REVIEW ARTICLE (META-ANALYSIS)

Effect of Home- and Community-Based Physical Activity Interventions on Physical Function Among Cancer Survivors: A Systematic Review and Meta-Analysis

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Abstract

Objective: To examine the effect of home- and community-based physical activity interventions on physical functioning among cancer survivors based on the most prevalent physical function measures, randomized trials were reviewed.

Data Sources: Five electronic databases—Medline Ovid, PubMed, CINAHL, Web of Science, and PsycINFO—were searched from inception to March 2016 for relevant articles.

Study Selection: Search terms included community-based interventions, physical functioning, and cancer survivors. A reference librarian trained in systematic reviews conducted the final search.

Data Extraction: Four reviewers evaluated eligibility and 2 reviewers evaluated methodological quality. Data were abstracted from studies that used the most prevalent physical function measurement tools—Medical Outcomes Study 36-Item Short-Form Health Survey, Late-Life Function and Disability Instrument, European Organisation for the Research and Treatment of Cancer Quality-of-Life Questionnaire, and 6-minute walk test. Random- or fixed-effects models were conducted to obtain overall effect size per physical function measure.

Data Synthesis: Fourteen studies met inclusion criteria and were used to compute standardized mean differences using the inverse variance statistical method. The median sample size was 83 participants. Most of the studies (n = 7) were conducted among breast cancer survivors. The interventions produced short-term positive effects on physical functioning, with overall effect sizes ranging from small (.17; 95% confidence interval [CI], .07—.27) to medium (.45; 95% CI, .23—.67). Community-based interventions that met in groups and used behavioral change strategies produced the largest effect sizes.

Conclusions: Home and community-based physical activity interventions may be a potential tool to combat functional deterioration among aging cancer survivors. More studies are needed among other cancer types using clinically relevant objective functional measures (eg, gait speed) to accelerate translation into the community and clinical practice.

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Recent projections indicate that by 2040, nearly 3 of 4 cancer survivors will be 65 years and older. Caring for this growing population is challenging, given that cancer and cancer-related therapies are associated with myriad late effects that may negatively affect quality of life and cause concern among survivors. Cancer survivors are at greater risk of losing physical functioning and independence as they age. Moreover, there is a growing concern that survivors may be experiencing accelerated aging and may have a higher prevalence of frailty compared with their cancer-free peers. The likelihood of functional limitations is even greater among survivors with comorbid conditions. Functional decline has been associated with a loss of independence, a loss of mobility, an increased mortality, and an increased rate of adverse health outcomes. Given these risks and concerns raised by survivors, there is a need for effective interventions to combat functional deterioration among aging cancer survivors.

Substantial evidence indicates that physical activity can prevent rapid functional deterioration, reduce mortality, and increase quality of life. However, fewer than 30% of cancer survivors achieve the recommended level of exercise (150min of aerobic exercise and ≥2d of resistance exercise weekly). Consequently, a number of physical activity intervention trials have been conducted to promote physical activity among cancer survivors. Currently, few of the effective interventions have been translated into the community and clinical practice. The lack of translations may be related to the experimental design (ie, randomized controlled trials conducted within high-resource settings) and the intense resources required to carry out the effective activity interventions.

Community-based and home-based physical activity interventions, on the other hand, may be a solution for accelerating the translation process by overcoming one of the barriers to dissemination. This is because these types of interventions are often implemented in a “real-world” setting that may have lower resources than major cancer centers or universities.

To date, systematic reviews evaluating physical activity interventions among cancer survivors have aggregated different intervention settings together (eg structure, supervised, home-based, community-based). In addition, reviews that calculated effect sizes have also combined all measures of physical functioning together or have considered physical functioning as part of their quality-of-life results or physiological outcomes. Given the translation potentials for community-based and home-based physical activity interventions and aligning with survivors’ and clinicians’ interest in physical functioning outcomes, it is the goal of this systematic review and meta-analysis to review randomized trials to examine the effect of home and community-based physical activity interventions on physical functioning among cancer survivors based on the most prevalent physical function measures. Our findings will help guide future home and community-based intervention development to have an emphasis on improving cancer survivors’ physical function beyond improvement of physical activity.

Methods

This review was completed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. The details of the protocol for this systematic review and meta-analysis, as well as a Medline Ovid search strategy example, were registered on PROSPERO (International Prospective Register of Systematic Reviews; http://www.crd.york.ac.uk/PROSPERO/; identification no. CRD42016036730).

