



Review article

## Indicators of community physical activity resources and opportunities and variation by community sociodemographic characteristics: A scoping review

Ann E. Rogers<sup>a,\*</sup>, Michaela A. Schenkelberg<sup>b</sup>, Peter Stoepker<sup>c</sup>, Danielle Westmark<sup>d</sup>,  
Deepa Srivastava<sup>e</sup>, David A. Dzewaltowski<sup>a</sup>

<sup>a</sup> Department of Health Promotion, College of Public Health, University of Nebraska Medical Center, 984365 Nebraska Medical Center, Omaha, NE 68198-4365, USA

<sup>b</sup> School of Health and Kinesiology, College of Education, Health, and Human Sciences, University of Nebraska at Omaha, 6001 Dodge Street, Omaha, NE 68182, USA

<sup>c</sup> Department of Kinesiology, College of Health and Human Sciences, Kansas State University, 920 Denison Avenue, Manhattan, KS 66506, USA

<sup>d</sup> Leon S. McGoogan Health Sciences Library, University of Nebraska Medical Center, 986705 Nebraska Medical Center, Omaha, NE 68198-6705, USA

<sup>e</sup> Department of Child, Youth and Family Studies, College of Education and Human Sciences, University of Nebraska-Lincoln, 840 N 14<sup>th</sup> Street, Lincoln, NE 68588-0236, USA

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### ABSTRACT

**Objective:** This scoping review synthesizes studies examining community-level variability in physical activity resource (assets) and opportunity (organized group physical activity services) availability by community sociodemographic characteristics to describe methodologies for measuring resources/opportunities, indicators characterizing availability, and associations between community-level sociodemographic characteristics and availability.

**Methods:** A systematic search was conducted in MEDLINE, CINAHL, PsycINFO, and Scopus for literature through 2022. Eligible studies quantitatively examined measures of physical activity resource/opportunity availability by community-level racial, ethnic, and/or socioeconomic characteristics within geospatially defined communities. Extracted data included: community geospatial definitions, sociodemographic characteristics assessed, methodologies for measuring and indicators of community physical activity resource/opportunity availability, and study findings.

**Results:** Among the 46 included studies, community geospatial units were defined by 28 different community boundaries (e.g., town), and 13% of studies were conducted in rural areas. Nearly all (98%) studies measured community-level socioeconomic status, and 45% of studies measured race/ethnicity. A total of 41 indicators of physical activity resource/opportunity availability were identified. Most studies (91%) assessed built environment resources (e.g., parks), while 8.7% of studies assessed opportunities (e.g., programs). Of 141 associations/differences between community sociodemographic characteristics and resource/opportunity availability, 29.8% indicated greater availability in communities of higher socioeconomic status or lower prevalence of minority populations. The remaining findings were in the opposite direction (9.2%), non-significant (36.9%), or mixed (24.1%).

**Conclusions:** Variability in physical activity resources/opportunities by community sociodemographic characteristics was not consistently evident. However, the indicators synthesized may be useful for informing population health improvement efforts by illuminating the physical and social conditions impacting population physical activity outcomes.

### 1. Introduction

Improving physical activity is a significant public health priority, as

this behavior is associated with numerous health benefits across the lifespan. These benefits include, in youth, improved weight status and bone health and, in adults, lower risk of all-cause mortality and chronic

\* Corresponding author.

E-mail address: [annerogers@unmc.edu](mailto:annerogers@unmc.edu) (A.E. Rogers).

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diseases such as type 2 diabetes and certain types of cancer (2018 Physical Activity Guidelines Advisory Committee, 2018; Piercy et al., 2018; U.S. Department of Health and Human Services, 2018). Despite these benefits, over 80 % of youth and 27 % of adults globally and over 70 % of youth and adults in the United States are insufficiently active (Healthy People 2030, 2020a; Healthy People 2030, 2020b; Healthy People 2030, 2020c; World Health Organization, 2022). Further, variability in physical activity by geospatially defined areas (e.g., communities) and demographic subgroups is well-established (Pickens et al., 2018; Whitfield et al., 2019; Whitfield et al., 2021; Aubert et al., 2022; Child and Adolescent Health Measurement Initiative, 2023). For example, lower-income and certain racial and ethnic minority populations (e.g., Hispanic) are commonly found to have lower levels of physical activity compared to higher-income and non-minority populations (Whitfield et al., 2019; Whitfield et al., 2021; Child and Adolescent Health Measurement Initiative, 2023). Additionally, although rural–urban differences in physical activity among youth are inconsistent (McCormack and Meendering, 2016), physical activity levels among adults have been found to be lower in rural communities compared to urban communities (Patterson et al., 2004; Reis et al., 2004).

Differences in the availability of community physical activity resources and opportunities may aid in explaining the variability in adult and youth physical activity outcomes by geospatial and demographic subgroups (Hallal et al., 2012; Pickens et al., 2018; Aubert et al., 2022; Physical Activity Alliance, 2022). Physical activity opportunities, for this review, are defined as reproduced or recurring social and physical environments in which physical activity occurs and include organized group physical activity services (e.g., sport team practice, fitness program) (Barker, 1968; Dziewaltowski, 2008). Resources are community assets that may be used for physical activity or to provide physical activity opportunities (e.g., parks, recreation facilities) (Emery and Flora, 2006; Flora, Flora and Gasteyer, 2016). Research has shown greater availability of resources, such as playgrounds, positively influences adult and youth physical activity outcomes (Davison and Lawson, 2006; Ding et al., 2011; Pontin et al., 2022). For example, Pate and colleagues (Pate et al., 2021) operationalized the concept of a “physical activity desert” and found that children living near parks had greater physical activity than children without parks near their homes. Additionally, a recent systematic review examined associations between physical activity and objective measures of the built environment (Pontin et al., 2022). Specifically, the review found positive associations between exposure to green space, leisure facilities, and parks and moderate-to-vigorous physical activity levels (Pontin et al., 2022).

