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Yoga for Children and Adolescents Affected by Cancer or Blood Disease

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Yoga for Children and Adolescents Affected by Cancer or Blood Disease

by

Kelsey Ellis

A THESIS

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Abstract

Children and adolescents (≤ 18 years of age) affected by cancer or blood disease face significant negative effects due to their disease and treatments. Yoga is one strategy that has been highlighted as safe, feasible, and potentially beneficial in experimental studies for this population. However, significant gaps and limitations exist in the current evidence and practice. First, efforts to collate a growing body of experimental evidence reporting on the effects of yoga are scarce, leaving the breadth of available evidence, the possible effects of yoga, and gaps and limitations in the evidence unknown. Second, despite the potential benefits of yoga, there are relatively few programs being delivered. Moving *evidence to practice* may be fostered by gathering feedback from key stakeholders, including the yoga instructors - who play a critical role in the safe and effective delivery of these programs. Therefore, the studies comprising this thesis sought to lay a foundation for future research and practice by summarizing the evidence to date reporting on the effects of yoga, and exploring yoga instructors' lived experiences preparing for and facilitating yoga, for children and adolescents affected by cancer or blood disease.

First, a systematic review was conducted wherein eight electronic databases and one trial registry were searched for experimental articles reporting on the effects of yoga for children and adolescents affected by cancer or blood disease. Results were summarized narratively. Across the eleven included studies, wide variability in the literature exists, and while yoga may promote benefits, several limitations in the current evidence were identified. Second, an interpretive description study was conducted via semi-structured interviews with fourteen yoga instructors who had experience facilitating yoga for this population. Data were analyzed using principles of interpretive description and thematic analysis. Findings from this interpretive description study highlight limitations in the yoga instructor training, and the necessity of prioritizing safe,

effective, and accessible yoga delivery. Collectively, the studies in this thesis offer important foundational research and practical information, support the continued study and use of yoga as a supportive care resource for children and adolescents affected by cancer or blood disease.

Keywords: childhood, cancer, hematology, yoga

Preface

Chapter 2 of this Thesis will be submitted as: Ellis K., Wurz A., McLaughlin, E., Schulte F., Sung L., Culos-Reed SN. A Systematic Review of Yoga for Children and Adolescents Affected by Cancer or Blood Disease to the *Journal of Alternative and Complementary Medicine*. July 2021.

Chapter 3 of this Thesis will be submitted as: Ellis K., Culos-Reed S.N., Schulte F., Sung L., Wurz A. Exploring yoga instructors' experiences delivering yoga to children and adolescents affected by cancer or blood disease to the *International Journal of Yoga Therapy*. July 2021.

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Dedication

This work is dedicated to the children and adolescents who I hope will benefit from this work in the future. As well, this work is dedicated to the yoga instructors involved, I hope these findings will support the incredible work you are doing.

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Chapter One: **Introduction and Literature Review**

1.1 Children and Adolescents Affected by Cancer or Blood Disease

1.1.1 Disease characteristics

Cancer is the result of a genetic change in single cells that proliferates uncontrollably and causes harm if left untreated.¹ Diagnoses of cancer among children and adolescents (≤ 18 years of age) are rare, representing $<2\%$ of all new cancer diagnoses each year.² Blood disease refers to a category of non-cancerous diseases, defined as any disease of the blood, involving blood cells, or tissues in which these are formed. For example, failure of bone marrow, lymph nodes, or spleen – or issues of bleeding or blood clotting.³⁻⁵ Diagnoses of blood disease among children and adolescents are also rare. Though few published reports documenting incidence exist, prominent organizations servicing this population suggest 0.02% of infants are born with hemophilia.^{3,6} Consequently, children and adolescents affected by cancer or blood disease represent a small population, yet both are causes of significant morbidity and mortality.⁷⁻¹⁰ Though disease characteristics differ among children and adolescents affected by cancer or blood disease, in some cases both receive similar treatments and thus may face similar side effects.

1.1.2 Negative effects of treatments

Treatments for children and adolescents affected by cancer commonly include chemotherapy, radiation, surgery, stem cell transplant, or a combination of these modalities.^{11, 12} Treatment for children and adolescents affected by blood disease often includes blood transfusions, supplements (e.g., folic acid, iron supplements), antibiotics, and/or stem cell transplant.^{7, 11} Notably, treatments for both cancer and blood disease include stem cell transplants and certain medications (e.g., hydroxyurea).^{7, 11} These treatments have been lauded for decreasing mortality rates, with 5-year survival rates in excess of 80% for most childhood

cancers and blood diseases.^{13, 14} Nevertheless, these populations face negative short- and long-term physical and psychosocial effects that may range in severity based on their disease, treatments received, and length of hospitalization.^{7, 10, 11, 15} Negative physical effects may include fatigue, pain, nausea, infection, and deconditioning, which may lead to further health complications.^{11, 16} Deconditioning is thought to be due to prolonged hospitalization and treatment-related fatigue and is associated with declines in physical mobility and strength resulting in impaired daily functioning.^{16, 17} Negative psychosocial effects span anxiety, distress, depression, low motivation, low self-efficacy, and behavioural, and social problems.^{15, 18-20} Taken together, these negative effects may lead to a decline in health and quality of life for children and adolescents affected by cancer or blood disease.¹⁸⁻²¹ Given the growing population successfully living beyond treatment (i.e., >80% surviving 5 years beyond diagnosis), there is a need to identify supportive care strategies to mitigate the negative symptoms and side effects faced, while enhancing health and quality of life.

1.2 Yoga as a supportive care strategy

Yoga is a form of movement that in the West most commonly includes postures (asanas), meditation (dhyana), and breathwork (pranayama).^{22, 23} Various types and kinds of yoga exist.²⁴ Within the field of chronic disease management, the most commonly described yoga types include gentle, hatha, and therapeutic yoga.^{22, 25} Hatha yoga includes movement, meditation, and breath work to promote strength, flexibility, and relaxation.²⁶ Therapeutic yoga is referred to as yoga postures and practice for the treatment of health conditions to prevent, reduce, or alleviate pain, suffering, or limitations.^{27, 28} Among adults affected by cancer, systematic reviews summarize the benefits of yoga interventions on physical functioning (e.g., strength, flexibility) and psychosocial functioning (e.g., mood, distress, anxiety).²⁹⁻³² Among children and adolescents affected by cancer,

there is far less research, however the evidence that is emerging suggests that yoga may be a viable supportive care strategy for children and adolescents affected by cancer or blood disease, with studies reporting on safety, feasibility, and potential benefits.

1.3 Summarizing the evidence

Nevertheless, the evidence published to date has yet to be summarized, making it difficult to draw firm conclusions about the state of the evidence. Indeed, the lack of reviews consolidating the available evidence reporting on the effects of yoga for children and adolescents with cancer or blood disease is problematic because mixed results have been reported across studies, with some finding improved outcomes and others finding no change. Thus, looking to single studies alone can amplify mixed messages about the role of yoga, and may result in overreliance on single study findings when describing the potential benefits of yoga for this population. To advance this field, it is important to understand the state of the evidence and to provide directions for future research. Therefore, a systematic review consolidating the evidence reporting on the effects of yoga is needed to summarize the breadth of available evidence (i.e., study, intervention, and participant characteristics), understand the possible effects of yoga, and identify limitations in the current evidence.

1.4 Moving evidence to practice

Although much remains to be learned about the effects of yoga and further research is certainly needed to draw firm conclusions, many types of yoga are considered gentle and accessible forms of movement.³³ Considering the positive role of movement for children and adolescents affected by cancer or blood disease,^{34, 35} movement guidelines recently published for children with cancer,³⁶ and the United Nations declaring movement as a basic childhood right,³⁷ helping this population move more is important. Combined with early evidence suggesting yoga

is safe, feasible, and potentially beneficial, uncovering how to deliver yoga safely and effectively, and ensuring this population can access safe opportunities to practice yoga is critical. Learning from those with lived experience offering yoga via research or programs to this population may provide invaluable information to support building and delivering safe and effective yoga opportunities.

1.5 Research objectives

To address a key gap in the literature (i.e., lack of a systematic review) and start to lay a strong foundation for offering safe and effective yoga to children and adolescents affected by cancer or blood disease, the purpose of the current work was to summarize the evidence to date reporting on the effects of yoga, and explore yoga instructors' lived experiences preparing for and facilitating yoga, for children and adolescents affected by cancer or blood disease.

Objective 1: *Chapter Two* (study 1) includes a systematic review summarizing the evidence on the effects of yoga for children and adolescents affected by cancer or blood disease. Specific research objectives were to: (1) describe study, intervention, and participant characteristics; (2) describe findings regarding the safety, feasibility, and potential effects of yoga; and (3) highlight the state of the literature by identifying limitations in the evidence to date.

Objective 2: *Chapter Three* (study 2) reports on a study examining yoga instructors' lived experiences preparing for and facilitating yoga for children and adolescents affected by cancer or blood disease. Specific research objectives included exploring yoga instructors': (1) perspectives on the role of yoga for children and adolescents affected by cancer or blood disease; (2) views on training and experience required to successfully facilitate yoga for children and adolescents affected by cancer or blood disease; and (3) experiences with yoga programs they have facilitated.

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Chapter Two: **Systematic Review**

Ellis K., Wurz A., McLaughlin, E., Schulte F., Sung L., Culos-Reed SN. A Systematic Review of
Yoga for Children and Adolescents Affected by Cancer or Blood Disease.

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2.1 Abstract

Background: As the incidence and survival rates for cancer and blood disease among children and adolescents continues to rise, so too does the need for interventions to address adverse effects. Yoga is one intervention with potential to address the negative effects of cancer and blood disease, yet no efforts have been made to synthesize the available evidence to draw conclusions.

Objective: This review sought to summarize evidence reporting on the effects of yoga for children and adolescents affected by cancer or blood disease to describe the characteristics of studies, safety, feasibility, and potential effects of yoga, and identify limitations in the literature.

Methods: Eight electronic databases and one trial registry were searched from database inception to February 2021. Experimental articles, published in English, and reporting on the effects of a yoga intervention with children and adolescents affected by cancer or blood disease ≤ 18 years of age were included. Risk of bias assessment, and data extraction were performed in duplicate. All results were summarized narratively.

Results: Eleven studies were included, comprised of 204 participants. Most studies used a single group, pre/post experimental design ($n=10$; 91%). Across studies, there was a variety in outcomes studied and measures used. There were no adverse events related to yoga reported, and most ($n=9$) studies described yoga as feasible. In general, studies reported that yoga had beneficial effects on physical activity behaviours (e.g., physical activity levels), symptoms and side effects (e.g., pain, fatigue), physical functioning (e.g., functional mobility), and psychosocial outcomes (e.g., quality of life, anxiety), although mixed findings were noted with some studies reporting benefits and others reporting no change. Key limitations in the identified evidence include a lack of studies designed to assess the effects of yoga (given the feasibility focus of

most of the work to date), variability in intervention “doses”, outcomes studied, and measurements used, and lack of interventions examining long-term effects and supporting the continued practice of yoga.

Conclusion: Though several limitations in the literature were noted, yoga was shown to be safe, feasible, and potentially beneficial for children and adolescents affected by cancer or blood disease. Findings from this review lay the foundation for researchers to continue to build the evidence supporting yoga for children and adolescents affected by cancer or blood disease.

Key words: children, pediatrics, yoga, cancer, hematology

2.2 Introduction

As the incidence and survival rates for children and adolescents (≤ 18 years of age) affected by cancer or blood disease continues to rise, so too does the need for interventions to address adverse effects.¹⁻⁸ Recent reviews have identified physical activity, defined as any bodily movement produced by skeletal muscles that requires energy expenditure⁹ as safe and beneficial for children and adolescents affected by cancer or blood disease.^{10, 11} Specifically, physical activity has been found to mitigate many adverse effects associated with their treatments, while promoting physical and psychosocial functioning.¹⁰⁻¹³

Yoga is one form of physical activity that in the West includes physical postures (asanas), breathwork (pranayama), and mindfulness/meditation (dhyana).¹⁴ Among children and adolescents affected by cancer or blood disease, researchers have found that yoga is safe, feasible, and may be a beneficial strategy to help manage negative effects while promoting positive outcomes.¹⁵⁻¹⁸ Indeed, findings from some experimental studies show that yoga may help children and adolescents affected by cancer or blood disease manage some of their disease- and treatment-related symptoms and side effects (e.g., pain, anxiety, nausea), and may have positive effects on health outcomes including physical activity behaviours (e.g., physical activity levels), physical functioning (e.g., functional mobility, flexibility), psychosocial functioning (e.g., mood), and quality of life.¹⁵⁻¹⁸ However, findings from other studies suggest mixed or no changes in physical activity behaviours, anxiety, or quality of life.¹⁹⁻²¹ These mixed findings, and lack of a review collating the early evidence, make the potential benefits of yoga unclear. This can make it hard for researchers to situate their findings in the current evidence and may also lead to overreliance on single studies to understand the effects of yoga.

Reviews reporting on the effects of yoga among adults affected by cancer describe significant physical and psychosocial benefits, including increased quality of life, better mood, improved sleep, greater strength and flexibility, and lower distress and symptoms of fatigue.²²⁻²⁵ This evidence is serving to reframe yoga as a supportive cancer care resource for adults affected by cancer. In fact, given the breadth of available evidence reporting on the benefits of yoga among adults affected by cancer, yoga has been recommended by The National Comprehensive Cancer Network, The Society for Integrative Oncology, as well as American Society of Clinical Oncology to aid in symptom management for this cohort.²⁶⁻³⁰

Among children and adolescents affected by cancer or blood disease, there is less evidence, and no systematic reviews. Thus, it may be difficult for clinicians and families to make evidence-informed decisions related to yoga. Further, as the evidence to date has not been summarized, it may be challenging for researchers to know how to intervene and build evidence-based, safe, feasible, and effective yoga interventions, that addresses limitations in the evidence. A review consolidating the available evidence reporting on the effects of yoga in children and adolescents affected by cancer or blood disease is needed to understand the possible effects of yoga, summarize the breadth of available evidence (i.e., study, intervention, and participant characteristics), and identify the limitations in the current literature. Thus, this systemic review sought to summarize the evidence reporting on the effects of yoga for children and adolescents affected by cancer or blood disease to: (1) describe study, intervention, and participant characteristics; (2) describe findings regarding the safety, feasibility, and potential effects of yoga; and (3) highlight the state of the literature by identifying limitations in the evidence to date.

2.3 Methods

The protocol for this review was registered apriori with PROSPERO (CRD42020196890), and the PRISMA guidelines were adhered to in the reporting of this systematic review.³¹

2.3.1 Eligibility criteria

To be included, studies had to meet the following criteria: (1) have a full-text available and be published in English in a peer-reviewed journal; (2) include a sample comprised of >50% children and adolescents (≤ 18 years of age) affected by cancer or blood disease (defined as current or past cancer or blood disease diagnosis); (3) use any experimental study design that provided the opportunity to participate in a yoga intervention, that may have included any of the following elements: asanas (postures), pranayama (breathwork), dhyana (meditative techniques), and/or relaxation. Studies were excluded if: (1) children and adolescents represented <50% of the sample(s) or results could not be examined separately from participants > 18 years old; (2) full-text was not available. No restrictions were placed on outcomes assessed. Children and adolescents affected by cancer and blood disease were included due to the potentially similar treatments these two groups receive (e.g., bone marrow transplants), and the need to understand the effects of yoga on the related negative treatment impacts (e.g., fatigue, pain) these populations face.⁷

2.3.2 Search strategy and information sources

The first author (KE) and librarian developed a search strategy (Supplemental File 1) in Medical Literature Analysis and Retrieval System Online (MEDLINE) which was reviewed by co-authors who have research and clinical expertise in pediatric oncology/hematology, physical activity, and yoga (FS, LS, AW, NCR). After the search strategy was tested with seed studies, it

was translated to the remaining 7 databases. On February 16, 2021ⁱ, the following databases were searched from database inception onwards: (1) MEDLINE Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily (OVID); (2) Excerpta Medica database Web of Science Core Collection (OVID); (3) SportsDiscus (EBSCO); (4) Cumulative Index to Nursing and Allied Health Literature (EBSCO); (5) Cochrane Database of Systematic Reviews (OVID); (6) Cochrane Central Register of Controlled Trials (OVID); and (7) Scopus, Alternative Medicine and Health (EBSCO). In addition, clinicaltrials.gov was searched.

All citations were exported to Covidence,³² and duplicates were automatically removed. Screening was conducted independently by two authors (KE, EM),ⁱⁱ first at the title/abstract level and then at the full-text level. Any disagreements over the eligibility of particular studies were resolved through discussion with additional authors (NCR, AW). Finally, reference lists of included studies were scanned independently by two review authors (KE, EM) to identify additional studies to screen. Inter-rater agreement was assessed at the title/abstract and full-text level and was 97% and 99%, respectively.

2.3.3 Data extraction

A standardized, pre-established data extraction excel (version 16.49) document was used to extract data from the included studies (Supplemental File 2). Extracted information included: (1) study characteristics (i.e., year of publication, study design, source of funding, conflict of interest); (2) sample characteristics (i.e. sample size, participant demographics, type of cancer or

ⁱ Initial search was run on August 11, 2020, and update search was conducted in February 16 2021

ⁱⁱ To ensure consistency, screening was conducted in batches. At the title/abstract level two authors (KE, EM) took the first sample of 50 citations, screened independently, and then met to discuss any discrepancies, prior to screening the remaining citations. Following this, the process to ensure consistency was repeated at the full-text level with a sample of four citations, prior to screening the rest of the articles.

blood disease, treatment status, disease status); (3) yoga intervention and yoga instructor characteristics (i.e., setting, details of the yoga intervention and control conditions, yoga instructor certifications and training details); (4) outcome measures and times of measurement; and (5) outcomes (not pre-specified, but based on study teams' knowledge grouped into the following categories: feasibility, PA behaviour (e.g., PA levels), symptoms and side effects (e.g., fatigue, pain), physical (e.g., balance) or psychosocial functioning (e.g., quality of life, anxiety), "other" outcomes (defined as outcomes that did not fit within the previously mentioned, outcome categories; e.g., length of hospital stay), and program experience. Data extraction was performed independently by two reviewers (KE, EM). Disagreements were discussed with additional authors (NCR, AW) until consensus was reached.

2.3.4 Risk of bias

Risk of bias for all included studies was independently assessed by two reviewers (KE, EM) using the Risk of Bias Assessment tool for Non-randomized Studies³³ and the Cochrane Collaboration tool for risk of bias of randomized controlled trials.³⁴ A standardized form was prepared and used to assess characteristics of each study against pre-specified domains as indicated by the tool. For the Risk of Bias Assessment tool for Non-randomized Studies, domains included selection of participants, confounding variables, measurement of exposure, blinding of outcome assessments, incomplete outcome data, and selective outcome reporting.³³ For the Cochrane Collaboration tool for randomized controlled trials, domains included random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessments, incomplete outcome data, selective outcome reporting, and other potential sources of bias.³⁴ Supplemental File 3 contains definitions for each domain as described by the authors of the tools used. Across domains, each study was classified as "low" to indicate low risk

of bias, “high” to indicate high risk of bias, or “unclear” to indicate unclear or unknown risk of bias. Discrepancies in scoring were settled via discussion and a decision made by consensus and/or discussion, and a third author (AW) was available if needed, but was ultimately not consulted.

2.3.5 Data synthesis

Extracted data were summarized following recommendations for narrative synthesis.³⁵ To achieve review objectives, summaries were prepared to describe: characteristics of the study, yoga intervention, yoga instructor, participants, outcomes, and measures; findings examining the safety, feasibility and potential effects of yoga; as well as risk of bias and limitations in the evidence to date. Specifically, the first author (KE) examined the extracted data, drafted summative tables, and then reflected on the data before narratively summarizing findings textually. Analysis involved examining tables for similarities and differences between the findings of different studies, patterns in the data, and limitations in the evidence. The narrative synthesis was then critically reviewed by all authors (KE, AW, EM, FS, LS, NCR).

2.4 Results

2.4.1 Study selection

A total of 5,055 citations were identified through electronic database searching and one clinical trial registry (Fig. 1). After removing duplicates, 4,123 citations were screened at the title/abstract level, resulting in 4,033 citations excluded. The remaining 90 citations were screened at the full-text level, and 79 studies were excluded with reasons provided (Supplemental File 4). Eleven studies met inclusion criteria and were included in the systematic review.

