more than 12 months.	20	Mean age at study: 35 years (range 21–52 years) Gender: 55% (<i>n</i> = 11) female; 45% (<i>n</i> = 9) male Ethnicity: 95% (<i>n</i> = 19) white; 5% (<i>n</i> = 1) other	Diagnosis: Leukaemia (<i>n</i> = 8, 40%), lymphoma (<i>n</i> = 6, 30%); central nervous system (<i>n</i> = 1, 5%); sarcoma (<i>n</i> = 4, 20%); other (<i>n</i> = 1, 5%) Age at diagnosis: 0–4 years (<i>n</i> = 6, 30%); 5–9 (<i>n</i> = 4, 20%); 10–15 (<i>n</i> = 1, 5%); 16–21 (<i>n</i> = 9, 45%) Treatment received: Not stated Treatment status: Off treatment

				Recruitment: Via a cancer centre; eligible patients mailed study letters; interested patients screened by phone to confirm eligibility Sampling method: Patients randomly selected until target number of responses was achieved			Time since treatment: 10–19 years (<i>n</i> = 7, 35%); 20–29 (<i>n</i> = 8, 40%); 30+ (<i>n</i> = 5, 25%)
Santa Maria et al. (2014) USA	To examine parenting styles and practices that may influence weight management among childhood central nervous system tumour survivors	Qualitative, secondary analysis of data, cross-sectional	Semi-structured interviews (group, conducted in pairs) Thematic content analysis	Patient group: Childhood central nervous system tumour survivors, currently aged 12–18 years old and who were overweight (BMI ≥85th percentile) Recruitment: Via a tumour registry at a cancer centre; 29 eligible survivors identified Sampling method: Not stated	8	Mean age at study: 15.25 years (SD = 1.49) (range 13–18 years) Gender: 62.5% (<i>n</i> = 5) female; 37.5% (<i>n</i> = 3) male Ethnicity: 50% (<i>n</i> = 4) black; 25% (<i>n</i> = 2) white; 25% (<i>n</i> = 2) Hispanic BMI status: Mean 32.4 (range 24–47)	Diagnosis: Craniopharyngioma (<i>n</i> = 2, 25%); pilocytic astrocytoma (<i>n</i> = 2, 25%); medulloblastoma (<i>n</i> = 1, 13%); glioma (<i>n</i> = 1, 13%); ganglioglioma (<i>n</i> = 1, 13%); temporal lobe atypical choroid plexus papilloma (<i>n</i> = 1, 13%) Age at diagnosis: 0–5 years (<i>n</i> = 3, 38%); 6–10 (<i>n</i> = 3, 38%); 11–15 years (<i>n</i> = 2, 25%) Treatment received: Radiotherapy 63% (<i>n</i> = 5) Treatment status: Off treatment Time since treatment: Mean 7.8 years (range 3–15 years) Diagnosis: Retinoblastoma (<i>n</i> = 1, 33%); acute lymphoblastic leukaemia (<i>n</i> = 2, 67%) Mean age at diagnosis: Not stated Treatment received: Not stated Treatment status: Off treatment Time since treatment: Not stated
Wright et al. (2013) Canada	To examine physical activity participation and related individual and environmental factors	Mixed methods, cross-sectional	Semi-structured interviews (individual) Directive content analysis	Patient group: Survivors aged 13–18 years who had completed treatment of cancer Recruitment: Recruited via an oncology follow-up clinic at tertiary care centre. Participants completed survey and indicated their interest in taking part in qualitative study; 48 completed survey, 3 interviewed Sampling method: Consecutive	3	Mean age: 16 years (range 13–18 years) Gender: 33% (<i>n</i> = 1) female; 67% (<i>n</i> = 2) male Ethnicity: Not stated	

25

(Continued)

Table 2. Continued.