Although the availability of physical activity resources and opportunities is shown to be associated with physical activity, it is not fully understood whether the availability of resources and opportunities differs across communities by racial, ethnic, and socioeconomic characteristics. A previous literature review found lower availability of parks, measured as number of parks and park acreage, among ethnic minority and low socioeconomic status populations (Rigolon, 2016). However, other studies have found inconsistent results regarding differences in the availability of physical activity facilities (e.g., playgrounds, sport facilities) (Macintyre, 2007) and physical environment characteristics such as walkability (Jacobs et al., 2019) by community socioeconomic status. These inconsistent findings may be due to heterogeneity in how variables are measured and the approaches used to characterize community physical activity resources and opportunities. Although previous reviews focus on characteristics of the built environment, attention to the availability of organized group physical activity services is lacking. To our knowledge, no study has formally synthesized the literature examining the availability of physical activity resources and opportunities, defined as community assets and organized group physical

activity services (i.e., settings in which physical activity is provided), by community racial, ethnic, or socioeconomic characteristics. The expected heterogeneity in study approaches precludes the conduct of a systematic review and meta-analysis (Peters et al., 2020), thus, a scoping review is warranted to map the available literature, clarify methods and indicators employed to characterize community physical activity resources and opportunities, and identify areas for further study.

Communities are complex systems, and the need for data on the full range of factors influencing community population health to inform decision-making is increasingly being recognized, including data illuminating the social, economic, and physical conditions in which people live, learn, work, and play (Institute of Medicine US Committee on Public Health Strategies to Improve Health, 2011; Robert Wood Johnson Foundation, 2015; Stoto and Ryan Smith, 2015; Van Brunt, 2017; Shroff et al., 2022). Community indicators can generate insights into health-related trends and outcomes and can inform efforts for improving health outcomes (Phillips, 2003). To improve population physical activity, indicators that provide information about both physical activity outcomes and determinants are needed (Pate, Sallis and Pollack Porter, 2020; Sallis and Pate, 2021). Assessing the availability and distribution of physical activity resources and opportunities within and between communities is necessary for illuminating inequalities in the distribution of such opportunities and understanding community physical and social conditions impacting physical activity. In addition to examining variability in the availability of physical activity resources and opportunities across communities, reviewing this body of literature allows for the synthesis of community indicators describing physical activity resources and opportunities. Such indicators may be useful for communities to understand unique conditions impacting physical activity outcomes and existing assets and services that can be used for community systems improvement.

This scoping review aims to synthesize the literature examining community-level variability in the availability (i.e., presence) of physical activity resources and opportunities by community racial, ethnic, and/or socioeconomic characteristics (hereafter referred to as socio-demographic characteristics). The aims of the review are to: 1) describe methodologies employed to measure community sociodemographic characteristics and availability of physical activity resources and opportunities, 2) generate an inventory of indicators for characterizing the availability of physical activity resources and opportunities, and 3) examine the associations between community-level sociodemographic characteristics and the availability of physical activity resources and opportunities. We hypothesized that a vast range of indicators would be used to assess community physical activity resources and opportunities and that such opportunities would vary by community sociodemographic characteristics. Specifically, we hypothesized that greater availability of physical activity resources and opportunities would be found in communities characterized by higher socioeconomic status (e.g., median household income) and lower prevalence of minority populations (e.g., percent Hispanic).

## 2. Methods

We conducted a scoping review in accordance with the PRISMA Extension for Scoping Reviews (Tricco et al., 2018) (Additional File 1) and JBI Manual for Evidence Synthesis with a defined Population, Concept, and Context (Peters et al., 2020, Peters et al., 2021). The review methods were established a priori and documented by the first author and reviewed by the senior author. As a scoping review, this study does not directly involve human subjects, and ethical approval was not required.

### 2.1. Inclusion criteria

As the focus of this review was on community factors and physical activity resources/opportunities available for any age, types of

participants or populations were not relevant inclusion criteria. The concept of the review considered all available evidence related to variation in the availability of community physical activity resources and opportunities according to community-level sociodemographic characteristics of race, ethnicity, or socioeconomic status. The context included studies originating from any country, as long as the unit of interest was defined by community geospatial boundaries.

To be eligible for the review, studies needed to include a whole-of-community approach (Wolfenden et al., 2014; Essay et al., 2021) where community was defined as a geospatial area in which a group of people lives, learns, works, and plays, and included two or more physical activity resources/opportunities within the geospatial area. Therefore, geospatial boundaries that included only one resource/opportunity (e.g., boundaries defined around a single park) or were defined around individuals' residences were not eligible for inclusion. These criteria allowed for assessing variability in resources/opportunities between geospatially defined communities. Secondly, studies needed to include an objective measure of the availability of public and/or private physical activity resources and opportunities within the defined community. For the purposes of this review, community physical activity resources and opportunities encompassed both assets for physical activity and organized group physical activity services, including programs, activities, parks, and indoor and outdoor recreation facilities (e.g., fitness centers, playgrounds). Availability was operationalized as a measure of the presence, amount, or density of resources/opportunities within the community. Thirdly, studies needed to include a measure of at least one community-level racial, ethnic, or socioeconomic variable. Fourthly, studies needed to quantitatively assess the associations between community-level racial, ethnic, or socioeconomic characteristics and the availability of physical activity resources and opportunities and/or differences in resource/opportunity availability by these community-level characteristics. Observational and experimental studies were eligible for inclusion, and studies needed to be in the English language. As recommended by the JBI Manual for Evidence Synthesis to ensure a comprehensive search (Peters et al., 2020, Peters et al., 2021), peer-reviewed published literature, published conference abstracts, theses/dissertations, and gray literature were eligible for inclusion. Criteria for exclusion were commentaries, editorials, or the like; and protocol studies, unless complementary to an included study.

## 2.2. Search strategy

With the assistance of a medical librarian, systematic electronic database searches were conducted in MEDLINE (EBSCO), CINAHL (EBSCO), PsycINFO (EBSCO), and Scopus (Elsevier) for literature through the end of December 2022. An initial limited search of MEDLINE via EBSCO was conducted to establish the search strategy. A combination of subject headings/controlled vocabulary and keywords were used on the topics of (1) *community*; and (2) *sociodemographic factors*; and (3) *physical activity*; and (4) *service, program, facility, or setting*. Results were limited to English and all dates were included, with the exclusion of letters to the editor, case studies/notes, review articles, and comments. The database searches were completed on December 13th, 2022, and December 28th, 2022. Additional articles were searched for by hand-searching and reviewing the reference lists of included full-text articles. The complete search strategy is provided in Additional File 2.

