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Review article

Barriers, facilitators, perceptions and preferences influencing physical activity participation, and the similarities and differences between cancer types and treatment stages - A systematic rapid review

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ABSTRACT

The aim of this systematic rapid review was to explore barriers, facilitators, perceptions and preferences of physical activity for people diagnosed with cancer, by cancer type and treatment stage.

The search strategy, implemented through four databases, included terms relating to cancer, physical activity, barriers, facilitators, perceptions and preferences, and relevant study designs. Studies reporting the outcomes of interests for adults diagnosed with cancer and living in Western countries were included and grouped according to the Social-Ecological Model and the Health Belief Model, and pragmatically.

A total of 118 studies, involving 15 cancers were included. Outcomes were most commonly explored within samples involving mixed cancers (32 studies) and breast cancer (31 studies), and at the post-treatment phase (52 studies). Across all cancers and during- and post-treatment, treatment- and disease-related side-effects were the most commonly identified barrier, social support and guidance was the most commonly identified facilitator, and promoting health and recovery was the most commonly identified perception of benefit of physical activity. Notable differences were identified in barriers, facilitators and perceptions across cancer types and treatment stages, with specific examples including: comorbidities were inconsistently reported as a barrier across cancers; time pressure was more commonly reported as a barrier post-treatment; and women with breast cancer reported inaccessibility of appropriate services more commonly during-treatment than post-treatment. Preference findings varied widely across cancer types and treatment phases.

These findings can be used to aid efforts to improve physical activity levels post-cancer by providing healthcare professionals with information to facilitate individualised advice and services.

1. Introduction

Participating in regular physical activity is well recognised as an important component of cancer care (Patel et al., 2019), with functional and quality of life benefits having been quantified and summarised in multiple systematic reviews (Mishra et al., 2012; Singh et al., 2018; Eyl et al., 2018; Swartz et al., 2017). The benefits of physical activity may also extend beyond quality of life, as higher post-diagnosis physical activity levels have been associated with lower risks of all-cause and cancer-specific mortality for up to 11 cancer types (Patel et al., 2019; Friedenreich et al., 2019). As a consequence of this evidence base, the World Cancer Research Fund recommends that following a cancer diagnosis, individuals should aim to complete at least 150 min of moderate intensity physical activity or 75 min of vigorous intensity physical activity per week (World Cancer Research Fund, 2018).

Unfortunately, findings from observational studies across multiple

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cancer types demonstrate that the majority of people with breast (54%–78%) (Hair et al., 2014; Harrison et al., 2009; Irwin et al., 2004; LeMasters et al., 2014; Mason et al., 2013), colorectal (60–70%) (LeMasters et al., 2014), prostate (53%) (LeMasters et al., 2014), lung (88%) (Coups et al., 2009), and mixed cancer types (51%-55%) (Fassier et al., 2016; Gjerset et al., 2011) do not meet physical activity guidelines and are insufficiently active or sedentary. Additionally, results from a large prospective breast cancer cohort study (n = 812) showed that compared with physical activity levels at 1-month pre-diagnosis (6.6 ± 0.4 h/week), women on average experienced a 23% reduction in weekly moderate-intensity physical activity at 4–12 months post-diagnosis (5.1 ± 0.6 h/week) (Irwin et al., 2003). Extended follow-up of the same cohort (n = 631) showed that women experienced a further decrease in physical activity between five to 10-years post-diagnosis. Specifically, almost 20% of women categorised as sufficiently active at the five-year follow-up were insufficiently active at the 10-year follow-up (Mason et al., 2013).

Since low physical activity levels have been identified across multiple cancer types, understanding factors that influence physical activity participation has become an area of increasing interest. Findings from a systematic scoping review published in 2021 identified that cancer patients recognised benefits of exercise, but that physiological and psychosocial factors presented as barriers to participation (Elshahat et al., 2021). Further, inaccessible facilities or programs also hindered participation (Elshahat et al., 2021). The findings were drawn from 98 studies, covering a variety of cancer types and treatment stages (i.e., pre-, during- and post-treatment). As proposed by the Health Belief Model, the intention to engage in physical activity following a cancer diagnosis is a complex function of a person's perceived susceptibility and severity of their diagnosis, belief in the benefits outweighing perceived barriers, and confidence in their abilities to engage in physical activity (i.e., self-efficacy) (Rosenstock, 1974). It is therefore plausible that factors influencing participation in physical activity post-cancer may differ across cancer types, patient and treatment characteristics, prognoses, as well as those at different treatment stages (National Cancer Institute, 2022a; National Cancer Institute, 2022b). Therefore, the aim of this systematic rapid review was to extend and resynthesise the results of the 2021 Elshahat et al. review (Elshahat et al., 2021), in order to explore barriers, facilitators, perceptions and preferences of physical activity for people diagnosed with cancer, by cancer type and by treatment stage. Acknowledging that the majority of exercise oncology research exploring these factors involves women with breast cancer (Elshahat et al., 2021), we also aimed to explore how the outcomes of interest differed across treatment stage within women diagnosed with breast cancer.

2. Methods

This systematic rapid review included i) studies identified by the Elshahat et al., (Elshahat et al., 2021) systematic scoping review (search period up to August 2020), and ii) studies identified by replicating and expanding on Elshahat et al's systematic search strategy (as described below) for the period between August 1st 2020 and May 11th 2022. The extended search was conducted to ensure recently published literature relevant to the aims of this review were included. This review was conducted using the Cochrane Rapid Review Methods guidance to conducting rapid reviews (Garritty et al., 2021) and the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines (Page et al., 2021). This review was prospectively registered on PROSPERO (ID# CRD42022327515). Ethical approval and consent to participate were not required for this review.

2.1. Search strategy

Relevant studies were identified by searching Embase, MEDLINE, PubMed and PsychINFO. The updated search strategy (Supplementary Table 1) included terms used by Elshahat et al. (Elshahat et al., 2021), which were related to cancers, physical activity, outcomes of interest (barriers, facilitators, perceptions and preferences of physical activity), and study design, as well as additional terms and synonyms, MeSH terms, Emtree and explodes (in PubMed, Embase and PsychINFO, respectively). Filters were used to identify publications conducted in humans and English only. Additional articles were identified by searching reference lists of included articles.

2.2. Eligibility criteria

Articles identified via the search strategy, as well as those included in the Elshahat et al. (Elshahat et al., 2021) review, were eligible for inclusion if the following criteria were met:

1. Reporting one or more of the outcomes of interest: barriers, facilitators, perceptions and preferences of physical activity in people diagnosed with cancer. Physical activity was defined as "any bodily movement, including exercise which is defined as planned and structured for the purpose of improving physical and/or psychosocial outcomes" (Riebe et al., 2018). For the purpose of this review, physical activity did not include specific musculoskeletal rehabilitation (e.g., pelvic floor, breathing, eye and swallowing exercises) (Luo et al., 2022) or activities of daily living.
2. Interventional studies involving physical activity, with either qualitative studies intentionally exploring physical activity, or quantitative studies that specified how outcomes were assessed. Non-interventional qualitative studies that intentionally explored physical activity were also eligible.
3. Participants were ≥ 18 years at the time of the study. Studies involving adults and children were included when the outcomes of interest pertaining to those ≥ 18 years could be separated from those less than 18 years.
4. The outcomes of interest were reported by the target sample (i.e., people diagnosed with cancer and ≥ 18 years at the time of the study).
5. Studies that involve physical activity in conjunction with other lifestyle behaviours or interventions (e.g., dietary, or psychosocial interventions) were included when the outcomes of interest pertaining to physical activity could be separated.
6. In English and studies conducted in the Western world (that is, Europe, North America, Australia and New Zealand).
7. Full-text, original article published in peer-review journal.