Author (Year)	Country of study	Focus of study ^a	Study design	Qualitative data collection and data analysis method	Patient group, recruitment and sampling method	Sample size (n)	Participant demographics	Participant clinical characteristics
Wu et al. (2015)	USA	To identify barriers and facilitators to exercise and healthy eating as reported both by survivors (and their primary supporters)	Qualitative, cross-sectional	Focus groups and Semi-structured interviews (individual, <i>n</i> = 3) Constant comparative method (based on Grounded Theory)	Patient group: Survivors aged 18–39 years who had been diagnosed with cancer at any time in their lives and who had completed active therapy Recruitment: Via clinics at a cancer centre, self-referral in response to advertisements through cancer organisations, participation in prior study and recruitment letters sent to eligible patients Sampling method: Not stated		Mean age: 27.6 years (SD = 6.6) Gender: 68% (<i>n</i> = 17) female; 32% (<i>n</i> = 8) male Ethnicity: 100% white	Diagnosis: Leukemia/lymphoma (<i>n</i> = 10, 40%); solid tumor (<i>n</i> = 12, 48%); brain tumour (<i>n</i> = 3, 12%) Mean age at diagnosis: 17.3 years; 64% (<i>n</i> = 16) diagnosed at 0–18 years old Treatment received: Not stated Treatment status: Off treatment Time since treatment: Not stated

^aFocus of included study, or focus of qualitative data collection if reported as part of mixed methods study (if stated to be different to focus of quantitative data collection).

TDF domain: skills

A loss of their physical skills due to the effects of cancer and its treatment was reported by survivors to be a barrier to PA in four studies (Burke et al., 2017; Kuntz et al., 2019; Lowe et al., 2016; Rokitka et al., 2021). Survivors reported a loss of strength, stamina, speed, flexibility and movement skills, which had affected their ability to do certain types of PA such as walking, running and jumping. This loss of skills had also affected their ability to re-engage in PA such as sports (particularly school-based) and leisure activities:

At the time when I had cancer, I had lost all of my muscle. I had to learn how to run again because I had been in bed a lot and couldn't do that. (Lowe et al., 2016; participant quote)

However, a facilitator of PA identified within one study was that engaging in PA (in this specific case, cycling) was perceived to lead to improved physical skills and ability (Burke et al., 2017), both in relation to cycling itself and other activities (e.g., football, running, climbing trees). Cycling also improved skills needed for PA such as strength and stamina:

It [biking] is quite good because it's also benefitting me in football because I can now kick it quite hard and far. (Burke et al., 2017; participant quote)

TDF domain: beliefs about capabilities

Two descriptive themes relating to survivors' beliefs about their perceived ability to be physically active were identified across five studies (Burke et al., 2017; Kuntz et al., 2019; Lowe et al., 2016; Rokitka et al., 2021; Wu et al., 2015). Regarding barriers to PA, all five studies reported that survivors perceived the cancer to have adversely affected their overall ability to be physically active. This was a result of: inactivity due to cancer and its treatment; treatment side-effects (e.g., fatigue); the presence of late effects; adverse health conditions; and not being their 'old physical self'. Survivors reported this prevented exercising and participating in activities such as dancing, walking or running longer distances. Others reported they could no longer do particular activities to the same level, or with the same ease, as they had before their cancer:

But the thing is, I had osteosarcoma so my leg can't stand a lot of ... can't run, because it's like, a lot of pounding and stuff like that. (Rokitka et al., 2021; participant quote)

In terms of facilitators, participants in Burke et al. (2017) reported that, despite being at first apprehensive and nervous about engaging in PA after having cancer (in this case cycling), doing so increased their confidence and self-efficacy. Through cycling they reported feeling an increasing competence regarding their fitness, and their skills in cycling and other activities, bringing them closer to where they were prior to their cancer diagnosis:

Obviously [I am] a bit nervous because there's always that feeling that you're going to fall off, but it's slowly getting better and I'm getting a bit more confident and stuff. (Burke et al., 2017; participant quote)

TDF domain: beliefs about consequences

Two themes (both facilitators) were evidenced in four studies relating to survivors' perceptions of the beneficial effects of PA on their health (Burke et al., 2017; Lowe et al., 2016; Rokitka et al., 2021; Wright et al., 2013). All four studies reported the belief among participants that being physically active, and increasing PA levels, was beneficial to their physical health by maintaining (e.g., maintaining weight), improving (e.g., getting stronger) and protecting their health (e.g., reducing the risk of poor health and cancer in future):

I think having a past of being sick and knowing that exercise helps is definitely a major motivator. (Rokitka et al., 2021; participant quote)

Table 3. Summary of qualitative findings regarding the barriers and facilitators to physical activity identified in included studies.

