Community-Based Group Physical Activity and/or Nutrition Interventions to Promote Health and Mobility in Older Adults: An Umbrella Review

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Abstract

Background

Physical activity and a healthy diet are important in helping to maintain mobility and quality of life with aging. Delivery of physical activity and nutrition interventions in a group setting adds the benefits of social participation.

Objectives

This umbrella review aims to identify group-based physical activity and nutrition interventions for community-dwelling older adults that improve mobility.

Methods

Five electronic databases (MEDLINE, Embase, CINAHL, Cochrane CENTRAL, Sociological Abstracts) were searched from inception to April 28, 2020. Eligibility criteria included systematic reviews exploring the effectiveness of physical activity and/or nutrition interventions, delivered in a group setting for community-dwelling older adults. Two reviewers independently performed eligibility screening, critical appraisal (using AMSTAR 2) and data extraction. Older adult/provider research partners informed data synthesis and results presentation.

Results

In total, 54 systematic reviews (1 high, 21 moderate, 32 low/critically low quality) were identified; 46 included physical activity only, and eight included both physical activity and nutritional supplements. No reviews included nutrition interventions alone. Combined aerobic/resistance, general physical activity, and mind-body exercise all improved physical function and balance (moderate-high certainty). Aerobic/resistance training improved aerobic capacity (high certainty). Resistance training and general physical activity improved muscle strength (moderate certainty). Aerobic/resistance training and general physical activity are likely to reduce falls among older adults (moderate certainty). There was no evidence of benefit for nutritional supplementation with physical activity.

Conclusions

Multicomponent group-based physical activity interventions can improve measures of mobility in community-dwelling older adults. We found no reviews focused on nutrition only, highlighting a gap in the literature.

Background

Mobility is a multifaceted construct, influenced by a range of physical, cognitive, psychosocial, environmental, financial, gender, cultural, and biographical factors (1). A comprehensive view of mobility reflects one's ability to move within their immediate home environment and the broader community (1). Reductions in mobility and the ability to carry out activities of daily living are common with aging and are recognized precursors to frailty, hospitalization, and death (2, 3). The effect of physical activity (PA) and diet quality on physical, cognitive, and social outcomes has been widely demonstrated; however, inactivity and malnutrition continue to affect the well-being and mobility of older adults (4–8).

Community-based programs delivered in group settings can address both the physical and psychosocial aspects of mobility, promoting a sense of belonging which aids in long-term adherence (9, 10). The Enhancing physical and community MoBility in OLDEr adults with health inequities using commuNity co-design (EMBOLDEN) trial is a multi-year program of research from XX University in [City, Country] (11). EMBOLDEN uses community-based co-design to integrate local community needs, preferences, and resources with high-quality scientific evidence. The interdisciplinary team of researchers collaborates with older adults and community organizations to enhance personal mobility and address health inequities.

Several systematic reviews have been published exploring a broad range of PA and/or nutrition interventions for older adults, making it challenging to bring together the best scientific evidence to inform program design. Umbrella reviews provide a rigorous methodology for synthesizing evidence from multiple existing systematic reviews (12), and may be particularly useful for a phenomenon such as mobility given the wide variety of interventions and uncertainty as to which interventions are more effective when delivered individually or in combination and within different populations and/or settings. To date, two umbrella reviews have reported the effectiveness of exercise interventions in pre-frail, frail, or sarcopenic older adults (13, 14), and one umbrella review has described the impact of nutritional interventions for community-dwelling older adults on body composition (15). Given the lack of recent, relevant synthesized evidence to meet our needs, our team undertook this umbrella review to help inform intervention design and provide a foundation for the EMBOLDEN project. This umbrella review aims to synthesize evidence from existing systematic reviews regarding the effectiveness of group-based PA and/or nutrition interventions to improve mobility in community-dwelling older adults.

Methods

This review was conducted following the *Joanna Briggs Institute* (JBI) guidance for umbrella reviews (12), and was registered with PROSPERO (CRD42020141352). Although originally conceptualized as a systematic review, upon initiation of screening it was determined that many systematic reviews existed, and an umbrella review was most appropriate.