2.3. Screening process

Results from the database searches were imported to EndNote (X9) (The EndNote Team, 2013) and duplicates were removed. The remaining articles were imported into Covidence, an online screening platform (Covidence systematic review software, 2022), and two independent reviewers (GCG and JCT or ERM) screened articles according to title and abstract, followed by full-text. Papers included in the Elshahat et al. review (Elshahat et al., 2021) also underwent full-text screening. Discrepancies were resolved by the wider authorship team.

2.4. Data extraction

Data from included articles were extracted and entered into an original Microsoft excel (Microsoft Corporation, 2018) data form by two independent authors (GCG and JCT or ERM). These data related to study characteristics including country of origin, sample size, and methods used to collect outcomes of interest, and cancer type and treatment stage of the sample. These data were also extracted from studies included in the Elshahat et al. (Elshahat et al., 2021) review. It is at this stage, that data from studies that involved a sample with mixed cancer types *and* mixed or unclear treatment stage (that is, both during- and post-

treatment) were excluded. Studies involving mixed cancer types *or* mixed or unclear treatment stages remained, as their findings were able to inform research question 2 and 1, respectively.

Data pertaining to outcomes of interest (barriers, facilitators, perceptions and preferences) were extracted and organised into subgroups consistent, when possible, with the subgroups identified and used by Elshahat et al. (Elshahat et al., 2021) to organise their results. The subgroupings of barriers and facilitators was informed by the Social-Ecological Model (physiological, psychosocial and cultural, and economic and environmental) (Bronfenbrenner, 1994; Lee and Park, 2021), the subgrouping of perceptions was guided by the Health Belief Model (perceived benefits and perceived risks) (Rosenstock, 1974), and a pragmatic approach was used to identify subgroups within preferences (mode, place to practice, person to provide information, time to commence program, company and time of day). Within the subgroups, data were further broken down into categories. When data did not fit in categories pre-defined by Elshahat et al. (Elshahat et al., 2021), new categories were created. Discrepancies in the chosen category for any given data were discussed between the authorship team.

2.5. Statistical analysis

To explore research question one, data derived from studies investigating mixed cancer types were removed from analysis, and outcomes of interest (barriers, facilitators, perceptions and preferences) were described by cancer type. To explore research question two, data from studies exploring mixed or unclear treatment stages were removed from analysis, and outcomes of interest were described by treatment stage (pre-, during- and post-treatment). To explore research question three, only data collected from studies exploring women with breast cancer were analysed, with studies including mixed or unclear treatment stages being removed from analysis and each outcome of interest described by treatment stage. When reporting results, percentages were calculated as the number of studies under any given outcome, divided by the total number of studies for that cancer type and/or treatment stage.

3. Results

The updated search strategy identified 8452 studies. Following removal of duplicates, 7701 studies underwent title and abstract screening, and 1060 papers (including Elshahat et al. (Elshahat et al., 2021) papers) were eligible for full-text screening. One-hundred and eighteen manuscripts were deemed eligible for analysis (Fig. 1).

From the included studies (n = 118), the mean sample size was 80 (range: 4–788), with just under one-quarter of studies conducted in the United States of America (23%), followed by Canada (20%) and the United Kingdom (14%). Over half of the included studies collected outcomes of interests through qualitative methods (64%) (e.g., focus groups and interviews), 30% via surveys or questionnaires, and 4% used mixed-methods. The outcomes of interest were explored mostly within

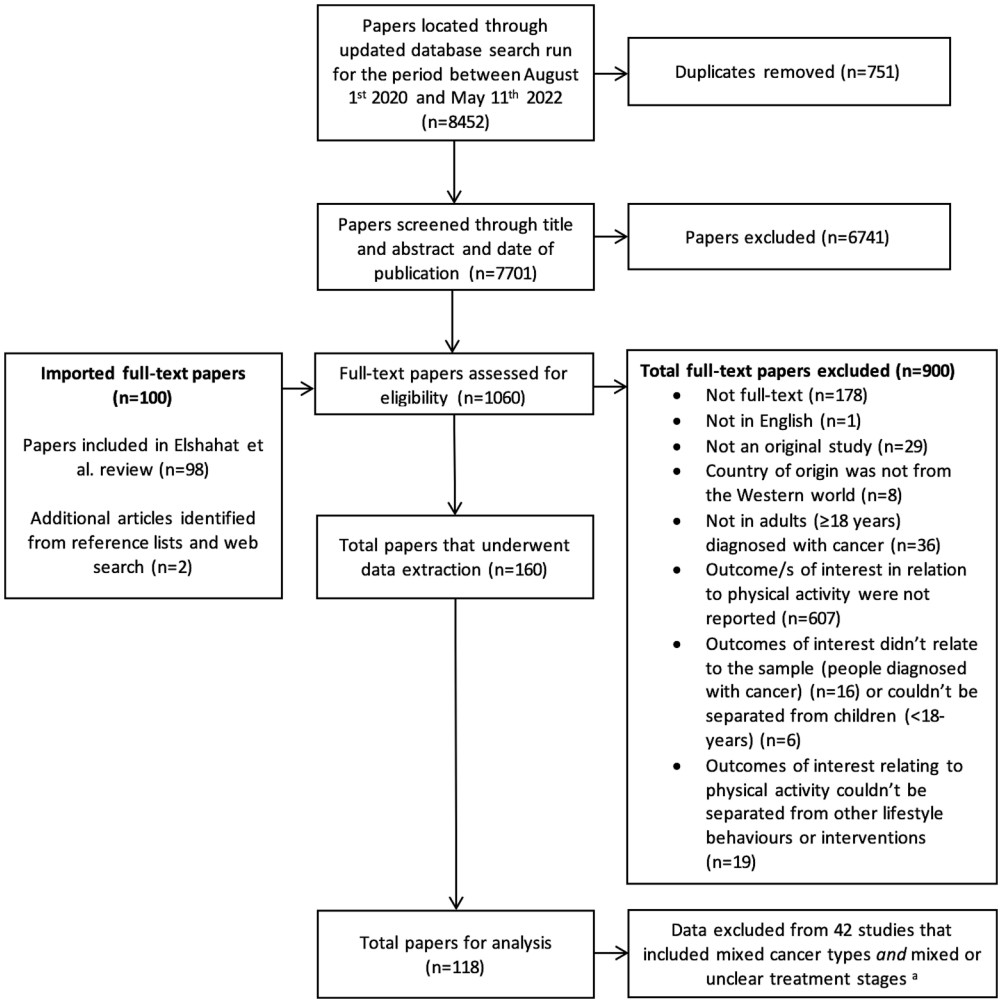

Fig. 1. PRISMA flowchart diagram.
[a] Studies conducted in samples with either mixed cancer types *or* with mixed or unclear treatment stages remained, as their findings were able to inform research question 2 and 1, respectively.

mixed cancer types (27%), followed by breast (26%), prostate (10%), and colorectal cancers (9%). Studies most frequently explored the outcomes of interest post-treatment (44%) and during-treatment (30%). Barriers were the most frequently reported outcome of interest (74%), followed by perceptions (55%), facilitators (52%), and preferences (32%) (Table 1). The proportion of papers reporting each outcome by cancer type and treatment stage are reported in Supplementary Table 2, with individual study characteristics (i.e., country, sample size, cancer type, treatment stage and outcomes of interest) reported in Supplementary Table 3.

Table 1
Study characteristics of the papers included in the review (n = 118).