## 2.3. Evidence screening and selection

Citations returned from the search were imported into a reference manager, Zotero, and duplicates were removed. One reviewer (AER) screened titles and abstracts to determine relevance. All relevant articles ( $n = 221$ ) were retained to undergo full-text screening following the inclusion/exclusion criteria defined above. A random sample of 15 % ( $n$

$= 33$ ) of the full-text articles were independently screened by the primary author (AER) and one of two reviewers (PS or MAS) to ensure reliability. One reviewer (AER) screened the remaining articles. Throughout the screening process, an additional investigator was consulted regarding areas of uncertainty.

## 2.4. Data extraction

A data extraction tool (Additional File 3) was developed by the first author and revised by the senior author. The tool was reviewed by two additional investigators (MAS, PS) for clarity and pilot tested on three randomly selected included articles. Following tool revision and finalization, two reviewers (AER, DS) independently extracted data for a random sample of 10 % ( $n = 5$ ) of the included articles to ensure reliability. One reviewer (AER) extracted data from the remaining included articles, and an additional reviewer (PS) confirmed accuracy by reviewing another 10 % ( $n = 5$ ) of the articles. Extracted data included title, author, publication year, study design, study location, community geospatial definition, urbanicity/rurality of communities analyzed, community sociodemographic characteristics analyzed and data source (s), community physical activity resources and opportunities assessed, methods to measure community physical activity resources and opportunities and data source(s), and community-level indicators of the availability of physical activity resources and opportunities. Each indicator was coded as public or private and exclusionary or non-exclusionary, based on author specification. Resources/opportunities specified as free-to-access were coded as non-exclusionary, and those specified as pay-for-use or restricted access, such as only available to a subgroup of the population, were coded as exclusionary (Ostrom and Ostrom, 1978). Finally, the results of the associations between and/or differences in community sociodemographic characteristics and physical activity resources and opportunities were synthesized.

## 2.5. Analysis and presentation of results

Study information was synthesized descriptively. Frequency counts and percentages were calculated for publication year, country of study location, community geospatial definitions, urbanicity/rurality of communities, sociodemographic characteristics and physical activity resources and opportunities assessed, and data sources. Indicators used to assess community physical activity resource/opportunity availability were synthesized and categorized according to type, and the number of studies assessing each indicator is presented in tabular form.

Associations between community-level sociodemographic characteristics and each indicator are summarized descriptively in tabular form. Findings are presented as positive, negative, mixed, or non-significant according to socioeconomic advantage (e.g., higher median income, lower poverty prevalence) and non-minority population status. We hypothesized greater resource/opportunity availability would be found in communities of higher socioeconomic status and/or lower prevalence of minority populations. Author-reported significant associations or between-community differences in the hypothesized direction (e.g., greater opportunity availability by greater socioeconomic advantage or larger non-minority [e.g., white for United States studies, author-specified non-minority] population), are classified as positive. Significant associations in the opposite direction (e.g., lower availability by larger non-minority populations) are classified as negative. Mixed results are characterized by 1) studies that assessed multiple socioeconomic variables or multiple racial/ethnic variables with varying results, 2) significant interactions between multiple sociodemographic characteristics, and 3) significant interactions with another variable (e.g., associations at census-tract level differ by state).

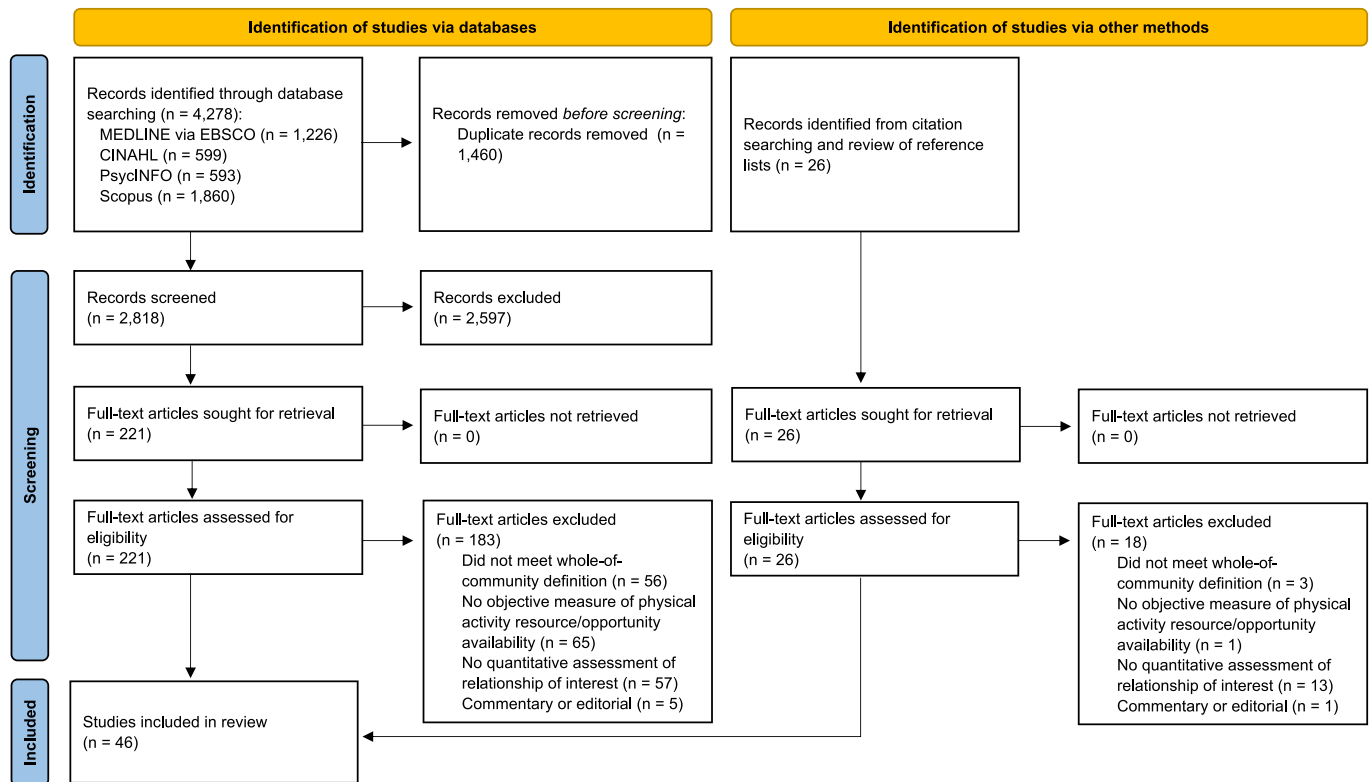


Fig. 1. PRISMA flow diagram for article screening and selection.