TDF domains and their descriptions ^a	Facilitator	Contributing studies	CERQual assessment of confidence in review finding and explanation (see footnotes)	Barrier	Contributing studies	CERQual assessment of confidence in review finding and explanation (see footnotes)
Knowledge <i>Existing procedural knowledge about PA, knowledge about PA guidelines, knowledge about evidence and how that influences what participants do</i>	None identified			None identified		
Social/professional role and identity <i>Boundaries between professional/social groups (i.e., is the PA behaviour something the participant is supposed to do?)</i>	None identified			None identified		
Skills <i>Competence and ability about the procedural techniques required to perform PA</i>	Engaging in PA leads to improved PA skills	Burke et al. (2017)	Low confidence ¹	Experiencing a loss of physical skills required for PA	Kuntz et al. (2019); Lowe et al. (2016); Rokitka et al. (2021); Burke et al. (2017)	Low confidence ²
Beliefs about capabilities <i>Perceptions about competence and confidence in performing PA</i>	Participation in PA leads to improved confidence and future PA	Burke et al. (2017)	Low confidence ¹	The negative impact of cancer and its treatment on the ability to do PA	Kuntz et al. (2019); Lowe et al. (2016); Rokitka et al. (2021); Wu et al. (2015); Burke et al. (2017)	Low confidence ²
Optimism <i>Whether participants' optimism or pessimism influences what they do</i>	None identified			None identified		
Beliefs about consequences <i>Perceptions about outcomes, advantages, and disadvantages of performing PA</i>	Participating in PA is beneficial to physical health	Lowe et al. (2016); Rokitka et al. (2021); Wright et al. (2013); Burke et al. (2017)	Low confidence ¹	None identified		
	Participating in PA is beneficial to mental health	Rokitka et al. (2021); Wright et al. (2013)	Low confidence ³			
Reinforcement <i>Previous experiences that have influenced whether or not the PA behaviour is performed</i>	None identified			None identified		
Intentions <i>A conscious decision to perform a PA behaviour or a resolve to act in a certain way</i>	Drawing motivation from others	Lowe et al. (2016); Rokitka et al. (2021)	Low confidence ³	Lack of motivation	Wu et al. (2015)	Low confidence ¹

(Continued)

Table 3. Continued.

TDF domains and their descriptions ^a	Facilitator	Contributing studies	CERQual assessment of confidence in review finding and explanation (see footnotes)	Barrier	Contributing studies	CERQual assessment of confidence in review finding and explanation (see footnotes)
Goals <i>Priorities, importance, commitment to a certain course of actions or PA behaviours</i>	Setting goals for PA	Wu et al. (2015)	Low confidence ¹	Conflicting priorities	Price et al. (2020); Wright et al. (2013)	Very low confidence ⁴
	Prioritising PA	Lowe et al. (2016); Wright et al. (2013)	Very low confidence ⁴			
Memory, attention and decision processes <i>Attention control, decision-making, memory (i.e., is the PA behaviour problematic because participants simply forget?)</i>	None identified			None identified		
Environmental context and resources <i>How factors related to the setting in which the PA behaviour is performed [e.g., people, organizational, cultural, political, physical, and financial factors] influence the PA behaviour</i>	Access to PA facilities and resources	Lowe et al. (2016); Wu et al. (2015); Burke et al. (2017)	Low confidence ¹	Lack of legitimate resources to guide PA	Wu et al. (2015)	Low confidence ¹
	Access to a PA facilities tailored to cancer survivors	Kuntz et al. (2019); Wu et al. (2015)	Very low confidence ⁴	Feeling embarrassed in gym environment	Wu et al. (2015)	Low confidence ¹
	Access to resources to develop new PA skills and interests	Wu et al. (2015)	Low confidence ¹	Lack of time to do PA	Rokitka et al. (2021); Wright et al. (2013)	Low confidence ³
	Tailored resources to enable informed decisions on PA	Lowe et al. (2016)	Low confidence ¹	Lack of opportunity to discuss PA with health professionals	Lowe et al. (2016); Wu et al. (2015)	Low confidence ¹
	Financial incentives to accessing gyms/facilities	Lowe et al. (2016)	Low confidence ¹	Financial barriers to accessing gyms/facilities	Lowe et al. (2016); Wu et al. (2015)	Low confidence ¹
	Home environment that is supportive of PA	Santa Maria et al. (2014); Price et al. (2020)	Very low confidence ⁴	A lack of PA opportunities in the home and family environment	Price et al. (2020)	Low confidence ¹
	Financial support from parents to access PA resources	Price et al. (2020)	Low confidence ¹			
Social influences <i>External influence from people or groups to perform or not perform the PA behaviour; How the views of colleagues,</i>	Keeping up with PA level of others	Wright et al. (2013)	Very low confidence ⁴	No one to engage in PA with	Lowe et al. (2016)	Low confidence ¹
	Friendships facilitate participation in PA	Lowe et al. (2016)	Low confidence ¹	Lack of positive parental modelling of PA	Santa Maria et al. (2014)	Very low confidence ⁴