	Included papers (n = 118)
Sample size	
Total, n	9,331
Mean (SD)	80 (144)
Range: Min-Max	4–788
Country of study, n (%)	
United States of America	27 (22.9)
Canada	24 (20.3)
United Kingdom	17 (14.4)
Australia	15 (12.7)
Norway	5 (4.2)
Sweden	5 (4.2)
Italy	4 (3.4)
Netherlands	4 (3.4)
Germany	3 (2.5)
New Zealand	3 (2.5)
Denmark	3 (2.5)
Spain	3 (2.5)
France	3 (2.5)
Ireland	1 (0.8)
Turkey	1 (0.8)
Method of assessment of outcomes of interest	
Qualitative interview	57 (48.3)
Survey/questionnaire	35 (29.7)
Focus group	12 (10.2)
Combined qualitative methods [a]	6 (5.1)
Mixed methods [b]	5 (4.2)
Other [c]	3 (2.5)
Cancer type investigated	
Mixed	32 (27.1)
Breast	31 (26.3)
Prostate	12 (10.2)
Colorectal	11 (9.3)
Lung	7 (5.9)
Ovarian	5 (4.2)
Multiple myeloma	4 (3.3)
Brain	3 (2.5)
Gynaecological	3 (2.5)
Head/neck	3 (2.5)
Testicular	2 (1.7)
Endometrial	1 (0.8)
Kidney	1 (0.8)
Leukemia	1 (0.8)
Lymphoma	1 (0.8)
Sarcoma	1 (0.8)
Treatment stage	
Post	52 (44.1)
During	36 (30.5)
Mixed	20 (16.9)
Unclear	8 (6.8)
Pre	2 (1.7)
Outcomes of interest reported [d]	
Barriers	87 (73.7)
Perceptions	65 (55.1)
Facilitators	61 (51.7)
Preferences	38 (32.2)

[a] Includes a combination of the following methods: individual qualitative interviews, focus groups, participant diaries, and open-ended questionnaires.
[b] Qualitative and quantitative design.
[c] Other methods include: barriers collected via reason for non-attendance to exercise sessions or reason for not completing exercise target, and barriers and facilitators were collected via telehealth appointment notes.
[d] Not equal to 100% as more than one outcome of interest may have been reported per paper.

3.1. Barriers, facilitators, perceptions and preferences

Fig. 2 shows the four outcomes of interest pertaining to this review, organised into subgroups and categories.

3.1.1. Barriers

The barriers to physical activity identified across 15 cancer types were extensive (Table 2). The most commonly identified barriers, irrespective of cancer type, were treatment- and disease-related side-effects (physiological; identified in 84% of studies), time pressures (psychosocial and cultural; identified in 62% of studies), and low mood, self-efficacy and motivation (psychosocial and cultural; identified in 59% of studies). Notable differences between cancer types included the presence of comorbidities as a barrier more commonly identified in studies involving multiple myeloma (50%), and head and neck (67%) cancers, compared with breast (4%), colorectal (12%), and prostate (25%) cancers. Low physical capacity was more commonly reported as a barrier in colorectal (62%), head and neck (67%), lung (80%), prostate (87%), and kidney (100%) cancers, compared with breast (22%) and ovarian cancer (25%); and time pressures was less commonly reported in studies involving lung cancer (20%) compared with all other cancers (>50% of studies) (Table 2). With respect to differences by treatment stage, treatment- and disease-related side-effects, time pressures and low mood, self-efficacy and motivation were also commonly identified barriers (consistent with the barriers identified across cancer types). Differences emerged between treatment stages with low physical capacity and time pressures more commonly identified as a barrier in studies assessing the post-treatment phase (49% and 76% of studies, respectively) compared with the during-treatment phase (23% and 52% of studies, respectively) (Table 2). Fig. 3 shows reported barriers and facilitators to physical activity during- and post-treatment for breast cancer (19 studies contributed to these results; Supplementary Table 4). Access to appropriate physical activity services were identified more commonly as a barrier during-treatment (50% of studies) compared with post-treatment (22% of studies) in women with breast cancer. The proportion of studies that identified all other reported barriers were similar across studies evaluating during- and post-treatment phases.

3.1.2. Facilitators

The most commonly identified facilitator was social support and guidance, which included receiving support from family, friends, and healthcare professionals, either in the form of company during physical activity or advice given about physical activity. This psychosocial and cultural facilitator was identified in 93% of studies when studies across all cancer types were included. Other commonly identified facilitators across 12 cancer types included perceived benefits associated with participating in physical activity (identified in 50% of studies) and having access to tailored services (identified in 64% of studies) (Table 3). Differences in facilitators between cancer types included: feeling well – identified as a facilitator in 60% of studies involving colorectal cancer but not identified in 36 studies across 10 other cancer types; symptom management – identified as a facilitator in 80% of studies involving people with colorectal cancer, two studies (25%) involving men with prostate cancer, and one study involving women with ovarian cancer (50%) but was not identified in studies involving other cancer types. There were no notable differences in facilitators between studies that explored during-treatment versus post-treatment (Table 3). Within studies involving women with breast cancer, only one study was conducted pre-treatment and highlighted social support and guidance, and accessible, tailored, and appropriate services to be facilitators of physical activity. Fig. 3 shows proportions of studies that identified specific facilitators to physical activity during- and post-treatment (n = 13). Previous positive physical activity experiences

