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REVIEW ARTICLE

Group-based exercise interventions for increasing physical activity in cancer survivors: a systematic review of face-to-face randomized and non-randomized trials

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Abstract

Purpose To increase physical activity (PA), interventions based on group dynamics may be superior to interventions that target aggregates of people but do not have formal strategies to enhance cohesion. This review examined the extent to which group dynamics processes have been integrated within exercise and/or PA interventions in cancer survivors, and explored the implementation and effectiveness of these interventions for increasing PA.

Methods A systematic review was conducted of English articles published January 2005–March 13, 2017 using the electronic databases PsycINFO, CINAHL, and PubMed Medline (National Library of Medicine). Studies in adult cancer survivors that had a controlled or uncontrolled experimental design, included face-to-face exercise, had a group-based component, and reported PA pre- and post-intervention were included. Self-reported PA effect sizes were estimated for pre- to post-intervention, separately for studies that implemented ≥ 1 group dynamics strategy versus none.

Results Twenty-three studies were reviewed, 34.8% ($n = 8$) included ≥ 1 group dynamics strategy ($M = 1.6 \pm 0.7$, range = 1–3). Most interventions were delivered in a healthcare or rehabilitation setting by an exercise professional, and face-to-face exercise dose ranged from 72.0–6000.0 min. PA effect size ranged from 0.3–1.2 for studies that implemented ≥ 1 group dynamics strategy versus 0.4–2.4 for those with none. Studies reviewed lacked detailed examples of group dynamics strategies, and none measured group cohesion.

Conclusions The additional benefit of group dynamics–based interventions for increasing PA in cancer survivors remains unclear. More research is needed to enhance the generalizability of face-to-face exercise interventions, and determine how to maximize the potential of including group dynamics strategies.

Keywords Physical activity · Intervention studies · Group structure · Cancer survivor

Introduction

There are over 15 million cancer survivors in the USA, and it is estimated that this number will increase to more than 20 million by 2026 [2, 44]. This growing number of cancer survivors is likely due to improvements in screening, early detection, and treatment [44, 45], and has drawn greater attention to survivors' post-treatment medical, physical, and psychosocial health needs. One recommendation for meeting these needs is encouraging cancer survivors to adopt and maintain a healthy lifestyle [44]. Engaging in physical activity (PA) following a cancer diagnosis and/or treatment has been shown to improve physical functioning and quality of life (QOL) [32, 58, 61] and is associated with reduced risk of recurrence and increased survival for certain cancers [41, 54]. Despite these benefits, the majority of cancer survivors do not meet PA recommendations [37, 56]. This may be due, in part, to cancer-specific barriers to engaging in PA (e.g., persistent treatment side effects, fatigue, feelings of fear, lack of knowledge of benefits) [16]. PA interventions that are structured and supervised, with exercise types and intensities tailored to the survivors' needs,

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can help overcome these barriers and are effective for facilitating increases in PA and improving physical function and QOL [10]. However, in order to make these supervised, structured opportunities widely accessible for cancer survivors, it is important to explore PA intervention implementation strategies that are effective and resource conscientious.

Individually supervised exercise, such as personal training, is often considered the "gold standard" for improving physical function and physiologic outcomes (e.g., physical fitness, body composition, and biomarkers), but this individualized approach is resource intensive. When considering interventions aimed at increasing PA as the primary outcome, group-based interventions are more resource conscientious, and have been shown to be more efficacious than those delivered to individuals [24], particularly when group dynamics principles targeting the group's environment, structure, and processes are used to enhance cohesion among participants [13].

Group dynamics is the field of study that examines the positive and negative forces that reside within groups, which posits that one's interactions with fellow members change both the individual and the other group members, and that a highly attractive group can exert much influence on its members whereas a weak group does not have the same ability [40]. Cohesion, defined as "a dynamic property reflecting group members' perceptions of the unity and personal attractions to task and social objectives of the group" [31], is hypothesized to be the essential characteristic underlying group dynamics, and that without it, a group may not exist at all. This has important implications for research and practice when considering the potential advantage of group-based interventions. A distinction must be made between an intervention delivered to an aggregate of people (e.g., no group cohesion) and a group that engages in strategies and principles that align with a group dynamics–based approach [12, 26]. Therefore, it is possible that interventions based on group dynamics may be superior to interventions that target aggregates of people but do not have formal strategies to enhance perceptions of cohesion (for description and examples of group dynamics strategies, see Estabrooks, 2007 [26]).

A meta-analysis by Burke et al. (2006) examined studies that directly compared delivery methods of PA interventions, and found that PA interventions that included exercise sessions in which group dynamics principles were used to increase cohesiveness (referred to as "true groups") were most effective for increasing PA adherence (e.g., attendance, exercise duration, metabolic equivalents) [11]. A realist review conducted by Harden et al. (2015) found that PA interventions based on group dynamics may also be more effective for increasing PA in older adults at risk for or living with chronic disease [35], which is applicable to the vast majority of cancer survivors. PA interventions based on group dynamics may be particularly effective for increasing PA in cancer survivors by offering a new network of support for PA [3], the opportunity to be surrounded by others with a shared experience, and providing greater physical benefits (e.g., improved aerobic fitness or muscular strength) than group counseling or support groups alone [55].