### 3. Results

#### 3.1. Study selection

Fig. 1 illustrates the PRISMA flow diagram of the article selection process. Screening resulted in the inclusion of 46 articles, 38 from database searching and 8 from citation searching and review of reference lists. The data extraction table is provided in Additional File 3 and is summarized below.

#### 3.2. Study characteristics

The number of studies by publication year and location is shown in Table 1. Approximately 61 % ( $n = 28$ ) of included studies were published after 2010. Nearly 44 % ( $n = 20$ ) of studies were conducted in the United States. About 37 % ( $n = 17$ ) of studies were conducted in Australia, China, Germany, Scotland, and Spain.

#### 3.3. Aim 1. Methodologies to measure community physical activity resource and opportunity availability

##### 3.3.1. Community geospatial definitions and urbanicity/rurality

Community geospatial units were defined according to 28 different boundaries across the included studies, provided in Additional File 3. The most used boundaries were census tract ( $n = 9$ , 19.6 %), geospatially defined neighborhood ( $n = 6$ , 13.0 %), and census block group ( $n = 5$ , 10.9 %). Other boundary definitions included datazone (a geography for small area statistics in Scotland), municipality, and zip code, each assessed in two studies (4.3 %). The remaining boundary definitions, such as tertiary planning units and local government areas, were assessed in one study each.

About 65.2 % ( $n = 30$ ) of studies were conducted in urban and suburban areas, 26 of which (56.5 %) were conducted only in urban areas. Six studies (13.0 %) included rural and urban communities, and

the remaining 10 studies (21.7 %) did not report urbanicity/rurality of the assessed communities.

##### 3.3.2. Community sociodemographic characteristics

The community-level sociodemographic characteristics and data sources used across the included studies are shown in Table 1. Nearly all ( $n = 45$ , 98 %) studies included a measure of socioeconomic status in analyses examining associations between community sociodemographic characteristics and physical activity resources/opportunities. Composite indicators combining multiple socioeconomic variables into a single index were used in approximately 46 % of studies. Commonly used income-related indicators were median household income and percent of residents living below poverty. Education-related indicators included percent of the population with a university education and with a high school education. Nearly half of the included studies used indicators of racial/ethnic composition, such as percent of minority (e.g., Hispanic, non-White) residents. Over 70 % of studies obtained sociodemographic data from national Census data. Other data sources included tax records and other national-level surveys.

##### 3.3.3. Availability of community physical activity resources and opportunities

The community physical activity resources and opportunities that were measured and corresponding data sources are shown in Table 2. Physical activity opportunities were categorized into two broad types, built environment resources and services. Built environment resources were those related to physical environment features for physical activity in the community. Indicators related to courses and programs for physical activity and indicators quantifying aspects of service delivery (e.g., recreation employment) were categorized as services. Most studies ( $n = 42$ , 91.3 %) measured built environment resources, such as parks and sports facilities. Approximately 34.8 % of studies used composite measures, or combined indices of multiple types of facilities and areas used for physical activity, including parks, recreation facilities, health