Data sources and searches

The search strategy was developed by 2 of the authors (M.C.S., Z.H.L.) and conducted by a reference librarian trained in systematic reviews. Articles were collected from Medline Ovid, Medline PubMed, CINAHL, Web of Science, and PsycINFO. Community-based interventions, physical function, cancer survivors, and related words were used as search terms. Searches were limited to studies including adults aged ≥18 years and published in the English language. We did not limit by publication date and had a wide age range to ensure our ability to capture all possible articles. Related search terms and the complete search strategy for Medline Ovid are available on PROSPERO. Additional articles were also retrieved through searching the references of included articles and review articles that evaluated physical activity interventions among cancer survivors.

Study selection

Duplicates were removed, and the remaining articles were screened in 2 phases. The first phase aimed to identify all home and community-based physical activity interventions among cancer survivors that assessed physical function. Articles were screened for eligibility systematically by title, abstract, and then by full text. Retrieved articles were excluded for the following reasons: not in English, observational study design, review or meta-analysis, nonhuman subjects, abstract only, included children (<17y of age), secondary analysis of an intervention, not a physical activity intervention, and physical function was not assessed. Articles not available in full text were also excluded because abstracts often provide limited information about all intervention components. Screening in this phase was conducted independently by 2 reviewers (D.A., K.D.), and any disagreement was settled by discussion between the 2 reviewers and 2 authors (M.C.S., Z.H.L.). Articles deemed eligible were included in the second phase of screening.

To inform the meta-analysis, the second phase of screening aimed to select studies that were randomized controlled trials and used the most prevalent physical function measurement tools. Articles were reviewed by 2 authors (M.C.S., Z.H.L.) for uses of measurement tools assessing mobility and physical performance capacity, as defined by Painter and Marcus. Articles were eligible for the systematic review and meta-analysis if they were in English, a home or community-based physical activity intervention, conducted among cancer survivors 18 years and older, were randomized controlled trials, and used the most prevalent functional measures. Article inclusion was determined by a final screening of the full text by 2 authors (M.C.S., Z.H.L.).

Quality assessment

A risk-of-bias tool was used to assess the bias in all studies. The tool identifies the quality of each study using an 11-item scale,
with possible responses of “yes,” “no,” or “don’t know.” Appropriate cut points for studies with a low risk of bias are not well established. Because of the nature of home and community-based studies (eg, do not allow for double-blind interventions), we used a generous range of 3 or more “yes” responses to identify a high-quality study.28

Data analysis

We conducted meta-analyses using the Cochrane Review Manager (RevMan) software, version 5.3.3 Based on the meta-analysis guidelines, a minimum of 2 studies for the chosen physical function measurement tools is required.29 Thus, our meta-analyses considered a measurement tool as prevalent if it was included in 2 or more studies. Only studies with these measures were included in our analysis. Postintervention final mean or mean change values of the aforementioned physical functioning measures from individual studies were used to calculate standardized mean differences and 95% confidence intervals (CIs).30 Standardized mean differences were used because this method takes into account the variability observed in the study when calculating the intervention’s effect size.30 The total number of participants included in the meta-analyses was based on the final sample sizes used for analyses in the individual studies. The standardized mean differences and 95% CIs were calculated using the inverse variance statistical method.30 Meta-analyses were conducted to assess effect size using random or fixed effects as indicated by the I². We used I² calculated by RevMan software to determine heterogeneity among studies. We were unable to assess publication bias because of the low number of studies (n<10) available for each type of functional measure.30

Results

Article retrieval and screening were conducted from January through March 2016. The screening process is outlined in figure 1. A total of 2080 articles (Medline Ovid, 441; Medline PubMed, 466; CINAHL, 317; Web of Science, 668; PsyCINFO, 188) were retrieved through database searches and 3 additional articles from reference searching. Of the articles retrieved from database searches, 996 were duplicates. One reviewer (K.D.) excluded 810 articles based on the title, 203 articles based on the abstract, and 37 articles based on the full text. The other reviewer (D.A.) excluded 804 articles based on the title, 217 based on the abstract, and 24 based on the full text. The level of agreement between the 2 reviewers on the number of excluded articles was 96%. Two authors (M.C.S., Z.H.L.) screened the remaining 61 original articles by full text.

