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Review

# A systematic review of outdoor gym use: Current evidence and future directions

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ABSTRACT

*Objectives:* While outdoor gyms are being rapidly installed around the globe, little is known about their implications on physical activity, and fitness and other health-related outcomes. The primary objective of this systematic review was to examine the effects of outdoor gyms on physical activity, fitness and other health-related outcomes. Secondary objectives were to describe outdoor gym characteristics, user characteristics, and outdoor gym usage.
*Design:* Systematic review.
*Methods:* Peer-reviewed papers published in English were obtained through online database searches of the following databases; EBSCO, SPORTdiscus, Medline, PsycINFO, Web of Science, Scopus and Informit. Searches covered the periods from database inception to January 2019. Studies that reported on the efficacy of outdoor gym use for physical activity, health-related outcomes or descriptive aspects of outdoor gyms and their users were eligible for inclusion.
*Results:* There was some support that outdoor gyms may improve physical activity, fitness and other health-related outcomes, however few experimental studies have been conducted. There was no consistency between outdoor gyms in terms types and number of installed equipment for each facility. Further, this review found discrepancies of whom were the most likely users of outdoor gyms and when they were mainly used.
*Conclusions:* This review contributes to the limited evidence on the impact and characteristics of outdoor gyms on physical activity and fitness and health-related outcomes.


## Practical implications

- Few intervention studies have investigated the impact of outdoor gyms on community-based physical activity, or on participant's fitness and other health outcomes. More rigorous study designs are needed.
- Half of the studies (n = 4) investigating the efficacy of outdoor gyms on physical activity found significant increases in MVPA in the areas where outdoor gyms had been installed. Therefore it remains unclear whether outdoor gyms may increase community-based physical activity.
- There was no clear consensus in the literature regarding which age or gender groups were the most likely users. Therefore, it is uncertain if equipment needs to be tailored to gender or age groups.
- Proximity to an outdoor gym appeared to influence use. Therefore, more outdoor gyms should be installed near place of residence and work.

## 1. Introduction

It is estimated 3.3 million people die annually as a result of physical inactivity, making it the fourth leading cause of non-communicable death worldwide.[1] Participation in regular aerobic and resistance-based (i.e., resistance training) physical activity can significantly reduce the risk of developing cardiovascular disease, various cancers, stroke, sarcopenic obesity, and diabetes, and improve mental health outcomes such as anxiety and depression.[2–4] While the benefits of regular physical activity are numerous, a significant proportion of the adult population remains inactive.[5]

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One potential strategy to encourage more population-based aerobic and resistance training is through the installation of outdoor gyms. Broadly defined, outdoor gyms refers to facilities that typically consist of simple and durable exercise apparatus that requires no electricity and are usually installed in open spaces such as outdoor park areas.[6] While the number and functional types often vary between facilities,[7] the equipment generally use an individual's own body mass to create resistance for activities relating to aerobic and/or resistance training, balance and stretching.[8] The advantages of outdoor gyms include their suitability for most adult age groups and fitness levels, often free of charge and their capacity to influence large numbers of people to be physically active due to their accessibility within local public spaces.[6] Of note, most outdoor gym equipment is designed and intended for adults, however, there are often age restrictions to prevent children from using the equipment, which may make these facilities less valuable for physical activity promotion in this group.

Outdoor gyms have been rapidly installed around the globe. For example, in Brisbane, Australia 150 of the city's parks are fitted with outdoor gym equipment.[9] In the state of Victoria, Australia over 65 Local Government Councils reported at least one outdoor gym installation,[10] and in Santiago, Chile, almost 2000 outdoor gyms have been installed.[11] Further, it is estimated that over half of the parks in Taipei and Tainan, Taiwan have outdoor gym installations.[12,13] Yet, little is known regarding their impact on physical activity, fitness and other health-related outcomes. To our knowledge, only one descriptive review has been conducted on outdoor gyms. Lee et al.[7] provided worthy information to this relatively new field of research, however, a number of important research questions remain unanswered such as examining the impact of outdoor gyms on park-based physical activity, on individuals' health, and on outdoor gym use and user characteristics. The current systematic review aimed to expand on their limitations by including intervention studies (e.g., randomised controlled trials) and prospective studies, as well as other quantitative studies (e.g., cross-sectional) not included in Lee et al.'s[7] review.

The primary objective of this systematic review was therefore to examine the effects of outdoor gyms on community-based physical activity (i.e., changes in park-based physical activity pre-post outdoor gym installations), and on individuals (i.e., as measured by fitness tests) and other health-related outcomes (i.e., any other health outcome that were examined such as diabetes-related, balance and falls risk). Secondary objectives were to describe the features, user characteristics, and use of outdoor gyms. This includes the characteristics of the population using these facilities (e.g., gender and age groups), and how the outdoor gyms are used (e.g., frequency of use, time of day and length of stay).