Qualitative research with breast and prostate cancer survivors supports the notion of group-based PA interventions for a cancer survivor population [9, 25, 64]. However, to date, quantitative studies in cancer survivors do not corroborate qualitative findings. For example, in 2009, Floyd and Moyer conducted a meta-analysis to test the hypothesis that exercise interventions or programs conducted in group-based settings would result in greater QOL improvements in breast cancer survivors than individually based exercise programs [33]. Results did not support their hypothesis, with group-based exercise interventions showing no advantage for improving QOL among breast cancer survivors. However, studies were considered to have a group format if there was *any* interaction among study participant, and the authors noted that none of the studies reviewed capitalized on group processes as a goal or "involved sufficient social interaction to create psychosocial improvement over and above those of individual programs" [33]. There is a need to disentangled interventions based on group dynamics versus interventions that target aggregates of people but do not have formal strategies to enhance perceptions of cohesion, in order to determine whether group-based interventions that utilize a group dynamics approach may be the most beneficial intervention delivery method for increasing PA among cancer survivors.

Thus, the purpose of this systematic review was to (1) examine the extent to which group dynamics principles have been implemented in PA interventions in cancer survivors, (2) describe the implementation characteristics, and (3) report effectiveness of face-to-face group-based exercise interventions for increasing PA among cancer survivors.

Methods

Eligibility criteria and search strategy

Studies were eligible if they were (1) published in English in a peer-reviewed journal, (2) published January 2005 (following the release of the Institute of Medicine's exercise guidelines for cancer survivors) through March 13, 2017, (3) studied adult cancer survivors, (4) used a controlled or uncontrolled experimental design (i.e., randomized controlled trial, or single-group, pre-post design), (5) included a face-to-face exercise component, (6) included a group-based component, and (6) measured and reported PA or exercise behavior pre- and post-intervention.

A systematic search was conducted following the Preferred Reporting of Systematic Reviews and Meta-analysis (PRISMA) guidelines and with assistance from a trained librarian. Electronic databases (PsycINFO, CINAHL, PubMed

Medline [National Library of Medicine]) were searched using the keywords and search terms listed in Appendix.

Study selection

Studies were chosen through a multi-step screening strategy. First, citations and abstracts divided among reviewers (HJL, SKM, SMH), then each were independently screened by two of the reviewers for fulfillment of eligibility criteria. A study that did not meet inclusion criteria (i.e., it was clear from the title that the study did not include adult cancer survivors, the study was not an intervention or quasi-experimental design [e.g., review, cohort], PA was not an outcome, there was no face-to-face exercise component) was excluded and assigned a reason. Articles that received a "maybe" rating were independently reviewed by a third reviewer, and any disagreements were resolved through discussion until final consensus was reached. Final selection of studies was based on full-text review of remaining articles. See Fig. 1, study selection flow chart.

Data abstraction

A data extraction codebook was developed using a modified version of a previously tested strategy [34], pilot-tested on four randomly selected studies included in the full-text review, and refined accordingly. Two reviewers abstracted all data. Discrepancies were resolved through discussion and direct reference to the full-text article, and if an agreement could not be reached, a third reviewer was consulted. Data abstraction was completed using 45 coded descriptors of study sample, research design, and intervention characteristics; 16 items describing the implementation of group dynamics strategies that targeted the group environment (e.g., distinctiveness, group size), group process (e.g., group goals, cooperation, competition, communication, group problem solving), group structure (e.g., roles, norms), and indicators of cohesion (e.g., social support) [12]; and 10 items describing PA measurement and effect size information. Risk of bias was assessed using the sources of bias outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* [36]. Attrition bias (the extent of incomplete outcome data) and reporting bias (selective reporting) were assessed only for PA data.

Data analysis

Descriptive statistics (means, medians, frequencies, range, etc.) were calculated, and pre- and post-intervention PA means and standard deviations were used to calculate effect size (Cohen's *d*). Effect sizes were calculated separately for studies that did not implement any group dynamics strategies, and for those who utilized one or more group dynamics strategy (i.e., studies who made any mention of implementing group dynamics strategies that targeted the group environment, group process, or group structure). Meta-analysis was not performed due to variations in study design and PA measures.