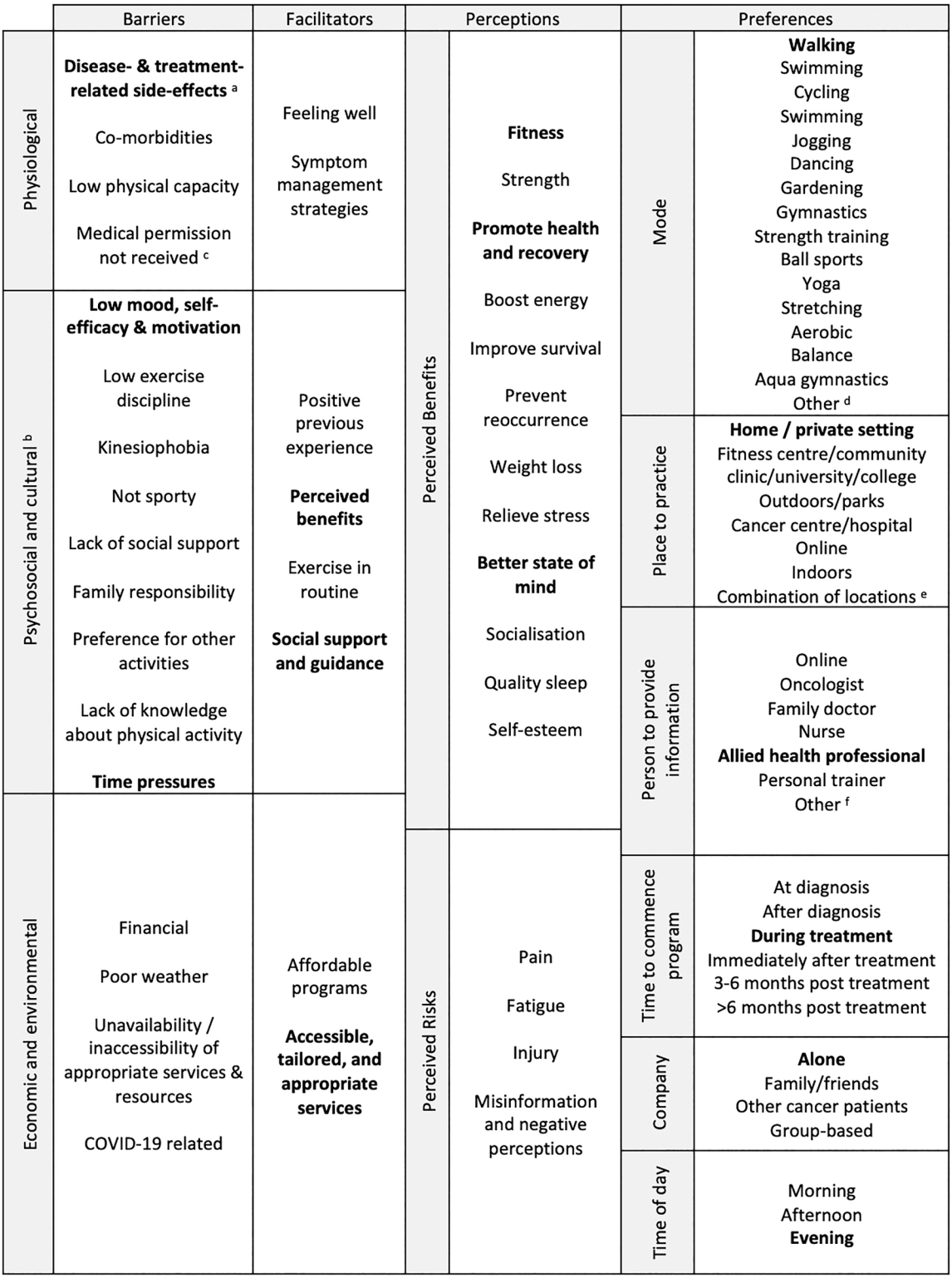

Fig. 2. Outcomes of interest organised into subgroups and categories underpinned by the Social-Ecological Model (barriers and facilitators), Health Belief Model (perceptions), and a pragmatic approach (preferences).

[a] Bolding of barriers, facilitators, and perceptions denotes the three most frequently reported categories (across the 118 included studies) per outcome. Bolding of preferences denotes the most frequently reported category per subgroup (e.g., mode, place to practice, person to provide information etc.).[b] The theme 'psychosocial and cultural' recognises the interrelationship between psychosocial (social factors and individual thought and behaviour) and cultural factors (set of values and ideologies of a particular community or group of individuals).[c] Refers to lack of medical permission to engage in physical activity or medical professional formally advised that physical activity was contraindicated.[d] Circuit training, boot camp, and modes as advised by a professional.[e] Combined indoor/outdoor; Combined home and cancer centre; Combined home and community centre; Combined cancer and community centers.[f] Mentored by a varsity university/college athlete or led by multiple myeloma patient.

Table 2
Number and proportions of papers reporting barriers by cancer type (n = 63) and treatment stage (n = 70).

			Psychosocial and cultural, n (%)																	
			Time pressures		Low mood, self-efficacy & motivation		Lack of social support		Family responsibility		Preference for other activities		Kinesiophobia		Low exercise discipline		Not sporty		Lack of knowledge	
Cancer type, n (%)[a]																				
Breast	23	(36.5)	14	(60.9)	14	(60.9)	10	(43.5)	10	(43.5)	7	(30.4)	6	(26.1)	2	(8.7)	4	(17.4)		
Colorectal	8	(12.7)	6	(75.0)	4	(50.0)	3	(37.5)	4	(50.0)	2	(25.0)			1	(12.5)				
Prostate	8	(12.7)	7	(87.5)	6	(75.0)	5	(62.5)	3	(37.5)	1	(12.5)	2	(25.0)	2	(25.0)				
Lung	5	(7.9)	1	(20.0)	3	(60.0)	2	(40.0)					2	(40.0)	2	(40.0)	1	(20.0)	1	(20.0)
Ovarian	4	(6.3)	3	(75.0)	2	(50.0)			2	(50.0)	1	(25.0)	1	(25.0)	1	(25.0)	1	(25.0)		
Head/neck	3	(4.8)	3	(100.0)	3	(100.0)	2	(66.7)	1	(33.3)	1	(33.3)	1	(33.3)	1	(33.3)	1	(33.3)		
Testicular	2	(3.2)	1	(50.0)																
Gynaecological	2	(3.2)	1	(50.0)			1	(50.0)												
Multiple myeloma	2	(3.2)			1	(50.0)							1	(50.0)						
Brain	1	(1.6)																		
Sarcoma	1	(1.6)			1	(100.0)	1	(100.0)												
Lymphoma	1	(1.6)			1	(100.0)														
Endometrial	1	(1.6)	1	(100.0)	1	(100.0)	1	(100.0)												
Kidney	1	(1.6)	1	(100.0)	1	(100.0)					1	(100.0)								
Leukemia	1	(1.6)	1	(100.0)																
Total	***63***	***(100.0)***	***39***	***(61.9)***	***37***	***(58.7)***	***25***	***(39.7)***	***20***	***(31.7)***	***13***	***(20.6)***	***13***	***(20.6)***	***9***	***(14.3)***	***7***	***(11.1)***	***1***	***(1.6)***
Treatment stage, n (%)																				
Pre	2	(2.9)	1	(50.0)	1	(50.0)														
During	31	(44.3)	16	(51.6)	21	(67.7)	13	(41.9)	9	(29.0)	4	(12.9)	7	(22.6)	2	(6.5)	4	(12.9)		
Post	37	(52.9)	28	(75.7)	24	(64.9)	16	(43.2)	13	(35.1)	9	(24.3)	10	(27.0)	6	(16.2)	3	(8.1)	1	(2.7)
Total	***70***	***(100.0)***	***45***	***(64.3)***	***46***	***(65.7)***	***29***	***(41.4)***	***22***	***(31.4)***	***13***	***(18.6)***	***17***	***(24.3)***	***8***	***(11.4)***	***7***	***(10.0)***	***1***	***(1.4)***

			Physiological, n (%)								Economic and environmental, n (%)							
			Treatment & disease related side-effects		Low physical capacity		Co-morbidities		Medical permission not received[b]		Unavailability/inaccessibility of appropriate services and resources		Poor weather		Financial issues		COVID-19 related	
Cancer type, n (%)[a]																		
Breast	23	(36.5)	19	(82.6)	5	(21.7)	1	(4.3)			10	(43.5)	11	(47.8)	4	(17.4)	4	(17.4)
Colorectal	8	(12.7)	7	(87.5)	5	(62.5)	1	(12.5)			3	(37.5)	2	(25.0)	1	(12.5)		
Prostate	8	(12.7)	7	(87.5)	7	(87.5)	2	(25.0)	1	(12.5)	4	(50.0)	2	(25.0)	4	(50.0)	1	(12.5)
Lung	5	(7.9)	4	(80.0)	4	(80.0)					3	(60.0)	2	(40.0)	1	(20.0)	1	(20.0)
Ovarian	4	(6.3)	4	(100.0)	1	(25.0)					3	(75.0)	2	(50.0)	2	(50.0)		
Head/neck	3	(4.8)	3	(100.0)	2	(66.7)	2	(66.7)			2	(66.7)	3	(100.0)	2	(66.7)		
Testicular	2	(3.2)	1	(50.0)							1	(50.0)			1	(50.0)		
Gynaecological	2	(3.2)	1	(50.0)							1	(50.0)			1	(50.0)		
Multiple myeloma	2	(3.2)	1	(50.0)			1	(50.0)										
Brain	1	(1.6)	1	(100.0)														
Sarcoma	1	(1.6)	1	(100.0)														
Lymphoma	1	(1.6)	1	(100.0)														
Endometrial	1	(1.6)	1	(100.0)							1	(100.0)	1	(100.0)				
Kidney	1	(1.6)	1	(100.0)	1	(100.0)					1	(100.0)	1	(100.0)				
Leukemia	1	(1.6)	1	(100.0)														
Total	***63***	***(100.0)***	***53***	***(84.1)***	***25***	***(39.7)***	***7***	***(11.1)***	***1***	***(1.6)***	***29***	***(46.0)***	***24***	***(38.1)***	***16***	***(25.4)***	***6***	***(9.5)***
Treatment stage, n (%)																		
Pre	2	(2.9)	1	(50.0)							1	(50.0)	1	(50.0)				
During	31	(44.3)	28	(90.3)	7	(22.6)	2	(6.5)	1	(3.2)	14	(45.2)	10	(32.3)	5	(16.1)	2	(6.5)
Post	37	(52.9)	32	(86.5)	18	(48.6)	3	(8.1)			19	(51.4)	17	(45.9)	10	(27.0)	4	(10.8)
Total	***70***	***(100.0)***	***61***	***(87.1)***	***25***	***(35.7)***	***5***	***(7.1)***	***1***	***(1.4)***	***34***	***(48.6)***	***28***	***(40.0)***	***15***	***(21.4)***	***6***	***(8.6)***

[a] Each row's denominator corresponds with the number of papers for the respective cancer type or treatment stage (e.g., the first column).
[b] Refers to lack of medical permission to engage in physical activity or medical professional formally advised that physical activity was contraindicated.