The second phase of screening found the most prevalent physical function measurement tools were the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) physical function subscale, the Late-Life Function and Disability Instrument (LLFDI), the European Organisation for the Research and Treatment of Cancer Quality-of-Life Questionnaire—Core 30 (EORTC QLQ-C30), and the 6-minute walk test (6MWT). The SF-36 is a quality-of-life questionnaire with a 10-item subscale for physical function. This subscale includes questions about the respondent’s ability to complete a variety of physical tasks.31 The SF-36 also has a physical component and a mental component summary score. We decided a priori to exclude articles that only reported the summary physical component score because the summary score included scores from other physical health—related subscales (eg, pain, general health) in addition to the physical function subscale score. The LLFDI is a self-report questionnaire that contains subscales for basic and advanced lower extremity physical functioning.32,33 The EORTC QLQ-C30 is also a self-report measure that evaluates quality of life with a 5-item subscale that focuses on physical function.34,35 The 6MWT measures the distance walked in meters by participants in 6 minutes.36 Although other objective measures of function (eg, gait speed, chair stand)37 were evaluated, these measures were performed differently across studies. Because of the heterogeneity, we decided to exclude studies that did not include the most prevalent physical function measurement tools.

After the second phase of screening, an additional 47 articles were excluded for the following reasons: secondary analysis of an intervention (n=3)37-39; included children (n=3)40-42; not a physical activity intervention (n=3)43-45; observational study design (n=10)46-55; single-arm intervention design (n=11)34,35,56-65; non-randomized trial (n=1)66; did not use the SF-36 physical functioning subscale (n=2)67,68; did not use LLFDI, EORTC QLQ-30, or 6MWT to assess physical function (n=13)69-80; and the main intervention was not home- or community-based (n=1).31

Study characteristics

The 14 studies included in this review consisted of 1959 participants (1768 participants included for the meta-analysis based on the final numbers used for analyses in individual studies) across 6 countries (United States, 82-92 Canada, 87 United Kingdom, 87 Australia, 93 Norway, 94 Korea). Study characteristics are presented in detail in table 1. All interventions were randomized controlled trials that lasted for 12 weeks,88-90,92,95 16 weeks,86 6 months,82,83,85 12 months,84,87,91,93 or the duration of cancer treatment (approximately 12–17wk).94 The mean age ranged from 44 to 73 years, and the mean body mass index ranged from 22 to 31 kg/m². Participants were predominantly white and women. The most prevalent cancer diagnoses were breast, followed by colorectal and prostate cancer. The average time since cancer diagnosis ranged from 4 months to 8 years, with 2 studies83,85 completed exclusively during cancer treatment. Two studies90,91 used objective physical activity measures (ie, accelerometer or pedometer) in addition to self-report activity measures to assess physical activity, while the other 12 studies used only self-reported measures such as the 7-day physical activity recall questionnaire,7 the Community Health Activity Model Program for Seniors,83,85,87,91 the International Physical Activity Questionnaire,84,94,95 or an exercise log.80 Most of the studies were deemed high quality with the risk-of-bias score ranging from 5 to 8.

Intervention components

The study components are described in 3 major categories of interventions below: behavioral change exercise interventions, home-based exercise interventions, and supervised exercise interventions. Most studies used more than one of these categories (see table 1). One study25 combined behavioral change and group-based exercise interventions. Seven studies90,92,94 combined behavioral change and home-based exercise interventions. One study24 used a supervised exercise intervention, 3 studies88,89,90,92,94
only used home-based exercise interventions, and 2 studies combined supervised and home-based exercise interventions.