Results

The initial search resulted in 3937 publications (see Fig. 1). Seventy-eight full-text articles were assessed for eligibility, and 28 articles (23 unique interventions) were included in final analyses. In the case of multiple reports from the same trial, the study reporting primary outcomes was used. Eleven

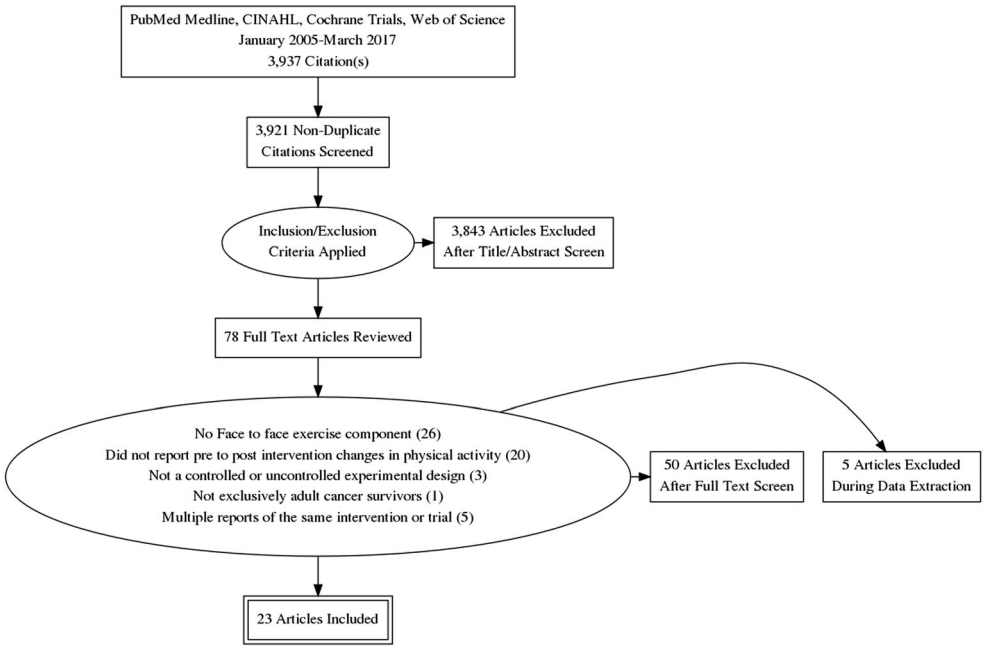


Fig. 1 Study selection flow chart

(47.8%) studies were conducted internationally, and the remaining were conducted in the USA.

Study population description

Study sample size ranged from 15 to 573 ($M = 114.8 \pm 135.3$). Study populations were exclusively breast ($n = 9$), exclusively prostate ($n = 4$), exclusively gastrointestinal ($n = 3$), and mixed/multiple ($n = 7$) cancer types. Twelve studies reported time since diagnosis (at study enrollment), and 9 of those provided means to calculate the average time since diagnosis ($M = 33.9 \pm 18.1$ months). The majority of studies (87.5%) targeted survivors who had completed chemotherapy or radiation treatment.

The average age of participants was $M = 57.6 \pm 8.5$ (range 47.8–73.1), with two studies not reporting average age [6, 59]. The majority of participants in each study were female, ($M = 67.5 \pm 38.1\%$), and ranged from 0 (studies of exclusively prostate cancer survivors) to 100 (studies of exclusively breast cancer survivors). Few studies reported race or ethnicity ($n = 9$, 31.9%), and the majority of participants in each study were non-Hispanic white ($M = 70.8 \pm 32.4\%$, median = 83.8%, range 0–97.0%). Five studies included African Americans, ranging from 5.0–31.5% of the study sample, and one study included exclusively African Americans [60]. Three studies included Hispanic/Latino participants, ranging from 1.8–15.1% of the study sample. Eight studies reported income, and of those, 5 studies reported that a substantial portion (> 30%) of their participants were "low income" (defined as an annual household income of < $40,000/year, < $35,000/year, or < $3000/per month). Seventeen studies reported education levels, and of those, 13 studies reported that the majority (> 50%) of the participants were "highly educated," defined as having a college education or more, or a mean number of years of education ≥ 14 years.

Intervention design

The most common setting for exercise sessions was a healthcare or rehabilitation facility (34.8%, $n = 8$). Interventions also took place in an academic/university setting ($n = 3$), a fitness facility ($n = 2$), or a combination of healthcare and university settings ($n = 1$). The setting where exercise took place was not specified in 33.3% ($n = 9$) studies.

Interventions were most commonly delivered by an exercise professional (e.g., physiologist, exercise specialist) (34.8%, $n = 8$). Other delivery agents were physical therapists, psychologists, social workers, nurses, trained research assistants, or specialized instructors (e.g., yoga, Qi). Five (25.9%) studies did not specify the delivery agent.

The number of studies that included group-based exercise, individually supervised (1:1) exercise, and individual PA counseling/education or group-based counseling/education as part of the intervention is shown in Table 1. Intervention duration ranged from 6 to 52 weeks ($M = 14.2 \pm 9.6$, median = 12), and face-to-face exercise session contact time (dose) ranged from 72.0–6000.0 min ($M = 1707.9 \pm 1493.3$, median = 1080.0).

Use of theory to guide interventions was reported by 8 studies (34.7%). Four studies mentioned the use of Social Cognitive Theory [43, 49, 50, 60], two mentioned the Theory of Planned Behavior [7, 20], and one mentioned Health Belief Model [60]. Other frameworks used were cultural competency [60, 62], social support [6], and the conceptual model of elderly cancer survivorship [62].