## 2. Methods

### 2.1. Protocol and registration

The Preferred Reporting items for Systematic Reviews and Meta Analyses (PRISMA) protocol was followed to guide and report the conduct and reporting of this systematic review[14] (see Supplementary Appendix A). The review was registered with the International Prospective Register of Systematic Reviews (PROSPERO), register number: CRD42018112963.

### 2.2. Eligibility criteria

Studies were considered eligible for inclusion if they[1] examined the influence of outdoor gyms on physical activity (i.e., reported on the percentage of users, increases/decreases of physical activity following an outdoor gym installation),[2] investigated the efficacy of outdoor gyms on individual's fitness (i.e., fitness tests) and other health related outcomes (i.e., all other health related outcomes that were included such as diabetes-related, balance and falls risk outcomes),[3] reported on characteristics of outdoor gym users (i.e., gender and age group) and described features of outdoor gyms (i.e., number of pieces of equipment and types of equipment), and were published in English peer-reviewed journals. All quantitative study designs were eligible for inclusion (i.e., experimental, prospective or cross-sectional) and study populations of all ages were included. Note, studies that used both qualitative and quantitative measures were included, but only the quantitative data was synthesised in the review. Studies were excluded if[1] they explored physical activity in open green spaces or parks without outdoor gym installations,[2] did not include enough data to synthesise and[3] included a qualitative only design.

### 2.3. Search strategy and screening

Seven databases (EBSCO, SPORTDiscus, Medline, PsycINFO, Web of Science, Scopus and Informit) were searched from the time of database inception up to and including January 2019. (The search strategy is outlined in the Supplementary Appendix B). All identified records were uploaded into EndNote X8 and de-duplicated through automatic and manual processes. The remaining articles were screened for relevance by two reviewers (AJ, RH) independently, based on the information in titles and abstracts. Each abstract was then classified into three categories: 'relevant', 'potentially relevant' and 'irrelevant'. Full-texts of relevant and potentially relevant articles were independently assessed against inclusion criteria by both reviewers (AJ, RH) before a final decision regarding the inclusion of articles was made. Any disagreements between the two reviewers were resolved through discussion with a third reviewer (RP). Additionally, reference lists from included articles were searched for additional relevant articles and forward citation tracking was used to identify any articles that may have been missed through the electronic database searches.

### 2.4. Data extraction

Two reviewers (AJ and RH) independently performed the data extraction. Extracted information included study aim, year of publication, country where study was conducted, study design, sample size, participant characteristics, outcome measures, analysis method, results and findings. Disagreements or uncertainties during the review process were resolved through consultation with a third reviewer (RP) until full agreement was reached.

### 2.5. Risk of methodological bias

Risk of bias was assessed by two reviewers (AJ and RH) and each study was independently scored using the 10-point Academy of Nutrition and Dietetics Quality Criteria Checklist: Primary Research tool,[15] which has been used in reviews of various topic areas.[16,17] The checklist assesses risk of bias for multiple study designs (e.g., experimental, observational and cross-sectional study designs) and evaluates population bias, study blinding, description of the intervention and assessment tool, statistical methods and study funding (see Supplementary Appendix C.1). As per standardised protocol, the quality of studies were regarded *positive* (+) if criteria 2, 3, 6 and 7, as well as one other validity criteria was denoted a 'yes', and considered *negative* (-) if six or more criteria were a 'no', 'unclear' or 'not applicable'. If the answer to validity criteria questions 2, 3, 6, and 7 was not a 'yes' then study was considered *neutral* (Ø). Any discrepancies regarding quality ratings were resolved with a third