(Continued)

Table 3. Continued.

TDF domains and their descriptions ^a	Facilitator	Contributing studies	CERQual assessment of confidence in review finding and explanation (see footnotes)	Barrier	Contributing studies	CERQual assessment of confidence in review finding and explanation (see footnotes)
<i>other professions, patients and families, and doing what you are told influence the PA behaviour</i>	PA builds friendships	Burke et al. (2017)	Low confidence ¹	Parental discouragement of PA Negative influence of parenting style	Lowe et al. (2016); Wright et al. (2013)	Very low confidence ⁴
	Parental modelling of PA behaviours	Santa Maria et al. (2014); Price et al. (2020)	Very low confidence ⁴		Santa Maria et al. (2014)	Very low confidence ⁴
	Parental encouragement and support for PA	Price et al. (2020); Wright et al. (2013); Burke et al. (2017)	Very low confidence ⁴	Lack of support for PA from school	Lowe et al. (2016)	Low confidence ¹
	Positive influence of parenting style	Santa Maria et al. (2014)	Very low confidence ⁴			
	PA helps to build relationships with parents	Price et al. (2020), Burke et al. (2017)	Low confidence ¹			
	Health professional encouragement of PA	Kuntz et al. (2019); Lowe et al. (2016)	Low confidence ¹			
Emotion <i>How feelings or affect [positive or negative] may influence PA</i>	PA increases positive emotions	Burke et al. (2017)	Low confidence ¹	Negative emotions act as a barrier to PA None identified	Wu et al. (2015); Wright et al. (2013)	Very low confidence ⁴
	PA creates positive feelings about self	Wright et al. (2013); Burke et al. (2017)	Very low confidence ⁴			
	Negative emotions motivating PA	Wu et al. (2015)	Low confidence ¹			
Behavioural regulation <i>Ways of doing things that relate to pursuing and achieving desired PA goals, standards, or targets; Strategies the participants have in place to help them perform the PA behaviour; Strategies the participants would like to have in place to help them do PA</i>	Slowly building up PA level	Wright et al. (2013)	Very low confidence ⁴	None identified		
	Adapting PA to ability	Wright et al. (2013)	Very low confidence ⁴			
	Having a routine helps sustain PA	Wu et al. (2015); Price et al. (2020)	Low confidence ¹			

Note: TDF indicates the Theoretical Domains Framework.

^aSource: TDF descriptions adapted from Cane et al. (2012) and Cheung et al. (2019).

¹Indicates minor concerns about methodological limitations and coherence; moderate or serious concerns about adequacy and relevance.

²Indicates minor concerns about coherence and adequacy; moderate or serious concerns about methodological limitations and relevance.

³Indicates minor concerns about coherence and relevance; moderate or serious concerns about methodological limitations and adequacy.

⁴Indicates minor concerns about coherence; moderate or serious concerns about methodological limitations, adequacy and relevance.