Behavioral change exercise interventions
Behavioral change interventions were based on the trans-theoretical model, social cognitive theory, stages of motivational readiness, and a combination of stages of readiness with motivational interviewing principles. In 2 studies, participants received in-person counseling at study allocation, whereas in others, behavioral counseling sessions were conducted through in-person group sessions or over the telephone. Participants were counseled weekly or
<table>
<thead>
<tr>
<th>Study</th>
<th>Functional Measure</th>
<th>Exp (n)</th>
<th>Con (n)</th>
<th>Study Population</th>
<th>Duration (wk)</th>
<th>No. of Sessions</th>
<th>Setting</th>
<th>Intervention Components</th>
<th>Results (Change in Function)</th>
<th>Study Quality Score (0–11)</th>
</tr>
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<tbody>
<tr>
<td>Basen-Engquist, 2006</td>
<td>SF-36 6MWT</td>
<td>35</td>
<td>25</td>
<td>Cancer diagnosis: Female breast Mean age: 56y (Exp) vs 54y (Con) White: 20% (Exp) vs 56% (Con)</td>
<td>26</td>
<td>21</td>
<td>Local church/community clinic</td>
<td>- Weekly group sessions ×16wk, biweekly group session ×8wk with workbook and stage-matched booklets - Encouraged 30min of MPA - Self-monitoring tool(s): Pedometer, activity log</td>
<td>Significant improvement of 6MWT in Exp vs Con</td>
<td>7</td>
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<td>Behavioral and group</td>
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<td>7</td>
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<tr>
<td>Bennett, 2007</td>
<td>6MWT</td>
<td>28</td>
<td>28</td>
<td>Cancer diagnosis: Breast and other Mean age: 56y (Exp) vs 60y (Con) White: 96% (Exp) vs 100% (Con)</td>
<td>26</td>
<td>3</td>
<td>Home</td>
<td>- 1 in-person MI counseling and 2 telephone MI counseling sessions - Encouraged 30min MPA - Self-monitoring tool(s): Pedometer</td>
<td>No significant difference in 6MWT between groups</td>
<td>7</td>
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<tr>
<td>Demark-Wahnefried, 2006</td>
<td>SF-36</td>
<td>89</td>
<td>93</td>
<td>Cancer diagnosis: Breast and prostate Mean age: 72y (Exp) vs 72 (Con) White: 82% (Exp) vs 83% (Con)</td>
<td>26</td>
<td>12</td>
<td>Home</td>
<td>- Bimonthly telephone calls with tailored print materials - Encouraged improvement of diet and activity level</td>
<td>No significant difference in physical functioning between groups</td>
<td>7</td>
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<tr>
<td>Kim, 2011</td>
<td>EORCT QLQ-C30</td>
<td>23</td>
<td>22</td>
<td>Cancer diagnosis: Breast and colorectal Mean age: 45y (Exp) vs 47y (Con) Korean: 100% (Exp) vs 100% (Con)</td>
<td>12</td>
<td>12</td>
<td>Home</td>
<td>- Weekly telephone counseling with workbook and stage-matched exercise prescription and nutritional advice - Encouraged 150+ minutes of MPA - Self-monitoring tool(s): Heart rate monitor</td>
<td>No significant difference in physical functioning between groups</td>
<td>6</td>
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<tr>
<td>Ligibel, 2012</td>
<td>EORCT QLQ-C30 6MWT</td>
<td>48</td>
<td>51</td>
<td>Cancer diagnosis: Breast and colorectal Mean age: 53y (Exp) vs 56y (Con) White: 92% (Exp) vs 92% (Con)</td>
<td>16</td>
<td>10–11</td>
<td>Home</td>
<td>- Telephone counseling with workbook - Encouraged 180+ minutes of MPA - Self-monitoring tool(s): Pedometer, activity log</td>
<td>Significant improvement of 6MWT and physical functioning in Exp vs Con</td>
<td>3</td>
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<tr>
<th>Study</th>
<th>Functional Measure</th>
<th>Exp</th>
<th>Con</th>
<th>Duration (wk)</th>
<th>No. of Sessions</th>
<th>Setting</th>
<th>Intervention Components</th>
<th>Results (Change in Function)</th>
<th>Study Quality Score (0–11)</th>
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<tbody>
<tr>
<td>Morey, 2009</td>
<td>SF-36, LLFDI</td>
<td>319</td>
<td>322</td>
<td>52</td>
<td>23</td>
<td>Home</td>
<td>- 15 telephone sessions and 8 prompts with tailored workbook and quarterly newsletter</td>
<td>Significantly less physical functioning and basic lower extremity functioning deterioration</td>
<td>7</td>
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<tr>
<td>Pinto, 2013</td>
<td>SF-36</td>
<td>106</td>
<td>86</td>
<td>12</td>
<td>12</td>
<td>Home</td>
<td>- 1 session of exercise advice with provider, 4 weekly, 4 biweekly, and 3 monthly telephone sessions with progress letter, activity and survivorship tip sheets</td>
<td>Significant improvement of physical functioning in Exp vs Con</td>
<td>7</td>
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<tr>
<td>Pinto, 2013</td>
<td>SF-36</td>
<td>20</td>
<td>26</td>
<td>12</td>
<td>12</td>
<td>Home</td>
<td>- Weekly and 3 monthly telephone sessions with progress letter, activity and survivorship tip sheets</td>
<td>No significant difference in physical functioning between groups</td>
<td>7</td>
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<tr>
<td>Supervised intervention Brown, 2015</td>
<td>SF-36</td>
<td>148</td>
<td>147</td>
<td>52</td>
<td>26</td>
<td>YMCA</td>
<td>- 2×/wk weightlifting group session ×13wk, then exercise prescription for 39wk</td>
<td>Significantly less physical functioning deterioration in Exp vs Con</td>
<td>8</td>
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Table 1 (continued)
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<thead>
<tr>
<th>Study</th>
<th>Functional Measure</th>
<th>Exp (n)</th>
<th>Con (n)</th>
<th>Study Population</th>
<th>Duration (wk)</th>