Twenty-one studies included face-to-face exercise sessions in a group format (see Table 1), and $n = 8$ studies (34.8%) included one or more group dynamics strategy. Eight studies mentioned social or peer support as an important component, or a reason/benefit of their exercise and/or counseling group-based structure, and one study measured social support using the Social Provisions Scale [51]. Four studies addressed the group environment (i.e., group size, distinctiveness), 6 studies targeted group processes (i.e., group goals, cooperation, competition, communication, group problem solving), and 1 study mentioned group structure (i.e., group norms). The number of group dynamics strategies implemented ranged from 1 to 3 ($M = 1.6 \pm 0.7$, median = 1.5). The specific group dynamics strategies implemented in each study are listed in Table 2. Although some studies utilized group dynamics strategies, no studies measured the degree to which the intervention increased group or social cohesion.

Physical activity outcomes

Most studies used a self-report questionnaire to measure PA (65.2%, $n = 15$), five (21.7%) used both an accelerometer and a self-report questionnaire, two studies used only an activity

Table 1 Intervention components

	No PA counseling/education	Individual PA counseling/education	Group-based PA counseling/education
Group-based exercise (*N* studies)	8	2	11
Individually supervised (1:1) exercise (*N* studies)			2

PA physical activity

Table 2 Summary of physical activity measures and changes

Citation	*N* intervention group	Group dynamics strategies	PA measure(s)	Units of measure	Baseline mean (SD)	Post-intervention mean (SD)	Effect size (d)
Any group-based exercise and no PA counseling/education							
Bourke L, 2011	9	None	Godin Leisure-Time Exercise Questionnaire	Leisure Score Index	M (SD) not provided	M (SD) not provided	2.4 (reported in the study)
Broderick JM, 2013	23	None	Accelerometer (Stayhealthy Inc.)	MVPA minutes per day	46.1 (25.5)	49.7 (25.9)	0.14
			Godin Leisure-Time Exercise Questionnaire	Leisure Score Index	17.5 (14.5)	37.1 (22.4)	1.04
Cormie P, 2013	10	Group size	Accelerometer (ActiGraph)	Weekly low, moderate, and vigorous activity minutes	Low = 341.7 (143.3) Mod = 179.6 (143.2) Vig = 1.8 (2.8)	Low = 356.7 (112.6) Mod = 165.4 (139.8) Vig = 1.7 (2.3)	Low = 0.11 Mod = − 0.10 Vig = − 0.04
			Godin Leisure-Time Exercise Questionnaire	Leisure Score Index	18.5 (17.2)	26.2 (28.8)	0.32
Guinan E, 2013	16	None	Accelerometer (Stayhealthy Inc.)	Minutes per week of light, moderate, and vigorous PA	Light = 332.6 (69.7) Mod = 31.8 (17) Vig = 24.7 (53.5)	Light = 318.1 (72.1) Mod = 30.7 (15.6) Vig = 15.7 (15.7)	Light = − 0.20 Mod = − 0.07 Vig = − 0.23
			Godin Leisure-Time Exercise Questionnaire	Total METS per week	23.1 (19.8)	38.7 (26.9)	0.66
Irwin ML, 2009	37	None	Pedometer	Steps per day	5083 (2312)	6704 (SD not reported)	Not able to calculate
			Questionnaire measuring past 6 months of recreational activity[a]	Minutes per week of recreational PA	12 (24)	M (SD) not reported	Not able to calculate
			Physical activity log (type and duration of recreational PA each day over last 7 days)	Minutes per week of recreational PA	30 (41.1)	159 (SD not reported)	Not able to calculate
Martin EA, 2015	44 (low-intensity exercise)	None	IPAQ short	MET hours per week	32.6 (35.3)	49.4 (55.4)	0.36
	40 (high-intensity exercise)	None	IPAQ short	MET hours per week	28.2 (32.5)	53.6 (41)	0.69
Ross Zahavich AN, 2013	15	None	Godin Leisure-Time Exercise Questionnaire	Leisure Score Index	M (SD) not provided	M (SD) not provided	Not able to calculate
Saarto T, 2012	263	Group size	2-week PA diary. Amount and type of PA. Corresponding intensity of activity assigned MET value	MET hours per week	27.4 (16.54)	30.5 (SD not reported)	Not able to calculate
Individually supervised (1:1) exercise and group-based PA counseling/education							
Rogers LQ, 2015	110	None	Accelerometer (ActiGraph)	≥ Moderate PA minutes per week	178 (124)	246 (153)	0.49
			Godin Leisure-Time Exercise Questionnaire	≥ Moderate PA minutes per week	40 (68)	169 (119)	1.33
Rogers LQ, 2009	21	Interaction/ communication, group problem solving	Accelerometer (ActiGraph)	Moderate PA minutes per day	14.2 (10.4)	22.3 (13.6)	0.67
			Godin Leisure-Time Exercise Questionnaire	≥ Moderate PA minutes per week	42 (54.5)	121 (73.2)	1.22
Group-based exercise and individual PA counseling/education							
Buffart LM, 2013	147	None	Physical Activity Scale for the Elderly (PASE)	Frequency of participating in a variety of leisure-time and lifestyle activities over last 7 days. Sum of time spent in each activity by corresponding item weight. Composite score from 0 to 400	12.9 (9.7)	19.4 (13.6)	0.55
Suh EE, 2013	35	None		Average minutes per day	41.3 (15.6)	70.9 (21.2)	1.59