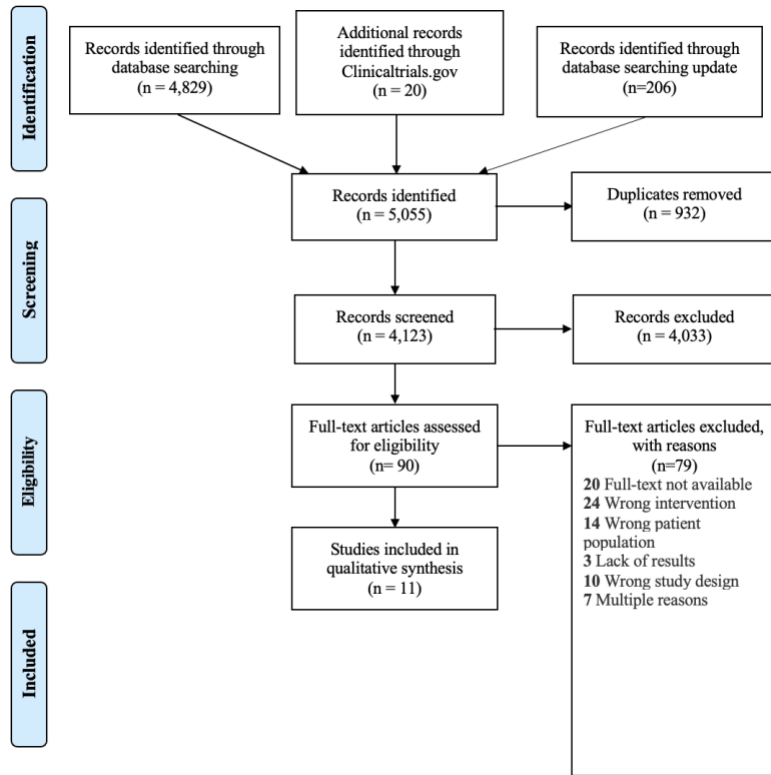


FIG. 1. Preferred Reporting Items for Systematic Review and Meta-Analysis flow diagram of search results and reasons for exclusion.

2.4.2 Study and sample characteristics

Table 1 includes an overview of study characteristics. Studies were published from 2010 to 2019, with most published from 2015 onwards (73%; n=8).^{15, 18-21, 36, 37} Over half of the studies were published in the United States (54%; n=6),^{15, 17, 19, 21, 37, 39} the remaining were published in Canada (27%; n=3),^{16, 18, 20} India (9%; n=1),³⁸ and Iran (9%; n=1).³⁶ Over 90% (n=10) were single group, pre/post study designs. One study (9%) was a randomized controlled trial.²¹ Across studies, quantitative methods were most commonly used to report on the effects of yoga (73%; n=8)^{16, 17, 21, 26-38, 39} and 27% (n=3) used mixed-methods approaches.¹⁸⁻²⁰

Table 1 also includes an overview of sample characteristics. A total of 204 participants were included, with sample sizes ranging from six to 70 participants. The mean age of participants ranged from 9.8 years of age to 15.0 years of age. Five (45%) studies included participants diagnosed with cancer (e.g., acute lymphoblastic leukemia, acute myeloid leukemia).^{15, 16, 19, 20, 38} Four (36%) studies included participants diagnosed with either cancer or blood disease.^{17, 18, 37, 39} In the remaining two (18%) studies participants were diagnosed with blood disease (i.e., hemophilia and sickle cell disease)^{21, 36} Overall, across studies 104 participants were diagnosed with cancer and 100 were diagnosed with blood disease. Most studies (82%; n=9) included participants who were on-treatment.^{16-18, 20, 21, 36-38} In the remaining studies, participants were off-treatment (9%; n=1)¹⁵ or treatment status was unreported (9%; n=1).³⁹

2.4.3 Yoga intervention and instructor characteristics

Table 2 provides an overview of yoga intervention characteristics. Yoga was defined differently across studies. All studies (100%; n=11) defined their yoga intervention as a practice including asanas (i.e., postures) and relaxation. The majority also defined yoga as including pranayama (i.e., breathing 82%; n=9)^{15, 17-21, 36-38} and most also included dhyana (i.e., meditation 54%; n=6).^{15, 19, 21, 37-39} In the randomized controlled trial (9%; n=1) the intervention group received yoga whereas the control group received contact control visits from a yoga instructor.²¹

Seven yoga interventions (64%) were delivered in-hospital only,^{17-19, 21, 37-39, 33} three (27%) were delivered in mixed settings which included a combination of hospital and remote delivery (i.e., delivered asynchronously via yoga videos^{15, 36} or synchronously via skype²⁰), and one (9%) was delivered in a community setting.¹⁶ All yoga interventions (100%; n=11) were led by a trained instructor, defined as a yoga instructor (64%; n=7),^{15, 16, 19, 21, 36-38} a yoga teacher

(27%; n=3),^{18, 20, 39} and in one study (9%)¹⁷ physical and occupational therapists and assistants.

Yoga instructors were described as having yoga certifications/trainings (e.g., certified yoga instructor, certified yoga teacher, trained yoga instructor; 73%; n=8),^{15, 16, 18-20, 37-39} and additional population or study-specific training (64%; n=7).^{16-21, 36} The additional trainings reported included training in yoga for children (18%; n=2),^{16, 18} therapeutic yoga (9%; n=1),¹⁷ study-specific yoga (18%; n=2),^{18, 20} yoga for cancer (9%; n=1),¹⁶ yoga for pediatric cancer (9%; n=1),¹⁹ and training and/or experience with hospitalized children affected by a hematological disease (18%; n=2).^{21, 36}

The duration of yoga interventions varied from 1 day to 14 weeks, with most (54%; n=6) being 6 weeks or longer.^{15-17, 19, 20, 36} No studies included follow-up periods. Yoga interventions were most often (27%; n=3) offered 1 time/week, with a range from 1 time/week to 5 times/week.^{17, 19, 20} The length of each session ranged from 20 to 60 minutes, and most (45%; n=5) had sessions that were 60 minutes in length.^{16, 17, 19, 36, 38} Finally, most yoga interventions (73%; n=8) were group-based yoga offering family members and/or friends the opportunity to participate.^{15, 17-20, 37-39} The three remaining studies (27%) did not specify whether family or friends could take part.^{16, 21, 36}

Table 1. Study and participant characteristics

Study characteristics			Sample characteristics				
First author, year, ^{Ref.} country	Funding	Conflict of interest	Sample size <i>n</i>	Disease characteristics	Treatment characteristics	Age (years) Mean±SD, Range)	Time since diagnosis (months)
Single group (n=10)							
Beheshtipoor, 2015, ³⁶ Iran	Yes	None	27	Disease type: Blood disease Disease diagnosis: Haemophilia A or B	Treatment status: On Treatment type (if applicable): On-demand therapy	11.5±3.9, 8-16	NR
Diorio, 2015, ¹⁸ Canada	None	None	11	Disease type: Cancer or blood disease Disease Diagnoses: Leukemia, lymphoma, solid tumor, brain tumor, or aplastic anemia	Treatment status: On Treatment type (if applicable): Chemotherapy and hematopoietic stem cell transplant	NR±NR, 7.7-16.4	Median: 2.2
Fukahara, 2015, ³⁷ United States of America	Yes	None	15	Disease type: Cancer or blood disease Disease Diagnoses: ALL, neuroblastoma, AML, Burkitt lymphoma, or Wilms tumor	Treatment status: On Treatment type (if applicable): NR	11.8±3.28, 7-17	NR
Geyer, 2011, ¹⁷ United States of America	Yes	None	6	Disease type: Cancer or blood disease Disease Diagnoses: Ewing sarcoma, AML, ALL, or Fanconi's anemia	Treatment status: On Treatment type (if applicable): Mixed Note. n=2 post bone marrow transplant, n=4 NR	11.2±NR, 5-19	NR
Govardhan, 2019, ³⁸ India	NR	None	18	Disease type: Cancer Disease Diagnosis: Brain Tumour	Treatment status: On	9.8±NR, 6-18	NR

					Treatment type (if applicable): Radiation and chemotherapy		
Hooke, 2016, ¹⁵ United States of America	Yes	None	13	Disease type: Cancer Disease Diagnoses: Leukemia, lymphoma, solid tumor, or CNS tumor	Treatment status: Off Treatment type (if applicable): Chemotherapy, radiation and surgery	12.92±2.68, 10-17	Mean: 10.5
Orsey, 2017, ¹⁹ United States of America	Yes	None	10	Disease type: Cancer Disease Diagnoses: ALL, Ewing's sarcoma, Germ cell tumor, Glioblastoma, Hodgkin's disease, Histiocytic neoplasm, Medulloblastoma, Osteosarcoma, or Spindle cell sarcoma	Treatment status: On Treatment type (if applicable): NR	NR±NR, 8-18	Range: (n=4) <3 - (n=3) >24
Stein, 2019, ²⁰ Canada	Yes	None	10	Disease type: Cancer Disease Diagnoses: Solid tumor, brain tumor, leukemia or lymphoma	Treatment status: On Treatment type (if applicable): Outpatient Chemotherapy	NR±NR, 11-18	Range: n=4 0-5 – n=5 12>
Thygeson, 2010, ³⁹ United States of America	None	None	16	Disease type: Cancer or blood disease Disease Diagnoses: ALL, Relapsed ALL, AML, Solid tumor, CNS tumor, or SCD	Treatment status: NR Treatment type (if applicable): NR Note. n=3 chemotherapy, n=13 NR	Overall 10.69±NR, 6-18 Children: 8.55±1.75, 6-12 Adolescents: 15.40±1.82, 13-18	Children mean: 8.25 Adolescents mean: 3.37
Wurz, 2014, ¹⁶ Canada	Yes	None	8	Disease type: Cancer Disease Diagnoses: Osteosarcoma, CNS tumor, ALL, CML, lymphoma, or multiple cancers	Treatment status: On Treatment type (if applicable): Chemotherapy, surgery, radiation, stem cell transplant	11.88±4.26, 5-17	NR
Randomized controlled trial (n=1)							

Moody, 2017, ²¹ United States of America	NR	NR	IG: 35 CG: 35	Disease type: Blood disease Disease Diagnosis: SCD VOC	Treatment status: On Treatment type (if applicable): Pharmacological pain treatment protocol	IG: 15±NR, 6-20 CG: 14±NR, 6-21 Note. IG and CG were balanced in terms of clinical and demographic variables	NR
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Notes. ALL=acute lymphoblastic leukemia; AML=acute myeloid leukemia; CG=control group; CNS=central nervous system; CML=chronic myeloid leukemia; IG=intervention group; NR=not reported; SD=standard deviation; Ref=reference; SCD=sickle cell disease; SCD VOC=sickle cell disease vaso-occlusive crisis.

Table 2. Yoga intervention characteristics

First author, year,^{Ref.} country	Duration	Frequency	Time/session length (minutes)	Yoga Intervention definition	Yoga Content	Setting and Supervision	Yoga instructor/teacher certification; and additional training	Support person (Y/N/NR), describe
Single group (n=10)								
Beheshtipoor, 2015, ³⁶ Iran	14 weeks Note. In hospital 8 weeks, at home 6 weeks	2x/week	60	Yoga	Asanas: Yes Pranayama: Yes Dhyana: No Relaxation: Yes	Setting: Mixed Supervised: Yes	Yoga instructor; Trained about haemophilic children in the haemophilia center	NR
Diorio, 2015, ¹⁸ Canada	21 days	4-5x/week Note. offered 4-5x/week aim of achieving 3x/week	NR	Individualized yoga for fatigue	Asanas: Yes Pranayama: Yes Dhyana: No Relaxation: Yes	Setting: Hospital Supervised: Yes	Certified yoga teacher; Training in children's yoga and study-specific yoga training	Y Family members participated in 26% of sessions
Fukahara, 2015, ³⁷ United States of America	1 day	1x	20-60	Bedside yoga	Asanas: Yes Pranayama: Yes Dhyana: Yes Note. included guided imagery Relaxation: Yes	Setting: Hospital Supervision: Yes	Certified yoga instructor; NR	Y n=18 parents/caregivers were study participants Note. participated in sessions and completed measures
Geyer, 2011, ¹⁷ United States of America	2 months	1x/week	60	Therapeutic yoga	Asanas: Yes Note. Postures for older children, yoga games for younger children Pranayama: Yes Dhyana: No Relaxation: Yes	Setting: Hospital Supervision: Yes	Physical and occupational therapists and assistants; Specialized training in therapeutic yoga instruction from Seattle area yoga professionals in addition to their own yoga practice	Y Families/caregivers were encouraged to participate
Govardhan, 2019, ³⁸ India	4 weeks	3-5x/week	60	Individualized yoga	Asanas: Yes Pranayama: Yes Dhyana: Yes Relaxation: Yes	Setting: Hospital Supervision: Yes	Trained yoga instructor; NR	Y The parent/guardian was required to be present during each session

Hooke, 2016, ¹⁵ United States of America	6 weeks	3x/week Note. In hospital 1x/week and at home 2x/week	45	Yoga	Asanas: Yes Pranayama: Yes Dhyana: Yes Relaxation: Yes	Setting: Mixed Supervision: Yes	Registered yoga instructor; NR	Y Study participants were encouraged to bring a friend or sibling (54% brought a friend or sibling), and/or parent (85% brought a parent) to class with them
Orsey, 2017, ¹⁹ United States of America	8 weeks	1x/week	60	Pediatric yoga	Asanas: Yes Pranayama: Yes Dhyana: Yes Relaxation: Yes	Setting: Hospital Supervision: Yes	Certified yoga instructor; Specific training in yoga for a pediatric cancer population	Y n=10 Parents/caregivers were study participants Note. participated in sessions and completed measures
Stein, 2019, ²⁰ Canada	10 weeks Note. In hospital 3 weeks, at home 7 weeks	1x/week	45	Individualized yoga	Asanas: Yes Pranayama: Yes Dhyana: No Relaxation: Yes	Setting: Mixed Supervision: Yes	Certified yoga teachers; Research and study-specific yoga training	Y Family members participated in 23% of sessions
Thygeson, 2010, ³⁹ United States of America	1 day	1x	45	Yoga based on Hatha principles	Asanas: Yes Pranayama: No Dhyana: Yes Relaxation: Yes	Setting: Hospital Supervision: Yes	Registered yoga teacher; NR	Y n=33 parents were study participants Note. participated in sessions and completed measures
Wurz, 2014, ¹⁶ Canada	12 weeks	2x/week	60	Pediatric yoga	Asanas: Yes Pranayama: No Dhyana: No Relaxation: Yes	Setting: Community Supervision: Yes	Certified yoga instructor; Training in yoga for cancer populations and children	NR
Randomized controlled trial (n=1)								
Moody, 2017, ²¹ United States of America	NR Note. (mean number of sessions = 2.5)	5x/week	30	Yoga	Asanas: Yes Pranayama: Yes Dhyana: Yes Relaxation: Yes	Setting: Hospital Supervision: Yes	Yoga instructor; Yoga training and experience with hospitalized children with SCDVOC	NR

Notes. Intervention definition=refers to how authors defined the intervention; N=no; NR=not reported; Ref=reference; SCD VOC=sickle cell disease vaso-occlusive crisis; x=times; Y=yes.

2.4.4 Outcomes and measures

Table 3 provides details on outcomes assessed and measurement tools used. In eight studies (72%; n=8)^{15-20, 38, 29} the primary outcome assessed was feasibility, whereas the primary outcome was quality of life (9%; n=1),³⁶ anxiety (9%; n=1),³⁷ and pain (9%; n=1) across single studies.²¹ Across studies collecting both quantitative and qualitative data, 21 different outcomes were measured, across six broad domains: feasibility (100%; n=11), physical activity behaviour (27%; n=3),^{16, 19, 38} symptoms and/or side effects (73%; n=7),^{15, 18-21, 37, 38} physical (e.g., functional mobility) or psychosocial functioning (91%; n=10),^{15-21, 36-39} “other” outcomes (18%; n=2),^{21, 36} and program experience (27%; n=3).^{18, 19, 29} A total of 27 tools were used to assess outcomes across these domains. Measures of feasibility included enrolment rate (i.e., number of participants recruited/number of participants enrolled), attendance rate, drop-out rate, study completion rate, and satisfaction survey results. Measures of physical activity behaviour included using actigraphy to collect an objective measure of physical activity,¹⁹ as well as self-reported information captured in an activity diary,¹⁹ a parent-proxy feedback form,¹⁹ and the Godin Leisure Time Exercise Questionnaire.¹⁵ For symptoms and side effects, three different measures were used to assess fatigue, of which the Pediatric Quality of Life inventory Multidimensional Fatigue Scale (PedsQL MFS) was most commonly used (n=3 out of 5 studies).^{15, 18, 20} For physical and psychosocial functioning, five different measures were used to measure quality of life, of which four were subscales within the Pediatric Quality of Life inventory (PedsQL).^{16, 18-20} Two different measures, including a study-specific questionnaire and patients’ medical chart review,³⁶ were used to assess “other” outcomes (i.e., number of bleeding events, referrals to the haemophilia clinic, and school absences). In one study, the outcome measures used to assess “other” outcomes were unclear.²¹ Two different qualitative approaches were used to collect participant and/or parent perspectives of program experience via open-ended questions on

surveys or forms (i.e., a satisfaction survey completed by participants and parents,¹⁹ and additional comments by parents recorded by a member of the research team in a quality control and safety form²⁰). In one study, the approach used to collect qualitative data on participants' program experience was unclear.¹⁸

Table 3. Outcomes studied and measurement tools used

First author, year, ^{Ref.} country	Outcomes measured	Time of measurements	Outcome measurement tools					
			Feasibility	PA Behaviour	Symptoms/effects	Phys/Psych	Other	Program experience
Single group (n=10)								
Beheshtipo or, 2015, ³⁶ Iran	Feasibility: Yes PA behaviour: No Symptoms/effects: No Phys/Psych: Yes Other: Yes Program experience: No	Baseline, mid-intervention (week 8), post-intervention (week 14)	Enrolment rate	N/A	N/A	Long version of Haemo-Quality of life	Study-specific questionnaire and medical records Note. During the last 4 weeks	N/A
Diorio, 2015, ¹⁸ Canada	Feasibility: Yes PA behaviour: No Symptoms/effects: Yes Phys/Psych: Yes Other: No Program experience: Yes	Baseline, mid-intervention (day 7, day 14), post-intervention (day 21) Note. SF-36 baseline and post-intervention only	Attendance rate and enrolment rate	N/A	PedsQL MFS	PedsQL 4.0 Generic Core Scale; PedsQL 3.0 Acute Cancer Module		Qualitative comments – measure unclear (i.e., Participants were asked what they liked and disliked about the yoga program and whether or not they felt the yoga program was of benefit.)
Fukahara, 2015, ³⁷ United States of America	Feasibility: Yes PA behaviour: No Symptoms/effects: Yes Phys/Psych: Yes Other: No Program experience: No	Pre and post yoga session	NR	N/A	Wong–Baker Faces Pain Scale	STAI scale	N/A	N/A
Geyer, 2011, ¹⁷ United States of America	Feasibility: Yes PA behaviour: No Symptoms/effects: No Phys/Psych: Yes Other: No	Baseline, post-intervention (week 8)	NR	N/A	N/A	PedsQL 4.0 Generic Core Scale	N/A	N/A

	Program experience: No							
Govardhan, 2019, ³⁸ India	Feasibility: Yes PA behaviour: Yes Symptoms/effects: Yes Phys/Psych: No Other: No Program experience: No	Baseline, post-intervention (week 4)	Attendance rate (i.e. minimum of 3 sessions/week)	Parent-proxy feedback form (i.e., overall daily activity)	Parent-proxy feedback form (i.e., symptoms)	N/A	N/A	N/A
Hooke, 2016, ¹⁵ United States of America	Feasibility: Yes PA behaviour: No Symptoms/effects: Yes Phys/Psych: Yes Other: No Program experience: No	Baseline, post-wait period (week 6), post-intervention (week 12)	Attendance rate and enrolment rate		PedsQL MFS; Adolescent Sleep-Wake Scale	STAI scale; BOT-2	N/A	N/A
Orsey, 2017, ¹⁹ United States of America	Feasibility: Yes PA behaviour: Yes Symptoms/effects: Yes Phys/Psych: Yes Other: No Program experience: Yes	Baseline and post-intervention (week 8) Note. satisfaction and actual data post-intervention only	Patient and parent satisfaction survey	Actigraphy; activity diary	Fatigue scale	PedsQL 4.0 Generic Module; PedsQL 3.0 Cancer Module	N/A	Satisfaction survey (i.e., parents and participants were given a brief satisfaction survey to determine how well they liked participating in the program and whether they would like to continue practicing yoga).
Stein, 2019, ²⁰ Canada	Feasibility: Yes PA behaviour: No Symptoms/effects: Yes Phys/Psych: Yes Other: No Program experience: Yes	Baseline, mid-intervention (week 5) and post-intervention (week 10)	Enrolment rate, drop-out rate, attendance rate	N/A	PedsQL MFS; and SSPedi	PROMIS-SF; and PedsQL 3.0 Acute Cancer Module	N/A	The quality control and safety checklist captured participants' qualitative positive, constructive, and overall feedback about the session.
Thygeson, 2010, ³⁹	Feasibility: Yes PA behaviour: No	Pre and post yoga session	Enrolment rate and completion	N/A	N/A	STAI scale	N/A	N/A

United States of America	Symptoms/effects: No Phys/Psych: Yes Other: No Program experience: No		rate of yoga sessions and study measurements					
Wurz, 2014, ¹⁶ Canada	Feasibility: Yes PA behaviour: Yes Symptoms/effects: Yes Phys/Psych: Yes Other: No Program experience: No	Baseline and post-intervention (week 12)	Enrolment rate, study completion rate, and attendance rate	Godin Leisure Time Exercise Questionnaire	N/A	PedsQL 4.0 general module; Timed Up and Go-3m; Back-Saver Sit and Reach Test; and ankle passive and active dorsiflexion range of motion	N/A	N/A
Randomized controlled trial (n=1)								
Moody, 2017, ²¹ United States of America	Feasibility: Yes PA behaviour: No Symptoms/effects: Yes Phys/Psych: Yes Other: Yes Program experience: No	Baseline and post first session	Enrolment rate and attendance rate	N/A	Wong–Baker Faces Pain Scale	STAI scale	Unclear	N/A

Notes. The enrollment rate was the number of participants enrolled over the number of participants recruited. PA Behaviour=physical activity behaviour outcome; BOT-2=Bruininks-Oseretsky Test of Motor Proficiency; MET= metabolic equivalent; MFS = Multidimensional Fatigue Scale; N/A=not applicable; PedsQL=Pediatric Quality of Life inventory; Phys/psych=physical and psychosocial functioning; PROMIS=Patient-Reported Outcomes Measurement Information System; SF=short form; SSPedi=Symptom Screening in Pediatrics Tool; STAI=Spielberger State Trait Anxiety Inventory; Ref=reference; Symptoms/effects=Symptoms and side effects.