<th>No. of Sessions</th>
<th>Setting</th>
<th>Intervention Components</th>
<th>Results (Change in Function)</th>
<th>Study Quality Score (0–11)</th>
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<td><strong>Home-based intervention</strong></td>
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<tr>
<td>Huesbo,94 2014</td>
<td>6MWT</td>
<td>33</td>
<td>34</td>
<td>Cancer diagnosis: Female breast</td>
<td>~17.2</td>
<td>~8</td>
<td>Home</td>
<td>- Telephone calls every second week</td>
<td>No significant difference in 6MWT between groups</td>
<td>6</td>
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<td>Mean age: 51y (Exp) vs 54y (Con)</td>
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<td>- Strength-training prescription with resistance bands and prescription for a daily brisk walking for 30min (MPA)</td>
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<td>Norwegian: 82% (Exp) vs 88% (Con)</td>
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<td>- Self-monitoring tool(s): Activity log</td>
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<td>Reis,90 2013</td>
<td>6MWT</td>
<td>22</td>
<td>19</td>
<td>Cancer diagnosis: Female breast</td>
<td>12</td>
<td>3</td>
<td>Home</td>
<td>- 3 in-person Nia* training sessions with prescription of 20–60min of Nia 3×/wk at home</td>
<td>No significant difference in 6MWT between groups</td>
<td>6</td>
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<td>Mean age: 54y (Exp) vs 54y (Con)</td>
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<td>- Provided Nia DVD</td>
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<td>White: 91% (Exp) vs 90% (Con)</td>
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<td>- Self-monitoring tool(s): Activity log</td>
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<td>Yuen,92 2007 (aerobic group)</td>
<td>6MWT</td>
<td>9</td>
<td>9</td>
<td>Cancer diagnosis: Female breast</td>
<td>12</td>
<td>4</td>
<td>Home</td>
<td>- 1 in-person training session with exercise prescription and weekly phone call ×3wk</td>
<td>No significant difference in 6MWT between groups</td>
<td>5</td>
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<td>Mean age: 53y (Exp) vs 55y (Con)</td>
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<td>- Aerobic prescription: 20–40min walking 3×/wk</td>
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<td>White: 87% (Exp) vs 86% (Con)</td>
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<td>- Resistance prescription: 8 exercises 3×/wk</td>
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<td>- Self-monitoring tool(s): Activity log</td>
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<td>Yuen,92 2007 (resistance group)</td>
<td>6MWT</td>
<td>11</td>
<td>9</td>
<td>Cancer diagnosis: Female breast</td>
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<td>4</td>
<td>Home</td>
<td>- 1 in-person training session with exercise prescription and weekly phone call ×3wk</td>
<td>No significant difference in 6MWT between groups</td>
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<td>Mean age: 54y (Exp) vs 55y (Con)</td>
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<td>- Aerobic prescription: 20–40min walking 3×/wk</td>
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<td>White: 57% (Exp) vs 86% (Con)</td>
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<td>- Resistance prescription: 8 exercises 3×/wk</td>
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<td>- Self-monitoring tool(s): Activity log</td>
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<td><strong>Supervised and home-based intervention</strong></td>
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<tr>
<td>Galvão,93 2014</td>
<td>SF-36</td>
<td>50</td>
<td>50</td>
<td>Cancer diagnosis: Prostate</td>
<td>52</td>
<td>104</td>
<td>Exercise clinic and home</td>
<td>- 1 weekly group sessions and 2 weekly home-based sessions for 26wk, then home-based for 26 additional weeks with booklet</td>
<td>Significant improvement of physical functioning in Exp vs Con</td>
<td>8</td>
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<td>Mean age: 72y (Exp) vs 72y (Con)</td>
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<td>- Encouraged aerobic exercise</td>
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<td>White: NR</td>
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<td>- Self-monitoring tool(s): Pedometer, heart rate monitor</td>
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bimonthly\textsuperscript{85} for the duration of the study. Other interventions decreased the frequency of counseling or group meetings over time.\textsuperscript{82,86–88} Bennett et al\textsuperscript{83} supplemented the initial counseling with 3 additional counseling sessions over 5 months. During counseling, all behavioral change interventions promoted self-monitoring of behavior. Participants were encouraged to time their exercise,\textsuperscript{82,86} use the pedometer provided,\textsuperscript{82,83,86–89} use the heart rate monitor provided,\textsuperscript{95} and log their activity in a diary.\textsuperscript{82,86–89} Participants also received printed materials that summarized counseling contents. They were provided activity-related education or were provided feedback on their activity level during counseling sessions, or both.\textsuperscript{82,85–89,95} The RENEW study conducted by Morey et al\textsuperscript{87} provided resistance bands, an exercise poster, and a table guide for food portioning in addition to printed contents and pedometers.