Search Strategy

A trained librarian conducted a search of MEDLINE, Embase, CINAHL, Cochrane CENTRAL, and Sociological Abstracts from inception to April 28, 2020 (Additional file 1). Searches were limited to systematic reviews/meta-analyses and randomized controlled trials (RCTs) published in English.

Study Selection

Citations were imported into DistillerSR (Evidence Partners, Ottawa, Canada) and duplicates were removed. Citations were reviewed by two independent reviewers using pre-determined criteria. At the title/abstract level, a study must have been selected by one reviewer for inclusion, while exclusion required two reviewers to agree. At the full-text level, disagreements were resolved through discussion by two reviewers, with input from a third team member as needed.

Eligibility Criteria

Types of Studies

Systematic reviews (narrative summary, meta-analysis, or network meta-analysis) of interventions published since 2010 were eligible. Scoping or narrative reviews that did not include critical appraisal of primary studies were excluded. Eligible reviews could include RCTs and non-randomized intervention studies, however, at least 80% of single studies included must have been interventions (i.e., not descriptive, qualitative, or observational).

Types of Participants

Eligible systematic reviews included studies involving community-dwelling older adults. Reviews were included if the pooled mean age or inclusion criteria identified an age of ≥ 55 years. If this information was not available, at least 70% of included studies must have reported a mean sample age of ≥ 55 years. Reviews in which studies were selected based on a specific health or disease status (e.g., cancer, sarcopenia) were excluded. In reviews that did not restrict by disease status, 70% of included studies must have been conducted in general sample of older adults. The choice of 70% was intended to include reviews in which the majority of included studies were relevant to the general population; most studies were either well above or well below this threshold.

Interventions

Eligible reviews must have included single studies of any PA (any movement resulting in energy expenditure), structured exercise (planned and repetitive movements), and/or nutrition intervention that could reasonably be delivered in a group-based setting (16).

Context

Single studies within eligible reviews must have been delivered in a community setting. Reviews that focused exclusively on interventions delivered in hospitals, rehabilitation centers, long-term care homes, or clinics were excluded. When the reviews did not set inclusion criteria by setting, at least 70% of included single studies were required to be community based.

Outcomes

Reviews must have synthesized (narratively or via meta-analysis) outcomes related to physical or community mobility. These outcomes were broadly classified into six domains: aerobic capacity, physical function, balance, falls/safety, muscular strength, and self-reported mental wellbeing/quality of life.

Reviews that focused exclusively on cognitive function or body composition were excluded. These criteria were not part of our original protocol as registered in PROSPERO but added at the full text screening level as the goals of these interventions and associated outcomes were quite distinct.

Assessment of Methodological Quality

Eligible reviews were critically appraised using A MeaSurement Tool to Assess systematic Reviews (AMSTAR 2) (17). AMSTAR 2 was completed independently by two reviewers, with conflicts resolved through discussion or the input of a third reviewer, as needed. Following consensus, results were entered into the online AMSTAR checklist, which provides an assessment of overall quality as critically low, low, moderate, or high based on seven critical domains (18).

Data Extraction

Data were extracted by two independent reviewers using a standardized form. Disagreements were resolved through discussion or by a third reviewer. Data were extracted related to review methodology (e.g., sources searched, publication date range, methodological quality of included studies, noted limitations) and details of included studies (e.g., study designs, participant characteristics, intervention descriptions, setting). To explore issues of equity, diversity and inclusion, any data regarding material deprivation, and percentage of low-income and/or immigrant populations were also extracted. Results from both narrative syntheses and meta-analyses were extracted within the six outcome categories described above. Any outcomes within these categories or composite outcomes in these areas (e.g., when multiple outcome measures were grouped and reported as standardized mean difference in a meta-analysis) were extracted, as reported. Data collection forms and full extracted data are available upon request.