Table 4. Summary of main findings

First author, year, ^{Ref.} country	Primary outcome	Main findings reported					
		Feasibility & Safety	Positive	Negative	No change	Mixed results	Qualitative Findings
Single group (n=10)							
Beheshtipoor, 2015, ³⁶ Iran	Quality of life	Feasibility: Yes, positive results Attendance rate: NR Adverse events: Yes, none	Phys/Psych: quality of life	Other: number of bleeding events, referrals to the haemophilia clinic, and school absences			
Diorio, 2015, ¹⁸ Canada	Feasibility	Feasibility: Yes, positive results Attendance rate: Yes, positive results Adverse events: Yes, none					Program experience: Increased energy levels, decreased nausea, reduced need for pain medication, reduced anxiety and agitation, better sleep, improved mood, and opportunity to relax, and ‘escape’ from the hectic hospital environment
Fukahara, 2015, ³⁷ United States of America	Anxiety	Feasibility: Yes, positive results Attendance rate: Yes, specific results NR Adverse events: NR		Symptoms/effects: pain ^a	Phys/Psych: anxiety		
Geyer, 2011, ¹⁷ United States of America	Feasibility	Feasibility: Yes, positive results Attendance rate: NR				Phys/Psych: quality of life (positive/no change) Note. Trended towards beneficial results	

		Note. Participants had to attend 5 sessions to be included. Adverse events: NR					
Govardhan, 2019, ³⁸ India	Feasibility	Feasibility: Yes, positive results Attendance rate: Yes, positive results Adverse events: Yes, none	Behav: overall daily activity	Symptoms/effects: symptoms ^a	Symptoms/effects: symptoms Note. Trended towards beneficial results		
Hooke, 2016, ¹⁵ United States of America	Feasibility	Feasibility: Yes, negative results Attendance rate: Yes, positive results Adverse events: NR		Phys/Psych: anxiety ^a Note. Children only	Symptoms/effects: fatigue, sleep, balance Phys/Psych: anxiety, balance Note. Anxiety was adolescents only, decreasing trend.		
Orsey, 2017, ¹⁹ United States of America	Feasibility	Feasibility: Yes, positive results Attendance rate: Yes, positive results Adverse events: NR			Behav: physical activity levels Symptoms/effects: fatigue Note: Trended towards beneficial results Phys/Psych: quality of life - cancer module Note: Worry trended towards beneficial results	Phys/Psych: quality of life – generic scale (positive/no change)	Program experience: One patient reported improved nausea, relaxation, but not long-term. One parent reported increased energy, and improved mood in their child.
Stein, 2019, ²⁰ Canada	Feasibility	Feasibility: Yes, negative results Attendance rate: Yes, negative results.			Symptoms/effects: fatigue, symptoms Phys/Psych: depressive symptoms, anxiety,		Program experience: Participants expressed the following positive comments: [sessions] were tailored to my specific needs, whenever I did yoga,

		Adverse events: Yes, none			anger, quality of life – cancer module		it would help me forget about problems at school and homework and focus on my breathing, and I loved the Skype sessions because I was in the comfort of my own home, so I felt more comfortable doing yoga.
Thygeson, 2010, ³⁹ United States of America	Feasibility	Feasibility: Yes, positive results Attendance rate: Yes, positive results Adverse events: NR	Phys/Psych: sense of well-being Note. Adolescents only	Phys/Psych: anxiety Note. Adolescents only	Phys/Psych: anxiety, sense of well-being Note. Children only for sense of well-being		
Wurz, 2014, ¹⁶ Canada	Feasibility	Feasibility: Yes, positive results Attendance rate: Yes, positive results. Adverse events: Yes, none	Phys/Psych: functional mobility, flexibility		Phys/Psych: range of motion	Behav: physical activity levels (positive, no change) Phys/Psych: (positive/no change)	
Randomized controlled trial (n=1)							
Moody, 2017, ²¹ United States of America	Pain	Feasibility: Yes, positive results Attendance rate: Yes, positive results Adverse events: Yes, five adverse events observed, two on the yoga arm (avascular necrosis and acute splenic sequestration). Note. All events were reported as unlikely caused by the study procedure.		Symptoms/effects: pain Note. Significant difference between groups	Phys/Psych: anxiety Other: length of hospital stay, opioid use Note. Anxiety trended towards beneficial results in both groups		

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Notes. positive refers to significant increases; negative refers to significant decreases; no change refers to no significant change. ^aFor this outcome decreases (i.e., '-') represent improvements. ^bFor this study, quantitative data was omitted because statistical analysis was not conducted. Behav=physical activity (PA) behaviour outcome; Phys/Psych=physical and psychosocial; Ref=reference; Symptoms/effects=symptoms and side effects

2.4.5 Main findings

Main findings for the single-group studies (n=10) and for the single randomized controlled trial (n=1) are summarized in Table 4. Although preliminary, summarizing the existing evidence enables insight into the potential effects of yoga for children and adolescents affected by cancer or blood disease. Quantitative results were categorized as positive (i.e., significant increase or improvement in outcome), negative (i.e., significant decrease and/or worsening in outcome), no change (i.e., non-significant changes in the data) or mixed (i.e., combination of positive, negative and/or no change). Of the ten single group studies, the authors of three studies (27%) did not perform statistical analyses to assess effects of yoga on select outcomes, and thus these are not reported in Table 4.^{17, 18, 20}

2.4.6 Feasibility and safety

Of the eleven studies that reported on feasibility, the majority (82%; n=9) were found to be feasible.^{16-18, 20, 21, 36-38} Two studies (18%) were described as not being feasible, one due to an enrolment rate of 32%,¹⁵ and the other due to not meeting the apriori defined feasibility threshold for attendance (i.e., 80% of participants attending a minimum of 60% of the sessions).²⁰ Nine studies tracked attendance of which seven (78%) reported positive results,^{15-21, 38, 39} one (11%) reported negative results,²⁰ and one (11%) did not report results.³⁷ Six studies tracked adverse events, of which five (83%) reported no adverse events.^{16, 18, 20, 36, 38} One study (17%) reported five adverse events during the study period, which were described as unlikely to be caused by the study procedure (e.g., avascular necrosis and acute splenic sequestration).²¹

2.4.7 Potential effect of yoga on physical activity behaviours

Of the three studies reporting on physical activity behaviours, one (33%) reported a positive effect from pre- to post-yoga intervention,³⁸ one (33%) reported no change from pre- to

post-yoga intervention,¹⁹ and one (33%) reported mixed results from pre- to post-yoga intervention (based on differences in subscales within the same measurement tool; i.e., increase in duration of physical activity and no change in frequency of physical activity).¹⁶

2.4.8 Potential effect of yoga on symptoms and side effects

Fatigue was the most commonly assessed symptom or side effect, assessed in five studies (45%).^{15, 18-20, 38} Most studies reporting on fatigue found no change from pre- to post-yoga intervention (80%; n=4)^{15, 18-20} and one reported a decrease from pre- to post- yoga intervention (20%).³⁸ Additional outcomes included pain (38%; n=3)^{21, 37, 38} and sleep (38%; n=3).^{15, 38} All three studies reporting on pain, showed a decrease in pain (100%),^{21, 37, 38} of these two (67%) showed changes from pre- to post- yoga intervention,^{37, 38} and one (33%) showed between group differences.²¹ Two studies examined sleep, one study (50%) reported improved sleep scores from pre- to post-yoga intervention,³⁸ and the other (50%) found no change in sleep from pre- to post-yoga intervention.¹⁵

2.4.9 Potential effect of yoga on physical or psychosocial outcomes

The most commonly reported physical or psychosocial functioning outcome reported was quality of life (54%; n=6).^{16-20, 36} Of these, mixed results (i.e., positive and no change, based on differences in subscales within the same measurement tool) for quality of life were found in three studies (50%),^{16, 17, 19} two (33%) reported no change from pre- to post-yoga intervention,^{18, 20} and one (17%) reported positive changes pre- to post-yoga intervention.³⁶ Anxiety was measured in four studies,^{15, 21, 37, 39} and was reported as no change from pre- to post-yoga intervention in one study (25%),³⁷ and mixed results (i.e., decrease and mixed) in two studies (50%).^{15, 39} In the randomized controlled trial (25%), anxiety showed no change from pre- to post- yoga intervention or between groups.²¹

2.4.10 Potential effect of yoga on “other” outcomes

One single group study included “other” outcomes, and found a decrease in number of bleeding events, referrals to the haemophilia clinic, and school absences from pre- to post-yoga intervention.³⁶ The randomized controlled trial also assessed an outcome classified as “other”, showing no changes from pre- to post-yoga intervention or between groups for length of hospital stay and opioid use.²¹

2.4.11 Program experiences

Three studies (27%) collected participant and/or parent perspectives of program experience using qualitative methods (Table 4).^{18, 19, 39} Of these, two studies (67%) reported positive changes in cancer-related symptoms (i.e., decreased nausea, increased relaxation), improved physical, psychosocial, and mental health (i.e., increased energy levels, improved mood).^{18, 19} In the remaining article (33%), participants also offered insights into aspects of the yoga intervention that were helpful, such as being tailored to their specific needs and favoring remote delivery.³⁹

2.4.12 Risk of Bias

Table 5 presents the risk of bias assessments for non-randomized controlled trials using the Risk of Bias Assessment tool for Non-randomized Studies. Of the ten non-randomized controlled trials, eight studies (80%) were classified as “low” risk of bias across all domains, one study (10%)¹⁹ was classified as “unclear” in one domain and “low” risk of bias across the remaining domains, and another study (10%)³⁸ was classified as “high” in one domain and “low” risk of bias across the remaining domains. Table 6 reports the risk of bias for randomized controlled trials using the Cochrane Collaboration tool for randomized controlled trials. The one randomized controlled trial was classified as “low” risk of bias across all domains.

Table 5. Risk of Bias using the Risk of Bias Assessment tool for Non-randomized Studies and the Cochrane Collaboration tool for randomized controlled trials

Author, year	Selection bias		Performance bias	Detection bias (blinding of outcome assessment)				Attrition bias (incomplete outcome data)				Reporting bias (selective reporting)
	Participant selection	Confounding variable	Measurement of exposure	Behav	Sympt	Phys/ Psych	Other	Behav	Sympt	Phys/ Psych	Other	
Single group (n=10)												
Beheshtipo or, 2015	Low	Low	Low	N/A	Low	Low	Low	N/A	Low	Low	Low	Low
Diorio, 2015	Low	Low	Low	N/A	Low	Low	N/A	N/A	Low	Low	N/A	Low
Fukahara, 2015	Low	Low	Low	N/A	Low	Low	N/A	N/A	Low	Low	N/A	Low
Geyer, 2011	Low	Low	Low	N/A	Low	Low	N/A	N/A	Low	Low	N/A	Low
Govardhan, 2019	Low	Low	High	Low	Low	N/A	N/A	Low	Low	N/A	N/A	Low
Hooke, 2016	Low	Low	Low	N/A	Low	Low	N/A	N/A	Low	Low	N/A	Low
Orsey, 2017	Low	Low	Low	Low	Low	Low	N/A	Unclr	Low	Low	N/A	Low
Stein, 2019	Low	Low	Low	N/A	Low	Low	N/A	N/A	Low	Low	N/A	Low
Thygeson, 2010	Low	Low	Low	N/A	Low	Low	N/A	N/A	Low	Low	N/A	Low
Wurz, 2014	Low	Low	Low	Low	N/A	Low	N/A	Low	N/A	Low	N/A	Low
Author, year	Selection bias		Performance bias	Detection bias (blinding of outcome assessment)				Attrition bias (incomplete outcome data)				Reporting bias (selective reporting)
	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Behav	Sympt	Phys/P sych	Other	Behav	Sympt	Phys/P sych	Other	
Randomized controlled trial (n=10)												
Moody, 2017	Low	Low	Low	N/A	Low	Low	N/A	N/A	Low	Low	N/A	Low

Notes. Behav=physical activity behaviour outcome; High=high risk of bias; Low=low risk of bias; N/A=not applicable; Phys/Phys=physical or psychosocial functioning; RCT=randomized controlled trial design; QOL=quality of life; SG=single group pre/post study design; Sympt=symptoms and side effects; Unclr=Unclr risk of bias.

2.5 Discussion

Yoga is emerging as a supportive cancer care tool that may offer benefits for children and adolescents affected by cancer or blood disease, yet no efforts to date have been made to synthesize the available evidence. This review summarized the available evidence reporting on the effects of yoga to describe the characteristics of studies, the safety, feasibility, potential effects of yoga, and identify limitations in the literature. Eleven yoga studies were included, comprised of 204 participants (sample sizes ranged from 6-70 participants). Most studies used a single group, pre/post experimental design (n=10; 91%). Across studies, there was a variety of outcomes studied and measures used. The results from this review suggest that yoga as an intervention for children and adolescents affected by cancer or blood disease is safe, feasible, and may have beneficial effects. Further, findings highlight that important limitations exist: most research is feasibility-focused, and there were varied intervention characteristics, outcomes studied, and measures used, which can make it hard to draw firm conclusions. Nevertheless, consolidating work to date lays the foundation for researchers to continue to build the evidence supporting yoga for children and adolescents affected by cancer or blood disease.

Research on yoga as an intervention for children and adolescents affected by cancer or blood disease is emerging, with eight of the eleven studies published after 2015. Yoga, in the West, is often viewed as a form of physical activity.^{16, 39} However, compared to the broader field of physical activity for children affected by cancer, there is much less research, as a recent review identified 69 experimental articles in pediatric oncology and exercise (compared to eleven articles herein).¹³ One reason for this may be that healthcare providers and families, whose beliefs have been shown to influence physical activity behaviours among this cohort,⁴⁰ may have a lack of knowledge of yoga or uncertainty as to what yoga can provide for this

population. For example, one study found that 15 out of 29 oncologists were hesitant or unlikely to suggest yoga for their adult patients affected by cancer because they had no knowledge of yoga as a therapy.⁴¹ In another study, there was consensus among a focus group of adults affected by cancer that they were unaware of what yoga entails (e.g., feared they needed special skills to join yoga), and further, a healthcare provider reported that many people perceive yoga to have a religious affiliation, which may deter patients and families.⁴² Thus, it is possible that similar beliefs exist among pediatric healthcare providers, as well as children and adolescents affected by cancer and their families, and may be a barrier to implementation whether in a research setting or as program delivery. Given the evidence suggesting that yoga is feasible and potentially beneficial for children and adolescents affected by cancer or blood disease, and is a gentle and adaptable form of physical activity that poses little risk, we must work to educate and promote yoga as a form of physical activity with the key stakeholder populations.

With regards to the breadth of evidence, consistent with work in an emerging area,⁴³ the majority of studies were pre/post feasibility-focused designs, which does preclude the capacity to draw causal conclusions and ultimately to perform a meta-analysis. Fully powered future trials that are designed to assess impact of yoga on specific outcomes, whether in a randomized controlled trial or another design, are needed. Additionally, three of eleven studies included in this review used a mixed-methods approach, which offered insights on perceived benefits of yoga and opportunities for program feedback.^{15, 29, 20} This is similar to the broader pediatric research, where qualitative studies have been found to offer invaluable information related to child and family experience in and perspectives of yoga programs.^{44, 45} Future work using a mixed-methods approach to explore stakeholders (e.g., families and children/adolescents) experience in a yoga intervention would allow researchers and program developers to use patient

and family voices to inform and optimize future programs. Taken together, future work moving beyond feasibility designs (e.g., to randomized controlled trials) and gathering qualitative feedback from key stakeholders (e.g., participants, families, health care providers, yoga instructors) will continue to build the evidence for the effectiveness of and experiences with yoga for this population.

In terms of intervention characteristics across studies, there was a wide variety of yoga intervention “doses” (i.e., yoga session length, intervention duration, and frequency), and no studies examined the “dose-response” relationship (i.e., varied “doses” of yoga programs resulting in varied effects on outcomes). In yoga for adults affected by cancer, there is some evidence to suggest that greater benefits may incur when yoga is practiced at higher frequencies,⁴⁶ or with longer sessions.⁴⁷ In addition, despite the lasting negative effects experienced by this population,⁴⁸ no work to date has examined the long-term effects of yoga, nor reported including strategies to support the continued practice of yoga post-intervention. Among adults affected by cancer, there is early evidence to suggest that yoga may improve outcomes such as anxiety, depression, fatigue, and quality of life, three and six months after the end of the yoga intervention, however these articles do not report tracking continued practice of yoga.⁴⁹⁻⁵² Further, there is evidence from a cross-sectional study that continued yoga practice (>6 months) may allow for long-term health maintenance among adults affected by cancer.⁵³ Given the significant and lasting health implications of treatments for children and adolescents affected by cancer or blood disease,⁴⁸ future studies should consider exploring if higher yoga intervention “doses” are associated with greater benefits, the potential long-term benefits of yoga, and strategies to support the continued practice of yoga among this population (e.g., implement long-term interventions).

The delivery of safe and effective yoga intervention in this population cannot occur without a trained yoga instructor.⁵⁴⁻⁵⁶ Across the studies to date, reported instructor trainings include basic yoga certifications and additional population-specific training (e.g., yoga for kids, yoga for cancer). However, the types of additional training varied across studies, and 35% of studies did not report whether yoga instructors received additional training. Researchers and clinicians have recommended that exercise professionals working with cancer survivors obtain additional cancer and exercise training (e.g., knowledge of treatment effects and contraindications).^{57, 58} Given this, it may be prudent for future work to consider consensus-building and report on the specialized trainings or experiences needed to safely and effectively deliver yoga to children and adolescents affected by cancer or blood disease.