**Table 1**
Study characteristics and design.

| Study design | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Reference | Citation number | Country | Sample size | Participants | Outcome measure | Design | Control group/park | Pre-post measures | Intervention study |
| Kim et al. | [23] | Korea | n = 35 | ≥65 years | Physical fitness tests (i.e. 30-s chair stand, 30-s arm curl, 22 cm up-and-go, one-leg stand, and 2-min step), push-ups, 6-min walk test, body composition, and diabetes related outcomes (i.e., Glucose, insulin, HOMA-IR, interleukin-6 and chemerin). | RCT | X | X | X |
| Sales et al. | [29] | Australia | n = 120 | 60–90 years | The Balance Outcome Measure for Elder Rehabilitation (Primary outcome). Physical measures (i.e. single leg stance, knee strength, hand grip strength, 2-min walk, functional mobility, sit-to-stand, and Gait speed), quality of life, psychological measures, physical activity, and number of falls over 12 months (Secondary outcomes) | RCT | X | X | X |
| Nguyen et al. | [31] | The United States | n = 6 | 35.0+/−9.0 years | Physical fitness tests (i.e. squat, push-up, curl-up, leg press, right and left leg extensions, chest press, lat pull down and vertical press) | Pre-post intervention | X | X | X |
| Cohen et al. | [6] | United States | n = 23,577 (observed), n = 742 (interviewed) | No specific target population | SOPARC and Intercept survey | Prospective | X | X | X |
| Cranney et al. | [18] | Australia | n = 23,905 | No specific target population | SOPARC and Intercept survey | Prospective | | X | X |
| del Campo Vega et al. | [25] | Uruguay | n = 7,342 | No specific target population | SOPARC | Prospective | | X | X |
| Sami et al. | [30] | United States | n = 1650 (pre-intervention), n = 1776 (post-intervention) | No specific target population | SOPARC | Prospective | | X | X |
| Chow et al. | [13] | Taiwan | n = 495 | No specific target population | SOPARC | Cross-sectional | | | |
| Copeland et al. | [28] | Canada | n = 1013 (observed in active parks), n = 139 (interviewed), n = 633 (observed in inactive parks) | No specific target population | SOPARC and Intercept survey | Cross-sectional | X | | |
| da Silva et al. | [26] | Brazil | n = 328 | ≥18 years | Intercept survey | Cross-sectional | | | |
| da Silva et al. | [27] | Brazil | n = 323 | ≥20 years | Intercept survey | Cross-sectional | | | |
| Furber et al. | [24] | Australia | n = 54 | No specific target population | Intercept survey | Cross-sectional | | | |
| Mora et al. | [11] | Chile | n = 1,023 | No specific target population | Intercept survey and Neck circumference | Cross-sectional | | | |
| Mora | [22] | Chile | n = 166 | ≥15 years | Observations and intercept survey | Cross-sectional | | | |
| Ramirez et al. | [21] | Colombia | n = 6722 | No specific target population | SOPARC | Cross-sectional | | | |
| Scott et al. | [8] | Australia | n = 66 | ≥50 years | Intercept survey | Cross-sectional | | | |
| Sibson et al. | [20] | Australia | n = 400 | ≥18 years | Intercept survey | Cross-sectional | | | |
| Stride et al. | [19] | Australia | n = 438 | ≥50 years | Intercept survey | Cross-sectional | | | |

**Table 2**
Outdoor gym characteristics.

| Study | Terminology | Number of exercise apparatus (per park) | Types of equipment/exercises (mentioned in text) | Instructions/onsite supervision support | Setting |
|---|---|---|---|---|---|
| Chow et al.[13] | Öutdoor fitness equipment¨ | 6 | Triple arm stretch, air walker, triple waist twister, single bonny rider, shoulder wheel, arm wheel | Not clear in text | Public park area |
| Cohen et al.[6] | Ffitness zone¨ | 8 | Dual pendulum, ski machine, leg press, leg curl, horizontal bars. Three additional pieces were not described in text | Not clear in text | Public park area |
| Copeland et al.[28] | Äctive parks¨ | 5–20 | Not clear in text | Not clear in text | Public park area |
| Cranney et al.[18] | Öutdoor gym¨ | 12 | Pull down, elliptical trainer, aerobic cycle, parallel bars, chest press | Exercise sessions, Ḧow to use an Outdoor gym guide¨ | Grassed open area near the beach |
| da Silva et al.[26] | Ffitness zone¨ | Not clear in text | Not clear in text | Not clear in text | Not clear in text |
| da Silva et al.[27] | Ffitness zone¨ | Not clear in text | Not clear in text | Not clear in text | Not clear in text |
| Del Campo Vega et al.[25] | Ffitness zone¨ | Not clear in text | Not clear in text | Not clear in text | Public park area |
| Furber et al.[24] | Öutdoor gym¨ | Not clear in text | Not clear in text | Not clear in text | Public park area |
| Kim et al.[23] | Öutdoor exercise equipment¨ | 6 | Pull weight, chair pull, leg extension, sky walk and cross-country | 6-week long exercise program. Guidelines on frequency, intensity and duration of workouts were provided, together with instructions and supervised exercise groups | Public park area |
| Mora et al.[11] | Öutdoor gym¨ | Average 4.6 per gym (1981 in total), 1–7+ pieces per outdoor gym | Not clear in text | Not investigated | City squares, sidewalks and parks |
| Mora[22] | Öpen gym¨ | 8–14 | Pictures of some equipment in displayed in the paper. Types of exercise apparatus described as being evenly distributed between muscular, aerobic and resistance machines | Not clear in text | Placed along a main avenue |
| Nguyen et al.[31] | Ffitness zone equipment¨ | Not clear in text | Elliptical, leg press, unilateral extension, chest press, lateral-pull down, vertical press | 6-week combined strength and cardiorespiratory training program, supervised by a study researcher | Public park area |
| Ramírez et al.[21] | Öutdoor gym¨ | 16 | Not clear in text | Not clear in text | Not clear in text |
| Sales et al.[29] | Öutdoor exercise park¨ | 8 | Push-up bar, modified pull-up bar, step-up station, hip abduction station, gangway, balance stool, balance beam, ramp + net, platform, snake pipe, screw turner, bench for sit-to-stand, stairs | 18-week exercise program, supervised by an accredited exercise physiologist twice a week | Respite house |
| Sami et al.[30] | Ffitness Zone¨ | 8 | Lateral pull, person back and arms combination resistance, vertical arm press, chest press, combination bars, sit up bench, parallel dip and stretch machine, plyometric steps | Not investigated | Public Park Area |
| Scott et al.[8] | Öutdoor gym¨ | 12[a] | Not clear in text | Eight exercise sessions over a 4 week period, instruction manual distributed to participants | Reserve near beach |
| Sibson et al.[20] | Ṧtretch station¨ | 6? | Stretching stations. Pictures of some stations depicted in text. | Website with information how to best use them; a plaque on each station promoting a range of stretching techniques | Urban park area |
| Stride et al.[19] | Öutdoor gym¨ | 12[a] | Equipment providing aerobic, strength, balance and flexibility exercise opportunities | Instruction classes targeting older adults | Reserve near beach |