**Table 1**  
Frequency of study publication year, location, and sociodemographic characteristics assessed.

Year of publication	N (%)	Studies
2005 and prior	2 (4.3)	(Gold, 1974; Estabrooks et al., 2003)
2006–2010	16 (34.8)	(Gilliland et al., 2006; Gordon-Larsen et al., 2006; Powell et al., 2006; Ellaway et al., 2007; Hillsdon et al., 2007; Pascual et al., 2007; Timperio et al., 2007; Abercrombie et al., 2008; Black, 2008; Macintyre et al., 2008; Moore et al., 2008; Oh, 2008; Dahmann et al., 2010; Lamb et al., 2010; Richardson et al., 2010; Billaudeau et al., 2011)
2011–2015	12 (26.1)	(Frost, 2011; Svastisalee et al., 2012; Cerin et al., 2013; Duncan et al., 2013; Pascual et al., 2013; Vaughan et al., 2013; Albaladejo et al., 2014; Astell-Burt et al., 2014; Kamel et al., 2014; Jones et al., 2015; Lara-Valencia and García-Pérez, 2015; Schneider et al., 2015)
2016–2020	12 (26.1)	(Flacke et al., 2016; Hughey et al., 2016; Li and Liu, 2016; Eime et al., 2017; Schüle et al., 2017; Rigolon et al., 2018; Thompson-Dyck, 2018; Cereijo et al., 2019; Garrison, 2019; Kroshus et al., 2019; Mouratidis, 2020; Wu and Kim, 2020)
2021 and later	4 (8.7)	(Heo et al., 2021; Şenol and Atay Kaya, 2021; Zhang et al., 2021; Won, 2022)
<b>Study location</b>		
Australia	3 (6.5)	(Timperio et al., 2007; Astell-Burt et al., 2014; Eime et al., 2017)
China	4 (8.7)	(Cerin et al., 2013; Li and Liu, 2016; Wu and Kim, 2020; Zhang et al., 2021)
Germany	3 (6.5)	(Schneider et al., 2015; Flacke et al., 2016; Schüle et al., 2017)
Scotland	3 (6.5)	(Ellaway et al., 2007; Macintyre et al., 2008; Lamb et al., 2010)
Spain	4 (8.7)	(Pascual et al., 2007, 2013; Albaladejo et al., 2014; Cereijo et al., 2019)
United States	20 (43.5)	(Gold, 1974; Estabrooks et al., 2003; Gordon-Larsen et al., 2006; Powell et al., 2006; Abercrombie et al., 2008; Black, 2008; Moore et al., 2008; Oh, 2008; Dahmann et al., 2010; Frost, 2011; Duncan et al., 2013; Vaughan et al., 2013; Kamel et al., 2014; Jones et al., 2015; Hughey et al., 2016; Rigolon et al., 2018; Thompson-Dyck, 2018; Garrison, 2019; Kroshus et al., 2019; Won, 2022)
Other <sup>A</sup>	9 (19.6)	(Gilliland et al., 2006; Hillsdon et al., 2007; Richardson et al., 2010; Billaudeau et al., 2011; Svastisalee et al., 2012; Lara-Valencia and García-Pérez, 2015; Mouratidis, 2020; Heo et al., 2021; Şenol and Atay Kaya, 2021)
<b>Sociodemographic characteristics assessed</b>		
<b>Socioeconomic status <sup>B</sup></b>		
Composite indicators	21 (45.7)	(Estabrooks et al., 2003; Gilliland et al., 2006; Ellaway et al., 2007; Hillsdon et al., 2007; Timperio et al., 2007; Macintyre et al., 2008; Lamb et al., 2010; Richardson et al., 2010; Frost, 2011; Cerin et al., 2013; Lara-Valencia and García-Pérez, 2015; Flacke et al., 2016; Hughey et al., 2016; Li and Liu, 2016; Eime et al., 2017; Schüle et al., 2017; Thompson-Dyck, 2018; Cereijo et al., 2019; Heo et al., 2021; Zhang et al., 2021; Won, 2022)
Income-related indicators	24 (52.2)	(Gold, 1974; Powell et al., 2006; Pascual et al., 2007, 2013; Abercrombie et al., 2008; Black, 2008; Moore et al., 2008; Oh, 2008; Dahmann et al., 2010; Billaudeau et al., 2011; Svastisalee et al., 2012; Duncan et al., 2013; Vaughan et al., 2013; Albaladejo et al., 2014; Astell-Burt et al., 2014; Kamel et al., 2014; Jones et al., 2015; Schneider et al., 2015; Rigolon et al., 2018; Garrison, 2019; Kroshus et al., 2019; Mouratidis, 2020; Heo et al., 2021; Won, 2022)
Education-related indicators	6 (13.0)	(Gordon-Larsen et al., 2006; Svastisalee et al., 2012; Albaladejo et al., 2014; Kroshus et al., 2019; Heo et al., 2021; Şenol and Atay Kaya, 2021)
<b>Race/ethnicity <sup>C</sup></b>		
Racial/ethnic composition indicators	21 (45.7)	(Gold, 1974; Gordon-Larsen et al., 2006; Powell et al., 2006; Abercrombie et al., 2008; Black, 2008; Moore et al., 2008; Oh, 2008; Dahmann et al., 2010; Svastisalee et al., 2012; Duncan et al., 2013; Vaughan et al., 2013; Kamel et al., 2014; Jones et al., 2015; Hughey et al., 2016; Rigolon et al., 2018; Thompson-Dyck, 2018; Garrison, 2019; Kroshus et al., 2019; Wu and Kim, 2020; Zhang et al., 2021; Won, 2022)
<b>Sociodemographic data sources</b>		
Census data	33 (71.7)	(Estabrooks et al., 2003; Gilliland et al., 2006; Gordon-Larsen et al., 2006; Powell et al., 2006; Ellaway et al., 2007; Hillsdon et al., 2007; Timperio et al., 2007; Abercrombie et al., 2008; Black, 2008; Moore et al., 2008; Oh, 2008; Dahmann et al., 2010; Lamb et al., 2010; Richardson et al., 2010; Frost, 2011; Cerin et al., 2013; Duncan et al., 2013; Vaughan et al., 2013; Astell-Burt et al., 2014; Kamel et al., 2014; Jones et al., 2015; Lara-Valencia and García-Pérez, 2015; Flacke et al., 2016; Hughey et al., 2016; Li and Liu, 2016; Rigolon et al., 2018; Thompson-Dyck, 2018; Garrison, 2019; Kroshus et al., 2019; Wu and Kim, 2020; Şenol and Atay Kaya, 2021; Zhang et al., 2021; Won, 2022)
Other sources <sup>D</sup>	10 (21.7)	(Pascual et al., 2007, 2013; Macintyre et al., 2008; Billaudeau et al., 2011; Svastisalee et al., 2012; Albaladejo et al., 2014; Eime et al., 2017; Schüle et al., 2017; Mouratidis, 2020; Heo et al., 2021)
Not reported	3 (6.5)	(Gold, 1974; Schneider et al., 2015; Cereijo et al., 2019)

<sup>A</sup> Other study locations include Canada, Denmark, England, France, Mexico, New Zealand, Norway, South Korea, and Turkey.

<sup>B</sup> Socioeconomic status composite indicators include multiple socioeconomic indicators combined into a single index (e.g., Socioeconomic Deprivation Index). Income-related indicators include median household income, percentage of population living on low income and percent of families 100 % below the federal poverty level. Education-related indicators include percent of individuals with a high school education or below. All indicators are provided in Additional File 3.

<sup>C</sup> Racial/ethnic composition indicators include percent of non-Hispanic residents, percent of Hispanic residents, and percent of Black residents. All indicators are provided in Additional File 3.

<sup>D</sup> Other sources include tax records, governmental statistics departments, and national survey data. Data sources are provided in Additional File 3.

clubs, and walking trails. Nearly 20 % of studies measured the availability of sports facilities in the community, such as baseball fields. Availability of physical activity opportunities in terms of organized physical activity services was measured in 8.7 % ( $n = 4$ ) of studies.

The most common method for measuring the availability of physical activity resources/opportunities was through accessing existing secondary datasets. These datasets were primarily accessed through governmental entities such as community park and recreation, geographic information, statistics, planning, and land management departments. Other secondary dataset sources included commercial and

non-profit organizations. Internet searching to identify and compile existing community physical activity resources and opportunities was the most common method for collecting primary data.

### 3.4. Aim 2. Inventory of indicators of community physical activity resource/opportunity availability

An inventory of indicators of community physical activity resource/opportunity availability, with the number of studies assessing each indicator by type, is shown in Fig. 2, with references in Additional File 4.