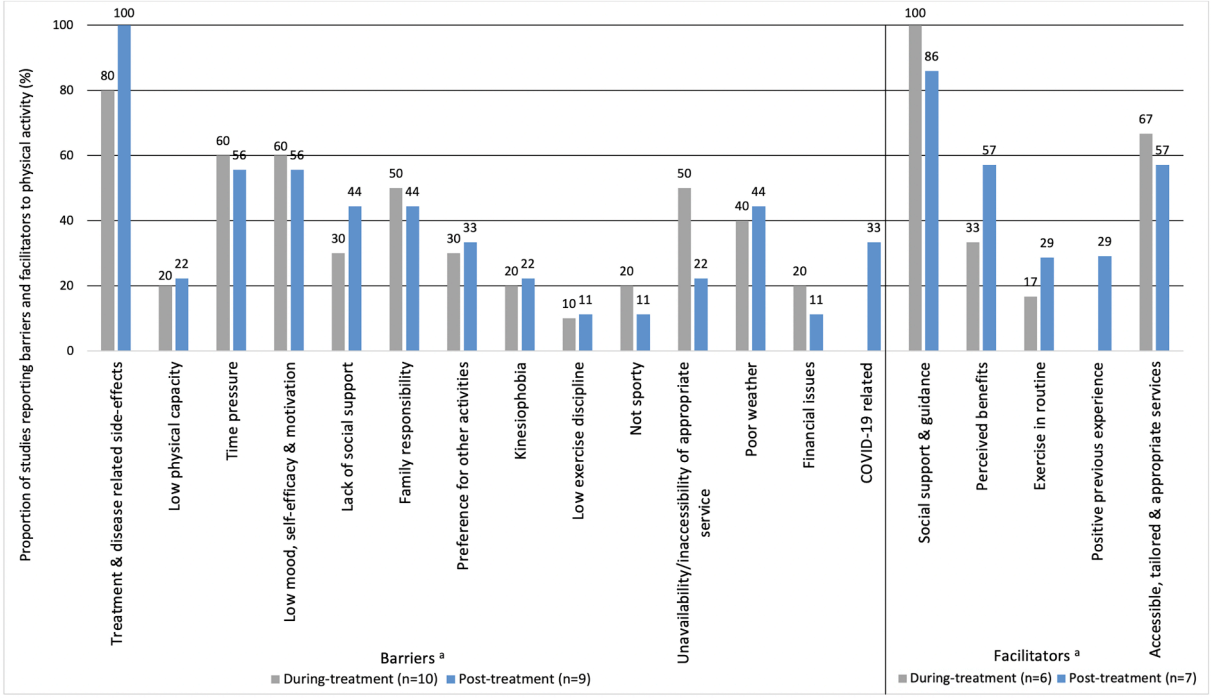

Fig. 3. Barriers and facilitators of physical activity during- and post-treatment for people diagnosed with breast cancer.
[a]One study that reported barriers and facilitators was conducted pre-treatment therefore was not included in Fig. 3.

Table 3
Number and proportions of papers reporting facilitators by cancer type (n = 42) and treatment stage (n = 51).

	Physiological, n (%)						Psychosocial and cultural, n (%)								Economic and environmental, n (%)			
	Symptom management strategies				Feeling well		Social support & guidance		Perceived benefits		Exercise in routine		Positive previous experience		Accessible, tailored & appropriate services		Affordable programs	
Cancer type, n (%)[a]																		
Breast	15	(35.7)					14	(93.3)	6	(40.0)	4	(26.7)	2	(13.3)	9	(60.0)		
Prostate	8	(19.0)	2	(25.0)			8	(100.0)	4	(50.0)					5	(62.5)		
Colorectal	5	(11.9)	4	(80.0)	3	(60.0)	5	(100.0)	3	(60.0)	1	(20.0)	1	(20.0)	5	(100.0)	1	(20.0)
Lung	5	(11.9)			1	(20.0)	5	(100.0)	3	(60.0)	2	(40.0)	1	(20.0)	3	(60.0)		
Ovarian	2	(4.8)	1	(50.0)			1	(50.0)	2	(100.0)								
Head/neck	1	(2.4)					1	(100.0)										
Brain	1	(2.4)							1	(100.0)			1	(100.0)	1	(100.0)		
Lymphoma	1	(2.4)					1	(100.0)							1	(100.0)		
Endometrial	1	(2.4)					1	(100.0)	1	(100.0)								
Gynaecological	1	(2.4)					1	(100.0)	1	(100.0)					1	(100.0)	1	(100.0)
Multiple myeloma	1	(2.4)					1	(100.0)							1	(100.0)		
Kidney	1	(2.4)					1	(100.0)							1	(100.0)		
Sarcoma																		
Testicular																		
Leukemia																		
Total	***42***	***(100.0)***	***7***	***(16.7)***	***4***	***(9.5)***	***39***	***(92.9)***	***21***	***(50.0)***	***7***	***(16.7)***	***5***	***(11.9)***	***27***	***(64.3)***	***2***	***(4.8)***
Treatment stage, n (%)																		
Pre	2	(3.9)			1	(50.0)	2	(100.0)			1	(50.0)			2	(100.0)		
During	20	(39.2)	2	(10.0)			16	(80.0)	10	(50.0)	4	(20.0)	5	(25.0)	14	(70.0)	1	(5.0)
Post	29	(56.9)	5	(17.2)	1	(3.4)	26	(89.7)	14	(48.3)	8	(27.6)	6	(20.7)	17	(58.6)	1	(3.4)
Total	***51***	***(100.0)***	***7***	***(13.7)***	***2***	***(3.9)***	***44***	***(86.3)***	***24***	***(47.1)***	***13***	***(25.5)***	***11***	***(21.6)***	***33***	***(64.7)***	***2***	***(3.9)***

[a] Each row's denominator corresponds with the number of papers for the respective cancer type or treatment stage (e.g., the first column).

and perceived benefits associated with participating in physical activity were more commonly identified as a facilitator for women with breast cancer post-treatment (29% and 57% of studies, respectively) versus during-treatment (0% and 33% of studies, respectively) (Fig. 3 and Supplementary Table 5).

3.1.3. *Perceptions*

The most commonly identified perceived benefits were that physical activity promotes health and recovery (identified as a perception in 83% of studies across all cancer types), and a better state of mind (identified in 70% of studies across all cancer types) (Table 4). All other perceived benefits across cancer types were identified in 8–51% of studies exploring perceptions. Potential for survival benefits was identified as a

Table 4
Number and proportions of papers reporting perceptions by cancer type (n = 47) and treatment stage (n = 50).