Data Synthesis and Certainty of Evidence

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach was used to assess the overall certainty of the evidence (19). The GRADE process was adapted to accommodate the umbrella review by considering both the findings across included reviews and across single studies within reviews by intervention type and outcome. Following the GRADE approach, reviews including primarily RCTs start at 'high' certainty, while reviews primarily including non-randomized studies start at 'low' certainty. The level of certainty was further downgraded based on risk of bias, inconsistency of findings, indirectness of interventions/outcomes, imprecision of effect measures, and/or publication bias, and were upgraded based on magnitude of effect size, dose-response relationship, and accounting for confounding. A narrative approach to data synthesis was used, with results presented in supporting tables and figure. Informative statements reflecting both the certainty of evidence and importance of the

size of the effect are presented to communicate overall findings within each intervention type and outcome category, in line with published recommendations (20). Only results that compared an intervention group to a control group were included in GRADE, although subgroup analyses are presented in accompanying tables.

The review team synthesized data with feedback and input from the larger research team and key stakeholders. After an initial draft, preliminary results and categories were presented to four older adult citizen and service provider partners from an established stakeholder group within the EMBOLDEN research program who were consulted via a one-time, virtual meeting. The aim of this engagement was to allow for feedback (via discussion) about the appropriateness of intervention/outcome groupings and to identify priority outcome measures (e.g., prioritize general physical function outcomes over measures such as body composition). Our older adult and service provider partners also contributed to developing public-facing documents, including a plain-language summary and infographic.

Results

The search identified 36,535 unique citations, of which 1,108 were potentially relevant; at this point, the team elected to limit to systematic reviews (Figure 1). A second screen identified 337 citations for full-text review, of which 54 were included (Table 1). A list of excluded studies with reasons is provided in Additional file 2.

Included reviews reported on several types of interventions, with some reporting separate results for more than one intervention type. Most reviews focused on exercise or PA only (n = 46) (21-66), while others included exercise with nutritional supplements (n = 8) (67-74). No reviews included group-based nutrition interventions alone. Exercise or PA interventions were categorized as resistance exercise (n = 11) (21, 30, 34, 35, 38, 46, 56, 61-63, 75), aerobic exercise (n = 4) (22, 24, 28, 51), combined aerobic and resistance exercise (n = 9) (23, 29, 34, 36, 44, 46, 50, 63, 75), general PA (n = 9) (32, 33, 35, 40, 45, 49, 52, 54, 66), mind-body exercise (e.g., Tai Chi, yoga, Pilates) (n = 8) (26, 27, 35, 43, 47, 55, 58, 59), dance (n = 5) (31, 37, 48, 57, 63), and other (n = 10) (25, 34, 35, 39, 42, 53, 63-65, 76). Nutritional supplements included protein (n = 4) (69, 72-74), creatine (n = 2) (67, 71), vitamin D (n = 1) (68), or dairy (n = 1) (70). Meta-analyses were undertaken in 34 reviews (21, 22, 26-30, 32-35, 40, 42, 43, 46, 48, 51, 53, 54, 56, 59, 61-63, 65, 66, 68, 70-75, 77), 19 reviews presented findings narratively (23, 24, 31, 37-39, 44, 45, 47, 49, 50, 52, 55, 57, 58, 64, 67, 69, 76), and one performed a network meta-analysis (25). Total sample sizes ranged from 153-28,523 when reported. Participants ranged from 42-98 years old, with most reviews only including studies with participants aged 60 and older. No reviews extracted data on material deprivation, low income, or immigrant populations.

Eligible reviews included 1,170 primary studies, of which 853 were unique (27.1% overlap across reviews, although some duplicates were included in reviews focused on different intervention types). Reviews with the most overlap by intervention type were exercise with nutritional supplements (36.2% overlap), dance (21.9% overlap), and resistance exercise (26.7% overlap). Single studies were published between 1983-

2020 (range 5 to 99 studies per review). Of these, 82% were randomized controlled trials and 18% were quasi-experimental, observational, or not reported.