Table 2 (continued)

Citation	*N* intervention group	Group dynamics strategies	PA measure(s)	Units of measure	Baseline mean (SD)	Post-intervention mean (SD)	Effect size (d)
			Amount of daily exercise in the previous week				
Group-based exercise and group-based PA counseling/education							
Bertheussen GF, 2012	163	None	Questionnaire = The Nord-Tr ø ndelag Health Study Physical Activity Questionnaire (HUNT 1 PA-Q)	Index score calculated based on the frequency *X* duration *X* intensity. Range from 0 (lowest) to 15 (highest)	3.6 (999)	5.7 (999)	Not able to calculate
Bloom JR, 2008	201	Interaction/ communication, group problem solving	Do you exercise 2 or more days per week for at least 30 mins?	Percent responded "Yes"	71% (M (SD) not provided)	77% (M (SD) not provided)	Not able to calculate
Casla S, 2014	50	Interaction/ communication	Godin Leisure-Time Exercise Questionnaire	Leisure Score Index	13.1 (11.5)	23.0 (12.6)	0.82
Culos-Reed SN, 2010	53	Interaction/ communication	Godin Leisure-Time Exercise Questionnaire	Leisure Score Index	26.4 (26.7)	45.1 (30.5)	0.65
Culos-Reed SN, 2007	31	1	Godin Leisure-Time Exercise Questionnaire	Leisure Score Index	31.7 (34.9)	68.2 (48.6)	0.86
Lee DH, 2013	12 (casually intervened)	None	IPAQ short	MET-h/week	10 (8.5)	46.1 (46.0)	1.09
	11 (intensely intervened)	None	IPAQ short	MET-h/week	12.1 (11.0)	35.4 (27.4)	1.11
May AM, 2009	76	None	Physical Activity Scale for the Elderly (PASE)	Frequency of participating in a variety of leisure-time and lifestyle activities over last 7 days. Sum of time spent in each activity by corresponding item weight. Composite score from 0 to 400	116.1 (60.5)	140.5 (77.5)	0.35
Midtgaard J, 2013	108	None	Saltin and Grimby questionnaire[b]	4 categories (i) sedentary, (ii) low- to moderate-intensity walking or cycling for pleasure, (iii) regular moderate to high PA > 3 h per week, and (iv) intense PA > 4 h per week	25.9% meeting PA goal of > 3 h/week	70.4% meeting PA goal of > 3 h/week at 12 months	Not able to calculate
Reynolds J, 2014	72	Group size, group problem solving	Self-report number of days in the past 7 days participated in moderate to strenuous exercise, and on average, how many minutes per day	Minutes of total PA per week	94.1 (87.0)	131.5 (91.0)	0.42
Spector D, 2012	73	None	IPAQ short	MET minutes per week	2085 SD not provided	2185 SD not provided	Not able to calculate
Stolley MR, 2009	23	Group norms, distinctiveness, interaction/ communication	IPAQ long	Minutes of total PA per day	Median = 61.8, SD not provided	Median = 92.1, SD not provided	Not able to calculate

[a] Kriska A, et al. 1990. Development of a questionnaire to examine relationship of physical activity and diabetes in Pima Indians. Diabetes Care 1990;13:401–11

[b] Saltin B, Grimby G. Physiological analysis of middle-aged and old former athletes. Comparison with still active athletes of the same ages. Circulation 1968;38: 1104–1115. IPAQ = International Physical Activity Questionnaire (https://sites.google.com/site/theipaq/)

Mod moderate, *Vig* vigorous, *PA* physical activity

log, and one study used a pedometer, questionnaire, and activity log (see Table 2). For studies that did not implement any group dynamics strategies *and* had adequate information to calculate effect size for self-reported PA ($n = 10$), the effect size ranged from 0.4–2.4. For studies that implemented one or more group dynamics strategy and had adequate information to calculate effect size for self-reported PA ($n = 5$), the effect size ranged from 0.3–1.2 (See Table 2).