			Perceived benefits, n (%)															
			Promote health & recovery		Better state of mind		Fitness		Boost energy		Self-esteem		Socialisation		Weight loss		Relieve stress	
Cancer type, n (%)[a]																		
Breast	18	(38.3)	12	(66.7)	13	(72.2)	8	(44.4)	7	(38.9)	7	(38.9)	6	(33.3)	3	(16.7)	7	(38.9)
Prostate	8	(17.0)	7	(87.5)	6	(75.0)	3	(37.5)	4	(50.0)	1	(12.5)	3	(37.5)	3	(37.5)	2	(25.0)
Colorectal	6	(12.8)	6	(100.0)	4	(66.7)	4	(66.7)	4	(66.7)	3	(50.0)			4	(66.7)	3	(50.0)
Lung	4	(8.5)	4	(100.0)	3	(75.0)	4	(100.0)	2	(50.0)	2	(50.0)	1	(25.0)			1	(25.0)
Ovarian	2	(4.3)	2	(100.0)					1	(50.0)			1	(50.0)	2	(100.0)		
Sarcoma	1	(2.1)	1	(100.0)	1	(100.0)			1	(100.0)			1	(100.0)				
Gynaecological	1	(2.1)			1	(100.0)							1	(100.0)				
Kidney	1	(2.1)	1	(100.0)			1	(100.0)	1	(100.0)	1	(100.0)			1	(100.0)		
Endometrial	1	(2.1)	1	(100.0)	1	(100.0)	1	(100.0)	1	(100.0)								
Leukemia	1	(2.1)	1	(100.0)					1	(100.0)	1	(100.0)	1	(100.0)			1	(100.0)
Testicular	1	(2.1)	1	(100.0)	1	(100.0)												
Brain	1	(2.1)	1	(100.0)	1	(100.0)	1	(100.0)			1	(100.0)	1	(100.0)	1	(100.0)	1	(100.0)
Head/neck	1	(2.1)	1	(100.0)	1	(100.0)	1	(100.0)					1	(100.0)	1	(100.0)		
Multiple myeloma	1	(2.1)	1	(100.0)	1	(100.0)	1	(100.0)			1	(100.0)						
Lymphoma																		
Total	***47***	***(100.0)***	***39***	***(83.0)***	***33***	***(70.2)***	***24***	***(51.1)***	***22***	***(46.8)***	***17***	***(36.2)***	***16***	***(34.0)***	***15***	***(31.9)***	***15***	***(31.9)***
Treatment stage, n (%)																		
Pre	2	(4.0)	2	(100.0)	1	(50.0)	1	(50.0)	1	(50.0)								
During	19	(38.0)	16	(84.2)	16	(84.2)	8	(42.1)	9	(47.4)	8	(42.1)	12	(63.2)	6	(31.6)	6	(31.6)
Post	29	(58.0)	22	(75.9)	23	(79.3)	13	(44.8)	15	(51.7)	15	(51.7)	10	(34.5)	9	(31.0)	15	(51.7)
Total	***50***	***(100.0)***	***40***	***(80.0)***	***40***	***(80.0)***	***22***	***(44.0)***	***25***	***(50.0)***	***23***	***(46.0)***	***22***	***(44.0)***	***15***	***(30.0)***	***21***	***(42.0)***

			Perceived benefits, n (%) (continued)								Perceived risks, n (%)							
			Strength		Quality sleep		Improve survival		Prevent reoccurrence		Fatigue		Risk of injury		Pain		Other negative perceptions & misinformation	
Cancer type, n (%)[a]																		
Breast	18	(38.3)	2	(11.1)	2	(11.1)	2	(11.1)	2	(11.1)	3	(16.7)	4	(22.2)	4	(22.2)	3	(16.7)
Prostate	8	(17.0)	3	(37.5)	1	(12.5)	1	(12.5)			1	(12.5)	1	(12.5)			2	(25.0)
Colorectal	6	(12.8)	3	(50.0)	1	(16.7)	1	(16.7)	1	(16.7)	2	(33.3)						
Lung	4	(8.5)	3	(75.0)							1	(25.0)	1	(25.0)	1	(25.0)	2	(50.0)
Ovarian	2	(4.3)	1	(50.0)														
Sarcoma	1	(2.1)																
Gynaecological	1	(2.1)																
Kidney	1	(2.1)	1	(100.0)	1	(100.0)												
Endometrial	1	(2.1)																
Leukemia	1	(2.1)			1	(100.0)												
Testicular	1	(2.1)																
Brain	1	(2.1)	1	(100.0)														
Head/neck	1	(2.1)							1	(100.0)								
Multiple myeloma	1	(2.1)																
Lymphoma																		
Total	***47***	***(100.0)***	***14***	***(29.8)***	***6***	***(12.8)***	***4***	***(8.5)***	***4***	***(8.5)***	***7***	***(14.9)***	***6***	***(12.8)***	***5***	***(10.6)***	***7***	***(14.9)***
Treatment stage, n (%)																		
Pre	2	(4.0)	1	(50.0)							1	(50.0)	1	(50.0)	1	(50.0)	1	(50.0)
During	19	(38.0)	11	(57.9)	1	(5.3)	1	(5.3)	1	(5.3)	2	(10.5)	2	(10.5)	3	(15.8)	2	(10.5)
Post	29	(58.0)	7	(24.1)	3	(10.3)	5	(17.2)	6	(20.7)	2	(6.9)					1	(3.4)
Total	***50***	***(100.0)***	***19***	***(38.0)***	***4***	***(8.0)***	***6***	***(12.0)***	***7***	***(14.0)***	***5***	***(10.0)***	***3***	***(6.0)***	***4***	***(8.0)***	***4***	***(8.0)***

[a] Each row's denominator corresponds with the number of papers for the respective cancer type or treatment stage (e.g., the first column).

perceived benefit in less than 20% of breast, prostate and colorectal cancer studies and not identified in studies involving other cancer types. Weight loss was a perceived benefit identified in studies involving people with ovarian, colorectal, kidney, brain and head and neck cancer (identified in > 66% of studies for these cancer types), and less so for studies in breast and prostate cancer (identified as a perceived benefit in 17% and 37% of studies, respectively). Regarding treatment stage, the belief that physical activity promotes health and recovery was also a commonly identified perception (consistent with perceptions identified across cancer types). However, differences emerged between studies exploring during- versus the post-treatment phase, whereby physical strength and socialisation were more commonly identified as perceived benefits during-treatment (58% and 63%, respectively), compared to post-treatment (24% and 34%, respectively) (Table 4). Similar to other cancer types, the one study which involved women with breast cancer and evaluated perceptions during the pre-treatment period found that perceived benefits of physical activity included promoting health and recovery, and better state of mind (Brahmbhatt et al., 2020). Improved fitness, strength, self-esteem and socialisation were more commonly identified as perceived benefits associated with physical activity during-treatment (as identified in 57%, 29%, 57% and 57% of studies, respectively), compared with post-treatment (33%, 0%, 33% and 17%, respectively) (Fig. 4). When assessing perceptions of risks associated with physical activity, less than 15% of studies across all cancer types and stages of treatment identified perceived risks, with identified risks including fatigue, pain, risk of injury or other (labeled as 'negative perceptions and misinformation') (Fig. 4 and Supplementary Table 6).

3.1.4. Preferences

Preferred modes of physical activity were explored among nine cancer types, from which 15 different modes of physical activity were identified. Walking was identified as a preferred mode in 100% of studies across all cancer types and treatment stages (Fig. 5). Undertaking physical activity within a home/private setting (identified in 88% of studies) and within clinics (e.g., fitness centres, community clinics, university clinics; identified in 65%) were most commonly identified as preferred settings for physical activity across cancer types. Receiving physical activity advice from allied health professionals or oncologists was identified as the preferred source of information in 70% and 60% of studies (across all cancer types), respectively. However, receiving advice from an oncologist was commonly identified as the preferred source of information during-treatment (100% of studies) versus post-treatment (60% of studies) (Supplementary Table 7a). Participating in physical activity in group-based settings was less commonly identified as a preference (identified in 22% of studies assessing the outcome according to cancer type) compared to participating in physical activity alone, with family members, or other people with cancer (identified as preferences in > 65% of studies). There was no evidence highlighting clear preferences related to timing of physical activity (e.g., morning, afternoon, evening) across cancer types or treatment stage, or within women with breast cancer (Supplementary Table 7b).