[a] Information taken from Cranney et al's study.

reviewer (RP). Inter-rater reliability between the two reviewers was calculated using Cohen's k.

## 3. Results

### 3.1. Study selection

A total of 669 records were retrieved from database searches (EBSCO: 221; SPORTdiscus: 137; Medline: 40; PsycINFO: 7; Web of Science: 20; Scopus: 36; Proquest; 221; Informit: 6) and an additional two studies were identified through forward citation tracking (see Supplementary Appendix D). After the removal of duplicates, a total of 41 potentially relevant studies were identified from the original database search. A total of 18 studies[6,8,11,13,18–31] published between 2012 and 2018 were included in the systematic review.

### 3.2. Risk of bias within studies

The quality of the experimental studies was high, with scores ranging from 6-9. The quality scores for the cross-sectional studies ranged from low to neutral (scores ranging from 0 to 7), while the retrospective studies were neutral to high quality (scores ranging between 5–8) (see Table C.1 in the Supplementary Appendix). The inter-rater reliability metrics indicated substantial agreement following independent full-text assessment for all 180 items (10 questions × 18 studies; k = 0.96). No studies were excluded due to overall quality ratings.

### 3.3. Study characteristics

Detailed information regarding the characteristics of included studies is presented in Table 1. The 18 included studies were conducted in nine different countries (Australia, Brazil Canada, Chile, Columbia, Korea, Taiwan, United States of America, and Uruguay). Included studies were RCT's (n = 2; efficacy studies), pre-post intervention designs (n = 1), prospective designs (n = 4) and cross-sectional designs (n = 11). Sample sizes ranged from 6[31] to 48[29] for the experimental studies, from 3426[30] to 23,905[18] for studies using prospective designs, and from 54[24] to 6722[21] for cross-sectional studies. Eight studies included age groups ranging from children to seniors,[6,11,13,18,21,25,28,30] four studies targeted only older adults,[8,19,23,29] four studies reported on adults 18 years and older,[20,26,27,31] one study reported on individuals 15 years and older,[22] and in one study the target group was unclear.[24] The number of outdoor gyms investigated in each study ranged from one[13] to 1981.[11]

### 3.4. Characteristics of outdoor gyms

The number of studied exercise apparatus varied from one[11] to 20[28] pieces per site, however this was unclear in six of the studies.[11,21,24–27] The type of exercise equipment also varied across facilities i.e., some included machine-like equipment (e.g., chest press and ski machine) and some used bar-like equipment (e.g., push-up bar and step-up station). Terminology, outdoor gym location and availability of instructional support varied between studies, see Table 2. One study deliberately used a different terminology '*stretching stations*', as authors described the equipment to be for stretching purposes as opposed to muscle strengthening or aerobic equipment.[20]