Risk of bias

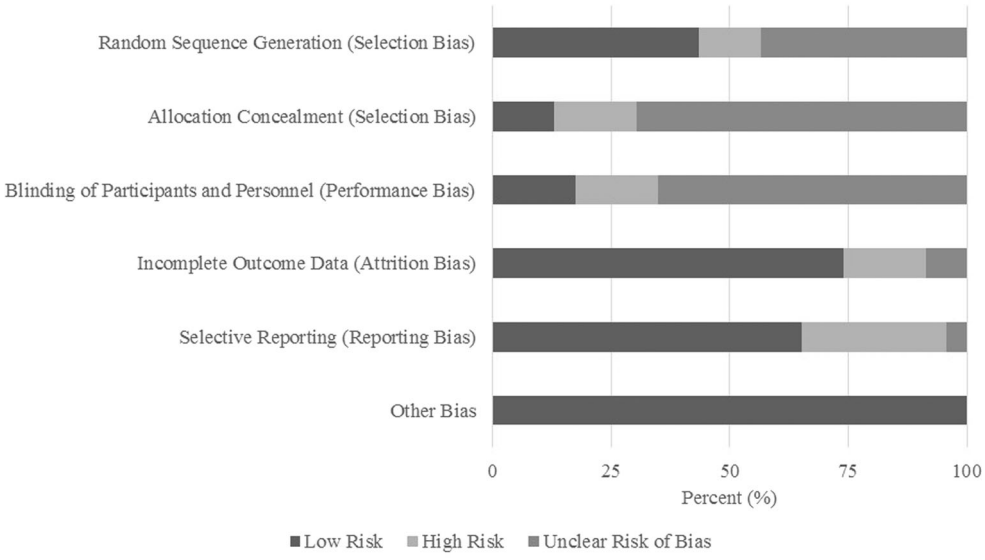
The results of the risk of bias assessment are shown in Fig. 2. For studies that were not of randomized design (i.e., single-group, pre-post), risk of selection bias and performance bias was deemed unclear. Among the studies that were randomized controlled trials, these sources of bias were split evenly between low and high risk of bias. The majority of studies were rated as low risk for attrition bias (73.9%), and low risk for reporting bias (65.2%). No other sources of bias were identified.

Discussion

The goals of this systematic review were to examine the extent to which group dynamics principles or strategies have been integrated in exercise and/or PA interventions for cancer survivors, and to describe the implementation characteristics, and effectiveness of face-to-face group-based exercise interventions for increasing PA among cancer survivors.

Twenty-three face-to-face exercise interventions for cancer survivors that included any group-based component and measured PA pre- and post-intervention were examined. The majority of these studies ($n = 15$) did not report the inclusion of any specific group dynamics strategies. Of the studies that did report group dynamics strategies ($n = 8$), the number of strategies implemented ranged from 1 to 3 (median = 1.5), which is fewer that the number of strategies employed in group dynamics–based interventions in the general population. In a systematic review of 20 group dynamics–based interventions conducted in 2010, there was an average of three group dynamics strategies implemented, with a range of 1–13 [29]. In an updated realist review of group dynamics–based interventions [35], there were approximately 6 group-based strategies employed within each intervention.

Eight of the reviewed studies [6, 15, 20, 21, 50–52, 60] described the group component of their study in a way that indicated social or peer support/socialization was a consideration. Examples of references to social support included the following: "In an effort to foster the social support that is associated with group-based exercise, participants attended weekly booster sessions" [20] and "The group sessions provided social support" [50]. Only one of the studies reviewed [21] discussed the intentional use of the group and referenced the application of group dynamics principles to target the group's environment, structure, and processes to enhance cohesion. In general, however, few studies provided explicit, detailed examples of how they intentionally fostered interaction and cohesion (e.g., incorporating partner exercises into the exercise session, instructing participants to work toward a common goal, team building activities such as a group name or t-shirt), and none measured the degree to which the intervention increased group or social cohesion, providing evidence of the degree to which group dynamics strategies worked.



*Incomplete outcome data and selective reporting were only assessed for physical activity data

Fig. 2 Risk of bias graph

The effectiveness of face-to-face exercise interventions for increasing PA from pre- to post-intervention was similar in studies that did not implement any group dynamics strategies, and those that implemented ≥ 1 group dynamics strategies. This suggests that interventions which include face-to-face exercise and a group-based component (i.e., exercise session, or counseling/education) are effective for increasing PA in cancer survivors, but the additional benefit of including group dynamics–based strategies remains unclear. This conclusion is limited by (1) the sparse number studies which implemented group dynamics strategies *and* provided adequate information to calculate PA effect size ($n = 5$), (2) the quantity and quality of group dynamics strategies implemented, and (3) the variation in intervention dose (face-to-face contact time), design, and PA measures. Currently, the minimum number of group dynamics strategies needed to elicit a detectable difference in effect between a "true group" versus "standard" group-based (i.e., a collective of individuals) intervention is unknown.

Three previous studies in cancer survivors have explored group cohesion in the context of PA but did not measure changes in PA, and were therefore excluded from this review [14, 19, 42]. These studies suggested that a group training or "team-based" environment is feasible for cancer survivors, increases cohesion, and has positive effects on physical function. To our knowledge, this was the first study to describe the use of group dynamics strategies to enhance cohesion, and increase PA among cancer survivors.

Limitations

The primary limitation of this review was the lack of adequate information required to conduct a meta-analysis, and the vast array of PA measures used. Due to the paucity of studies that utilized objective (e.g., pedometer, accelerometer) measures of PA, our effect size estimations were limited to self-report measures. This finding is consistent with others who concluded that only a small number of studies have incorporated accelerometer-based measures of PA in cancer survivor populations [8].