Qualitative comments from women diagnosed with breast cancer throughout treatment phases provide further context to the results reported above and are presented in Supplementary Table 8.

4. Discussion

Findings from the 118 studies included within this systematic rapid review provide clear insight into the barriers of participating in physical activity for people with cancer, as well as factors that may facilitate physical activity participation and promotion post-cancer diagnosis. Findings also provide insight into how people with cancer perceive physical activity, particularly the potential benefits and risks, as well as their preferences for how, where, and when they participate in physical activity and with whom. Barriers, facilitators, perceptions and preferences were typically similar across cancer types and treatment stages. However, some notable differences were also identified specific to cancer types and treatment stages. Understanding similarities and differences can aid efforts to improve physical activity levels post-cancer by providing healthcare professionals with information to facilitate individualised advice and services.

As identified by previous systematic reviews (Elshahat et al., 2021;

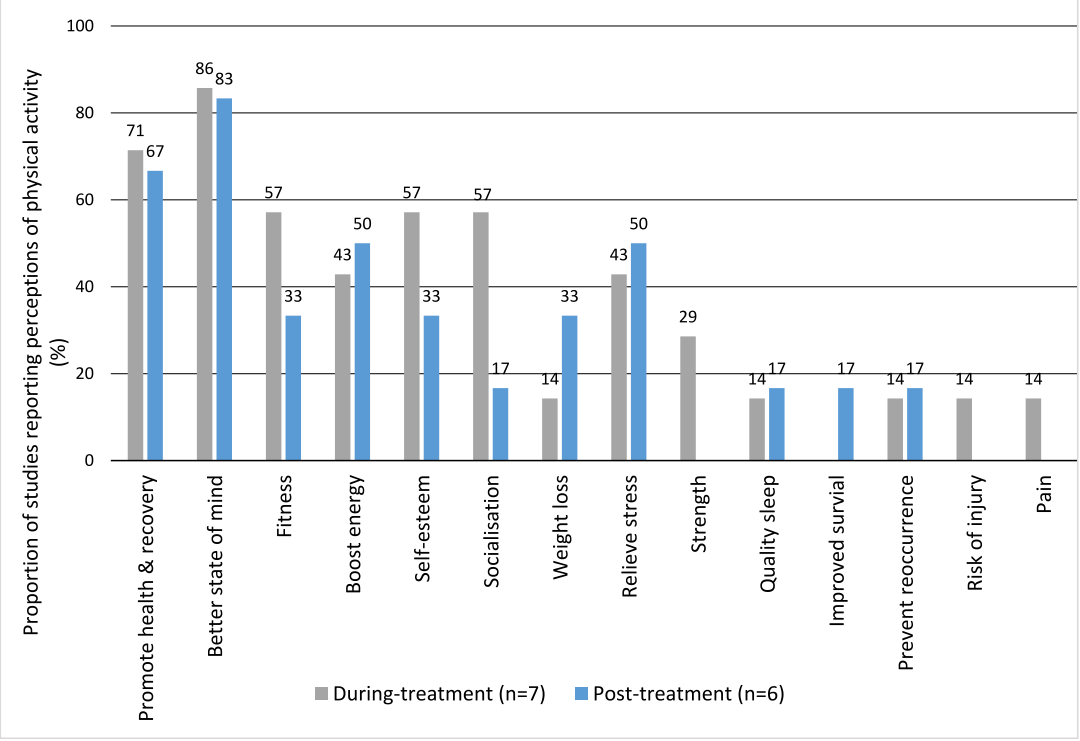

Fig. 4. Perceptions of physical activity during- and post-treatment for people diagnosed with breast cancer.

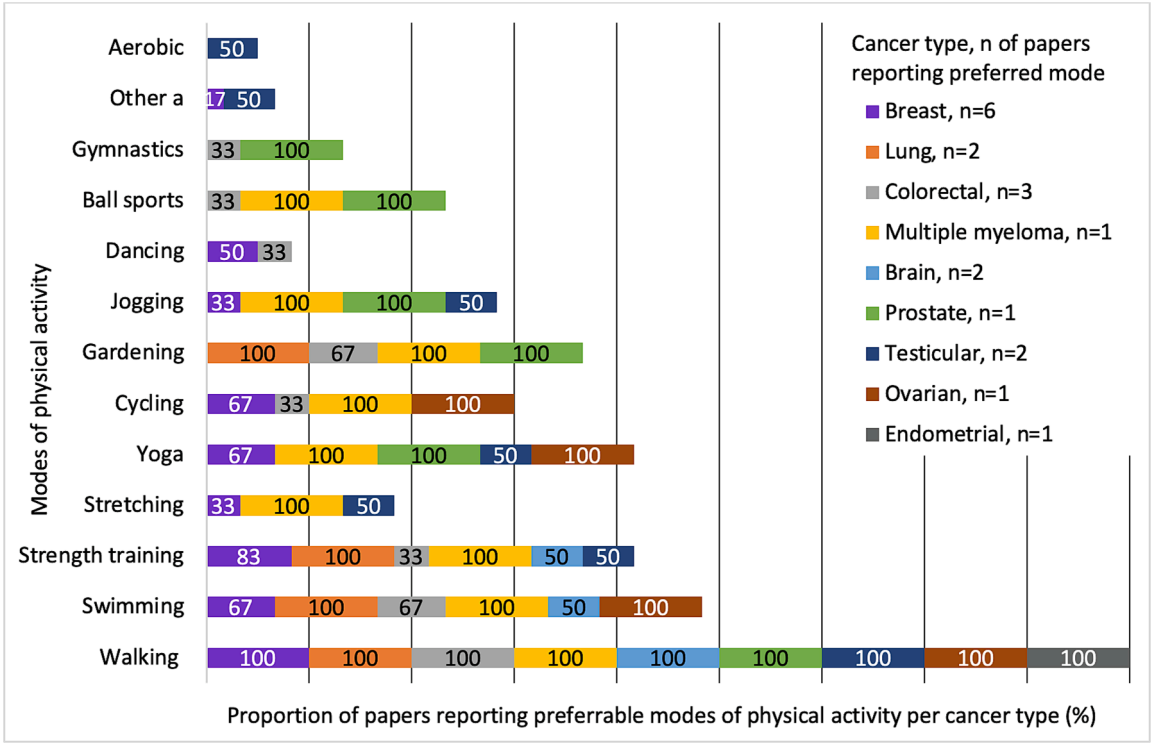

Fig. 5. Proportions of papers reporting preferrable modes of physical activity by cancer type .
[a] Includes circuit training, boot camp, and modes as advised by a professional.

Clifford et al., 2018), disease- and treatment-related side-effects were frequently identified as barriers to physical activity among people with cancer. However, this review highlights that the specific treatment- and disease-related side-effects differ by cancer type. For example, incontinence was reported by a prostate cancer cohort (Patel et al., 2021), whereas sensations of choking during physical activity were reported by a head and neck cancer cohort (Rogers et al., 2022). Barriers including the presence of comorbidities and low physical capacity were also more commonly identified by specific cancer types. Differences in barriers between treatment stages were reported by women with breast cancer. In particular, the unavailability and inaccessibility of appropriate services was more commonly identified as a barrier during-treatment versus post-treatment. Identifying and understanding barriers that are specific to different cancer types and treatment stages may enable the development of more targeted and effective behaviour change advice provided by healthcare professionals throughout the cancer trajectory.