Within the eleven studies included herein, the large and varied number of outcomes assessed and measures used makes it difficult to compare, contrast, and explore patterns in the data. Nevertheless, the outcomes studied are similar to other supportive cancer care resources, like physical activity, suggesting that assessing the potential impact of yoga across symptoms, side effects, as well as physical and psychosocial health is important for this cohort.¹³ Given the potential for additional or different yoga benefits, future work should continue to explore more yoga-specific outcomes as well (e.g., mindfulness, attention-regulation).^{23, 25} Also, the variability in tools used is an issue as it precludes the ability to perform a meta-analysis, which is a similar concern in the physical activity research for children and adolescents affected by cancer or blood disease.¹³ There is a need to identify the most common tools used (e.g., the PedsQL MFS tool to measure fatigue and the PedsQL to measure quality of life), and consider consensus-building on the use of tools to facilitate comparison of outcomes across studies and build the evidence-based for yoga's implementation in this population.

With regards to participants, there were small and mostly female samples found across studies. Studies exploring the effects of yoga may wish to ensure larger and more representative samples are recruited to ensure studies are powered to detect changes in outcomes, and determine the effects of yoga in this cohort. One solution and future direction is to conduct multi-site trials and to trial diverse recruitment strategies (e.g., working with advisory members of ethnic or racial minorities to ensure outreach material is appropriate).

Overall, there were no adverse events related to yoga reported and most (n=9) studies described yoga as feasible. In terms of possible benefits associated with yoga, the studies included in this review suggest a potentially positive effect across physical activity behaviour (e.g., physical activity levels), symptoms and side effects (e.g., pain, fatigue), physical functioning (e.g., functioning mobility), and psychosocial functioning (e.g., anxiety, quality of life). However, it is important to note that across studies several of these outcomes were also reported as mixed results or no change (i.e., physical activity behaviours, fatigue, anxiety, quality of life). One possible reason may be due to treatment status. The majority of studies (n=8) measured the effects of yoga for children and adolescents on-treatment, thus participants may have been facing significant disease- and treatment-related symptoms and side effects during the yoga intervention, and may have been facing a decline in health outcomes. Therefore, preliminary findings showing no change in outcomes may be seen as potentially positive as they suggest that yoga may mitigate usual declines in health outcomes.

Finally, risk of bias across studies was generally deemed low, indicating that the ten single group pre/post studies and the one randomized controlled trial were well-conducted studies. The one single group pre/post study with a high risk of bias for performance bias (i.e., inadequate measures of exposure)³⁸ highlights the need to conduct research using validated and

reliable measures. The one study with a mixed risk of bias for attrition bias (i.e., incomplete data)¹⁹ highlights the need for strategies to ensure self-report data collection measures are properly completed.

2.6 Conclusion

Yoga appears to be a safe, feasible, and potentially beneficial for children and adolescents affected by cancer or blood disease. To continue understanding the potential role of yoga for this cohort, concerted research efforts are required that continue to build on this evidence. Future work should consider using varied design and methodological approaches, exploring the “dose-response” relationship, consensus-building to identify important outcomes and measures, and examining long-term effects and strategies to support continued practice of yoga. This review lays a strong foundation to support efforts examining the effects of yoga to promote health outcomes and mitigate disease effects among children and adolescents affected by cancer or blood disease.

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2.8 Bridging Text

This systematic review was conducted to synthesize the literature reporting on the effects of yoga for children and adolescents affected by cancer or blood disease, enabling an understanding of the characteristics of studies that have been conducted to date, reporting on findings examining safety, feasibility, potential effects of yoga, and identifying limitations in the literature to date, so as to inform future directions. The main findings for the systematic review (*Chapter Two*) can be summarized as:

1. Yoga is safe, feasible, and may be associated with improvements in physical activity behaviours (e.g., physical activity levels), symptoms and side effects (e.g., pain, fatigue), physical (e.g., functional mobility), and psychosocial outcomes (e.g., quality of life, anxiety, mood).
2. Key limitations in the current literature include the variability in the “dose” of yoga as an intervention, outcomes studied, and measurements used. Looking ahead, researchers may wish to consider strategies to increase sample sizes so as to ensure trials are powered to detect changes within and between subjects following a yoga intervention, as well as collate perspectives from key stakeholders via qualitative or mixed methods work, and examine the potential lasting effects of yoga.

Based on the emerging evidence for yoga as a safe, feasible, and potentially beneficial intervention for children and adolescents affected by cancer or blood disease, there is a need to consider what is needed for successful implementation. One factor to consider in moving yoga *evidence to practice* is the yoga instructor, those tasked with delivering yoga. Yoga instructors’ play a critical role in the safe and effective delivery of yoga, and their perspectives could provide insights into the training needed to deliver yoga to this population, as well as yoga program

delivery considerations for safety, feasibility, and benefits. Thus, an interpretive description examination of yoga instructors' lived experience with the delivery of yoga programs for children and adolescents affected by cancer or blood disease was completed (*Chapter Three*). More specifically, we explored yoga instructors' perspectives of the role of yoga, training and experience required, and factors that could impact the delivery of yoga in research or program settings. While we had initially hoped to gather additional key stakeholder perspectives, including health care providers, and children and families affected by cancer or blood disease, the pandemic limited our outreach abilities. This first study provides novel insights from a rarely captured perspective, yet one that is central to effective program delivery. Future work will build upon these findings, gathering additional insights to ultimately move *evidence* for the role and delivery of yoga *to practice*, informing the sustainable implementation of yoga for children and adolescents affected by cancer or blood disease.

Chapter Three: **Interpretive Description Manuscript**

Ellis K., Culos-Reed S.N., Schulte F., Sung L., Wurz A. Exploring yoga instructors' experiences delivering yoga to children and adolescents affected by cancer or blood disease.

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3.1 Abstract

Yoga may offer children and adolescents affected by cancer or blood disease benefits, yet there are challenges translating evidence to practice. Yoga instructors are one critical component for the delivery of yoga as an intervention, whether in a research setting or as program.

Understanding yoga instructors' experience offering yoga to children and adolescents affected by cancer or blood disease could provide information to guide required competencies and training, as well as elucidate factors to consider in future research and programs. Therefore, this interpretive description study sought to understand yoga instructors' lived experiences preparing for and facilitating yoga for children and adolescents affected by cancer or blood disease.

Fourteen yoga instructors with experience facilitating yoga for this population participated in semi-structured interviews, which were transcribed verbatim and analyzed using principles of interpretive description and thematic analysis. Five unique themes were identified: (1) *I believe in and see the benefits of yoga on and off the mat*; (2) *With training, I know what I know, and I know what I don't know*; (3) *What I need to deliver a safe yoga program*; (4) *What I need to deliver an effective yoga program*; (5) *What I need to ensure yoga is widely available*. Findings highlight the varied and comprehensive training opportunities yoga instructors sought to ensure safe and effective delivery of yoga, while also elucidating their training limitations. Further, yoga instructors shared their perspective on developing research and programs with a focus on safety, effectiveness, and access. It is hoped this work will spur efforts to define required competencies and training to work with this population, while laying the foundation for future research and programs.

3.2 Background

A diagnosis of cancer or blood disease as a child or adolescent is relatively rare, yet both are a leading cause of morbidity and mortality for children and adolescents.¹⁻⁴ Fortunately, survival rates for many cancers and blood diseases are increasing,⁵⁻⁶ leading to a growing population of children and adolescents managing the symptoms (e.g., anemia, infections) and side effects (e.g., nausea, pain, fatigue) of their cancer or blood disease and its treatments.⁷⁻¹⁰ These symptoms and side effects may culminate to adversely impact physical, psychosocial, and cognitive functioning, and reduce overall quality of life from diagnosis onwards.⁷⁻¹¹ Thus, there is a need for targeted strategies to manage the challenges of their disease and its treatments.

Yoga, as taught in Western societies, is one strategy that may promote health and quality of life while building self-regulatory skills such as mindfulness and resilience.^{12, 13} Researchers have found that yoga can reduce disease and treatment-related effects and promote physical, psychosocial, and cognitive functioning among adults affected by cancer or blood disease.¹³⁻¹⁷ Among healthy children and adolescents, yoga may promote physical (e.g., improving balance and flexibility) and psychosocial functioning (e.g., managing and improving stress and anxiety).¹⁸⁻¹⁹ Among children and adolescents affected by cancer or blood disease, there is considerably less evidence; however, the work that has been done suggests yoga is safe and feasible, and a potentially beneficial strategy to mitigate negative disease and treatment effects while promoting physical and psychosocial outcomes.²⁰

Nevertheless, conducting research to explore the effects of yoga for children and adolescents affected by cancer or blood diseases is challenging, and few programs exist. This may be related to the unique needs of this relatively small population,^{1,21} and a relative lack

of individuals with the necessary expertise to offer yoga to this population.²² Yoga instructors with the knowledge, skills, and competencies required to deliver yoga safely and effectively to children and adolescents affected by cancer or blood disease are likely critical to the conduct of research and programs.²²⁻²⁵ Yoga instructors (also referred to as yoga teachers) are individuals who have completed a minimum of 200 hours of training, which equips them to deliver yoga to healthy adults.²⁶ Following this, yoga instructors may go on to receive additional training to work with various subsets of the general population (e.g., individuals pre- and post-child birth), clinical populations (e.g., cancer, depression, heart disease, chronic pain), and a range of age groups (e.g., older adults and children).^{22, 27-29} As well, some may go on to become yoga therapists, an additional certification process that requires >800 hours of training to deliver yoga therapy (a particular type of yoga which is non-prescriptive and adapts the practice to the needs of people with different health conditions).³⁰

Few, if any, training programs exist to equip yoga instructors with the knowledge, skills, and competencies required to deliver yoga to children and adolescents affected by cancer or blood disease. Thus, learning from those with experience facilitating yoga in research and/or programs to children and adolescents affected by cancer or blood disease could inform required competencies for those working with this cohort, lay the foundation for training programs, and elucidate factors to consider when translating evidence to practice. Therefore, this interpretive description study sought to understand yoga instructors' lived experiences preparing for and facilitating yoga for children and adolescents affected by cancer or blood disease. Specific research objectives included exploring yoga instructors': (1) perspectives of the role of yoga for children and adolescents affected by cancer or blood disease; (2) views on training and experience required to successfully facilitate yoga for

children and adolescents affected by cancer or blood disease; and (3) experiences with yoga programs they have facilitated.

3.3 Methods

Principles of interpretive description informed study conduct.^{31, 32} Within this interpretive description study, a constructivist paradigm was adopted, which acknowledges that each participant has a unique and varied reality based on their own experiences and social interactions.³³ The constructivist paradigm informed all aspects of this study, from the generation of research questions through to final reporting wherein participants' voices and lived experience were centred.³³

3.3.1 Recruitment & participants

Prior to recruitment, approval was obtained from the Health Research Ethics Board of Alberta (HREBA.CC-20-0146). A convenience sample of individuals with experience delivering yoga to children and adolescents affected by cancer or blood diseases in diverse settings were identified through the study team's network and snowball sampling (wherein recruited participants were asked to provide the names and email addresses of other individuals they knew were teaching yoga to this population). After the first eight individuals were identified and recruited to participate in this study, it was noted that only two yoga programs were represented. Thus, using the results of an environmental scan,³⁴ the first author (KE) identified and purposefully recruited six additional participants who had diverse yoga delivery experiences and who taught yoga in contexts and programs that differed from those previously identified. This decision was made to enhance the likelihood of greater variation in lived experiences.^{32, 33}

Potential participants were eligible to take part in this study if they: (1) were a self-identified yoga instructor; (2) had experiences designing and/or delivering yoga programs for children and adolescents affected by cancer or blood disease; (3) were able to provide informed consent via an online survey; and (4) were able to complete a remote (i.e., via videoconference or phone) interview in English.

3.3.2 Procedures

After potential participants were identified, they received the study invitation email to ascertain interest. Once interest was confirmed, they received a second email with a link directing them to a secure survey hosted on Qualtrics, which included a page to self-screen and complete informed consent. Following informed consent, participants were automatically directed to a brief sociodemographic questionnaire that collected information on age, occupation, experience teaching yoga, and prior yoga training. Participants were also asked to report their interview preferences (i.e., videoconference or telephone). Six participants chose to have their interview via telephone, and eight selected videoconferencing (i.e., Zoom). After taking a few moments to establish rapport by asking about the participants' day, discussing current events, and ensuring the participant felt at ease, the first author (KE) began audio-recording and started the interview. A semi-structured interview guide (Supplemental File 5) was followed that was designed to elicit open-ended responses and contained accompanying probes to encourage participants to provide more detail and/or clarify what they were saying.^{32, 33} Questions covered participants' experiences in and perspectives of yoga for children affected by cancer or blood disease. Interviews lasted on average 32 minutes (range=21-45 minutes) and were transcribed verbatim (omitting any identifying information) by the first author (KE) within five days of completing the interview.

3.3.3 Data analysis

Sociodemographic information was exported and managed in excel (version 16.49) Descriptive statistics (i.e., means and frequencies) were used to describe the sample. Transcribed qualitative data was managed in NVivo (version 12.3.0) and analyzed following the flexible steps of thematic analysis outlined by Braun et al., with principles of interpretive description.^{31, 35} Specifically, the first author (KE) read individual transcripts multiple times prior to coding and wrote their thoughts in a reflexivity journal. Next, the first author (KE) inductively coded participants' transcripts, generating initial codes relevant to the research questions based on the scaffold (i.e., theoretical framework) established.^{31, 35}

Following this, the first author (KE) began generating semantic and latent level themes and subthemes by examining the codes and associated quotes. Patterns in the data were explored and sorted into higher level groupings via low-inference interpretation grounded in participants' voices.^{32, 33, 35} At this point, the senior author (AW) reviewed the themes and subthemes defined by the first author (KE) and challenged interpretations. Thus began an iterative process of reviewing and discussing various ways to interpret and present the data. During this process, a third author (NCR) was invited to review the themes, subthemes, their descriptions, and selected quotes to continue refining and challenging the first (KE) and senior authors' (AW) interpretations. The result was a table including theme and subtheme labels, descriptions and representative quotes, which was reviewed and approved by three authors (KE, AW, NCR).

3.4 Quality criteria

Aligned with the study paradigm and following from interpretive description, various strategies were used to enhance study quality.^{33, 36} First, to ensure *analytical logic*, interview

recordings were transcribed verbatim (omitting only identifying information), including meaningful pauses and utterances to aid in revealing contextual nuances allowing insight into the participants lived experiences.^{33, 36} Further, detailed descriptions of themes and subthemes were developed, and verbatim quotes with sufficient context were selected from the raw data, to illustrate the meaning of the themes and exemplify data interpretation. This was done to promote transparency and allow others' to draw their own conclusions of how the authors' interpreted the data.^{33, 36} Second, to promote *epistemological integrity* all aspects of this study were aligned with the constructivist paradigm of acquiring knowledge, and followed principles of interpretive description throughout by exploring participants' lived experience and acknowledging the role of the researcher.^{33, 36} Third, to increase *interpretive authority*, the first author (KE) engaged in reflexivity by taking notes in a journal during data collection (i.e., during and after interviews) and analysis (i.e., while reading and coding transcripts). This was done to enhance awareness and monitor the impact of their beliefs, experiences, and biases on their interpretation of the data (see Supplemental File 6 for the first authors and interviewers (KE) reflexivity statement).³⁶ Fourth, to promote *representative credibility*, two approaches were used to challenge the first authors' (KE) interpretations of the data, critical friends and synthesized member-checking.^{36, 37} Critical friends (AW, NCR) were consulted to challenge the first author's (KE) interpretations and allow for multiple and alternative explanations of the data. This was accomplished through reflection, exploration, and discussion aimed at understanding each of their interpretations of the data. With regards to synthesized member-checking, all participants were invited to review the theme table including theme and subtheme labels, descriptions, and selected quotes, to ensure these reflected their thoughts and experiences.

3.5 Results

3.5.1 Participants

Table 1 provides an overview of participant characteristics. Fourteen participants with an average age of 44 years (range; 26-64 years), participated in interviews. Most participants ($n=11$) reported <5 years of experience teaching yoga to children and adolescents with cancer or blood disease. The majority of participants ($n=13$) had completed 200 to 500 hours of yoga instructor training. Many ($n=10$) reported having received specific training to teach yoga to adults affected by cancer, some ($n=8$) described taking training to teach yoga to children without a history of chronic disease, and a few ($n=3$) described having received training to teach yoga to children with cancer. Further, Table 1 includes participant's teaching experiences within yoga research and/or programs for children and adolescents affected by cancer or blood disease. Of note, these details were gathered via qualitative interviews. Most participants ($n=11$) described their experiences teaching yoga to children and adolescents affected by cancer only, whereas some ($n=3$) described teaching to children and adolescents with cancer and blood disease. Some participants ($n=5$) described having experiences delivering yoga in-hospital or clinic, and others ($n=5$) delivered yoga in community-based settings. Others delivered in mixed settings, including one instructor delivering in-hospital and in community-based settings, and some ($n=3$) in-hospital and online.

Table 1. Yoga instructor sociodemographic, experience, and training information

Yoga instructor Characteristic	
Age (mean \pm <i>SD</i>)	44 \pm 12 (range 26-64)
Occupation	
Research/Academia (<i>n</i> , %)	(5, 36%)
Director/owner of community yoga program (<i>n</i> , %)	(3, 21%)
Yoga Therapist (<i>n</i> , %)	(3, 21%)
Yoga Teacher/Instructor (<i>n</i> , %)	(1, 7%)
Integrative HCP or specialist (<i>n</i> , %)	(3, 21%)
Years of experience general yoga (<i>n</i> , %)	
0-5 (<i>n</i> , %)	(2, 14%)
6-10 (<i>n</i> , %)	(1, 7%)
>10 (<i>n</i> , %)	(11, 79%)
Years of experience facilitating yoga for children and adolescents with cancer or blood disease	
0-5 (<i>n</i> , %)	(11, 79%)
>10 (<i>n</i> , %)	(3, 21%)
Student population (<i>n</i> , %) ^a	
Cancer only (<i>n</i> , %)	(11, 79%)
Cancer and blood disease (<i>n</i> , %)	(3, 21%)
Setting for teaching yoga ^a	
Hospital/clinic only (<i>n</i> , %)	(5, 57%)
Community only (<i>n</i> , %)	(5, 43%)
Hospital and community (<i>n</i> , %)	(1, 7%)
Hospital and online (<i>n</i> , %)	(3, 21%)
Research-based yoga experience ^a	
Yes (<i>n</i> , %)	(10, 71%)
No (<i>n</i> , %)	(4, 29%)
Training	
General yoga teacher training (200-500 level) (<i>n</i> , %)	(13, 93%)
Pediatric specific yoga training (<i>n</i> , %)	(8, 57%)
Cancer specific training (<i>n</i> , %)	(10, 71%)
Pediatric cancer or blood disease specific training (<i>n</i> , %)	(4, 29%)

Notes. HCP=healthcare provider; No.=number; *SD*=standard deviation; ^aThis data was collected during the qualitative interview and was subsequently categorized by the first author (KE).

3.5.2 Main results

Five unique themes representing yoga instructors' lived experiences preparing for and instructing yoga for children and adolescents affected by cancer or blood disease were identified: (1) *I believe in and see the benefits of yoga on and off the mat*; (2) *With training, I know what I know, and I know what I don't know*; (3) *What I need to deliver a safe yoga program*; (4) *What I need to deliver an effective yoga program*; (5) *What I need to ensure yoga is widely available*. Of note, Supplemental File 7 contains additional quotes for each theme. To enhance readability of the table, quotes with repetitive words or excess or additional information within quotes was replaced with "[...]" and to maintain confidentiality pseudonyms were used.