### 3.5. Study designs and measures

Information regarding designs for each study is detailed in Table 1. The intervention studies assessing physical fitness and other health outcomes included: a two-arm 18-week RCT pre-post intervention design[29]; a three-arm 6-week RCT pre-post intervention design[23]; and, a 6-week pre-post experimental (no control group) study.[31] Kim et al.[23] recruited senior participants from a Welfare Centre to participate in a 6-week supervised exercise program. The exercise program encompassed set exercises that utilised six pieces of outdoor gym equipment (i.e., pull weight, chair pull, leg extension, sky-walk and cross country). Participants were randomised to either the (i) resistance exercise group, (ii) the combined aerobic and resistance exercise group, or (iii) the control group, and assessed at baseline and 6-week post baseline. Study retention for the control, resistance-only and the combined exercise groups, were 67%, 75%, 81% respectively. Sales et al.[29] recruited participants through health promotion events and advertisement in local newspapers, magazines and online networking media. Participants were randomly allocated to either the intervention or control group. For the intervention group, exercise sessions were provided twice weekly and supervised by an accredited exercise physiologist. Study retention for the control group was 68% and 77% for the intervention group. Nguyen and Raney.[31] recruited participants from parent centres in Los Angeles Unified School district low-income public schools. The program included a cardiorespiratory physical activity and full-body resistance training workout, and participants had to carry out the exercises three days per week in the presence of a study researcher. The researcher was verified participant compliance, timed cardiorespiratory sessions, recorded the resistance training repetitions and answered any questions. All participants completed the 6-week program.

Four studies assessed changes in park-based physical activity levels before and after the installation of an outdoor gym.[6,18,25,30] All studies (4/4) used the System for Observing Play and Recreation in Communities (SOPARC) protocol[32] to collect observational data on park and outdoor gym use and on user demographics (i.e., age, sex, ethnicity). Half the studies (2/4) also used intercept surveys to collect additional information such as self-report physical activity, park and outdoor gym use.[6,18]

Among cross-sectional studies using observational measures, 3/4 studies used the SOPARC protocol[13,21,28] and 1/4 employed a non-standardised observation protocol[22] to measure park and outdoor gym activity (see Table C.2 in the Supplementary Appendix for more details regarding the studies using observational measures).

Ten of the 18 included studies employed intercept surveys to collect various demographic information,[6,11,18–20,22,24,26–28] of which five included at least one validated test regarding physical activity.[18,19,26–28] Among the aforementioned studies, The Godin Leisure-time Exercise questionnaire[33] was used in one study,[28] the 3-Question Physical Activity Questionnaire[34] was employed in two studies,[18,19] the International Physical Activity Questionnaire[35] was used in two studies[26,27] and one study[11] assessed three items from the Global Physical Activity Questionnaire.[36]

### 3.6. Impact of outdoor gyms on physical activity, fitness and other health-related outcomes (primary objective)

There were four intervention studies that evaluated the impact of outdoor gym installations on physical activity using SOPARC.[6,18,25,30] Installations of outdoor gyms were associated with an overall increased level of moderate-to-vigorous physical activity (MVPA),[6,18,25,30] with rates of outdoor gym use among park users of 1.9% (total observations = 23,905)[18] and 5.5% (total observations = 23,577).[6] For example, Cranney et al.[18] found the proportion of people engaging in MVPA in the outdoor gym area increased significantly from baseline (6%) to post-installation (36%) and to follow-up (40%). Del Campo Vega et al.[25] also found statistically significant increases in people who engaged in MVPA from baseline to follow-up in areas where outdoor gyms had