**Table 2**  
Frequency of physical activity resource and opportunity types measured and data sources.

Physical activity indicator types	N (%)	Studies
<b>Built environment resources</b>		
Composite measures <sup>A</sup>	16 (34.8)	(Estabrooks et al., 2003; Gilliland et al., 2006; Gordon-Larsen et al., 2006; Powell et al., 2006; Hillsdon et al., 2007; Timperio et al., 2007; Abercrombie et al., 2008; Black, 2008; Macintyre et al., 2008; Moore et al., 2008; Lamb et al., 2010; Frost, 2011; Duncan et al., 2013; Jones et al., 2015; Schneider et al., 2015; Cereijo et al., 2019)
Sports facilities	9 (19.6)	(Hillsdon et al., 2007; Pascual et al., 2007, 2013; Timperio et al., 2007; Macintyre et al., 2008; Billaudeau et al., 2011; Svastisalee et al., 2012; Albaladejo et al., 2014; Eime et al., 2017)
Parks, playgrounds, and green space	26 (56.5)	(Ellaway et al., 2007; Abercrombie et al., 2008; Black, 2008; Moore et al., 2008; Oh, 2008; Richardson et al., 2010; Svastisalee et al., 2012; Cerin et al., 2013; Pascual et al., 2013; Vaughan et al., 2013; Astell-Burt et al., 2014; Kamel et al., 2014; Jones et al., 2015; Lara-Valencia and García-Pérez, 2015; Flacke et al., 2016; Hughey et al., 2016; Li and Liu, 2016; Schüle et al., 2017; Rigolon et al., 2018; Thompson-Dyck, 2018; Garrison, 2019; Mouratidis, 2020; Wu and Kim, 2020; Heo et al., 2021; Şenol and Atay Kaya, 2021; Zhang et al., 2021)
<b>Services</b>		
Courses and programs	2 (4.3)	(Dahmann et al., 2010; Kroshus et al., 2019)
Service delivery	2 (4.3)	(Gold, 1974; Won, 2022)
<b>Physical activity data sources</b>		
<b>N (%)</b>		
Facility visits	3 (6.5)	(Dahmann et al., 2010; Jones et al., 2015; Lara-Valencia and García-Pérez, 2015)
Internet searching	8 (17.4)	(Estabrooks et al., 2003; Macintyre et al., 2008; Moore et al., 2008; Dahmann et al., 2010; Frost, 2011; Jones et al., 2015; Kroshus et al., 2019; Zhang et al., 2021)
Observational audit	4 (8.7)	(Cerin et al., 2013; Kamel et al., 2014; Schneider et al., 2015; Hughey et al., 2016)
Parks and Recreation Department contact	4 (8.7)	(Estabrooks et al., 2003; Dahmann et al., 2010; Jones et al., 2015; Lara-Valencia and García-Pérez, 2015)
School district contact	1 (2.2)	(Estabrooks et al., 2003)
Existing datasets <sup>B</sup>	39 (84.8)	(Gold, 1974; Gilliland et al., 2006; Gordon-Larsen et al., 2006; Powell et al., 2006; Ellaway et al., 2007; Hillsdon et al., 2007; Pascual et al., 2007, 2013; Timperio et al., 2007; Abercrombie et al., 2008; Black, 2008; Moore et al., 2008; Oh, 2008; Lamb et al., 2010; Richardson et al., 2010; Billaudeau et al., 2011; Svastisalee et al., 2012; Duncan et al., 2013; Vaughan et al., 2013; Albaladejo et al., 2014; Astell-Burt et al., 2014; Kamel et al., 2014; Jones et al., 2015; Lara-Valencia and García-Pérez, 2015; Flacke et al., 2016; Hughey et al., 2016; Li and Liu, 2016; Eime et al., 2017; Schüle et al., 2017; Rigolon et al., 2018; Thompson-Dyck, 2018; Cereijo et al., 2019; Garrison, 2019; Mouratidis, 2020; Wu and Kim, 2020; Heo et al., 2021; Şenol and Atay Kaya, 2021; Zhang et al., 2021; Won, 2022)
Yellow Pages	4 (8.7)	(Estabrooks et al., 2003; Abercrombie et al., 2008; Moore et al., 2008; Frost, 2011)

<sup>A</sup> Composite measures summed the availability of multiple types of resources (e.g., sports facilities, parks, playgrounds, and green space) into a single measure. See Additional File 5 for descriptions of each composite measure.

<sup>B</sup> Existing datasets include data obtained from commercial databases (e.g., InfoUSA), governmental offices, and geographic information datasets. See Additional File 3.

Physical activity opportunities in the included studies were specified as public, private, exclusionary, non-exclusionary, private and exclusionary, or public and non-exclusionary. Studies that did not explicitly differentiate opportunities by public/private or exclusionary/non-exclusionary were categorized as General. Overall, 41 unique indicators were identified, with most indicators ( $n = 36$ ) characterizing built environment resources. Primary categories included composite measures ( $n = 10$ ), sports facilities ( $n = 12$ ), and parks, playgrounds, and green space ( $n = 14$ ). Of the built environment resource indicators, the most frequently used indicators were the number of physical activity facilities ( $n = 17$  studies), the number of physical activity facilities per population ( $n = 11$  studies), and the percentage of park land/green space per total land ( $n = 10$  studies). Only five indicators characterized physical activity services in the community.

### 3.5. Aim 3. Sociodemographic characteristics and physical activity resources and opportunities

Table 3 synthesizes the relationships between community sociodemographic characteristics and physical activity resource/opportunity availability by frequency and direction (i.e., positive, negative, mixed, non-significant) for each indicator assessed. As no public/exclusionary or private/non-exclusionary indicators were identified, the private, exclusionary, and private and exclusionary categories and the public, non-exclusionary, and public and non-exclusionary categories were combined into private/exclusionary and public/non-exclusionary, respectively, to synthesize results. The numbers in the cells indicate

the number of independent associations of each type across all included studies. Thus, studies assessing multiple indicators of the same type (e.g., two indicators of public/non-exclusionary sports facilities) are counted for each independent relationship with community socio-demographic characteristics. Additional File 4 provides an expanded table synthesizing the relationships between community sociodemographic characteristics and each indicator in Fig. 2.