Similar to other reviews of the literature that have used evaluation frameworks such as RE-AIM (www.re-aim.org) to examine factors associated with external validity (i.e., reach, implementation) [23, 53], less than half of the interventions reviewed here reported on variables related to generalizability, including setting or racial representativeness. This remains concerning for researchers and practitioners who look to the literature to adopt evidence-based programs. The lack of reporting on these contextual issues may impede scalability. For example, lack of reporting on sample characteristics beyond cancer diagnoses and treatment information limits the translation of face-to-face group-based exercise to different populations (e.g., racial/ethnic minorities, rural, low socioeconomic status). In addition, this review was limited to studies published after 2005, in English, and did not include the gray literature or studies that included children or adolescents.

Future directions

The questions raised by this review require future study in applying group dynamics to PA promotion in cancer survivors. Translating PA intervention research into sustainable, accessible PA programs for cancer survivors remains a challenge [4, 47]. It has been widely accepted that face-to-face interventions are effective for improving QOL and physical function in cancer survivors [63]; however, many of these interventions are resource intensive and often do not have lasting effects on long-term PA behavior change [38, 57]. Group-based interventions that utilize a "true group" approach are appealing for increasing PA among cancer survivors because they require fewer resources than individually supervised exercise and may enhance PA maintenance [28, 39, 48].

In order to further this field of study, more research is needed to understand which strategies (e.g., group goal setting) elicit the greatest effect on PA adherence and maintenance in cancer survivors. Work has been conducted to attribute perceptions of cohesion with PA behaviors and examples of strategies and when they have been initiated are plentiful in the literature [11, 27, 30, 34, 35, 48]. Study designs that optimize both efficacy and efficiency, such as the multiphase optimization strategy (MOST) [17, 18, 46], may be appropriate to understand the optimal number of strategies needed to have an impact while still maintaining practicality (i.e., simultaneous mechanistic and pragmatic advancements). MOST could provide a framework for optimizing and evaluating group dynamics–based PA interventions to determine the minimum number and type of strategies needed to optimize intervention effects and increase PA in cancer survivors.

This review of face-to-face interventions to increase PA in cancer survivors also found that generalizability and consistency was lacking. The most commonly used study settings and delivery agents observed in this review may limit the sustainability, and scalability of these interventions to other settings and populations [1]. For example, the use of exercise professionals or physical therapists trained specifically in exercise for cancer survivorship to deliver these interventions is not viable for community-based settings, such as those in underserved and rural communities. Future studies that apply hybrid implementation-effectiveness designs [22] could examine the use of highly trained professionals to guide or instruct community health educators to retain the benefit of group-based face-to-face delivery. Notably, there is some work to be done to apply the concepts of dissemination and implementation to group-based interventions for cancer survivors. For example, how should a group dynamics–based exercise program delivered in a rehabilitation clinic at a large,

urban cancer center be adapted for delivery in a community-based fitness facility in a rural setting? Is a group dynamics–based exercise intervention that works for breast cancer survivors, which is then delivered to prostate cancer survivors, equally effective for increasing PA (i.e., do males and females respond in the same way)? Further, although previous studies have shown exercising with others who are similar to oneself, in ways such as age and gender, may be most beneficial [5], it may not be realistic to retain homogeneity of cancer type when disseminating group dynamics–based interventions to community settings. Future work is needed to establish the effectiveness of "true group" interventions for increasing PA in cancer survivors across diverse audiences and settings. However, the use of "true group" or team-based approaches to increase cohesion and subsequent PA adherence or maintenance (i.e., group cohesion as a mediator of PA behavior change) had not yet been examined in a cancer survivor population.

Conclusions

This review found that face-to-face exercise interventions with a group component can effectively increase PA, but the additional benefit of a "true group" PA intervention in cancer survivors is inconclusive. Due to the limitations in PA measurement, lack of detail in reporting of group dynamics strategies, and absence of group cohesion measures, we cannot definitively determine whether implementing these strategies will enhance the effectiveness of face-to-face interventions for increasing PA in cancer survivors. Further, despite speculation that the social support received from the group may contribute to PA adherence and subsequent improvements in QOL, how or why these interventions might work in cancer survivors, and how to optimize the use of group dynamics strategies is unknown. Future studies are needed to determine the effects of implementing group dynamics strategies on dimensions of group cohesion in cancer survivors, the moderating effects of group cohesion on PA adherence and maintenance, and the subsequent mediating effects of PA and group cohesion on QOL.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Appendix

Medline search conducted on March 13, 2017.