Survivors in two studies also reflected on the positive mental health benefits that can be gained through being active (Rokitka et al., 2021; Wright et al., 2013). Exercise can lead to a 'brighter outlook', 'feeling energetic', 'feeling better' as well as helping to reduce stress:

I think [physical activity] gives me a brighter outlook ... like wanting me to be better ... (Wright et al., 2013; participant quote)

TDF domain: intentions

Two themes relating to intentions for PA were identified across three studies (Lowe et al., 2016; Rokitka et al., 2021; Wu et al., 2015). A lack of motivation to do exercise was reported by a survivor in one study (Wu et al., 2015), whilst in two studies, motivation to exercise came from a feeling of responsibility to others:

I think about the kids who are just lying in bed, getting all that medicine and they can't go exercise. It's kind of like motivation, and I feel like I'm doing it for them. (Lowe et al., 2016; participant quote)

TDF domain: goals

Three goal-oriented themes were identified across four studies (Lowe et al., 2016; Price et al., 2020; Wright et al., 2013; Wu et al., 2015). In terms of facilitators, one study reported that survivors stated that having goals helped to maintain PA:

Participants reported that having a goal and routine helped survivors sustain healthy habits. For instance, one survivor registered for a running race, which encouraged him to run regularly. (Wu et al., 2015; authors' interpretation)

Prioritising PA was reported by two studies to facilitate participation in activities and exercise (Lowe et al., 2016; Wright et al., 2013). However, it was also acknowledged in two studies that young people may have other priorities such as school work or social occasions, which can interfere with engagement in PA (Price et al., 2020; Wright et al., 2013):

Everything proves that it is good for you. There is no reason not to do it, but I think there [...] are other priorities in life. (Price et al., 2020; participant quote)

TDF domain: environmental context and resources

All eight studies contributed to aspects of environmental context and the availability of resources. The value of being able to access facilities and resources for PA was found across three studies (Burke et al., 2017; Lowe et al., 2016; Wu et al., 2015). Memberships of gyms and wellness centres and having equipment were noted to increase motivation, improve accessibility to, and facilitate, exercise. However, in one study survivors expressed feeling embarrassed in gym environments (Wu et al., 2015). This stemmed from an awareness of their physical limitations due to cancer and its treatment.

Two studies reported that survivors expressed an interest in facilities or experiences that were specifically tailored to cancer survivors (Kuntz et al., 2019; Wu et al., 2015). Such programs would provide an environment where survivors would feel more comfortable and equipment would be suitable for all physical abilities. In addition, such opportunities would enable survivors to interact with other young adult survivors through group exercises or providing activities which facilitate PA whilst also allowing survivors to meet and talk:

Even do a gym that would cater to different physical abilities and make it more comfortable for them, because it could be intimidating to go to a normal gym so maybe a cancer survivor only gym that does have all the different levels of weights for them. (Wu et al., 2015; participant quote)

Similarly, Wu and colleagues reported that programs which enabled survivors to be ‘introduced’ to new activities and opportunities for PA, helped them to identify activities they may want to do, facilitated their engagement and helped them to develop skills and could also facilitate survivors’ PA (Wu et al., 2015). Survivors also expressed an interest in learning from personal trainers:

Introducing people to new sports or activities that they maybe haven’t done before and then helping them get ready for, ‘Hey, want to do a triathlon? Great, here’s some information. Here’s what you need to do to do that’. (Wu et al., 2015; participant quote)

The study by Wu et al. (2015) reported that survivors found it difficult to find legitimate information regarding exercise. Similarly, in another study, survivors identified that tailored and reliable information on what exercise to do and how to exercise safely could be useful and help make informed decisions:

Having a resource, whether it’s a person on an online community, to help me make informed decisions and follow good practices for managing my health, like knowing good ways to exercise and use my time effectively to exercise, and exercise right so I don’t hurt myself or do something stupid like that. (Lowe et al., 2016; participant quote)

A lack of time to exercise, often due to work commitments, was reported as a main barrier to exercise by survivors in two studies (Rokitka et al., 2021; Wright et al., 2013):

Eight participants (40%) reported that it was difficult to regularly find time to exercise, usually because of work schedules. (Rokitka et al., 2021; authors’ interpretation)

Financial barriers to accessing exercise facilities and programs, or professionals that could help with exercise, were reported by survivors in two studies (Lowe et al., 2016; Wu et al., 2015). As such, a survivor in one study reported that discounted or free gym memberships could help facilitate exercise (Lowe et al., 2016). In a study that focused on parental support for PA, survivors commented that financial support from their parents enabled them to attend exercise classes, the gym and also obtain the necessary equipment needed for activities:

Money wise, my mom sends me money [...] and I like exclusively keep the money she sends me for like yoga and the gym and things like that which is a huge help. (Price et al., 2020; participant quote)