**Home-based exercise interventions**

Three of the home-based exercise interventions selected for our meta-analysis did not specify the use of behavioral change theory or behavioral change strategies. These studies aimed to increase encouragement in strength and aerobic exercise,\textsuperscript{94} aerobic exercise alone,\textsuperscript{92} and resistance exercise alone.\textsuperscript{92} One study\textsuperscript{90} targeted a specific cardiovascular and whole-body conditioning program called Nia. Across studies, participants were instructed to walk briskly for 30 minutes a day and perform strength training 3 times a week,\textsuperscript{94} follow instructional Nia DVDs for 20 to 60 minutes a day for 3 days a week,\textsuperscript{90} walk or perform other aerobic activities 3 days a week,\textsuperscript{92} and perform strength-training exercises 3 days a week.\textsuperscript{92} Participants were given resistance bands\textsuperscript{92} and dumbbells\textsuperscript{92} to support strength training. One study\textsuperscript{94} also included biweekly phone calls for surveillance and support. In the study conducted by Reis et al,\textsuperscript{90} investigators met with participants in person every 6 months to enhance the movements of Nia.

**Supervised exercise**

Supervised exercises was performed one-on-one\textsuperscript{91} or in a group within a community facility.\textsuperscript{84,93} Supervision was either in conjunction with home-based exercise\textsuperscript{91,93} or preceded the home-based exercise maintenance portion of the intervention.\textsuperscript{84,93} All the studies in this section prescribed supervised exercise twice a week. Exercise consisted of aerobic and strength training, but there was an emphasis on strength-training exercises.\textsuperscript{21,91,93} Researchers provided free weights, resistance bands,\textsuperscript{91} heart rate monitors, and pedometers\textsuperscript{93} to encourage home-based exercise once\textsuperscript{91} or twice\textsuperscript{91} a week in addition to the supervised activity. After supervised exercises ceased, participants were given a booklet, a detailed prescription for maintenance, or both.\textsuperscript{84,93}

**Comparison groups**

Interventions were compared with control participants who received standard care,\textsuperscript{82,84,86,90,94} a low-impact intervention,\textsuperscript{85,88,89,91,93} or those wait-listed to receive the intervention.\textsuperscript{87} Low-impact interventions included bimonthly general health counseling and printed material,\textsuperscript{82} a pedometer and general health educational booklet,\textsuperscript{93} motivational interviewing counseling at study allocation and printed survivorship educational material,\textsuperscript{82,88} monitoring phone calls,\textsuperscript{88} a combination of printed survivorship educational material and monitoring phone calls,\textsuperscript{89} or supervised and home-based whole-body stretching and relaxation exercises.\textsuperscript{91}
Meta-analysis for mobility and performance capacity outcomes

The median number of participants across the 14 studies was 83 per study, with the middle 50% (25th to 75th percentile) of study sizes falling between 41 and 182. Statistical testing for heterogeneity indicated that the estimated effect size had relatively low variability within each subtype of mobility and performance capacity measures ($I^2 = 0\% - 46\%$) (figs 2 and 3). This suggests that the effect sizes obtained from our meta-analysis are consistent across studies.