((((((((((((((((((“previous history”[Title/Abstract]) OR Recurrence[Title/Abstract]) OR “personal history”[Title/Abstract]) OR Recurrences[Title/Abstract]) OR Recrudescences[Title/Abstract]) OR Relapse[Title/Abstract]) OR Relapses[Title/Abstract]) OR Survivors[Title/Abstract]) OR Survivor[Title/Abstract]) OR Survivors[MeSH Terms])) AND (((Neoplasms[MeSH Terms]) OR Neoplasm*) OR cancer[Title/Abstract]))) OR surveillance mammogra*[Title/Abstract]))) AND ((((adult[Title/Abstract]) OR “middle aged”[Title/Abstract])) OR ((“Young Adult”[Mesh] OR “Adult”[Mesh]) OR “Middle Aged”[Mesh]))) AND ((Exercise[MeSH Terms]) OR Exercise[Title/Abstract]) OR Jogging[MeSH Terms]) OR jog*[Title/Abstract]) OR running[MeSH Terms]) OR run*[Title/Abstract]) OR Motor activity[MeSH Terms]) OR “Motor activity”[Title/Abstract]) OR Polymeric exercise[MeSH Terms]) OR Resistance training[MeSH Terms]) OR “Resistance training”[Title/Abstract]) OR Swimming[MeSH Terms]) OR swim*[Title/Abstract]) OR Walking[MeSH Terms]) OR walk*[Title/Abstract]) OR yoga[MeSH Terms]) OR yoga[Title/Abstract]) OR Weight Lifting[MeSH Terms]) OR “Weight Lifting”[Title/Abstract]) OR Gardening[Title/Abstract]) OR Gardening[MeSH Terms]) OR stretch*[Title/Abstract]) OR Leisure Activities[MeSH Terms]) OR Muscle Stretching Exercises[MeSH Terms]) OR Dancing[MeSH Terms]) OR danc*[Title/Abstract]) OR Bicycling[MeSH Terms]) OR Bicycling[Title/Abstract]) OR Stair Climbing[MeSH Terms]) OR climb[Title/Abstract]) OR Hiking[Title/Abstract]) OR Sports[MeSH Terms]) OR sport*[Title/Abstract]) OR Motor activity[MeSH Terms]) OR “Motor activity”[Title/Abstract]) OR Health Promotion[MeSH Terms]) OR “Health Promotion”[Title/Abstract]) OR Physical Conditioning, Human[MeSH Terms]) OR plyometric exercise[MeSH Terms]) OR Aerobic[Title/Abstract]) OR “Muscle-strengthening”[Title/Abstract]) OR “Resistance training”[Title/Abstract]) OR plyometric[Title/Abstract]) OR jump*[Title/Abstract]) OR Baseball[Title/Abstract]) OR Basketball[Title/Abstract]) OR Bicycling[Title/Abstract]) OR Boxing[Title/Abstract]) OR Football[Title/Abstract]) OR soccer[Title/Abstract]) OR Softball[Title/Abstract]) OR golf[Title/Abstract]) OR Gymnastics[Title/Abstract]) OR Hockey[Title/Abstract]) OR “Martial Arts”[Title/Abstract]) OR “Tai Ji”[Title/Abstract]) OR “Tai chi”[Title/Abstract]) OR Mountaineering[Title/Abstract]) OR “Racquet Sports”[Title/Abstract]) OR Tennis[Title/Abstract]) OR track[Title/Abstract]) OR skating[Title/Abstract]) OR skiing[Title/Abstract]) OR soccer[Title/Abstract]) OR swim*[Title/Abstract]) OR “Weight Lifting”[Title/Abstract]) OR Wrestling[Title/Abstract]) OR Volleyball[Title/Abstract])) AND ((((((((((((((((((((trial[Title/Abstract]) OR study[Title/Abstract]) OR studies[Title/Abstract]) OR controlled) OR control[Title/Abstract]) OR case[Title/Abstract]) OR cases[Title/Abstract]) OR mask*[Title/Abstract]) OR “4 arm”[Title/Abstract]) OR “four arm”[Title/Abstract]) OR single[Title/Abstract]) OR doubled[Title/Abstract]) OR triple[Title/Abstract]) OR single[Title/Abstract]) OR pre-

test[Title/Abstract]) OR pretest[Title/Abstract]) OR posttest[Title/Abstract]) OR post-test[Title/Abstract]) OR "program evaluation"[Title/Abstract])) OR ((("Clinical Studies as Topic"[Mesh] OR "Evaluation Studies" [Publication Type] OR "Evaluation Studies as Topic"[Mesh] OR "Cross-Sectional Studies"[Mesh] OR "Observational Studies as Topic"[Mesh] OR "Cross-Over Studies"[Mesh] OR "Case-Control Studies"[Mesh] OR "Multicenter Studies as Topic"[Mesh] OR "Cohort Studies"[Mesh] OR "Longitudinal Studies"[Mesh] OR "Follow-Up Studies"[Mesh] OR "Controlled Before-After Studies"[Mesh]) OR ("Controlled Clinical Trial" [Publication Type] OR "Randomized Controlled Trial" [Publication Type] OR "Clinical Trial, Phase III" [Publication Type] OR "Clinical Trial, Phase II" [Publication Type] OR "Clinical Trial, Phase I" [Publication Type])) OR "Evidence-Based Medicine"[Mesh]))

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