Two studies that focused on parental factors influencing PA (Price et al., 2020), and weight management (Santa Maria et al., 2014), stated that survivors reported that a home environment that was supportive of, and provided opportunity for, PA was an important positive influence on their exercise behaviours. Similarly, survivors in the study by Price and colleagues reported that a family and home environment in which there were limited choices in activities to do together, or a lack of a routine in which the family were active together, was a barrier to their own PA:

I think they think it is important, but we don’t as a family go out and go out for a run or a walk or a bike, I mean we try but it is not a routine. (Price et al., 2020; participant quote)

In the context of follow-up care, a lack of information and education regarding the importance of PA from their healthcare professionals was reported as a barrier to PA in two studies (Lowe et al., 2016; Wu et al., 2015). This was either due to a lack of opportunity to discuss this or due to not having regular or recent clinic visits (Lowe et al., 2016), or survivors not always getting the information they required despite seeking it from healthcare professionals who they perceived to have a better understanding of survivors needs after cancer (e.g., physiotherapist) (Wu et al., 2015):

[I’ve heard nothing about health-risk behaviors, physical activity or nutrition], and of course, there hasn’t really been much of a context for that to come up because I haven’t seen a doctor regularly in a while, and I didn’t go through any exit counselling. (Lowe et al., 2016 participant quote)

TDF domain: social influences

Six studies provided data on how others were perceived to help or hinder survivors' engagement with PA (Burke et al., 2017; Kuntz et al., 2019; Lowe et al., 2016; Price et al., 2020; Santa Maria et al., 2014; Wright et al., 2013). For example, keeping up with the PA level of peers was suggested to be a facilitator by a survivor in one study (Wright et al., 2013) and friendships were stated to provide an opportunity for PA in another (Lowe et al., 2016). A survivor in the same study also reported that having no one else to engage in exercise was a barrier to PA:

I think I would have been in better shape ... if I would have had somebody to exercise with me when I was younger after I had cancer. (Lowe et al., 2016; participant quote)

In Burke's study, survivors described how cycling enabled them to build meaningful, supportive and fulfilling friendships by providing an opportunity to connect with friends, share common interests and experiences, demonstrate their capability and overcome feelings of isolation they had experienced due to treatment, no longer feeling like a cancer patient, but like a 'kid again' (Burke et al., 2017).

Positive parental modelling of PA behaviours was an important influence on the PA of children in the two studies which focused on the influence of parents (Price et al., 2020; Santa Maria et al., 2014). However, an additional nuance suggested by survivors in the study by Price and colleagues was that parental modelling was more complex in that survivors whose parents took part in PA for recreation and enjoyment purposes appeared to be more active than those survivors who described their parents' motivations to be active were more centred on health and appearance reasons:

Adolescent and young adult cancer survivors who described their parents' physical activity as high but externally motivated (e.g., to reduce morbidity, enhance physical appearance) seemed to be less involved in physical activity themselves. (Price et al., 2020; authors' interpretation)

Likewise, in the study by Santa Maria and colleagues (2014), survivors expressed that a lack of positive parental modelling was a barrier to their engagement in PA:

My mom talks to me about losing weight. She's like, you need to get up and exercise. Thing is, she weighs more than me. (Santa Maria et al., 2014; participant quote)

This study also reported that parenting style could be both a facilitator and a barrier to children's exercise practices (Santa Maria et al., 2014). Children who, from their responses via interview, appeared to be from a family with an authoritative parenting style – one which was described as being demanding but responsive, which promotes assertiveness and responsibility and has clear behavioural expectations and rules – were more likely to describe participation in exercise, than those from permissive or authoritarian home environments.

Parental encouragement for PA was reported in three studies (Burke et al., 2017; Price et al., 2020; Wright et al., 2013). This included providing prompts and reminders, encouragement to continue or increase PA levels, support to try out new activities and parents also engaging in PA alongside their children. However, the study by Price and colleagues found that whilst this encouragement could be viewed as positive and supportive, some survivors felt it could be negative and controlling, particularly if the activities were not chosen by the child:

Adolescent and young adult cancer survivors felt this type of support was negative when they perceived their parents as "pushing" or "urging" them to participate in physical activities that they did not choose or find enjoyable. (Price et al., 2020; authors' interpretation)