**Table 3**
Outdoor gym use and demographics of users.

| Reference | Frequency of visiting an outdoor gym | Duration of time spent in an outdoor gym | Time of day when outdoor gyms were mostly used | Proximity to outdoor gyms | Observed gender difference in equipment use | Age group mostly using the outdoor gym |
|---|---|---|---|---|---|---|
| Chow et al.[13] | | Average 9-min, no more than 5-min per piece of equipment | Mornings (0630-0830) and afternoons (1530–1730) | | F > M; (72% vs 28%) | Seniors (53%) |
| Cohen et al.[6] | | | Mornings (0930–1030) and afternoons (1530–1730) | 33% of users lived within a quarter of a mile and 24% lived between a quarter and half a mile of an outdoor gym | F > M; 45.6% vs 54.4% (post-intervention) and 46.1% vs 53.9% (follow-up) | 60.3% of users were Adults (post-intervention) and 64.4% of users were adults (follow-up) |
| Copeland et al.[28] | | | Week day evenings, particularly in the season of Spring | | F < M; (37% vs 63%) | Young people (numbers not specified) were observed to be the most regular users. 25–39 year-olds reported to be the most likely (45%) users. |
| Cranney et al.[18] | | | | 67% of outdoor gym users were local residents (post-installation), and 62% at follow-up | F < M (percentages not specified) | Children 46% and adults (42%) at baseline, then children 57% (follow-up) and 32% (post-installation) |
| da Silva et al.[26] | 69% reported visiting the outdoor gym ≥ 3 times per week, 31% reported visiting the outdoor gym up to twice per week | 49% reported using the outdoor gym ≥ 31 min, 51% reported using the outdoor gym ≤ 30 min | | Mean distance from home to outdoor gym was 2007 m | F > M (54.3% vs 45.7%) | |
| Del Campo Vega et al.[25] | | | | | F < M (83% at baseline and 68% at post-installation) using the strength outdoor gym, F > M (63% at baseline and 66% at post-installation) using the aerobic outdoor gym | |
| Furber et al.[24] | 58% of respondents reported visiting the outdoor gym at least once per week | | | | | |
| Mora et al.[11] | 32% reported visiting the outdoor gym ≥ 4 times per week, 38% reported visiting the outdoor gym three times per week | 77% of respondents reported using the equipment for ≥ 30 min | | | | |
| Mora[22] | 59% reported visiting the outdoor gym ≥ 3 times per week, 33% reported visiting the outdoor gym between one and three times per week | 87% of respondents reported using the equipment for ≥ 15 min | Mornings and evenings | | F < M (55% vs 45% on weekend days) and (53% vs 47% on week days) | 15–29 year olds (46% on weekend days and 59% on week days) |
| Ramirez et al.[21] | | | Mornings | | F > M (51.7% vs 48.3%) | Adults (61.5%) |
| Sami et al.[30] | | | | | F < M 51% vs 49% (pre-intervention) and 62% vs 38% (post-intervention) | Adults 36% at pre-intervention and 44% at post-intervention |
| Stride et al.[19] | 66% of respondents reported visiting the outdoor gym at least once per week | | | 55.2% of respondents lived within two kilometres of the outdoor gym | | |

Six studies (da Silva et al., 2017, Kim et al., 2018, Nguyen and Raney, 2014, Sales et al., 2017, Scott et al., 2014, Stride et al., 2017) were not included in this table due to not reporting on relevant information.

been installed. Two of the included studies did not find significant increases in MVPA in the areas where outdoor gyms had been installed.[6,30]

Three studies evaluated the impact of outdoor gyms on individual physical fitness and other health-related outcomes.[23,29,31] Sales et al.[29] found no significant improvements in the test battery The Balance Outcome Measure for Elder Rehabilitation (BOOMER; primary outcome), or in a number of secondary outcomes (i.e., hand grip strength, gait speed, fear of falling or quality of life) at the study's primary end-point. The 18-week intervention however found significant improvements in some secondary outcomes (i.e., single leg stance, knee strength, 2-min walk-test and sit-to-stand test) at the primary end-point.[29] Kim et al.[23] reported significant improvements in 2/7 fitness tests for the resistance-only intervention group (i.e., push-up and 6-min walk test), while the combined resistance and aerobic intervention group revealed significant effects in 3/7 fitness tests (i.e., 2-min step, push-up and 6-min walk test). Only the combined resistance and aerobic intervention group found significant improvements in 3/5 diabetes related outcomes (i.e., insulin, HOMA-IR, chemerin).[23] The pre-post intervention study evaluated a combined resistance and cardiorespiratory training program, which found significant improvements in a number of health outcomes (i.e., weight loss, reduced body fat percentage waist circumference and increased muscular endurance repetitions) but not for other outcomes (i.e., rHR, systolic BP and diastolic BP).[31] All of the above-mentioned studies reported their results immediately after the intervention; none included follow-up results.

### 3.7. Outdoor gym user demographics

Differences in outdoor gym usage among age groups and gender, as well as other user demographics are shown in Table 3. Four studies found that most outdoor gym users were living in close proximity to the outdoor gym.[6,18,19,26]

### 3.8. Outdoor gym use

Five of the included studies reported on the time of day the outdoor gyms were used.[6,13,21,22,28] Four studies investigated the length of time users exercised in an outdoor gym, of which three used self-report measures[11,22,26] and one employed observational measures.[13] The frequency of visiting an outdoor gym for exercise purpose was reported in four studies.[11,22,24,26] There was considerable variability in terms of reporting on outdoor gym use; see Table 3 for more detailed information.