I believe in and see the benefits of yoga on and off the mat

This theme captures when yoga instructors described the positive changes they noticed or believed the children and adolescents affected by cancer or blood disease they worked with (i.e., defined as students, from this point onward) received from participating in yoga. Yoga instructors described each of the three main components in Western conceptualizations of yoga (i.e., postures, mindfulness, and breathing) as important to access these benefits. Within this theme, two subthemes emerged. First, yoga instructors saw or heard their students mention benefits spanning physical (e.g., improving nausea and perceptions of pain) and psychosocial domains (e.g., improving feelings of anxiety and instilling a sense of control). Second, yoga instructors described how yoga seemingly offered their students a number of self-management tools that could be used within and beyond yoga sessions to navigate the challenges inherent with a diagnosis of cancer and its associated treatments.

My students feel better from yoga. This subtheme captures when yoga instructors described seeing or hearing from their students that they felt better during and after yoga classes and sessions. The changes spanned improvements in physical (e.g., reducing physical deconditioning, managing nausea and pain) and psychosocial domains of wellness (e.g., managing anxiety, better mood, feeling more connected).

“[I think yoga was] beneficial for the kids who have participated [...] having them move and reduce the risk of severe deconditioning.” - Linda, 37, 200-500 hour certified yoga teacher (CYT), Research/academia

Yoga instructors attributed these changes and benefits to the three main components of Western yoga (physical postures, mindfulness and breathing) and the practice as a whole.

“I definitely have noticed especially in the moments where there is more stillness and maybe guided visualizations or mindfulness meditation at the end of a session, the patient is reporting less pain, more ease in the body, more relaxation, able to I think enjoy the time in the hospital more. [...] [The benefits I noticed in my participants are] helping with symptoms like nausea, vomiting, and pain management.” - Olivia, 36, 200-500 hour CYT, Research/academia

My students acquired transferrable skills during our sessions. This subtheme captures yoga instructors' perceptions that their students gained an array of skills that they could use to navigate many of the challenges they experienced as a function of their disease. Yoga instructors described when they witnessed their students (or their students shared about) using skills such as coping tools and self-management techniques they learned in yoga during treatments, medical procedures, and in their day-to-day life.

“This one patient that I had grew such an appreciation for focusing on her breath especially when she was struggling, she even said ‘when I start to feel pain the nurse is going to get my medications, I start to focus on my breath and I come back to my breathing and I remember my breath is always there.’ [...] she could really come back to [her breathing] and it was really grounding for her and really helpful for her.” - John, 26, 200-500 hour CYT, Research/academia

“Parents would say, ‘do [lion’s breath](#) for the doctor’ instead of ‘let me see down your throat’. So, the child then sees [procedures] as more of play.” - Elizabeth, 55, 200-500 hour CYT, meditation, mindfulness specialist

Finally, yoga instructors were of the opinion that these skills offered their students a sense of control and ability to navigate their disease and its treatments.

“If a child wakes up screaming in the middle of the night, they [know], here's an app, we can put a frog meditation [...] here's the skill, here's something I can try, very practical. [...] It's just giving them [...] some control over their experience.” - Lisa, 47, 200-500 hour CYT, Yoga therapist

With training, I know what I know, and I know what I don’t know

This theme captures when yoga instructors discussed the training they sought to safely and effectively deliver yoga to their students.

“I did have some adult specific cancer training and as well I have specific training for children but not specifically children with cancer. I also have specific training in pain care and pain science which I think is super relevant to working with this population.”
- Jennifer, 51, 200-500 hour CYT, Director/owner of community yoga program

As well as the limitations in their training - both in terms of competencies (i.e., enhanced clinical training) and support to manage emotional distress (for themselves and their students).

“For yoga within a clinical setting and with this population [...] we need some more training and education around [diagnoses, contraindications, and emotional support training to support yoga instructors’ themselves]. I have lost students [...] you’re not really prepared to deal with that.” - Susan, 32, 200-500 hour CYT, Director/owner of community yoga program

“I think the only thing that I didn’t feel prepared in was the difference in how the chemo protocols work.” - Julia, 60, certified yoga therapist, Research/academia

Yoga instructors commented that only after numerous training programs and experiential opportunities in basic yoga (i.e., 200-500 hour yoga instructor training), population-specific yoga (i.e., cancer-specific), and children’s yoga did they feel equipped with the knowledge, skills, and confidence to individualize and modify yoga to ensure safety.

“I took [a cancer-specific yoga training], I had a children’s yoga certificate [...] If I had only done that 200 hour training I would not have been equipped I don’t think [...] there is so much small tailoring that happens with cancer patients.” - Mary, 40, 200-500 hour CYT, Director/owner of community yoga program

“I did my first 500 hours many years ago in yoga teaching [...] I’ve done a lot of clinical work [in cancer and yoga]. Once you have the specific cancer knowledge in terms of [treatment and its effects, you’ll feel prepared to work with this population]. I’ve worked with a lot of kids [which helped prepare me].” - Sarah, 59, 200-500 hour CYT, Yoga Teacher/instructor

What I need to deliver a safe yoga program

This theme captures when yoga instructors shared that safely delivering yoga was their priority in programs for children and adolescents affected by cancer or blood disease, and would continue to remain so moving forward. Within this theme, two sub-themes emerged. First, yoga instructors commented how programs must be designed and delivered with safety first - offering a number of ways in which they and their programs prioritize safety. Second, yoga instructors commented that safe delivery could be promoted via clear and direct communication with healthcare providers, parents and students.

In my class, it's safety first. This subtheme captures when yoga instructors described how the yoga they delivered was designed with safety at the forefront.

“Safety was always the top priority anytime you are teaching the session.” - John, 26, 200-500 hour CYT, Research/academia

Yoga instructors' considerations for safety included: (1) individual factors (e.g., age, diagnosis, contraindications, treatments, symptoms, medical equipment); (2) yoga program factors (e.g., intensity, pose selection); (3) yoga instructor preparation (e.g., adverse event procedure training, patient condition); (4) infection prevention (e.g., sanitization, wearing proper personal protective equipment, limiting touch); and (5) staffing considerations (e.g., instructor training, co-facilitators).

“[We need to know] a pretty standard range of medical characteristics [details on students' diagnosis, treatments, side effects, and functioning] we also had a pretty detailed adverse event and reporting form that the 2 moderators were trained in [...] just to be very mindful if something happens, everybody knows exactly what the steps are to take care of that adverse event.” - Jane, 32, 200-500 hour CYT, Research/academia

“Also, the protocols and stuff around sanitizing anything that we bring in, gloves and gowns and face shields and just minimizing and limiting touch [...] just to make sure that we’re as safe as possible when we go into a patient’s room.” - Olivia, 36, 200-500 hour CYT, Research/academia

“Having a co-facilitator was the key piece to safety because there is just an element of like what the children brought when they wanted to talk or [...] when the kid was needing extra modifications and support, one of the instructors could go and support them.”

- Mary, 40, 200-500 hour CYT, Director/owner of community yoga program

Communicating with the healthcare team, parents, and students would (or will) help me continue to deliver safe classes. This subtheme captures when yoga instructors spoke about the necessity of communicating with healthcare providers, parents, and students to ensure safety. Some yoga instructors had experience communicating with healthcare providers, parents, and students, for others it’s something they would want to have.

“Also safety measures, what kind of modifications you know how do you educate patients on what can’t be done, what can be done, when do you stop [...] before we begin every [...] their oncologists have to had the all clear every single day, you know looking at their numbers and blood counts, today is a good day too you know do a little bit strenuous, today is not a good day to do things. So, their medical team nurses were on board and watching for us continuously.” - Jessica, 47, 200-500 hour CYT, Integrative healthcare provider or specialist

Either way, all yoga instructors viewed communication with healthcare providers, parents, and students as vital to ensure the yoga instructor were equipped to deliver a safe class.

Indeed, yoga instructors were of the opinion that acquiring medical information from healthcare providers was essential to ensure safety.

“I would also want to know from a physician’s perspective what they can or cannot do [...] main physical considerations or limitations from a healthcare provider perspective. [...] being mindful [...] we also communicated a lot with the parents, so we were able to find out kind of things that gave us almost like an inside edge, what we are going to need to look out for with this participant so we could really be proactive.” - Jane, 32, 200-500 hour CYT, Research/academia

What I need to deliver an effective yoga program

———This theme captures yoga instructors’ perspective of the level of adaptability required when delivering yoga to their students with complex needs and in the small spaces available (i.e., hospital room settings). Yoga instructors mentioned a high level of flexibility is required when working with kids generally, as they may have short attention spans (e.g., frequently changing postures or practices), and that it is important that each session is driven by the students’ age, needs, and preferences.

“Flexibility is also really key when you’re working with kids generally, so kids have short attention spans, especially the younger kids so having the flexibility to kind of move around from pose to pose or from section of a practice to section.” - Linda, 37, 200-500 hour CYT, Research/academia

To meet the complex changing needs of children affected by cancer or blood disease, yoga instructors reflected that they were not attached to one plan for the session, but rather to come prepared with a few different structured plans that can be modified based on each student’s condition that given day and time (e.g., modify from lying in bed, to sitting, to standing).

Further, preparing flexible plans that were adaptable to fit the small space they have to work with in-hospital (e.g., using the bed as a prop) was essential.

“You had to be quite flexible, in some of the bone marrow transplant rooms that the children are in, they’re really confined, small spaces, like you really had to get innovative using the bed, [...], so maybe doing a forward fold and put your hands forward on the bed or maybe adjusting the bed.” - John, 26, 200-500 hour CYT, Research/academia

Also, yoga instructors reported that it is important to consider the family system. Specifically, it was helpful if yoga instructors had flexibility in their schedules to account for the student and families’ competing schedules, as well as the students’ changing condition, in order to deliver yoga when they are available and feeling their best. In this sense, yoga instructors highlighted the importance of an adaptable, changing schedule.

“[You’re] not just working around the schedule of the child,[...] and then we have parents [...]. If you’re able to be really really flexible with your time and your availability, that [will make it easier to deliver to this population].” - Jane, 32, 200-500 hour CYT, Research/academia

“The busyness of parent’s lives makes it a very big challenge, you know they’re navigating so many things.” - Mary, 40, 200-500 hour CYT, Director/owner of community yoga program

Finally, this theme captures yoga instructors’ perceptions about their role to incorporate fun and engaging techniques to facilitate effective yoga delivery. To achieve this, yoga instructors incorporated themes, props, and animated educational video resources. It was the

belief of yoga instructors' that these strategies facilitated delivery, and may have promoted student attendance, engagement, and experience.

"When you bring in their interest in a yoga session, it makes it also more fun and playful for patients. As I mentioned, bringing in some of the toys that they might have into the yoga session, doing yoga with their toys, any superheroes, and renaming poses to be other superheroes language." - Olivia, 36, 200-500 hour CYT, Research/academia

What I need to ensure yoga is widely available

This theme captures when yoga instructors described factors they saw as integral to enhancing the availability of yoga for their students, as well as other children and adolescents affected by cancer or blood disease. Two subthemes emerged; first, yoga instructors were of the opinion that increasing the number of yoga programs offered beyond the hospital setting may allow diverse students (e.g., off treatment) to access yoga. Second, yoga instructors mentioned the necessity of acquiring support through more funding and from gatekeepers such as healthcare providers and students' parents and family, to ensure yoga is widely available to their students.

I need to offer yoga across settings to address the diverse needs of students. This subtheme captures when yoga instructors discussed their mixed opinions of how to best offer yoga via various delivery settings (i.e., in hospital, community, and/or online).

"I think that being able to continue sessions even maybe between cycles for kids, so when they're not just in-patients but being able to offer sessions virtually when they're at home between cycles I think could be really awesome. [...] I think a program again that could be delivered in both in person and virtually would be really great." - Linda, 37, 200-500 hour CYT, Research/academia

Some yoga instructors believed delivering programs in-hospital was optimal, allowing yoga instructors to come to in-patient students, thus overcoming many barriers to attendance. Whereas others shared that in-person programs (i.e., hospital and community) often faced barriers to program delivery due to a lack of space or having students in isolation due to bone marrow treatments.

“Obviously, the space is a really bit of a barrier, you would like to have a little bit more space so they can freely move. [...] what’s neat about having it as an in-patient is that the patient are already going to be in a hospital, you know where they’re going to be, you can go to them. Whereas I think it’s harder when a parent or a child needs to come to you. [...] I think starting with in-patients and then kind of maybe branching out, maybe having more community-based model but I think ideally just the resources to offer to all the children in the hospital that are in-patient.” - John, 26, 200-500 hour CYT,

Research/academia

Some yoga instructors commented that in these cases, online delivery may be a suitable alternative. Many yoga instructors suggested an ideal program would include offering yoga in-hospital for patients, and offering community-based and/or online programming to support out-patients and survivors.

“As well, [what helped us deliver yoga to this population was] we had space donated from studio in the community [...]. I think there are a lot of children that aren’t being reached who could totally benefit from [online] programs. [...] Ideally, I would like to see an in-hospital program, but one that could perhaps transition into the community.”

- Jennifer, 51, 200-500 hour CYT, Director/owner of community yoga program

I need more support. This subtheme captures when yoga instructors described needing more support. Support covered the need for funding, staff, as well as healthcare provider and family support, as both may act as gatekeepers for delivering yoga to the students. Lack of funding impeded the ability to hire and train enough staff. Those that had a lack of staff reported less outreach, and fewer potential students having the opportunity to access yoga at the frequency intended.

“Staffing has been what's sort of been tough for us [...] our goal within oncology is to have a consult for every child that comes into the hospital [...] we're consulted on about 40% of those kids in order to continue to grow and actually provide more personalized service we need more staff and in turns we need more funding. [...] I think that ideally yoga should be offered a minimum of two to three times per week for an inpatient setting, we're not there just due to staffing volume.” - Amy, 34, 200-500 hour CYT, Integrative HCP or specialist

Yoga instructors commented that while healthcare providers, parents, and students were mostly supportive of yoga, some held misconceptions that may have negatively impacted program attendance. Thus, there is a need for continued education among these groups on the evidence of yoga to ensure their support.

“I think just education, getting healthcare providers on board we'd have much better luck recruiting.” - Jane, 32, 200-500 hour CYT, Research/academia

“I think getting more people on board [...] promoting to the people who the parents are listening to and that's the medical professionals, if we can encourage them to prescribe yoga as exercise as the critical part of the care, that would be beautiful.” - Suzanne, 64, 200-500 hour CYT, Yoga Teacher/instructor

3.6 Discussion

This interpretive description study explored yoga instructors' lived experiences preparing for and facilitating yoga for children and adolescents affected by cancer or blood disease. Findings highlight yoga instructors' perceptions of the positive impact yoga had on their students. As well, results reveal the varied and comprehensive training and experiences that yoga instructors had, along with their recognition of limitations in their knowledge, which together outline future directions for defining required competencies and training experiences. Finally, yoga instructors provided insights that could inform future research and programs based on their perceptions of what is needed for yoga to be delivered safely, effectively, and accessibly.

Yoga instructors believed yoga offered children and adolescents affected by cancer or blood disease benefits spanning physical (e.g., reducing deconditioning, pain, and nausea) and psychosocial well-being (e.g., managing anxiety). These findings align with benefits that have been reported from children's, adolescents' and parents' perspectives, who have also reported improvements in symptoms, mood, and relaxation following yoga.³⁸⁻⁴⁰ Yoga instructors also described the ways they saw their students using yoga off the mat, viewing yoga as an important self-management tool that enabled the children and adolescents' they worked with to cope with symptoms and side effects from their disease and treatments. This extends findings from research exploring yoga in other clinical populations, where yoga has been suggested to be a tool to promote self-management, or one's ability to build resilience, mindfulness, and actively cope with their condition.¹²⁻¹⁵ Thus, yoga may be one way to support children and adolescents affected by cancer or blood disease; however, this needs to be confirmed via further research exploring the role of yoga to promote positive outcomes and foster self-management knowledge, skills, and confidence with this cohort.

Defining required competencies for individuals offering services to this population and ensuring comprehensive training for the delivery of yoga programs is important.²² The insights yoga instructors provided with regards to the scope and limits of their own knowledge serves as a vital launching point to guide population-specific training. Specifically, yoga instructors in this sample desire further clinical training (e.g., disease and treatment knowledge) and access to practical experiences, which aligns with recommendations for specialized training to ensure safe and effective delivery of yoga among other clinical populations.^{23, 41}

With regards to yoga delivery, the yoga instructors in this study iterated the critical nature of prioritizing safety, effectiveness, and access within yoga research and programs. The sentiments expressed align with recommendations for integrating evidence-informed yoga into cancer care,^{23, 25, 28} and when developing yoga interventions for individuals with health conditions.^{22, 41} Indeed, yoga instructors highlighted the multiple levels that need to be considered when offering yoga to this population, such as taking into account individual factors, clinical support and logistics, yoga program factors (e.g., low intensity), and communication with healthcare providers. Further, yoga instructors' insights extended research that describes the challenges of implementing yoga for children and adolescents affected by cancer or blood disease²⁵ when they commented on the need to consider staffing factors (e.g., hiring and training more staff) to ensure safety and enhance access. As seen in the physical activity literature for this population,⁴² yoga instructors in this study explained the importance of flexibility, tailoring, and the “fun” factor when striving to promote engagement and realize benefits. Future work may wish to incorporate these findings and explore ways to tailor to this cohort and individual students. Several models for this exist, including one that has been used with children and adolescents affected by cancer.⁴³

In terms of enhancing access to yoga for children and adolescents affected by cancer or blood disease via research and programs, yoga instructors described key factors impacting delivery, including setting factors, costs, and the hesitation of healthcare providers and families to promote yoga in this population. Each of these have been identified in the literature as barriers to movement opportunities for clinical populations.^{25, 44, 45} First, though most yoga instructors had experience in hospital settings, they described the importance of considering alternative settings (i.e., online and community), to move yoga beyond the hospital setting and enhance access across the disease continuum.²⁰ Thus, there is a need to test the delivery and effects of yoga beyond the hospital specifically by considering the individual (e.g., on-treatment, off-treatment, long-term care) and the goals of yoga (e.g., as a tool to cope with treatments vs lasting effects). Second, yoga instructors reflected that hiring, training, and retaining instructors was costly, given their experience and expertise. Looking forward, researchers and program developers will need to consider budgeting for the hiring and training of yoga instructors through grants, partnerships, or cost-recovery fee-based models. Finally, yoga instructors described needing buy-in at multiple levels, which is not surprising as healthcare providers and parents are regarded as gatekeepers to their patient's and children's health.^{46, 47} Equipping these gatekeepers with information about yoga and the expertise of yoga instructors could influence their perceptions and willingness to recommend or support participation.⁴⁴

3.7 Considerations

Notwithstanding the contributions this study makes to research and practice, there are important considerations to take into account when interpreting the findings. First, though efforts were made to diversify the sample and perspectives obtained, the majority of participants ($n=8$) were acquired from two main research-based programs with which the study team had close

affiliations. In addition, the majority of yoga instructors facilitated yoga for children affected by cancer only ($n=11$), highlighting the underrepresented nature of blood disease in both research and practice.²⁰ Further, many yoga instructors ($n=10$) facilitated yoga for children and adolescents affected by cancer or blood disease as part of research. This could be due to the nature of yoga, as a new intervention with, as of yet, few knowledge translation efforts resulting in programs being available.³⁴ Finally, most yoga instructors ($n=11$) were relatively new to the field of yoga for children and adolescents affected by cancer or blood disease, having less than 5 years of experience. Recruiting others from varied research settings, obtaining insights from those offering yoga as a program only, or hearing from those with diverse delivery (e.g., online programs) or years of experience may have resulted in different insights. Second, the first author and interviewer (KE) was in a lab known for yoga research with clinical populations. Though this could have impacted participants responses, efforts were made to minimize bias, including ensuring anonymity. Third, given the nature of their role delivering yoga, it is possible some yoga instructors may have been less willing to disclose negative effects from yoga that they might have seen. Finally, future work looking at experiences of children, adolescents, and their parents with yoga could provide further insights into the potential benefits of yoga and additional delivery and program considerations.

3.8 Conclusion

This study provides insight into the varied and comprehensive training yoga instructors sought to ensure safe and effective delivery of yoga, while also elucidating current training limitations, and how this may impact yoga intervention delivery. Yoga instructors' perspectives also offer important information related to developing programs that prioritize safety, ensure effectiveness, and have greater access in mind. Ultimately, it is hoped findings from this work

will spur efforts to define required competencies and training to work with this population, while laying the foundation for future research and programs.