Methodological Quality of Included Reviews

Methodological quality of the reviews was variable (summary in Figure 2, full assessment in Additional file 3), with one review (35) rated as having high confidence in findings. The confidence for the remaining reviews were moderate (n = 21) (24, 25, 30, 32, 33, 39, 51, 52, 55, 56, 59, 62-65, 68-71, 76, 77), low (n = 14) (26, 29, 31, 40, 42, 43, 46, 49, 54, 57, 58, 66, 67, 72), and critically low (n = 18) (21-23, 27, 28, 34, 37, 38, 44, 45, 47, 48, 50, 53, 61, 73-75). Most reviews did not report protocol registration, describe an adequate search strategy, justify excluded studies, or incorporate risk of bias in interpreting review findings.

Findings of Reviews

A summary of findings by intervention type and outcome category, alongside review quality is listed in Table 2, with summary of certainty of evidence (GRADE) in Figure 3.

Aerobic capacity

The effect of interventions on aerobic capacity was reported in 13 reviews (Additional file 4). Across reviews, 97 studies were reported, of which 92 were unique (overlap, 5.2% across intervention types). Aerobic capacity was most often assessed using measured or predicted maximal or peak oxygen consumption (VO₂ peak). Based on high-certainty evidence, a combination of aerobic and resistance training results in meaningful improvements in aerobic capacity in older adults. Based on moderate certainty evidence, aerobic exercise probably results in improvements in aerobic capacity. Dance interventions may result in increased aerobic capacity, although this is based on low-certainty evidence and findings may change as more information becomes available. Interventions that combined exercise with nutritional supplements may make little to no difference in aerobic capacity of older adults, although this is based on low-certainty evidence. The evidence is very uncertain about the effect of mind-body exercise or resistance exercise alone on aerobic capacity in older adults (very low certainty evidence). Other exercise types, including aquatic exercise and a combination of PA and cognitive training were also examined for their effect on aerobic capacity. No included reviews explored the effect of general PA interventions on aerobic capacity.

Physical function

In total, 44 reviews reported on 516 single studies, of which 372 were unique (27.9% overlap across intervention types). Physical function was typically assessed using the Timed Up and Go test, chair stands, gait speed, and six-minute walk test; often findings from single studies were compiled into a composite score for self-reported and/or measured physical function within meta-analyses (Additional file 5). Based on moderate certainty evidence, interventions that included a combination of aerobic and

resistance training, interventions focused on general PA, and mind-body exercise interventions are all likely to result in improvements in physical function in older adults. Resistance training and dance interventions may also increase physical function (low certainty evidence). Low certainty evidence suggests that aerobic exercise interventions and exercise combined with nutritional supplements may have little to no impact on physical function.

Balance

In total, 25 reviews reported on 217 single studies, of which 181 were unique (16.6% overlap). Static and dynamic balance tests (e.g., single-leg stance, Berg Balance Scale) and composite balance measures were used across reviews (Additional file 6). High certainty evidence suggests that participation in mind-body exercise interventions increases balance in older adults. General PA interventions and interventions that combined aerobic and resistance training are also likely to result in improvements in balance in older adults, based on moderate-certainty evidence. Dance interventions may improve balance; however, this is based on low certainty evidence. Also based on low certainty evidence, resistance training and aerobic exercise alone may result in little to no change in balance. No included reviews explored the effects of exercise and nutritional supplements on balance.

Falls and safety

Number of falls, risk of falling, and fall-related injuries were measured across 10 reviews including 88 single studies, 78 of which were unique (11.4% overlap). Interventions that combined aerobic and resistance exercise and interventions focused on general PA are likely to result in a small reduction in the risk of falls or fall-related injuries in older adults, based on moderate certainty evidence (Additional file 7). Based on low-certainty evidence, mind-body exercises may have little to no meaningful effect on fall risk, although these findings may change as more data are available. Dance interventions may reduce falls, but the evidence is of very low certainty. Also based on very low certainty evidence, aerobic training alone and resistance training alone may have little to no effect on falls risk. No reviews reported the risk of falls within interventions that combined exercise and nutrition.