## 4. Discussion

The primary objective of this review was to synthesize the evidence from quantitative studies to describe the influence of outdoor gyms on community-based physical activity, fitness and other health-related outcomes. In addition, this review examined the characteristics of outdoor gyms, user characteristics and how these exercise facilities are being utilized. To our knowledge, this is the first review of outdoor gyms that has included data from RCTs and other experimental designs.

### 4.1. Influence of outdoor gyms on physical activity, and fitness and other health-related outcomes

While outdoor gyms are being rapidly installed around the globe, only a small body of literature has examined whether outdoor gyms are an effective strategy for influencing community-based physical activity. Half (2/4) of the studies reported significant increase in MVPA in areas where outdoor gyms had been installed,[18,25] while the other two study's findings failed to reach statistically significant increases.[6,30] All experimental studies targeting fitness and other health-related outcomes (n = 3) found significant results in some but not all outcomes. As can be seen in Appendix Table C.3, a variety of measures were assessed and outcomes were mixed. It is difficult to draw firm conclusions from these studies given the variety of measures used. The experimental studies included populations narrow in age, making generalisation of results to other populations difficult. For instance, Kim et al.[23] reported significant improvement in some fitness, diabetes and other health-related outcomes. Similarly, Sales et al.[29] found no significant results in their primary outcome (balance), or quality of life or falls efficacy, but reported significant improvements in some fitness tests (secondary outcomes). Nguyen and Raney[31] reported significant improvements in most fitness and health-related outcomes.

### 4.2. Outdoor gym characteristics

In regards to outdoor gym installations, this review found that these facilities have been installed in a variety of settings, and while they have been predominantly installed in parks, no studies have investigated how the location influence usage. For example, there may be differences in levels of usage between exercise facilities installed in different settings (i.e., parks vs. walking tracks). In addition, future studies may consider whether outdoor gyms installed in proximity to other facilities may attract more users, such as adjacent to children's playgrounds or sports grounds. This may be valuable information for city planners or urban designers to ensure equipment is installed in locations that attract maximum users. Moreover, proximity emerged as a relevant factor influencing outdoor gym use. For example, studies reported that moderate to high proportions of outdoor gym users lived in close proximity to parks where gym equipment had been installed.[6,18,19,26] Interestingly, a recent review found mixed associations between access to parks and physical activity,[37] and quality of park facilities to be more important than proximity to parks in promotion of physical activity.[38] Future studies should integrate proximity measures in their designs to better understand how proximity to outdoor gyms may influence usage. This information may inform guidelines, such as those from the National Heart Foundation[39] to help communities promote a more active lifestyle, and facilitate local councils to identify potential locations of where to install outdoor gyms to maximise potential reach.

Our findings regarding the number and type of exercise apparatus per park, and the diverse terminology used to describe an outdoor gym are consistent with Lee et al.'s[7] review. Indeed, our review found that there were eight different ways to describe the concept of an outdoor gym and that each study site varied in numbers and types of installed equipment. Type of equipment can be broadly defined as machine-like and bar-like equipment that may target aerobic and resistance-based physical activity, balance or stretching. Given the global interest in outdoor gyms, greater consistency and clarity in the description of installed equipment in forthcoming studies would be advantageous.

### 4.3. Outdoor gym users

Age and gender were the most frequently reported sociodemographic characteristics of outdoor gym users. There was no consensus in the literature regarding which age or gender groups are the most likely to use the outdoor gym equipment. For example, four of the included studies reported higher prevalence of women, one study reported no gender difference, and three studies indicated a higher proportion of male outdoor gym users. It is there-

fore unclear how the type of outdoor exercise apparatus affects who utilises the outdoor gyms. It is possible that some machines (i.e., air walker and triple arm stretch) might attract older participants whereas some equipment (i.e., bars and swings) may be more appealing for younger users. Likewise, some equipment may be more appealing to men than women, and vice versa. Therefore, the reported gender differences may be explained by some equipment being more suitable towards either males or females. In addition, ethnicity or cultural background may also influence outdoor gym use. For example, one study found that a larger proportion of outdoor gym users spoke another language than English at home.[19] Most evidence of included studies is from poorly described demographical groups, therefore better quality reporting and evaluation across various population groups is necessary. Forthcoming studies should also investigate suitability and acceptability of equipment across age groups and both genders, as well as cultural backgrounds.