3.9 References

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Chapter Four: **Global Discussion**

4.1 Summary of main findings

This thesis contributes to research examining the use of yoga among children and adolescents affected by cancer or blood disease, and highlights strategies to bridge the gap between evidence and practice. In *Chapter Two*, findings from the systematic review show that yoga is safe, feasible, and potentially beneficial among children and adolescents affected by cancer or blood disease. In *Chapter Three*, the interpretive description study results highlight additional possible benefits of yoga for children and adolescents affected by cancer or blood disease from the perspective of yoga instructors. Results also underscore the varied and comprehensive training required to facilitate yoga for this population and iterate the necessity of prioritizing safety, effectiveness, and access within yoga research and programs delivered. Collectively, the findings from these two studies lay a strong foundation for future practice and research.

4.2 Practical contribution

The studies comprising this thesis make a number of practical contributions which are detailed below.

4.2.1 Yoga is safe, feasible, and potentially beneficial

In *Chapter Two* the available evidence reporting on the effects of yoga for children and adolescents affected by cancer or blood disease was synthesized. This included identifying and summarizing the breadth of research and highlighting the limitations in the evidence to date. Practically, the knowledge that yoga is safe, feasible, and potentially beneficial can offer stakeholders (e.g., healthcare providers, families, children/adolescents) assurance that yoga may be a viable, evidence-based intervention for children and adolescents to mitigate the negative

effects of their disease and treatments, while promoting or maintaining health and quality of life. Further, the limitations identified offer researchers and program developers important information to inform the design of future research, which includes guidance around study design, sample size, and intervention characteristics. Taken together, the findings from this review support recently published guidelines and recommendations suggesting *movement* is important for all children and adolescents affected by cancer¹ and calls to promote physical activity among pediatric clinical populations.² Thus, yoga may be one, of many ways, this population can move more.

4.2.2 Moving evidence to practice

In *Chapter Three*, yoga instructors provided a number of insights to guide delivery of safe, effective, and accessible yoga programs. Not only did the feedback gleaned from yoga instructors align with, and extend recommendations for integrating evidence-informed yoga for clinical populations,³⁻⁵ but this feedback also provided possible solutions to some of the barriers highlighted in the literature reporting on the implementation of yoga in cancer care.⁶⁻⁷

First, when designing and delivering programs, individual characteristics (e.g., age, preferences, medical characteristics, and contraindications) must be collected and used to tailor yoga. To streamline this process, researchers and program developers may wish to incorporate referral or intake forms that include the child's/adolescent's medical characteristics, any concerns, movement history, and personal preferences (Supplemental File 8). Yoga instructors also commented that for children on-treatment, their condition may change day-to-day, and thus communication with healthcare providers and parents prior to the yoga session, as well as communication with the child to ensure they understand their limitations (e.g., what pain is good pain vs unsafe) may be helpful to ensure safe delivery. Helping yoga instructors feel comfortable

asking the healthcare team questions and communicating with their students and their parents is therefore vital, though not often included within training programs. Following from this, yoga instructors explained that the information that could be collected through referral or intake forms, alongside open communication, would enable them to better tailor the intensity of the sessions (via guiding their selection of poses and sequencing) to ensure safety. For example, if a child is facing significant symptoms and side effects, delivering lower intensity sessions by modifying postures (e.g., bed or chair-based) or focusing on meditation and breathing techniques rather than physical postures may be favorable. This can only be learned through a detailed intake form and in liaising with the healthcare team, child/adolescent, and/or their family. Finally, yoga instructors were adamant that for younger ages, the “fun” factor² must be considered to promote engagement. Yoga instructors suggested using props and themes based on the child’s interest for example, bringing in their toys as props and renaming poses using superhero language. Moving forward, programs should focus on making all *movement* fun in a way that doesn’t feel like “exercise” or “treatment”.

Second, there is evidence to suggest healthcare providers and families, who act as gatekeepers to their patients’ or child’s health, may be hesitant to promote yoga for adults and children/adolescents affected by cancer.^{4, 6, 8, 9} In order to overcome this barrier, researchers and program developers should consider including an educational component for stakeholders (e.g., healthcare providers, families, children/adolescents) to ensure they are informed on the evidence supporting the safety, feasibility, and potential benefits of yoga. One possible strategy is to translate the evidence from the review presented in *Chapter Two* into clear and concise knowledge translation resources (e.g., brochures, infographics) for healthcare providers and families, ensuring they can then make evidence-based decisions about promoting yoga for their

patients. Another solution may be to take a family-centered approach, including parents/siblings in delivery. Showing families what yoga entails and allowing them to see first-hand the potential benefits for their child (as well as for themselves), may confer support from parents, siblings, and important others.

Third, one component of moving *evidence to practice* is to ensure that yoga instructors are properly equipped with the knowledge, skills, and competencies to facilitate yoga safely and effectively to this population.^{5, 6} Training to ensure the competency of yoga instructors facilitating yoga to clinical populations, including children and adolescents affected by cancer or blood disease, has been identified as a barrier in the literature to date.^{5, 6} Therefore, establishing the minimum level of training and experience required when working with clinical populations such as children and adolescents affected by cancer or blood disease is critical,⁶ and the findings from this thesis are an important first step. *Chapter Three* highlighted yoga instructors' perspectives on their training and limitations in knowledge. Yoga instructors established that the minimal level of training and experience required were experiential opportunities in basic yoga (i.e., 200-500 hour yoga instructor training),¹⁰ population-specific yoga (i.e., cancer-specific),¹¹ and children's yoga. However, while many instructors had experiences or training in yoga for cancer, many felt they needed more knowledge on disease, treatment protocols, and side effects. Indeed, by building this knowledge, yoga instructors may be able to deliver yoga more effectively for this population. For example, delivering programming that targets certain disease-specific side effects (e.g., postures promoting balance and coordination for individuals with brain tumors). In the adult literature, the Yoga Thrive Teacher Training program has been delivered to support increased cancer-specific knowledge and the role of movement, building from the Thrive Health exercise oncology training.^{12, 13} In terms of facilitating yoga effectively for children, yoga

instructors should seek to obtain additional trainings, or at a minimum have experiential opportunities working with children in various settings. Overall, the findings from *Chapter Three* may serve as a vital launching point to guide specific training for this population.

Further, in *Chapter Two* the summaries of the evidence to date revealed the inconsistencies in reporting on yoga instructor trainings, with 35% of studies not reporting whether yoga instructors received additional trainings. In addition, of those that reported the yoga instructor training, many showed variability in trainings received. Moving forward, there is a need for transparent reporting of training for intervention delivery to enhance potential to replicate research.

4.3 Limitations and potential future directions

4.3.1 Limitations

Chapter Two identified various limitations in the literature, which were summarized in that chapter. Three that are important to note include: (1) a lack of studies designed to assess the effects of yoga, due to the feasibility focus of the work to date; (2) an over-reliance on a positivist perspective, with little work including other approaches or ways of knowing (e.g., qualitative or mixed-methods research); and (3) a high level of variability across published studies with regards to yoga interventions (i.e., yoga session length, intervention duration, frequency, and content), yoga instructor's qualifications, outcomes assessed, and measures used. Consequently, many research questions remain to be asked and answered. While a number of possible future directions could be suggested to address these limitations, three potential future studies are highlighted herein, including a randomized controlled trial to assess the effects of yoga, exploring various key stakeholders' lived experiences in programs, and building a yoga

network to facilitate consensus-building around intervention and instructor characteristics, outcomes, and measures.

4.3.2 The effects of yoga on pain, fatigue, and quality of life

Children and adolescents affected by cancer or blood disease experience significant negative effects due to their disease and treatments including pain and fatigue, which may negatively impact their quality of life.¹⁴⁻¹⁶ These negative effects are most burdensome when on treatment for cancer or blood disease (e.g., bone marrow transplant), however these may persist post-treatment.¹⁴⁻¹⁶ Our review¹⁷ showed potential benefits, however it is important to note that some studies showed positive changes and some reported no change in these outcomes. Further, none of these studies reported exploring prolonged yoga participation and/or examining long-term, or lasting effects from participating in a yoga intervention. Therefore, the purpose of a future multi-site randomized controlled trial study would be twofold. First, examine the effects of yoga on pain, fatigue, and quality of life for children ***on-treatment*** for cancer or blood disease. And second, using follow-up assessments, examine the lasting effects of yoga for children and adolescents who are ***post-treatment*** for cancer or blood disease. The intervention group of children and adolescents on treatment for cancer or blood disease (and their family members) would receive a gentle yoga delivered in-hospital during treatment by a trained yoga instructor for 3x/week for 15-60 minutes. Once children and adolescents are discharged (e.g., out-patient or survivors), yoga would continue to be offered online asynchronously 2x/week for 15-60 minutes for 8 weeks, and continued practice of yoga would be tracked via attendance to the online sessions. The control group would receive visits from the yoga instructor 3x/week for 15-60 minutes in person for in-patients, and online 2x/week for 15-60 minutes once discharged. The control group would consist of other activities based on the child's interest (e.g., board games)

but would not involve any of the common Western yoga elements (i.e., postures, breathwork and meditation). The main outcomes assessed would include pain via the Spielberger State Trait Anxiety Inventory, fatigue via the Pediatric Quality of Life inventory (PedsQL) Multidimensional Fatigue Scale, and quality of life via the PedsQL 4.0 Generic scale.¹⁸⁻²⁰ Outcomes would be assessed at baseline, discharge, 3 months, and 6 months from baseline. Findings would enable a better understanding of the effects of yoga on pain, fatigue, and quality of life among this population, and insight into the potential lasting effects of yoga for this population.

4.3.3 Exploring experiences within yoga research and practice

Positivist paradigms contribute invaluable evidence to facilitate rigorous research that allows for comparison between groups.²¹ However, there are other ways of knowing, one of which is post-positivism. Indeed, this approach can furnish understanding of a phenomena that goes beyond the methods of quantitative data collection, elucidating differing perspectives and gaining an understanding of underlying values, beliefs, and assumptions.^{21, 22} As seen in *Chapter three* of this thesis, exploring perspective from a key stakeholder group offered insight into the competencies of yoga instructors, and factors to consider when translating *evidence to practice*. These findings may be used to inform the design and implementation of safe, effective, and accessible programs. However, these recommendations could be stronger if they included qualitative data from other key stakeholders (e.g., health care providers, families, children/adolescents). Therefore, a future study could explore the lived experiences of healthcare providers, parents, and children and adolescents to offer insight into their: (1) perceived benefits of yoga for children and adolescents affected by cancer or blood disease; and (2) views on barriers, facilitators, and recommendations for programs. A multi-perspective qualitative study

design, taking a social constructivist paradigm, could be used to explore the stakeholders' multiple realities, created and co-developed based on their social interactions and relationships.²² Aligned with the paradigm, this proposed study could use semi-structured interviews to allow a deeper understanding of each individuals' lived experience, building on the knowledge from the few studies that have conducted qualitative work in this field.^{23, 24} Findings would contribute to the evidence for the role of yoga among children and adolescents affected by cancer or blood disease, and specifically the various stakeholders voices could be used to advocate for more support for yoga programs. This would enable an understanding from multiple perspectives of the logistical barriers and facilitators to delivering programs in this population, providing recommendations to inform and optimize the design and implementation of future programs.

4.3.4 Building a yoga network

In *Chapter Two*, the variability across intervention characteristics (i.e., yoga session length, intervention duration, frequency, and content), yoga instructor training, outcomes assessed, and measures used revealed that there is a lack of understanding of what intervention “dose” and content is needed to incur the greatest benefit from yoga in this population, and highlighted some of the challenges to pooling evidence in this area. While this thesis makes an important first step by highlighting these limitations and understanding yoga instructors' perspectives, work is needed to identify and promote *best practice* recommendations for yoga interventions, instructor characteristics (experience and training), outcomes studied, and measures used. Therefore, a future study could aim to develop guideline and recommendation statements for intervention and instructor characteristics, outcomes assessed, and measures used in yoga research and programs for children and adolescents affected by cancer or blood disease. First, this future study could use the results from an environmental scan identifying yoga

programs for children and adolescents affected by cancer or blood-disease²⁵ to identify and recruit a network of program leaders, developers, yoga instructors, healthcare providers, and other relevant stakeholders (e.g., researchers, hospital administrators). Once this yoga network of key stakeholders has been identified, the next step could be to use the Delphi survey technique.²⁶ This method has been used within the larger field of pediatric exercise oncology,² as well as in the area of yoga for individual with Huntington disease.²⁷ The Delphi survey technique is a process that utilizes a series of closed and open-ended questions, wherein key stakeholders have the opportunity (typically over a number of iterations) to select the level to which they agree with statements. For example, questions could be asked around research and programming (e.g., thoughts on intervention characteristics, yoga instructor training, and relevant outcomes and measures). This future study would not only address important limitations identified in *Chapter Two* with regards to variability in reporting of yoga instructor training across studies, but would also build upon yoga instructors' perspectives in *Chapter Three* with regards to the comprehensive training opportunities required to deliver safe and effective yoga for this population.

4.4 Conclusion

This thesis represents an important first step towards building a greater understanding of the safety, feasibility, and potential benefits of yoga for children and adolescents affected by cancer or blood disease, and lays a strong foundation to support knowledge translation and programming efforts. The two studies included herein addressed the need for a systematic review, and integrated feedback from yoga instructors – an unrepresented stakeholder that is critical to the conduct of both research and programs. Taken together, this thesis contributes to an area of research that is emerging, and suggests that yoga may be an important supportive care

resource for children and adolescents affected by cancer or blood disease, while also clearly articulating current limitations. Looking ahead, it is hoped the findings from this thesis will positively impact future research and practice, and ultimately the lives of children and adolescents affected by cancer or blood disease.

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4.6 Supplemental files

4.6.1 Supplemental File 1. Search Strategy

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily

Search string

- 1 Pediatrics/
- 2 Exp Child/
- 3 Adolescents/
- 4 Minors/
- 5 (Schoolchild* or kid* or toddler* or child* or pediater* paediatric* or
peadiatric* or kindergar* or preschool* or pre-school* or primary
school* or secondary school*).kf,tw.
- 6 (Adolesc* or teen* or minors or juvenil* or youth* or boy* or girl* or
puber* or pubescen* or prepubescen* or pre-pubescen* or prepuber*
or pre-puber* or elementary school* or high school* or highschool*
or school age* or schoolage*).kf,tw.
- 7 1 or 2 or 3 or 4 or 5 or 6
- 8 Yoga/
- 9 Relaxation Therapy/
- 10 Meditation/
- 11 Relaxation/
- 12 Mind-body Therapies/
- 13 Integrative oncology/
- 14 (yoga or yoga posture* or yoga-based or yogic or yogic-
posture*).kf,tw.
- 15 (relax* or relaxation technique* or meditation).kf.
- 16 (hatha or ashtanga or bikram or iyengar or kripalu or kundalini or
sivananda or vinyasa or raja or radja or bhakti or jnana or kriya or
karma or yama or niyama or asana* or pranayama* or pratyahara or
dharana or dhyana or samadhi or bandha or mudra or
suryanamaskar).kf,tw.
- 17 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16
- 18 neoplasms/ or exp neoplasms by histologic type/ or exp neoplasms by
site/
- 19 Hematology/
- 20 exp Hematologic diseases/
- 21 (cancer* or oncolog* or neoplas* or carcinom* or tumor* or tumour*
or malignan* or hematooncological or hematolo* or haematolo* or
bonemarrow transplant* or lymphom* or leukemia* or leukaemi* or
ALL or AML or hodgkin* or T-cell or B-cell or non-hodgkin or
sarcom* or Ewing* OR osteosarcom* OR wilms* OR
nephroblastom* OR neuroblastom*OR rhabdomyosarcom* OR

- teratom* OR hepatom* OR blastoma* ohepatoblastom* OR PNET*
 OR medulloblastom* OR retinoblastom* OR meningiom* OR gliom*
 OR thrombocyt*).kf,tw.
- 22 18 or 19 or 20 or 21
- 23 7 and 17 and 22

Embase

Search string

- 1 Pediatrics/
- 2 Child/
- 3 adolescent/ or hospitalized adolescent/
- 4 "minor (person)"/
- 5 (Schoolchild* or kid* or toddler* or child* or pediatri* paediatr* or
 peadiatric* or kindergar* or preschool* or pre-school* or primary
 school* or secondary school*).kw.
- 6 (Adolesc* or teen* or minors or juvenil* or youth* or boy* or girl*
 or puber* or pubescen* or prepubescen* or pre-pubescen* or
 prepuber* or pre-puber* or elementary school* or high school* or
 highschool* or school age* or schoolage*).kw.
- 7 1 or 2 or 3 or 4 or 5 or 6
- 8 Yoga/
- 9 Relaxation Training/
- 10 meditation/ or mindfulness meditation/
- 11 Integrative oncology/
- 12 (yoga or yoga posture* or yoga-based or yogic or yogic-
 posture*).tw,kw
- 13 (relax* or relaxation technique* or meditation).kw.
- 14 (hatha or ashtanga or bikram or iyengar or kripalu or kundalini or
 sivananda or vinyasa or raja or radja or bhakti or jnana or kriya or
 karma or yama or niyama or asana* or pranayama* or pratyahara or
 dharana or dhyana or samadhi or bandha or mudra or
 suryanamaskar).tw,kw.
- 15 8 or 9 or 10 or 11 or 12 or 13 or 14
- 16 Malignant neoplasm/ or childhood cancer/
- 17 Hematology/
- 18 exp Hematologic disease/
- 19 (cancer* or oncolog* or neoplas* or carcinom* or tumor* or
 tumour* or malignan* or hematooncological or hematolo* or
 haematolo* or bonemarrow transplant* or lymphom* or leukemia*
 or leukaemi* or ALL or AML or hodgkin* or T-cell or B-cell or
 non-hodgkin or sarcom* or Ewing* OR osteosarcom* OR wilms*
 OR nephroblastom* OR neuroblastom*OR rhabdomyosarcom* OR
 teratom* OR hepatom* OR blastoma* ohepatoblastom* OR PNET*

- OR medulloblastom* OR retinoblastom* OR meningiom* OR gliom* OR thrombocyt*).tw,kw.
- 20 16 or 17 or 18 or 19
- 21 7 and 15 and 20

SportDiscuss / AltHealthWatch

Search string

- 1 DE "PEDIATRICS" OR DE "CHILDREN'S health" OR DE "JUVENILE diseases"
- 2 DE "CHILDREN" OR DE "TEENAGERS" OR DE "YOUTH"
- 3 TI (Schoolchild* or kid* or toddler* or child* or pediater* paediatric* or paediatric* or kindergart* or preschool* or pre-school* or "primary school*" or "secondary school*"). OR AB (Schoolchild* or kid* or toddler* or child* or pediater* paediatric* or paediatric* or kindergart* or preschool* or pre-school* or "primary school*" or "secondary school*"). OR KW (Schoolchild* or kid* or toddler* or child* or pediater* paediatric* or paediatric* or kindergart* or preschool* or pre-school* or "primary school*" or "secondary school*")
- 4 TI (Adolesc* or teen* or minors or juvenil* or youth* or boy* or girl* or puber* or pubescen* or prepubescen* or "pre-pubescen*" or prepuber* or "pre-puber*" or "elementary school*" or "high school*" or highschool* or "school age*" or schoolage*). OR AB (Adolesc* or teen* or minors or juvenil* or youth* or boy* or girl* or puber* or pubescen* or prepubescen* or "pre-pubescen*" or prepuber* or "pre-puber*" or "elementary school*" or "high school*" or highschool* or "school age*" or schoolage*). OR (TW Adolesc* or teen* or minors or juvenil* or youth* or boy* or girl* or puber* or pubescen* or prepubescen* or "pre-pubescen*" or prepuber* or "pre-puber*" or "elementary school*" or "high school*" or highschool* or "school age*" or schoolage*).
- 5 1 OR 2 OR 3 OR 4
- 6 DE "YOGA" OR DE "YOGA for children" OR DE "YOGA postures" OR DE "YOGA techniques" OR DE "YOGA training & conditioning" OR DE "YOGIS"
- 7 DE "RELAXATION therapy"
- 8 DE "MEDITATION"
- 9 AB (yoga or "yoga posture*" or "yoga-based" or yogic or "yogic-posture*" or relax* or "relaxation technique*" or meditation or hatha or ashtanga or bikram or iyengar or kripalu or kundalini or sivananda or vinyasa or raja or radja or bhakti or jnana or kriya or karma or yama or niyama or asana* or pranayama* or pratyahara or dharana or dhyana or samadhi or bandha or mudra or suryanamaskar) OR TI (yoga or "yoga posture*" or "yoga-based" or yogic or "yogic-posture*" or relax* or "relaxation technique*" or meditation or hatha or ashtanga or bikram or iyengar or kripalu or kundalini or sivananda or vinyasa or raja or radja or bhakti or jnana or kriya or karma or yama or niyama or asana* or pranayama* or pratyahara or dharana or dhyana or samadhi or bandha or