As with friendships, taking part in PA with parents was seen to strengthen the parent/child relationship (Burke et al., 2017; Price et al., 2020). Survivors were stated to value this type of support which enabled them to spend more time with their family in a non-medical context where they were no longer the patient:

Through cycling, they were able to build meaningful friendships and foster relationships with their parents, which made them feel supported. (Burke et al., 2017; authors' interpretation)

In two studies (Lowe et al., 2016; Wright et al., 2013), there was evidence that parents may also present as a barrier by discouraging PA either due to their wish for their children to focus on their studies, or due to them being apprehensive about their child engaging in sports. In one of these studies, a participant also perceived their school to be unsupportive of PA:

At first it limited my physical activities because at first my parents didn't want me to do things. I went to a private high school and because the administration viewed my health history, I don't think they really wanted me to be involved with sports, so I gravitated towards music and had fun with that. (Lowe et al., 2016; participant quote)

Receiving encouragement from healthcare professionals to be more active was reported in two studies (Kuntz et al., 2019; Lowe et al., 2016). This encouragement was seen to be positive and something the survivors welcomed. In one study (Lowe et al., 2016), survivors stated that their healthcare professionals highlighted the importance of PA to them. This included informing survivors of the benefits of PA, but also giving guidance on the amount and type of exercise:

They talk about that and how important it is to stay healthy. Right when I finished treatment, they were telling me that my bones were probably really weak and that it would be important to do weight bearing activities, so I run a lot. (Lowe et al., 2016; participant quote)

TDF domain: emotion

Three studies provided information on the role emotions play in PA (Burke et al., 2017; Wright et al., 2013; Wu et al., 2015). In two, survivors commented that feelings of stress, depression, embarrassment and frustration could prevent PA (Wright et al., 2013; Wu et al., 2015). However, in one study, there was evidence that experiencing negative emotions such as stress and fear about one's health could also play a part in motivating a return to PA:

I was like, man, I'm going to die of a heart attack or something, and for me that thought was frightening enough that I was like I need to do something ... I think that's what sparked me to start working out again, and hit the gym. (Wu et al., 2015; participant quote)

Survivors in one study reported that participating in cycling resulted in positive emotions such as feeling a sense of happiness, excitement, pride and a sense of achievement (Burke et al., 2017). Participating in PA was also seen to bring about positive feelings towards the survivors themselves, making them feel better and more positive about their physical self:

makes me feel better about myself and makes me feel good after I'm done. (Wright et al., 2013; participant quote)

TDF domain: behavioural regulation

Three studies contributed to four themes of facilitators of PA concerning behavioural regulation (Price et al., 2020; Wright et al., 2013; Wu et al., 2015). In one study, a survivor expressed that slowly building up PA levels after treatment could help facilitate PA, whilst another participant suggested that it was adapting and changing activities after treatment that helped to maintain PA (Wright et al., 2013). In one study, survivors suggested that introducing new activities either maintained their interest in PA, or could help to stimulate interest in others:

Similarly, introducing interesting activities, such as video games involving physical activities, can motivate survivors, particularly young ones, to do exercise. (Wu et al., 2015; participant quote)

In two studies (Price et al., 2020; Wu et al., 2015), the routine was acknowledged as being potentially beneficial to maintaining PA:

... and if we had a schedule, I think it would be easier to do something as a whole family or at least my mom, my dad, and me. (Price et al., 2020; participant quote)

Discussion

This systematic review and qualitative evidence synthesis have systematically identified, appraised and synthesised qualitative research evidence on the barriers and facilitators to PA, as perceived by CCSs. To our knowledge, this is the first review to summarise qualitative evidence of these issues in CCSs. By bringing together existing qualitative evidence on the topic and by using a theoretically driven synthesis to map the review findings, it has enabled a systematic way to view insights into the factors which CCSs perceive to help or hinder their PA behaviours, whilst including studies that were not necessarily targeting this research question.