### 4.4. Outdoor gym use

Three studies examining duration of time spent in an outdoor gym based their results on self-report[11,22,26] and one used observational measures.[13] The results from all three studies indicated the majority of respondents spent between 15 to 30 min exercising in the outdoor gym, in contrast, Chow et al.'s[13] reported that the average time spent using the equipment was nine min. This difference in time spent using the equipment may be due to the different assessment methods. Another explanation may be that self-reported measures have the tendency to over- or underestimate the true value. Indeed, Copeland et al.[28] highlighted the issue of over-reporting by comparing observational data and survey data, where the self-reported use of park equipment was more frequent than the observational data. In addition, Chow et al.,[13] reported that the majority of outdoor gym users did not interact with the equipment long enough to meet the physical activity recommendations. It is worthy to mention that one can accumulate physical activity from various activities and users are not necessarily expected to meet physical activity guidelines predominantly from using the outdoor gyms alone.

### 4.5. Other considerations

Other factors that can be considered to be examined by future studies include socioeconomic status. Socioeconomic status is an established determinant of physical activity[40] and lower socioeconomic status has been associated with a decreased likelihood of meeting resistance training guidelines.[41] To date, few studies have reported on the socioeconomic status of participants, or the socioeconomic status of the park locations. Outdoor gyms offer a free facility which may be useful for low socioeconomic status groups. Interestingly, one study specifically recruited participants through low-income public schools and eligibility criteria specifically stated participants had to be unable to afford a gym membership.[31] Forthcoming research should investigate the use and interventions of outdoor gyms to promote physical activity in lower socioeconomic groups given that this subpopulation has a higher prevalence of physical inactivity.

We also suggest that future studies may consider investigating differences in user-rates between trail-based outdoor gym equipment (i.e., equipment spaced out along a trail) and clustered outdoor gym equipment (i.e., multiple pieces of equipment in the same spot). Given there is little understanding of what outdoor gym design of gym is optimum for attracting the greatest amount of users, this information, in addition to equipment suitability for different sub-populations, will be useful for designing outdoor gyms. Moreover, a recent study by Cho and Ho (2018) examined the energy expenditure and intensity of activity in older adults when using a selected number of outdoor gym equipment (i.e., air walker, ski machine, waist twister and arm stretch). Their findings indicated that the air walker and ski machine represented MVPA, whereas the waist twister and arm stretch only represented light physical activity.[42] These results raise questions in regards to the function of other equipment not included in Cho and Ho's (2018) study, and to ensure that installation of outdoor gyms include some equipment that may represent MVPA.

### 4.6. Limitations and strengths

Limitations of our review included using studies published in English. Also, numerous limitations of the field arose while conducting this review. First, there is a lack of published experimental designs testing the effects of outdoor gyms. Only two RCTs and one uncontrolled experimental study have investigated fitness and other health-related outcomes using outdoor gyms, precluding the ability to conduct a meta-analysis. Limited research has been conducted on promoting community-based outdoor gym use. Given the global spread of outdoor gyms, interventions that promote the use of such facilities are needed. For example, these community-based interventions may be app-based, educational, and promote social support, as such approaches have been found efficacious in promoting aerobic and resistance-based physical activity in park-based studies.[43,44] It also remains unclear whether parks attract already active or inactive people, therefore, it is difficult to establish whether outdoor gyms may increase overall population-based physical activity. Although, it may be difficult to conduct RCT's in parks, alternative study designs (e.g., stepped wedge, multiple time series) that are of better quality than observational designs are encouraged[45] to establish whether outdoor gyms are an effective strategy to increase population physical activity. Although the present data show promise, there are currently not enough studies with rigorous designs and/or that use objective physical activity measures to clearly establish the efficacy of outdoor gym use as an effective strategy to influence population physical activity behaviour. However, large scale studies are beginning to emerge in this field.[46]

A strength of this systematic review was that it included all quantitative research designs (i.e., experimental, observational and cross-sectional) in the peer-reviewed literature. Further, we reviewed the various types of outdoor gyms, populations using the facilities, and how the outdoor gyms are being used.

## 5. Conclusion

Outdoor gyms have the potential to facilitate the promotion of a more active lifestyle by using public spaces. While findings provide some evidence that outdoor gyms can increase physical activity and improve selected fitness and health-related outcomes for their users, more rigorously designed studies are needed to establish whether outdoor gyms are an effective strategy to increase physical activity, especially resistance training, in the community. Proximity appears to be an important factor to be considered in the installation of outdoor gym facilities. Results from this review also show promise in improving fitness and other health-related outcomes for seniors, however, more studies are needed to examine these outcomes in other populations. Further, there was almost equal use of equipment among both men and women, thus outdoor gyms are salient for both genders. Other strategies to promote outdoor gym behaviour need to be investigated. Future research should also examine ways to increase long-term use of equipment, assess long-term efficacy and include measures of how outdoor gyms impact on the health status of participants. Given the wide range of measures

that were used across studies, future studies may use more similar outcome measures that allow for meta-analyses of study data.

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## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.jsams.2019.08.003.

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