- mudra or suryanamaskar) OR KW (yoga or "yoga posture*" or "yoga-based" or yogic or "yogic-posture*" or relax* or "relaxation technique*" or meditation or hatha or ashtanga or bikram or iyengar or kripalu or kundalini or sivananda or vinyasa or raja or radja or bhakti or jnana or kriya or karma or yama or niyama or asana* or pranayama* or pratyahara or dharana or dhyana or samadhi or bandha or mudra or suryanamaskar)
- 10 6 or 7 or 8 or 9
- 11 DE "CANCER"
- 12 DE "HEMATOLOGY"
- 13 DE "BLOOD diseases" OR DE "ANEMIA" OR DE "ERYTHROCYTE disorders" OR DE "HEMOPHILIA" OR DE "MONONUCLEOSIS" OR DE "SICKLE cell anemia"
- 14 TI (cancer* or oncolog* or neoplas* or carcinom* or tumor* or tumour* or malignan* or hematooncological or hematolo* or haematolo* or "bonemarrow transplant*" or lymphom* or leukemia* or leukaemi* or ALL or AML or hodgkin* or "T-cell" or "B-cell" or "non-hodgkin" or sarcom* or Ewing* OR osteosarcom* OR wilms* OR nephroblastom* OR neuroblastom* OR rhabdomyosarcom* OR teratom* OR hepatom* OR blastoma* OR hepatoblastom* OR PNET* OR medulloblastom* OR retinoblastom* OR meningiom* OR gliom* OR thrombocyt*) OR AB (cancer* or oncolog* or neoplas* or carcinom* or tumor* or tumour* or malignan* or hematooncological or hematolo* or haematolo* or "bonemarrow transplant*" or lymphom* or leukemia* or leukaemi* or ALL or AML or hodgkin* or "T-cell" or "B-cell" or "non-hodgkin" or sarcom* or Ewing* OR osteosarcom* OR wilms* OR nephroblastom* OR neuroblastom* OR rhabdomyosarcom* OR teratom* OR hepatom* OR blastoma* OR hepatoblastom* OR PNET* OR medulloblastom* OR retinoblastom* OR meningiom* OR gliom* OR thrombocyt*) OR TW (cancer* or oncolog* or neoplas* or carcinom* or tumor* or tumour* or malignan* or hematooncological or hematolo* or haematolo* or "bonemarrow transplant*" or lymphom* or leukemia* or leukaemi* or ALL or AML or hodgkin* or "T-cell" or "B-cell" or "non-hodgkin" or sarcom* or Ewing* OR osteosarcom* OR wilms* OR nephroblastom* OR neuroblastom* OR rhabdomyosarcom* OR teratom* OR hepatom* OR blastoma* OR hepatoblastom* OR PNET* OR medulloblastom* OR retinoblastom* OR meningiom* OR gliom* OR thrombocyt*)
- 15 11 or 12 or 13 or 14
- 16 5 and 10 and 15

CINAHL

Search String

- 1 (MH "Pediatrics")
- 2 (MH "Child") OR (MM "Child, Hospitalized") OR (MM "Child, Preschool")
- 3 (MH "Adolescence") OR (MH "Adolescent, Hospitalized") OR (MH "Minors (Legal)")
- 4 TI ((Schoolchild* or kid* or toddler* or child* or pediater* paediatric* or pediatric* or kindergar* or preschool* or pre-school* or "primary school*" or "secondary school*").) OR AB ((Schoolchild* or kid* or toddler* or child* or pediater* paediatric* or pediatric* or kindergar* or preschool* or pre-school* or "primary school*" or "secondary school*").)
- 5 TI ((Adolesc* or teen* or minors or juvenil* or youth* or boy* or girl* or puber* or pubescen* or prepubescen* or "pre-pubescen*" or prepuber* or "pre-puber*" or "elementary school*" or "high school*" or highschool* or "school age*" or schoolage*).) OR AB ((Adolesc* or teen* or minors or juvenil* or youth* or boy* or girl* or puber* or pubescen* or prepubescen* or "pre-pubescen*" or prepuber* or "pre-puber*" or "elementary school*" or "high school*" or highschool* or "school age*" or schoolage*).)
- 6 1 or 2 or 3 or 4 or 5
- 7 (MH "Yoga") OR (MH "Yoga Pose")
- 8 (MH "Relaxation Techniques")
- 9 (MH "Meditation")
- 10 (MH "Integrative Medicine")
- 11 TI ((yoga or "yoga posture*" or "yoga-based" or yogic or "yogic-posture*")) OR AB ((yoga or "yoga posture*" or "yoga-based" or yogic or "yogic-posture*"))
- 12 TI ((relax* or "relaxation technique*" or meditation)) OR AB ((relax* or "relaxation technique*" or meditation))
- 13 TI ((hatha or ashtanga or bikram or iyengar or kripalu or kundalini or sivananda or vinyasa or raja or radja or bhakti or jnana or kriya or karma or yama or niyama or asana* or pranayama* or pratyahara or dharana or dhyana or samadhi or bandha or mudra or suryanamaskar)) OR AB ((hatha or ashtanga or bikram or iyengar or kripalu or kundalini or sivananda or vinyasa or raja or radja or bhakti or jnana or kriya or karma or yama or niyama or asana* or pranayama* or pratyahara or dharana or dhyana or samadhi or bandha or mudra or suryanamaskar))
- 14 7 or 8 or 9 or 10 or 11 or 12 or 13
- 15 (MH "Neoplasms") OR (MH "Childhood Neoplasms") OR (MH "Neoplasms by Histologic Type") OR (MH "Neoplasms by Site")
- 16 (MH "Hematology") OR (MH "Hematologic Diseases+")
- 17 TI ((cancer* or oncolog* or neoplas* or carcinom* or tumor* or tumour* or malignan* or hematocological or hematolo* or haematolo* or "bonemarrow transplant*" or lymphom* or leukemia* or leukaemi* or ALL or AML or hodgkin* or "T-cell" or "B-cell" or "non-hodgkin" or sarcom* or Ewing* OR osteosarcom* OR wilms* OR nephroblastom* OR neuroblastom* OR rhabdomyosarcom* OR teratom* OR hepatom* OR blastoma* ohepatoblastom* OR PNET* OR medulloblastom* OR retinoblastom* OR meningiom* OR gliom* OR thrombocyt*)) OR AB ((cancer* or oncolog* or neoplas* or carcinom* or tumor* or tumour* or malignan* or hematocological or hematolo* or haematolo* or "bonemarrow transplant*" or lymphom* or leukemia* or leukaemi* or ALL or AML or hodgkin* or "T-cell" or "B-cell" or "non-hodgkin" or sarcom* or Ewing* OR osteosarcom* OR wilms* OR nephroblastom* OR neuroblastom* OR rhabdomyosarcom* OR teratom* OR hepatom* OR blastoma* ohepatoblastom* OR PNET* OR medulloblastom* OR retinoblastom* OR meningiom* OR gliom* OR thrombocyt*).)
- 18 15 or 16 or 17
- 19 6 and 14 and 18

Cochrane Database of Systematic Reviews

ID	Search Hits
#1	MeSH descriptor: [Pediatrics] this term only 622
#2	MeSH descriptor: [Child] explode all trees 55053
#3	MeSH descriptor: [Minors] this term only 8
#4	(Schoolchild* or kid* or toddler* or child* or pediater* paediatric* or paediatric* or kindergart* or preschool* or "pre-school*" or "primary school*" or "secondary school*"):ti,ab,kw in Cochrane Reviews 2716
#5	(Adolesc* or teen* or minors or juvenil* or youth* or boy* or girl* or puber* or pubescen* or prepubescen* or "pre-pubescen*" or prepuber* or "pre-puber*" or "elementary school*" or "high school*" or highschool* or "school age*" or schoolage*):ti,ab,kw in Cochrane Reviews 764
#6	#1 OR #2 #3 OR #4 OR #5 3488
#7	MeSH descriptor: [Yoga] this term only 650
#8	MeSH descriptor: [Relaxation Therapy] this term only 1334
#9	MeSH descriptor: [Meditation] this term only 593
#10	MeSH descriptor: [Mind-Body Therapies] this term only 148
#11	(yoga or "yoga posture*" or "yoga-based" or yogic or "yogic-posture*"):ti,ab,kw 3295
#12	(relax* or "relaxation technique*" or meditation):ti,ab,kw 18049
#13	(hatha or ashtanga or bikram or iyengar or kripalu or kundalini or sivananda or vinyasa or raja or radja or bhakti or jnana or kriya or karma or yama or niyama or asana* or pranayama* or pratyahara or dharana or dhyana or samadhi or bandha or mudra or suryanamaskar):ti,ab,kw 1020
#14	#7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 20774
#15	MeSH descriptor: [Neoplasms] this term only 6065
#16	MeSH descriptor: [Neoplasms by Histologic Type] this term only 8
#17	MeSH descriptor: [Neoplasms by Site] this term only 18
#18	MeSH descriptor: [Hematology] this term only 30
#19	MeSH descriptor: [Hematologic Diseases] explode all trees 14295
#20	(cancer* or oncolog* or neoplas* or carcinom* or tumor* or tumour* or malignan* or hematooncological or hematolo* or haematolo* or "bonemarrow transplant*" or lymphom* or leukemia* or leukaemi* or ALL or AML or hodgkin* or "T-cell" or "B-cell" or "non-hodgkin" or sarcom* or Ewing* OR osteosarcom* OR wilms* OR nephroblastom* OR neuroblastom* OR rhabdomyosarcom* OR teratom* OR hepatom* OR blastoma* OR hepatoblastom* OR PNET* OR medulloblastom* OR retinoblastom* OR meningiom* OR gliom* OR thrombocyt*):ti,ab,kw 582539
#21	#15 OR #16 OR #17 OR #18 OR #19 OR #20 587824
#22	#6 AND #14 AND #21 80

Scopus

(TITLE-ABS-KEY (kid* OR child* OR pediater* OR paediatric* OR pediatric* OR adolesc* OR teen* OR minor* OR juvenil* OR youth*)) AND (TITLE-ABS-KEY (yoga OR "yoga posture*" OR "yoga-based" OR yogic OR "yogic-posture*" OR "relaxation technique*" OR meditation OR hatha OR ashland OR bigram OR iyengarii OR kristall OR bendaline OR banana OR vinyls OR raja OR raja OR bhakti OR nana OR kariya OR karma OR yama OR akiyama OR asana* OR pranayama* OR takahara OR parana OR ghana OR sandhi OR banda OR mudra OR surnames) .) AND (TITLE-ABS-KEY (cancer* OR "hematolo* disease*" OR oncolog* OR neoplas* OR carcinom* OR tumor* OR tumour* OR malignan* OR hematological OR hematolo* OR haematolo* OR "bonemarrow transplant*" OR lymphom* OR leukemia* OR leukaemi*) .)

Clinicaltrials.gov

(kid OR child OR pediatric OR pediatrics OR paediatric OR paediatrics OR adolescent OR adolescence OR teen OR teenager OR teenagers OR minor OR minors OR juvenile OR youth) AND (yoga OR yoga posture OR yoga-based OR yogic OR yogic-posture OR relaxation technique OR meditation OR hatha) AND (cancer OR oncology OR neoplasm OR carcinoma OR tumor OR tumour OR malignant OR malignancy OR hematological OR hematological OR haematological OR bonemarrow transplant OR lymphoma OR leukemia OR leukaemia)

4.6.2 Supplemental File 2: Data extraction and risk of bias form

Data extraction form:

Authors, year	Corresponding author + email	Country	Disease type	Treatment phase	Treatment type	Sample size (n)	Age (yrs) (mean, SD, range)	Age of diagnosis	Time off treatment/time since diagnosis (where applicable)	Intervention setting	Intervention duration	Intervention frequency	Intervention session length	Intervention content (e.g., asanas, pranayamas, etc)	Control group characteristics	Supervision	Results- feasibility	Results - participant outcomes	Follow-up	Notes	Measurement times	Outcome measures	Future directions & limitations	funding

Risk of bias form:

|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|

4.6.3 Supplemental File 3: Risk of bias domain definitions

The Cochrane Collaboration's tool for assessing risk of bias		
Type of bias	Bias domains	Definition
Selection bias	Random sequence generation	Whether an effective randomization method occurred and produced comparable groups.
	Allocation concealment	Whether intervention allocations could have been foreseen in advance of, or during, enrolment.
Performance bias	Blinding of participants and personnel	Whether effective measures were used to blind study participants and personnel from knowledge of which intervention a participant received.
Detection bias	Blinding of outcome assessments	Whether effective measures were used to blind outcome assessors from knowledge of which intervention a participant received.
Attrition bias	Incomplete outcome data	Whether there were differences in the completeness of data for main outcomes between groups, or inadequate handling of incomplete outcome data.
Reporting bias	Selective outcome reporting	Whether there was a selective outcome reporting as examined by the review authors, and what was found.
The Risk of Bias Assessment tool for Non-randomized Studies		
Type of bias	Domain	Definition
Selection bias	Selection of participants	Whether the study participants were consecutively recruited, and the data was collected prospectively.
	Confounding variables	Whether there was a natural progression and learning effect* during the consideration of diseases and intervention.

Performance bias	Measurement of exposure	Whether data were obtained from trustworthy sources, such as medical records, or structured interviews.
Detection bias	Blinding of outcome assessments	Whether the outcome assessments were blinded or if blinding was not present, its absence was judged to have no effect on the outcome measurements.
Attrition bias	Incomplete outcome data	Whether information about the number of participants before and after the study exists, and the baseline did not differ with respect to completed and failed study participants.
Reporting bias	Selective outcome reporting	Whether there was a selective outcome reporting as examined by the review authors, and what was found.

4.6.4 Supplemental File 4: Reasons for exclusion

First author, year	Title	Main reason for exclusion
Abrams D. et al., 2012	Integrative medicine practice patterns across the US: Results from a survey of 29 centers	Wrong study design
Anonymous, 2014	Accepted scientific research works (abstracts).	Lack of results
Barrows et al., 2002	Mind-body medicine. An introduction and review of the literature.	Full text not available
Baumann et al., 2013	Clinical exercise interventions in pediatric oncology: A systematic review	Wrong intervention
Beheshtipoor N. et al., 2012	The effect of yoga technique on quality of life in children and adolescents with hemophilia	Full text not available
Ben-Arye E. et al., 2011	Complementary medicine oncology research in the Middle-East: Shifting from traditional to integrative cancer care	Wrong patient population
Benton T.D. et al., 2007	Anxiety and depression in children and adolescents with sickle cell disease	Wrong intervention
Brown et al., 2017	A Mind-Body Approach to Pediatric Pain Management.	Multiple reasons
Caswell, L J; Eland, J M. 1989	"Don't bump my bed, don't touch my feet!".	Wrong intervention
Chang C.-W. et al., 2012	The effectiveness of non-pharmacological interventions on fatigue in children and adolescents with cancer: A systematic review	Wrong intervention
Clerici C.A., et al., 2009	Complementary and alternative medical therapies used by children with cancer treated at an italian pediatric oncology unit	Multiple reasons
Cohen E., et al., 2016	A systematic review of mind-body interventions for pain in children	Full-text not available
Coombs A. et al., 2020	The effect of exercise and motor interventions on physical activity and motor outcomes during and after medical intervention for children and adolescents with acute lymphoblastic leukemia: A systematic review	Wrong intervention
Cotton, S et al., 2014	Integrative Care Therapies and Pain in Hospitalized Children and Adolescents: A Retrospective Database Review.	Wrong intervention

CTRI, 2017	A Randomized parallel group clinical trial on effectiveness of Ayurvedic medicines in reducing adverse effects of radiotherapy, improving disease free survival, quality of life of oral cancer patients	Wrong intervention
Danhauer et al., 2017	Review of yoga therapy during cancer treatment.	Wrong patient population
Diorio et al., 2016	Development of an Individualized Yoga Intervention to Address Fatigue in Hospitalized Children Undergoing Intensive Chemotherapy.	Wrong study design
Dumaplin CA, 2006	Pediatric pharmacology. Avoiding admission for afebrile pediatric sickle cell pain: pain management methods.	Wrong intervention
Dumaplin, C, 2006	Avoiding admission for afebrile pediatric sickle cell pain: pain management methods.	Wrong intervention
Ellen, et al., 1994	The use of alternative therapies by children with cancer.	Full-text not available
Evans, S. et al., 2012	Complementary and Alternative Medicine Use in Children with Cancer	Full-text not available
Friedman E., et al., 2016	Implementation of a yoga program in a pediatric Hem/Onc/BMT population	Lack of results
Furzer et al., 2013	Characteristics and quality of life of patients presenting to cancer support centres: patient rated outcomes and use of complementary therapies.	Wrong intervention
Gan, G.G., et al., 2015	Complementary and alternative medicine use in patients with hematological cancers in Malaysia	Multiple reasons
Goswami, et al., 2016	Evaluation of Gandhakadi Yoga as an adjuvant therapy in the management of Beejadushtijanya Pandu (thalassemia major).	Wrong intervention
Gottschling, S., et al., 2006	CAM use in pediatric oncology	Full-text not available
Govea, B 2003	Wide World of Yoga.	Full-text not available
Hanagavadi M., 2012	Psychosocial issues: Support for people with hemophilia and their families in India	Full-text not available

Hartmann F. & Vlieger A.M. 2012	Effects of mind-body therapies in children	Wrong patient population
Jacobs et al., 2021	Challenges of Implementing Multicenter Studies of Yoga for Pediatric Cancer and Hematopoietic Stem Cell Transplantation Recipients	Wrong study design
Kanitz, et al., 2013	Keeping the balance--an overview of mind-body therapies in pediatric oncology.	Wrong study design
Kanitz, et al., 2013	Keeping the balance - an overview of mind-body therapies in pediatric oncology.	Duplicate – wrong study design
Kanitz, et al., 2013	Eurythmy therapy in the aftercare of pediatric posterior fossa tumour survivors--a pilot study.	Wrong intervention
Karlik, et al., 2014	Associations between healthy lifestyle behaviors and complementary and alternative medicine use: integrated wellness.	Wrong study design
Kasturi G, 2017	Clarification on methodology requested for "results of a pilot yoga intervention to improve pediatric cancer patients"	Wrong study design
Keenan H et al., 2019	The effects of physical activity on quality of life in the pediatric oncology population: A systematic review	Full-text not available
Kelly K. M., 2004	Complementary and alternative medical therapies for children with cancer.	Wrong intervention
Kelly K. M., 2007	Complementary and alternative medicines for use in supportive care in pediatric cancer.	Wrong intervention
Ladas E.J., et al, 2012	Use of traditional complementary/alternative medicine (TCAM) among children with cancer in Buenos Aires, Argentina	Full-text not available
Ladas E.J., 2018	Integrative Medicine in Childhood Cancer.	Wrong intervention
Landier et al., 2010	Use of complementary and alternative medical interventions for the management of procedure-related pain, anxiety, and distress in pediatric oncology: an integrative review.	Wrong intervention
Lopez, et al., 2018	Adolescent-young adults (AYA) with cancer seeking integrative oncology	Wrong study design

	consultations: demographics, characteristics, and self-reported outcomes.	
Mak C. et al., 2016	MiYoga, an embodied movement program for children with cerebral palsy: Experiences of children and parents	Wrong patient population
Massola 2020	Integrative therapies to pediatric inpatient in bone marrow transplantation center: Experience with written narratives	Wrong intervention
McClafferty H., 2011	Complementary, holistic, and integrative medicine: Mind-body medicine	Wrong patient population
McCurdy, E.A., 2003	Religiosity is associated with the use of complementary medical therapies by pediatric oncology patients	Wrong study design
McDaniel D. et al., 2018	Customizing integrative oncology for adolescent and young adults with cancer	Full-text not available
McLean et al., 2006	Lifestyle, biomechanical, and bioenergetic complementary therapies in pediatric oncology.	Full-text not available
Miladinia M. et al., 2017	Complementary and alternative medicine in the pediatrics with leukemia: A narrative review study	Wrong intervention
Moody K. et al., 2010	Yoga for pain and anxiety in pediatric hematology-oncology patients: Case series and review of the literature	Full-text not available
Moody K et al., 2010	Yoga for pain in pediatric hematology-oncology patients	Full-text not available
Muhlbauer N. et al., 2019	Go with the flow: A feasibility study to assess a yoga program for AYA survivors and siblings	Full-text not available
Myers C. et al., 2005	Complementary therapies and childhood cancer	Wrong intervention
Nanthakumar C. et al., 2018	The benefits of yoga in children.	Wrong patient population
NCT03768336, 2018	A Stress Management and Resiliency Program for Adolescent and Young Adult Survivors	Lack of results
Ndao et al., 2013	Use of complementary and alternative medicine among children, adolescent, and young adult cancer survivors: a survey study.	Multiple reasons