By synthesising published data, we have highlighted that CCSs who have completed hospital-based treatment still continue to face a variety of complex influences on their behaviour. Data mapped onto nine of the TDF domains. By far, the majority of descriptive themes (both barriers and facilitators) mapped onto the domains of Environmental Context and Resources and Social Influences, with many of these themes relating to the influence of parents. Although parental influence and support is recognised as a key factor in the PA of children and adolescents (Biddle et al., 2011; Martins et al., 2015), including those with physical disabilities (McKenzie et al., 2021), the weighting of these issues in the review findings could be due to parental factors being the main focus of two of the included studies (Price et al., 2020; Santa Maria et al., 2014). Nevertheless, this highlights the potentially important role that parents may have in both the development and the implementation of PA interventions for CCSs. However, parental engagement and involvement in such interventions for CCSs are noted to be rare (Brown et al., 2020; Raber et al., 2016).

Our synthesis also identified other influential factors previously reported in young people without a history of cancer, such as the availability of social support, access to facilities, issues relating to time and money, as well as perceived competence and self-consciousness about appearance (Biddle et al., 2011; Brunton et al., 2003). However, this review helps to bring together evidence of how these factors influence PA in the context of childhood cancer survivorship such as how survivors perceive the cancer and treatment to have impacted on their physical skills and capability; how survivors may feel uncomfortable in typical exercise environments; the potential need for resources and advice tailored to survivors; and the role healthcare professionals may play in encouraging PA. These findings not only help to illuminate the challenges CCSs face, but also the ways in which interventions could begin to support CCSs to be more physically active.

The use of the TDF provided a 'theoretical lens' through which the likely influences on PA could be viewed to identify what personal, social and environmental changes need to occur in order to improve PA in CCSs (Atkins et al., 2017). These results when used in conjunction with the Behaviour Change Wheel (BCW) (Michie et al., 2014), a framework developed for characterising and designing behaviour change interventions, will help to inform important decisions, including what intervention functions and behaviour change techniques are likely to be effective in bringing about a change in the PA behaviour of CCSs. For example, for barriers identified in the TDF domains of Environmental Context and Resources and Social Influences, intervention functions suggested by the BCW include environmental restructuring and modelling. Behaviour change techniques associated with these intervention functions include the demonstration of the behaviour, social support, and restructuring the physical environment.

The GRADE-CERQual approach was used to assess the confidence of the review findings and the extent to which they were a reasonable representation of the perceived influences on PA behaviours of CCSs. In doing so, the majority of review findings were found to be of low confidence. This was mainly due to a paucity of data in terms of its richness, the small number of primary studies (and participants) which contributed to each review finding, and the lack of

studies that focused on PA (as opposed to health behaviours in general), as well as the inclusion of heterogeneous samples. Taken together, these issues highlight the lack of research that has been undertaken to explore PA behaviours in CCSs, and specifically research to understand the barriers and facilitators to PA. Therefore, although this review offers a valuable first step in the development of an evidence-based and theoretically informed intervention, further primary research is needed.

Strength and limitations

The review was carried out according to the methodological and reporting standards set out by both PRISMA and ENTREQ. A rigorous and reproducible search strategy of multiple data sources was utilised and at least two independent reviewers carried out screening, data checking and quality assessment. In addition, backward and forward citation searching was used to avoid missing studies, and where necessary, authors of potentially eligible studies were contacted to clarify study details to confirm inclusion/exclusion.

Although a theoretical framework was utilised to categorise the perceived influences on PA behaviours in CCSs, initial inductive coding ensured that any data that potentially did not fit within the TDF domains would still be captured by the synthesis. However, all data did in fact map onto the TDF domains. Additionally, the GRADE-CERQual approach was used to assess how much confidence could be placed on each of our review findings.

The eligibility criteria was restricted to enable the identification of issues pertinent to survivors of childhood cancer who had completed active cancer treatment. However, in doing so, only eight papers were eligible and half of the included studies contained a minority of patients who were diagnosed older than 18 years. Additionally studies included participants currently aged 8–52 years old, making it difficult to identify how the influences of PA may differ across age groups. The majority of papers originated from the USA, with the remainder from Canada and the UK, thus limiting the generalisability of findings.

Conclusion

Sub-optimal levels of PA are a well-documented issue in CCSs. This review is the first to systematically identify, appraise and synthesise qualitative evidence regarding the barriers and facilitators to PA, as perceived by CCSs no longer on active hospital-based treatment. Few studies were eligible and although multiple influences on the PA behaviour of CCSs were identified, confidence in the review findings was low. Therefore, this highlights that further in-depth qualitative research is needed in this area to strengthen the evidence-base, and to further inform intervention development.

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