Muscle strength

Within reviews reporting muscle strength outcomes, 34 reviews reported on 369 single studies, of which 292 were unique (20.9% overlap). Various measures were reported, including handgrip strength, upper body strength, lower body strength, muscle mass, and overall muscle strength (Additional file 8). Both resistance exercise interventions and general PA interventions likely increase upper and lower body strength (moderate certainty evidence). Aerobic exercise alone, combined aerobic and resistance exercise, mind-body exercise, and dance interventions may result in improvements in muscle strength, however this is based on low certainty evidence and findings may change as more data become available. Also based on low certainty evidence, interventions that combined exercise with nutritional supplements may not improve muscle strength.

Health-related quality of life and self-reported wellbeing

In total, 14 reviews reported health-related quality of life and self-reported wellbeing outcomes (Additional file 9). Given the variation in constructs measured within this domain (e.g., activities of daily living, quality of life (SF-36), perceived mental health) and limited number of reviews for each outcome type, these results were not incorporated into the overall summary of findings using GRADE.

Discussion

We provide a high-level synthesis regarding overall effectiveness of group-based PA and nutrition interventions to improve mobility among community-dwelling older adults. Interventions that combined aerobic and resistance exercise, and general PA interventions were found to result in meaningful improvements in physical function, balance, aerobic capacity, and muscle strength in older adults, and are also likely to reduce falls and fall-related injuries.

Our findings support a multifaceted approach to health and wellbeing among community-dwelling older adults. Similar findings are reflected in two overviews of reviews focused on all adults over the age of 18, including older adults (78, 79), which informed the recent Canadian 24-Hour Movement Guidelines (80). These guidelines also recommend a combination of aerobic, resistance, and balance exercises for adults aged 65+. Recent evidence has found that older adults face unique barriers and hesitancy to engage in certain types of exercise, such as resistance training (81). It is encouraging that benefits for each of our outcome domains were seen across a range of intervention types. This suggests that effective interventions for older adults can incorporate a variety of type of exercises or physical activities that are most likely foster enjoyment. This approach can also improve accessibility to PA within this population by building upon existing community services and group-based PA programs that provide the additional benefit of social participation, which enhances enjoyment, adherence, and sustainability of PA (82).

Our findings did not provide any convincing evidence for the addition of protein, creatine, vitamin D, or dairy supplementation to PA interventions within community-dwelling older adults. However, the overall quality of the systematic reviews and single studies was low to moderate, and numerous distinct comparator groups were used to test intervention effectiveness. These reviews typically synthesized highly heterogeneous single studies, including a wide range in “dose” of both exercise and dietary components of the interventions; this may have limited the ability to see effects of specific combinations of interventions when synthesized together. Future high-quality studies with similar intervention and comparator groups may provide better understanding of the role of combined diet and nutrition interventions on mobility-related outcomes in older adults. No reviews focused on group-based nutrition interventions alone, nor did any explore or report on domains of equity, diversity, and inclusion, highlighting priorities for future research.

There are several inherent limitations of this umbrella review that should be considered in interpreting results. Included reviews were limited to those in English, published since 2010. At the systematic review Loading [MathJax]/jax/output/CommonHTML/fonts/TeX/fontdata.js

collect this data. Given the large number of included reviews, the overlap in single studies across reviews is unsurprising. The highest amount of overlap of studies evaluating physical function outcomes is attributable to our broad characterization of this outcome and the overlap in single studies among reviews focused on resistance, exercise and nutrition, and dance interventions. Although 27.9% overlap in single studies exists, each review contributing to these results focused on specific outcomes (e.g., gait speed alone, composite physical function measures), and we do not anticipate this greatly influenced our overall certainty of evidence. Although we would expect targeted aerobic, resistance, or combined aerobic and resistance exercise to be more effective than general PA interventions, certainty in the evidence was influenced by higher risk of bias and heterogeneity across both single studies and reviews of aerobic, resistance and combined interventions, reflective of variation in types of interventions and tools used to assess outcomes.