In addition to cancer-specific barriers, people with cancer also reported barriers experienced by the general population. Specifically, time pressures were a common barrier across all treatment stages, although was more commonly reported post-treatment compared to during-treatment. This potentially reflects changes (specifically, reductions) to work and other time-related pressures during the treatment phase, and concurrently the challenges faced once treatment ends and people are required to return to their pre-cancer work roles and societal expectations. This finding is consistent with previous literature in cancer populations (Elshahat et al., 2021; Clifford et al., 2018) and among the general population (Spiteri et al., 2019; Reichert et al., 2007), with work-related demands (Safi et al., 2022; Burton and Turrell, 2000) often reported as the foundations of time pressures. Also in line with previous literature from both cancer (Elshahat et al., 2021) and general populations (Spiteri et al., 2019), low mood, self-efficacy and motivation were identified as commonly experienced barriers, regardless of cancer type or treatment stage.

Social support and guidance were the most commonly identified facilitators of physical activity across all cancer types and treatment stages, which is consistent with what has been reported in previous literature (Elshahat et al., 2021; Clifford et al., 2018). Receiving social support and guidance was identified as particularly useful in promoting physical activity by 11 of the 12 cancer types reporting facilitators. In breast and prostate cancer studies, professional guidance resulted in physical activity being a catalyst for positive health behaviour change that extended beyond physical activity (e.g., diet, alcohol consumption and lifestyle choices) (Brahmbhatt et al., 2020; Loughney et al., 2021). The findings highlight the importance of all members of the healthcare team, as well as patients' families, to be in support of participation in physical activity. Despite the compelling evidence in support of physical activity post-cancer, patients reported that members of their healthcare team expressed caution about starting or increasing physical activity participation, and in one study, a 'lack of doctor's permission' was reported as a barrier to physical activity (Elbourne et al., 2022). Some patients also reported that families and friends express inherent concerns regarding their engagement in physical activity during and following cancer treatment. This was reinforced with the redistribution of daily activities among family members to reduce the 'normal' load on the patient (Emslie et al., 2007), which may have contributed to reductions in physical activity levels post-diagnosis (Romero-Elías et al., 2020; Granger et al., 2016). These findings highlight the need for better healthcare workforce, patient and carer education regarding the potential benefits of physical activity post-cancer to health, function, and survival. Rather than expressing cause for caution with engaging in physical activity, encouraging patients to move more, start slow, and progress according to symptom response is a simple message that all could endorse and support (Cormie et al., 2018).

Findings from this review also support the need to educate patients as part of formal provision of physical activity advice and support. Despite the evidence that participation in physical activity reduces the number and severity of treatment-related side-effects, including but not limited to lymphedema (Hayes et al., 2022), pain (Campbell et al., 2019), and fatigue (Campbell et al., 2019), symptom management was *not* identified as a facilitator across nine cancer cohorts (including breast

cancer – the most commonly researched cancer type) in 35 studies specifically investigating facilitators. Hence, educating patients about the potential (and specific) side-effects of their disease and treatment, alongside the potential of physical activity to ameliorate these adverse effects could provide a useful mechanism for overcoming barriers and facilitate physical activity participation. There also exists strong, epidemiological evidence that participation in physical activity post-cancer (during or following treatment) is associated with improved survival outcomes in 11 cancer types, including seven of the 15 cancers that were represented within this review (Friedenreich et al., 2019). Yet, less than 20% of studies conducted in breast, prostate and colorectal cancers (representing some of the most common cancers throughout the Western world (Bray et al., 2018) identified improved survival as a perceived benefit.

Access to tailored physical activity services was also a commonly identified facilitator across all cancer types and treatment stages. Unfortunately, the availability of services, particularly those targeted towards a specific cancer type beyond breast cancer, are limited (Schmitz et al., 2019). This limitation may be in part a consequence of the research contributing to cancer-specific physical activity guidelines being disproportionately from trials in breast cancer cohort studies (Campbell et al., 2019). Even for women with breast cancer, the availability and ability to access targeted physical activity support and advice is dependent on country and city, socioeconomic status and place of residence (rural, regional versus urban) (Eakin et al., 2012). Access and availability inequities are further exacerbated for rare cancers, cancer types associated with poorer prognosis (e.g., brain and ovarian) or cancer types associated with the presence of other comorbidities, such as head and neck and blood cancers (Leukaemia Foundation, 2019). Improving access, availability, and affordability of cancer-specific physical activity services during and following treatment will likely be a key factor in improving physical activity rates post-diagnosis, with workforce development and training, and better government reimbursement of physical activity services likely underpinning this.

The findings of this review that relate to physical activity preferences clearly highlight that a one-size fits all approach to physical activity services will fail to meet the needs and preferences of all cancer patients. Although walking was the most frequently reported preferred mode of physical activity, 14 other modes were identified across cancer types and treatment stages. Similarly, there were multiple preferences reported with respect to physical activity mode, delivery, location, setting (alone or with others) and timing of a program. Facilitating access to cancer-specific physical activity services that include flexible modes of delivery (face-to-face, telehealth, digital-delivery) and that ensures a patient-centred and directed approach to advice given (Spence et al., 2020) would ensure that patient preferences are understood and considered, which may help support patients to become or remain physically activity post-diagnosis. Identifying group level preferences (e.g., competitive sports for men) could also be used to develop physical activity programs that cater to the preferences of the majority of group members. This tailored approach aligns with the Exercise and Sports Science Australia's exercise and cancer position statement which emphasizes the importance of exercise professionals providing an individualised exercise prescription by considering patient- and cancer-specific needs (Hayes et al., 2019).

A limitation of this review was that the included data were drawn from samples within Western countries, such as Europe, North America, Australia and New Zealand. As such, findings may not be generalisable to people living outside these countries, particularly to people living in developing countries. Additionally, barriers, facilitators, perceptions and preferences were typically exploratory outcomes of interest for the included studies. Consequently, while this review did not involve a formal assessment of risk of bias, the overall evidence base would likely be graded as weak. Further, the methods of assessing the outcomes of interest among the included papers (e.g., use of closed questions and/or multiple-choice answers) may also have influenced what was reported by participants and subsequently review findings. Strengths of this review included the systematic search strategy used to explore specific research questions, the number of databases searched – both of which aligned with PRISMA guidelines (Page et al., 2021), and the inclusion of data from 118 studies, all of which add confidence to our key findings. Additionally, our findings were organised and purposely presented to allow for direct comparisons of the outcomes of interest across cancer types and treatment stages, facilitating a clearer picture of areas warranting future research attention. Specifically, exploration of these outcomes of interests in less common cancer types, and at all stages of the cancer trajectory, including cancers more typically diagnosed at advanced stage, is necessary and would provide further insights that could aid integration of exercise into cancer care for all. Future research that considers different perspectives (e.g., of clinicians, nurses, carers) of barriers, facilitators, perceptions and preferences to physical activity, and that can provide insight into how to apply this new knowledge to optimise integration of physical activity in routine cancer care is also warranted.

5. Conclusion

Key findings from this review, that when actioned could lead to increases in physical activity levels for those diagnosed with cancer, include: i) improved healthcare workforce and patient education with respect to the importance of physical activity post-cancer, ii) provision of physical activity advice and support from healthcare professionals to people with cancer that considers and integrates patient-specific needs (e.g., relative to cancer type and treatment stage) and preferences, and iii) incorporation of behaviour change strategies that identify and discuss barriers, facilitators, perceptions and preferences.

6. Funding and conflicts of interest

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The authors disclose no conflicts of interest for this paper.

7. Declarations

Ethical approval and consent to participate and publish are not applicable to this paper. All available data is included in the paper and supplementary materials.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2023.102255.

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