Overall, 4 of the 5 physical functioning measures showed significant small (.17) to medium (.45) effect sizes (see figs 2 and 3). A significant positive effect on self-reported physical functioning among 802 cancer survivors was found for 8 interventions that used the SF-36 physical functioning subscale (standardized mean difference = 0.17; 95% CI, 0.07–0.27) (see fig 2A). This translates to a 2.1-point increase in SF-36 physical functioning score among the experimental groups.

Only 2 interventions (37, 97) found a significant positive effect on self-reported physical functioning. As for the 2 interventions that used the LLFDI—basic lower extremities measure, a significant improvement on the self-reported basic function of lower extremities was indicated among 305 cancer survivors (standardized mean difference = 0.17; 95% CI, 0.02–0.33) (see fig 2B). The raw mean difference showed a 2.5-point increase in LLFDI—basic lower extremities score among the experimental groups. However, LLFDI—advanced lower extremities measure did not show a significant effect size (see fig 2C). Two interventions that used the physical functioning subscale of the EORTC QLQ-C30 found a significant positive effect on self-reported functioning in 71 cancer survivors, with a standardized mean difference of 0.44 (95% CI, 0.11–0.77) (see fig 2D). This translates to a 3.9-point increase in the EORTC QLQ-C30 physical functioning subscale.

Lastly, a significant and positive effect on 160 cancer survivors’ objectively measured mobility and performance capacity was observed in the 6 interventions that used the 6MWT.
The mean difference between groups showed a 27.5-m increase in the 6MWT among the experimental group. Of 6 studies, only 2 interventions\textsuperscript{82,86} found a significant and positive effect on the 6MWT when considering the studies individually.

### Discussion

This systematic review and meta-analysis evaluated the effect of home and community-based physical activity interventions on physical functioning among cancer survivors based on the most prevalent physical function measures. To our knowledge, we are one of the first systematic reviews and meta-analysis to make this evaluation. Previous reviews\textsuperscript{16,22} on physical activity interventions in cancer survivors have combined home-based, community-based, and other structured interventions. In addition, most reviews have focused on the physical activity outcomes or have considered physical functioning as part of the quality of life or physiological outcomes.\textsuperscript{18,21,24,25}

Overall, we found that most of the interventions were conducted among breast cancer survivors, followed by colorectal and prostate cancer survivors. The most prevalent physical functioning measures used by interventions were the SF-36, LLFDI, EORTC QLQ-30, and 6MWT. Our findings indicate that home and community-based physical activity interventions had a positive effect on 4 of the 5 mobility and performance capacity measures in cancer survivors, despite the variability among individual studies.

The interventions produced a small to moderate positive effect on physical functioning in cancer survivors. Interventions differed widely in regards to type of exercise intervention (aerobic, resistance, or weight training), duration (12\textendash52 wk), number of sessions (3\textendash104 sessions), and settings (home, group, or combinations).

Our results found improvement of physical functioning among survivors participating in physical activity interventions and are in agreement with a previous meta-analysis\textsuperscript{98} and systematic review\textsuperscript{19} on physical activity interventions that evaluated physical functioning among cancer survivors. However, neither study exclusively evaluated home and community-based physical activity interventions. The previous meta-analysis\textsuperscript{98} also differed from our current study analytically; it included mean differences, while our study included standardized mean differences. The standardized mean differences we used accounted for the variability observed in the individual studies based on the measurement scales they used. Despite these differences, our results support their findings. Fong et al\textsuperscript{99} indicated an increase of 3.4 points (95% CI, 0.4\textendash6.4) on the SF-36 physical functioning component. In our meta-analysis we found a 2-point increase (95% CI, 6.5\textendash3.5; \( P = .004 \)). Even though the home and community-based physical activity interventions seemed to produce a smaller increase compared with previous findings,\textsuperscript{98} the 2-point increase still fell within the range of 2.0 to 7.8 points of the minimal clinically important difference for the SF-36 physical functioning component.\textsuperscript{99} As for the 6MWT, Fong indicated an increase of 29 m (95% CI, 3\textendash55), while we found an increase of 28 m (95% CI, 15.1\textendash39.86; \( P < .0001 \)). Both of our findings suggest that physical activity interventions were able to produce positive and significant increases in aerobic capacity; however, improvements fell below the conservative estimate of 54 to 80 m of the minimal clinically important difference for the 6MWT.\textsuperscript{100}