A strength of this umbrella review was the collaboration with older adults and service provider partners to identify relevant outcomes. Our partners prioritized the inclusion of quality of life and wellbeing outcomes, as these outcomes are front of mind for older adults and providers. Self-reported functional measures were found to be more meaningful to our older adult partners than measures designed to capture physiology or function. However, very few studies reported these outcomes separately as they were commonly combined within meta-analyses, thus we are unable to distinguish between self-reported and measured function.

Conclusion

Group and community-based PA interventions that combine aerobic and resistance, general PA and mind-body exercise can improve mobility measures in older adults. No reviews focused on group-based nutrition interventions alone, and very few identified quality of life outcomes, highlighting a need for future synthesis work. The results of this umbrella review will be used to inform the co-design of a community-based, mobility-enhancing intervention.

Abbreviations

AMSTAR 2: A MeaSurement Tool to Assess systematic Reviews

EMBOLDEN: Enhancing physical and community MoBility in OLDEr adults with health inequities using commuNity co-design trial

GRADE: Grading of Recommendations Assessment, Development and Evaluation

JB: Joanna Briggs Institute

PA: physical activity

RCT: randomized controlled trial

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Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

The datasets supporting the conclusions of this article are included within the article and its additional files.

Competing interests

SMP declares that he is a named inventor on a patent held by Exerkine, but receives no fees/payment, and is an unpaid member of the Scientific Advisory Board for Enhanced Recovery.

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Authors' contributions

SNS, CM, DS, DFL, SMP, KBN, EA, AK, CCK, PLS, and RG conceptualized and designed the study. SNS, KT, CM, DS, DFL, GC, and RG acquired, analyzed, and interpreted the data. SNS, KT, and RG drafted the manuscript. All authors substantively revised the manuscript and have approved the submitted version.

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Not applicable

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Table 2

Due to technical limitations, table 2 is only available as a download in the supplementary files section.

Figures

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Figure 1

PRISMA Flow Diagram

Figure 2

AMSTAR 2 Summary of Systematic Review Quality

	Aerobic capacity	Physical function	Balance	Falls/safety	Muscular strength
Resistance	↔ very low certainty ^{a,c,e}	↑ low certainty ^{b,c}	↔ low certainty ^{b,c}	↔ Very low certainty ^{b,c,e}	↑ moderate certainty ^c
Aerobic	↑ moderate certainty ^b	↔ low certainty ^{b,c}	↔ low certainty ^{b,c}	↔ very low certainty ^{b,c,e}	↑ low certainty ^{b,c}
Aerobic + Resistance	↑ high certainty	↑ moderate certainty ^a	↑ moderate certainty ^c	↑ moderate certainty ^c	↑ low certainty ^{b,c}
General physical activity	n/a	↑ moderate certainty ^c	↑ moderate certainty ^c	↑ moderate certainty ^c	↑ moderate certainty ^c
Exercise and nutrition	↔ low certainty ^{d,e}	↔ low certainty ^{b,c}	n/a	n/a	↔ low certainty ^{b,c}
Mind-body exercise	↔ very low certainty ^{c,d,e}	↑ moderate certainty ^c	↑ high certainty	↔ low certainty ^{c,e}	↑ low certainty ^{b,c}
Dance	↑ low certainty ^{b,c}	↑ low certainty ^{b,c}	↑ low certainty ^{b,c}	↑ very low certainty ^{b,d,e}	↑ low certainty ^{b,c,e}

Notes:

^a start at low certainty due to non-randomized study designs

^b downgraded due to risk of bias

^c downgraded due to inconsistency in effects

^d downgraded due to indirectness of interventions/outcomes

^e downgraded due to imprecision in effect estimate

^f downgraded due to publication bias

^g upgraded due to large effect

^h upgraded due to dose-response relationship

ⁱ upgraded due to accounting for confounding

Figure 3

GRADE Summary of Certainty of Evidence

Supplementary Files

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- [table2.docx](#)