Nervik et al., 2011	Commentary on "Feasibility study: effects of therapeutic yoga on quality of life in children hospitalized with cancer".	Wrong study design
Orsey, A.D., 2017	Results of a pilot yoga intervention to improve pediatric cancer patients' quality of life and physical activity and parents' well-being: Additional information on the yoga intervention	Multiple reasons
Ott M.J. 2006	Mind-body therapies for the pediatric oncology patient: Matching the right therapy with the right patient	Multiple reasons
Pandya, S.S. 2013	Complimentary and alternative therapy - Yoga in palliative care	Full-text not available
Park, et al., 2013	The impact of Yoga upon young adult cancer survivors.	Adult population
Purwanto K. 2011	Self healing program towards the recovery of teenager cancer patients	Full-text not available
Rheingans, J. 2007	A systematic review of nonpharmacologic adjunctive therapies for symptom management in children with cancer.	Wrong intervention
Roth, et al., 2009	Pediatric oncologists' views toward the use of complementary and alternative medicine in children with cancer.	Wrong study design
Stringer, H. 2014	Meditation Shows Potential for Relieving Pediatric Cancer Pain.	Wrong intervention
Sung L., et al 2015	intensity of a 3-week individualized yoga program for hospitalized children with cancer.	Full-text not available
Thrane, S. 2013	Effectiveness of Integrative Modalities for Pain and Anxiety in Children and Adolescents With Cancer: A Systematic Review.	Wrong intervention
Tucker, L. 2019	conquering cancer...courtney butler-robinson	Multiple reasons
Tucker, L. 2019	conquering cancer.	Multiple reasons
Velez-Florez et al., 2018	Mind-Body Therapies in Childhood Cancer.	Wrong intervention
Veneri et al., 2018	Using the International Classification of Functioning, Disability, and Health Model to Gain Perspective of the Benefits of Yoga in Stroke, Multiple Sclerosis, and Children to Inform Practice for Children with Cerebral Palsy: A Meta-Analysis.	Wrong patient population

Weaver L., et al., 2015	Systematic Review of Yoga Interventions for Anxiety Reduction Among Children and Adolescents.	Wrong patient population
Wilford J., et al., 2020	A Multi-Modal Family Peer Support-Based Program to Improve Quality of Life among Pediatric Brain Tumor Patients: A Mixed-Methods Pilot Study.	Wrong intervention
Williamson E., 2019	Effect of yoga on metabolic parameters of a young adolescent with cerebral palsy: A single subject design	Wrong patient population
Anonymous, 2017	Professional Pulse. Study: Yoga improves Quality of Life for Pediatric Cancer Patients and Their Parents.	Full-text not available
Anonymous, 2004	Move Through Recovery.	Full-text not available
Anonymous, 2005	Young Cancer Patients Aided with Yoga.	Full-text not available
Anonymous, 2018	ACM International Conference Proceeding Series	Wrong patient population
Anonymous, 2013	2013 SYR Accepted Poster Abstracts	Wrong patient population

4.6.5 Supplemental File 5: Interview guide

1. What were your experiences within pediatric oncology or hematology yoga programs? Were your experiences with cancer patients and/or survivors? Blood-disease patients and/or survivors? Or both? Are you currently teaching? Were you teaching prior to COVID-19? In what setting? In-hospital? In the community? Remotely? Name of program(s)?

Probe: Can you tell me about your thoughts regarding yoga for pediatric [oncology and/or hematology] patients and survivors? And why do you say that?

Probe: What do you like/not like about this initiative?

Probe: What level of flexibility has been required to effectively deliver yoga programs in your setting? In-Hosp? For this pop?

Probe: Would you recommend the program to other families with childhood patients or survivors, and why?

Probe: Would you like to see yoga as part of standard care for this population?

2. What are your thoughts on the yoga instructor training you have received?

Probe: We want to know more about your training. Did you do specific training on top of your yoga instructor training? Was it pediatric specific? Cancer/blood-disease specific? Other?

Probe: Did you feel prepared to work with childhood cancer/blood-disease patients or survivors? Why or why not?

Probe: What would have helped you feel more prepared?

Probe: If applicable, did you feel comfortable being part of the clinical care team?

Probe: Did you feel comfortable delivering yoga for eligible patients or survivors?

Probe: What information would you have needed on the patient/survivor in advance?

Probe: Do you feel that your role and responsibilities within the yoga program were clearly defined? How so? Why or why not?

Probe: How would you improve the training for future yoga instructors to teach this program? What additional resources would, if any, would have helped you feel more comfortable delivering yoga?

Probe: Were there any measures put into place to ensure quality control within program delivery?

Probe: What measures were put into place to ensure participant safety?

Probe: Was there a protocol for adverse events? If yes, please describe.

3. Can you tell me about the things that made it hard, or were barriers, to delivering the yoga?

Probe: What did you do to work around these challenges?

Probe: How often was something of higher priority, such as clinical care, conflicting with the delivery of yoga? How would you overcome this?

4. Can you tell me about the things that made it easier to deliver yoga?

Probe: What would help to deliver yoga for this population within your setting?

5. Do you think patients and their families benefited from participating in the program? How so?

Probe: What benefits, if any, did you notice? (e.g., physical, mental, emotional, functional)

Probe: What do you think of the value of moving more/physical activity for childhood cancer and blood-disease patients or survivors?

Probe: Did you notice if patients or survivors had positive behaviors following the yoga sessions?

6. What aspects of the program, if any, would you want to change to make the program work more effectively in your settings?

Probe: What are your thoughts on yoga programs delivered in other settings for this population? (Hospital, community or remote delivery, as applicable)

7. What do you think an ideal yoga program would look like?

Probe: In what setting would it be delivered? (i.e. in-hospital, community, remote) For what population? (i.e. would it be delivered to childhood hematology and/or oncology patients and/or survivors? Children who are on or off treatment?)

8. Is there anything else you'd like you share about your experiences?

Thank you for your time and sharing your perspectives.

4.6.6 Supplemental File 6: Reflexivity statement

My position:

I have experiences as a research assistant, volunteer, and fitness instructor in physical activity for individuals affected by cancer (including yoga). Specifically, I helped to facilitate an online yoga class for adolescents and young adults affected by cancer, where I saw the benefits of yoga for individuals affected by cancer. Further, as a research assistant I conducted follow-up interviews with participants, where I heard about their positive experiences from yoga. Through my experiences I have become an advocate of physical activity for individuals affected by cancer and I believe strongly in the benefits of physical activity for children and adolescents. Finally, I regularly practice yoga and believe strongly in the benefits.

My potential impact on this research :

During the interview process, my beliefs, experiences, and biases towards the importance of physical activity/yoga may have influenced how I posed questions, the language I used in transitions (e.g., giving positive responses when they say something that aligns with my beliefs), and how I probed participants' responses (e.g., probe more on ideas that align with my beliefs). Similarly, when analyzing my data, I expected yoga instructors to notice benefits from yoga, therefore I may have unintentionally coded data that align with my beliefs and missed ideas that don't align with my beliefs.

4.6.7 Supplemental File 7: Additional quotes

I believe in and see the benefits of yoga on and off the mat	<i>My students feel better from yoga</i>	<p><i>“The mindfulness piece - seeing children and teens who are experiencing a lot of stress and anxiety and uncertainty, having an opportunity to just tune in into their bodies. Seeing them in Savasana [final relaxation pose] and seeing their bodies fully released and relaxed [...] I think [yoga] can offer a range of benefits.” - Jane, 32, 200-500 hour CYT, Research/academia</i></p> <p><i>“I think there were physical benefits and emotional psychosocial benefits. We could see the lift of the mood I think that they really enjoyed coming together like the kids themselves as a little community. I think it helped with discomfort and energy levels.” - Jennifer, 51, 200-500 hour CYT, Director/owner of community yoga program</i></p>
	<i>My students acquired transferrable skills during our sessions</i>	<p><i>“We definitely had kids who talked about using more of the mindfulness components say when they are experiencing pain and in that window of time between when they get the pain medication and when the pain medication actually kicks in. We’ve definitely had kids talk about ‘that’s when I’ll do my deep breathing.’” - Linda, 37, 200-500 hour CYT, Research/academia</i></p>

		<p><i>“A nurse would be like ‘where is [the yoga instructor], I have a patient that’s going to really react to my drawing of blood’ for example and I would go in and we would do our breathing ball together. One of my teens’ favorites, was using alternate nostrils breathing and if they had an IV or they were in treatment [...] one particular teen told me [...] she used alternate nostrils breathing during the PET scan. So that’s a big deal when somebody is [using these techniques] and you know that they feel anxious about having an enclosed MRI.”</i> - Elizabeth, 55, 200-500 hour CYT, meditation, mindfulness specialist</p>
<p>With training, I know what I know, and what I don’t know</p>	--	<p><i>“The yoga and cancer specific training I’ve done [...] is very comprehensive [...]. Learning that if somebody has a lumbar puncture and they can’t do the spinal flexion [...] Also I started facilitating first [...]. I feel prepared [to deliver to this population] [...] that shadowing piece [...] has been really really important.”</i> - Jane, 32, 200-500 hour CYT, Research/academia</p> <p><i>“The ability to manage the emotions that come up are really important [...] holding that emotional space, a safe space for the kids. [...] There should be some level of training for yoga instructors to be working with youth in that environment.”</i> - Mary, 40, 200-500 hour CYT, Director/owner of community yoga program</p> <p><i>“I don’t feel that our base level training are enough to work in special populations.”</i> - Jennifer, 51, 200-500 hour CYT, Director/owner of community yoga program</p>

		<p><i>“[basic things you need to know are] knowing the patient's medical and creating that therapeutic relationship with them.” - Julia, 60, certified yoga therapist, Research/academia</i></p>
<p>What I need to deliver a safe yoga program</p>	<p><i>In my class, it's safety first</i></p>	<p><i>“[safety considerations included] having really well-trained instructors.” - Jane, 32, 200-500 hour CYT, Research/academia</i></p> <p><i>“The intensity of the actual session wasn't super strenuous, so usually safety wasn't a concern but things such as watching making sure that their line is not going to get tangled when they put their arm up [...].” - John, 26, 200-500 hour CYT, Research/academia</i></p> <p><i>“Making sure like reviewing all of what their symptoms were and making sure we were not doing anything that was contraindicators.” - Mary, 40, 200-500 hour CYT, Director/owner of community yoga program</i></p> <p><i>“Yoga looks a lot different within oncology than some of the other parts of the hospital as well so we do a lot of breath work, a lot of meditation gentle seated and bed yoga [...] My organization is very policy focused so we have a lot of written procedures and guidelines in terms of contraindications as well as like watching lines, and tubes and drains and things.” - Amy, 34, 200-500 hour CYT, Integrative HCP or specialist</i></p>
	<p><i>Communicating with the healthcare team, parents, and students would (or will) help me continue to deliver safe classes</i></p>	<p><i>“If they've had a leg amputation and they have a prosthetic leg and they can't weight bear yet, I would</i></p>

		<p><i>need to know that.” - Jane, 32, 200-500 hour CYT, Research/academia</i></p> <p><i>“I was meeting with oncologists and nurses and sometimes physiologists, so it was like an integrated team and understanding each child’s cancer diagnosis and where they’re at and it’s really critical because you’re not just teaching to a general population or a general class where you’re saying the postures, you really need to understand contraindications and what’s safe.” - Susan, 32, 200-500 hour CYT, Director/owner of community yoga program</i></p> <p><i>“I have a really good relationship with our medical team and I have and I’m still learning about different types of treatment protocols and are able to kind of work yoga therapy in among them [...] our consult order has stipulations that can be no restrictions which can be weight bearing, head below heart type of asana with postures, we also have chair bed yoga only or breathwork meditation only [...] We also really pour through the charts and reach out to other members of the team we look at PT and OT notes as well as psychosocial notes, just to determine what other contraindications might be you know, might be there for a patient.” - Amy, 34, 200-500 hour CYT, Integrative HCP or specialist</i></p> <p><i>“Before we begin every session that is these few minutes of education to what pain is good pain, what pain is not good pain” - Jessica, 47, 200-500 hour CYT, Integrative HCP or specialist</i></p>
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<p>What I need to deliver an effective yoga program</p>	<p>--</p>	<p><i>“We can modify sessions to really adapt to the child’s condition on a day-to-day basis, understanding that their condition can change pretty rapidly from day to day and over the course of say one cycle of treatment.” - Linda, 37, 200-500 hour CYT, Research/academia</i></p> <p><i>“[Yoga is] all levels - you don’t have to be ambulatory. We can do the session in the bed with the patient, or on a chair, so we can modify the yoga poses to fit the physical need of a child. [...] we have to be adaptable to making the session fit in the space, which isn’t large in the hospital. [...] Obviously, there is quite a lot of different equipment in the hospital room, but we manage to have a couple of mats that can fit in there.” - Olivia, 36, 200-500 hour CYT, Research/academia</i></p> <p><i>“Yeah, I mean the challenges that they all face just getting there if they’re not feeling well, I think it’s the biggest [barrier], just the timing of where they’re are all at with their different treatments makes it hard, and how they’re feeling.” - Mary, 40, 200-500 hour CYT, Director/owner of community yoga programs</i></p> <p><i>“If the child is not feeling well that day and really does not want to move there’s other practices that we’re already doing anyway, you know awareness, breath awareness, breathing practices, relaxation so it’s very adaptable and basing it on where the person is you know in that moment. [...] [yoga is] very adaptable because you can just do gentle movements in the bed, in the chair [...]. I don’t think it’s cookie cutter, it’s not one way is the only way, we’re meeting people where they are [...] we</i></p>
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		<p><i>need a program that is open enough that you can make those adjustments so that everybody is served.” - Julia, 60, certified yoga therapist, Research/academia</i></p> <p><i>“I was just there to make sure the [yoga sessions] went smoothly, to get props and equipment and make sure all the children were engaged [...] [Getting to know student preferences was important to] weave in or integrate in the imagery or some of the cues their favorites characters to keep them involved.” - Jane, 32, 200-500 hour CYT, Research/academia</i></p> <p><i>“Using a lot of props, using different kinds of stress balls really engaged the kid a lot and it made it easier to facilitate [...] doing a session that the child is going to enjoy and knowing what their likes are after a couple days and after doing a couple sessions with them [...] Then the kids feel seen a bit, then they’d say ‘oh yeah I really liked that and you tailored this to my likes and needs’ so I think that’s what really important too.” - John, 26, 200-500 hour CYT, Research/academia</i></p>
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<p>What I need to ensure yoga is widely available</p>	<p><i>We need to offer yoga across settings to address the diverse needs of students</i></p>	<p><i>“Then access so if you are offering it in a community [...] offering it at a time and in a location that people can get to [...] [What would help facilitate the program is] if you could have community locations in different part of the city [...] I think that would be really really nice to actually see them offered across the board [hospital, community and online], just because it kind of makes it clear that yoga is an important part of care and recovery when it’s offered in the hospital and in the community and I think that way there would be different options for people. [...] it would be an ideal world if there would be offerings from each of those areas.” - Jane, 32, 200-500 hour CYT, Research/academia</i></p> <p><i>“Other barriers would include just where to hold it like, if we can’t get access to the hospital it becomes a barrier for parents to get children to a studio at a certain time, you know it would be great to transition to in-hospital program where there is just more accessibility to the children.” - Jennifer, 51, 200-500 hour CYT, Director/owner of community yoga program</i></p> <p><i>“But I think making yoga accessible is really important because don't forget even pre COVID you would have a child you know going through a bone marrow transplant in isolation I mean [online] is a great form of delivery for accessibility.” - Julia, 60, certified yoga therapist, Research/academia</i></p>
	<p><i>We need more support</i></p>	<p><i>“I think just education, getting healthcare providers on board we’d have much better luck recruiting. When healthcare providers said ‘you’re feeling nauseous, you</i></p>

		<p><i>aren't feeling well, and yoga is something that helps a lot of kids.' I think education about what yoga can and cannot do and that's probably it at this point, these are key points for facilitators."</i> - Jane, 32, 200-500 hour CYT, Research/academia</p> <p><i>"It took some trust from parents too, wanting to make sure that it wasn't going to make their kids too tired but that their kids enjoyed it. [...] So we did a few parent/child sessions as well and those were really fun, and I think a good way to get the parents like comfortable to what we were doing."</i> - Mary, 40, 200-500 hour CYT, Director/owner of community yoga program</p> <p><i>"More trained teachers [would help to deliver yoga for this population]. [...] Helping to educate [students] about what actually yoga is, is really important and educating in language that children can understand about the benefits and how it empowers them for healing and gives them tools."</i> - Julia, 60, certified yoga therapist, Research/academia</p> <p><i>"If funding would be more available to have maybe extra hands [that would help to deliver yoga for this population]. [...] I think sometimes parents would have personal preferences or the children not to do that [yoga] but I think that is a barrier only initially as we educate parents on the importance of physical activity and yoga and the benefits they can bring. They usually get on board but sometimes that can be a barrier."</i> -</p>
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		Jessica, 47, 200-500 hour CYT, Integrative HCP or specialist
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4.6.8 Supplemental File 8: Physical Activity Screening and Referral Form

Adapted from the international Pediatric Oncology Exercise Guidelines¹

<i>Affix Patient Label Here</i>	Tumor Information: Date of Diagnosis: Primary Tumor Type: Metastasis (Identify location, and organ): Stage: <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4
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Treatment: **see reverse side for more comment space if needed**

Chemotherapy Type: Dates: Comments:	Radiation Dates: Comments:	Surgery (include side of body if applicable) Type: Date:
Other:		

Current Side Effects: **see reverse side for more comment space if needed**

<input type="checkbox"/> Anemia <input type="checkbox"/> Ataxia <input type="checkbox"/> Bone or joint issues <input type="checkbox"/> Cardiotoxicity	<input type="checkbox"/> Decreased range of motion <input type="checkbox"/> Fatigue <input type="checkbox"/> Leukopenia <input type="checkbox"/> Nausea/vomiting	<input type="checkbox"/> Osteoporosis/Osteopenia <input type="checkbox"/> Osteonecrosis <input type="checkbox"/> Pulmonary toxicity <input type="checkbox"/> Thrombocytopenia
Other:		

Other Medical Issues that May Impact Exercise Participation

<input type="checkbox"/> Condition:	<input type="checkbox"/> Medications:
<input type="checkbox"/> Injury:	<input type="checkbox"/> Other:

Participants Preferences and Barriers to Yoga:

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Participants Yoga History:

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Movement and/or Yoga Clearance:

- ☐ No yoga at this time
- ☐ Modified movement with consideration of _____
- ☐ Yoga under supervision of QEP
- ☐ Unrestricted exercise

HCP Signature:	Stamp:	Date:
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Additional Comments:

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1. Wurz A, McLaughlin E, Lategan C, et al. The international Pediatric Oncology Exercise Guidelines (iPOEG). *Translational Behavioral Medicine*. 2021.