A total of 141 associations between community sociodemographic characteristics and indicators of physical activity resource/opportunity availability were assessed across the 46 included studies. Of those, 106 were with socioeconomic advantage (e.g., higher median income), and 35 were with racial/ethnic composition regarding non-minority population status. Nearly 30 % ( $n = 29$ ) of associations with socioeconomic advantage were positive, such that greater physical activity opportunity availability was found in communities with greater socioeconomic advantage. Approximately 37.8 % ( $n = 40$ ) of associations were non-significant, 22.6 % ( $n = 24$ ) were mixed, and 12.3 % ( $n = 13$ ) were negative. Among general composite indicators specifically, most associations with socioeconomic advantage ( $n = 9$ , 60 %) were positive. However, a majority of public/non-exclusionary ( $n = 8$ , 66.7 %) and private/exclusionary ( $n = 8$ , 57.1 %) composite indicators had non-significant associations with socioeconomic advantage. For indicators of other types, the relationships with socioeconomic advantage were more evenly distributed across directions.

Approximately 37.1 % ( $n = 13$ ) of associations with racial/ethnic composition suggest greater physical activity resource/opportunity availability in communities with larger non-minority populations.

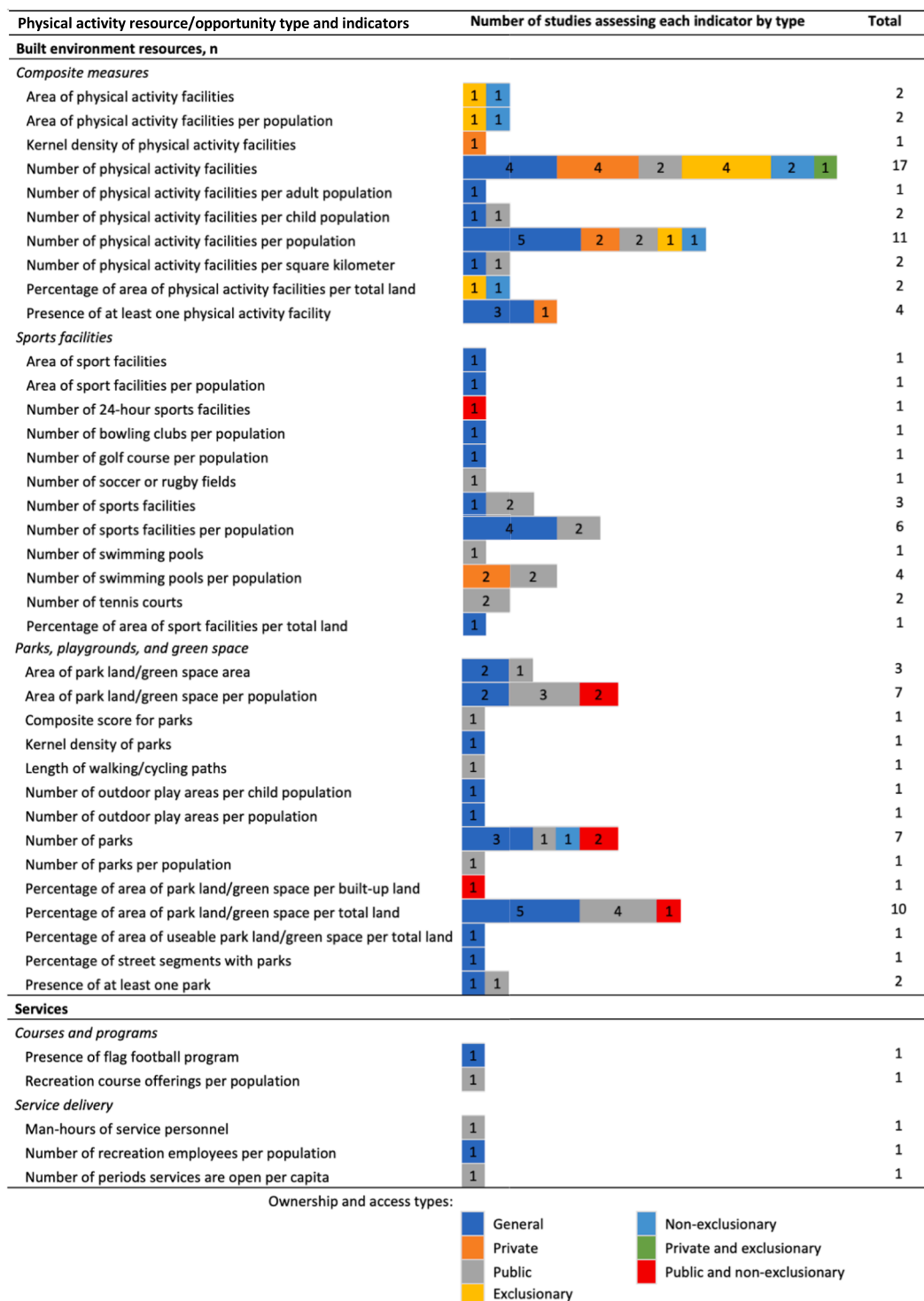


Fig. 2. Physical activity resource and opportunity indicators and number of studies assessing each indicator.

About 34.3 % ( $n = 12$ ) of associations with non-minority population status were non-significant and 28.6 % ( $n = 10$ ) were mixed. Most associations between non-minority population status and general composite indicators were positive ( $n = 4$ , 66.7 %), while the associations with parks, playgrounds, and green space, were predominantly mixed or non-significant ( $n = 15$ , 78.9 %). Overall, associations with racial/ethnic composition were investigated to a lesser extent than associations with socioeconomic advantage.

#### 4. Discussion

The present scoping review synthesized and described the literature examining community-level variability in physical activity resource and opportunity availability by community sociodemographic characteristics. The review aimed to 1) describe the approaches used in existing studies; 2) provide an inventory of community-level physical activity resource/opportunity indicators; and 3) examine associations between community sociodemographic characteristics and physical activity resource/opportunity availability. Findings across the 46 included

**Table 3**  
Number of relationships between community sociodemographic characteristics and community physical activity resources and opportunities.