Although these community-based or home-based programs have lower efficacy, their higher reach and possible greater potential for sustainability could lead to broader population-level improvements.\textsuperscript{101}

Individual studies\textsuperscript{82,84} with the largest effect sizes from the SF-36 physical functioning subscale used community-based interventions that met in groups. As for the 6MWT, the largest effect size also came from a community-based intervention that met in groups\textsuperscript{82} and a home-based intervention with telephone counseling.\textsuperscript{86} Our results suggest that community-based interventions that meet in groups and are using cognitive-behavioral therapy may be the most effective physical activity intervention format for improving physical functioning among cancer survivors.

### Future research

Several questions still remain after our review. We found that most of the studies (10 of 14) only evaluated physical functioning at the end of the intervention. Four interventions followed up their participants either for another 12 weeks or 26 weeks to evaluate the maintenance of functional change after ending the intervention. Among these studies, some have found that physical functioning benefits gained from the intervention were not sustained.\textsuperscript{85,87} This is similar to the findings from other systematic reviews and meta-analyses that have evaluated change in physical activity in cancer survivors.\textsuperscript{16,19}

Another area that needs further exploration is the use of other objective mobility and performance capacity measures in physical activity intervention studies. These include measures of gait speed, timed up and go, and repeated chair stands.\textsuperscript{27} Several studies included these objective measures, but they were excluded from our review and meta-analysis during the screening process because of inconsistencies in the chosen protocols. With the use of the chair rise test as an example, in some studies participants were instructed to complete 5 chair stands as fast as they could (using the Short Physical Performance Battery protocol),\textsuperscript{102} while other
Studies instructed participants to complete as many chair rises as they could in 30 seconds (using the Senior Fitness Test protocol). The use of different protocols makes it difficult to make comparisons across studies. Additionally, only 2 of 14 studies used objective physical activity measures. Self-report measures, which were used in most of these studies, may be subject to a reporting bias. Studies will need to include objective mobility and performance capacity measures more consistently in order to strengthen the evidence supporting the use of home and community-based physical activity interventions by clinicians as an additional method to help improve physical functioning in cancer survivors. Future interventions may also benefit from inclusion of objective physical activity measures, for physical activity is an important contributor to maintenance of high physical functioning. By using objective activity measures, consistent reporting of the level of activity across studies may help a future meta-analysis determine whether sufficient activity was produced in different home or community-based interventions to increase physical function.

**Study limitations and strengths**

Our review has several limitations. The search strategy included only peer-reviewed articles in English available in select databases. There may be other studies that were not captured by our search strategy because they were in another language or not available in a database or through reference searching. Furthermore, our review was limited to randomized trials available in full text. Our results need to be interpreted with caution because they may be subject to bias by not including observational study designs or articles that did not have full text available. Although steps were taken to address incomplete reporting in randomized controlled trials, incomplete reporting may have inflated the effect size estimates. In addition, our review may not be generalizable to all other cancer types because most of the interventions were conducted among breast, prostate, and colorectal cancer survivors.

Our review has several strengths. First, we focused on home and community-based physical activity interventions for cancer survivors in treatment and off treatment. Our meta-analysis also included studies that used less frequently used physical functioning measures such as the LLFDI and EORTC QLQ-C30. Importantly, we also calculated the effect size using the standardized mean difference, which accounted for the variability among individual studies.

**Conclusions**

In conclusion, our review and meta-analysis indicate that home and community-based physical activity interventions can improve physical functioning among cancer survivors. Referring patients to existing community-based programs (eg, LIVESTRONG at the YMCA and Silver Sneakers) may complement physical functioning improvements gained through clinic-based rehabilitation. Given the results showing larger effect sizes in studies that used cognitive-behavioral counseling, providing cognitive-behavioral interventions to supplement existing community-based programs may further improve outcomes. Research has shown that by using behavioral change theories (such as the cognitive-behavioral therapy), interventions were able to produce a larger and more sustainable effect on behavior change. More research is needed to provide objective evidence on improvements in physical functioning among cancer survivors engaging in home and community-based physical activity interventions, and to evaluate the sustainability of these improvements. Translating effective interventions into the community and clinical practice not only can create a public health impact by reaching more survivors, but also will ensure greater accessibility given the limited resources and transportation issues faced by many aging cancer survivors.

**References**