PA indicator type	Socioeconomic advantage					Non-minority population status				
	Total	Positive	Negative	Mixed	NS	Total	Positive	Negative	Mixed	NS
<b>Overall, n</b>	106	29	13	24	40	35	13	0	10	12
<b>Composite measures</b>										
General	15	9	2	1	3	6	4	0	2	0
Private/exclusionary	14	4	0	2	8	4	2	0	1	1
Public/non-exclusionary	12	2	2	0	8	0	0	0	0	0
<b>Sports facilities</b>										
General	10	2	0	1	7	0	0	0	0	0
Private/exclusionary	2	0	0	0	2	0	0	0	0	0
Public/non-exclusionary	11	2	4	3	2	1	1	0	0	0
<b>Parks, playgrounds, and green space</b>										
General	17	3	4	6	4	7	0	0	4	3
Public/non-exclusionary	20	6	1	7	6	12	4	0	2	6
<b>Courses and programs</b>										
General	1	0	0	1	0	1	0	0	0	1
Public/non-exclusionary	1	1	0	0	0	1	1	0	0	0
<b>Service delivery</b>										
General	1	0	0	1	0	1	1	0	0	0
Public/non-exclusionary	2	0	0	2	0	2	0	0	1	1

NS: Non-significant; PA: Physical activity

The number in the cell indicates the number of independent associations of that type across all included studies. Studies assessing multiple indicators of the same type (e.g., two indicators of public/free sports facilities) are counted for each independent relationship with community sociodemographic characteristics.

studies illustrate, as hypothesized, heterogeneity in approaches used to define communities and characterize resource/opportunity availability. For instance, 28 different geospatial boundaries were applied to define communities, and 41 unique indicators were used to characterize physical activity resource/opportunity availability. Relationships between community sociodemographic characteristics and physical activity resources/opportunities are inconsistent across indicators and studies. Although some included studies suggest, as hypothesized, communities of greater socioeconomic status and non-minority population prevalence may have greater availability of physical activity resources/opportunities compared to communities of lower socioeconomic status and larger prevalence of minority populations, most associations were mixed or non-significant.

The present review identified 28 community geospatial boundaries across 15 study locations, and most of the boundary definitions were examined in two or fewer studies each. This limited the ability to determine whether the physical activity resource/opportunity indicators used in the included studies and variability by sociodemographic characteristics differed by community unit size. Zooming in and zooming out to more and less granular geospatial scales may allow different indicators of physical activity opportunities to emerge. Thus, assessing physical activity opportunities, and variability by sociodemographic characteristics, across multiple geospatial scales would provide a more comprehensive understanding of community recreation systems and patterns of variability in opportunity. Further, assessing physical activity resources and opportunities across multiple geospatial scales may strengthen understanding of the influence of such opportunities on physical activity outcomes and the scales at which these opportunities are most influential (Essay et al., 2023).

Much of the existing research on physical activity resources and opportunities has focused on the built environment, whereas physical activity-related programs and activities have received little attention. As participation in organized physical activity programs is associated with increased physical activity (Marques, Ekelund and Sardinha, 2016; Dunton et al., 2019; National Academies of Sciences and Medicine, 2019), enhancing the surveillance of such programs is a significant public health priority (National Academies of Sciences and Medicine, 2019). Additionally, while built environment resources such as parks provide infrastructure for both informal (e.g., individual exercise) and organized (e.g., sport practices) physical activity (Dahmann et al., 2010), organized physical activity services can likewise enhance the impact of built environment resources by

encouraging use (National Academies of Sciences and Medicine, 2019). Thus, strengthening assessment of the availability of physical activity-related services, in addition to built environment resources, within and across communities is necessary to obtain a comprehensive understanding of physical activity opportunities and to inform decision-making to improve opportunities and physical activity outcomes.

An important finding of this review is that the examination of physical activity resources/opportunities in rural communities is lacking in this body of research, as most studies included only urban and suburban areas in their analyses. Insufficient physical activity and associated chronic conditions, such as obesity, are larger problems in rural compared to urban communities (Patterson et al., 2004; Whitfield et al., 2019). Limited resources and infrastructure for physical activity may partially explain these poorer outcomes (Umstattd Meyer et al., 2016). For example, research has found that outdoor public open spaces and amenities for physical activity, such as trails, are lacking in rural communities, and those that do exist are often poorly maintained or informal (Yousefian et al., 2009). As the availability of physical activity resources and opportunities, as well as associations between availability and community-level sociodemographic characteristics, are likely different in rural compared to urban communities (Umstattd Meyer et al., 2016), there is a need to examine rural community physical activity systems further to understand the unique physical and social conditions impacting physical activity in these populations.

Routine community assessment in both rural and urban communities is necessary for informing efforts to improve population health outcomes, such as physical activity, and for understanding whether improvements are occurring over time (Carver and Scheier, 2002; Stoto and Ryan Smith, 2015; Liu and Barabási, 2016; Van Brunt, 2017; Shroff et al., 2022). Data to understand health outcomes and the conditions impacting health outcomes locally are critical, as intervention and policy efforts are commonly driven at local levels (Greenlund et al., 2022). Physical activity opportunities and resources that may be used to provide opportunities have been shown to influence physical activity outcomes (Davison and Lawson, 2006; Ding et al., 2011; Pontin et al., 2022), and assessing the availability of such opportunities locally is necessary for understanding physical activity outcomes within and across communities. The inventory of community physical activity resource/opportunity indicators and the identified data sources synthesized in this review may be useful for advancing community assessment and physical activity



improvement efforts, as they provide methods for assessing the provision of equitable physical activity opportunities.

This review focused on the availability of physical activity resources/opportunities, but it is important to note that availability does not equate to accessibility, nor does availability necessarily translate to increased physical activity. Availability addresses one facet of access, as opportunities must be present for people to access and them, and this review characterized opportunities as exclusionary or non-exclusionary based on whether opportunities were freely accessible. However, research should examine other facets of access to (e.g., transportation time, rules of access), use of, and characteristics of (e.g., presence of restrooms, physical activity time during programs) physical activity resources/opportunities, as these characteristics may also vary by community sociodemographic characteristics and influence physical activity behaviors (Gilliland et al., 2006). For instance, a recent study found variability in adult physical activity behaviors across different locations (e.g., homes, parks) and that where adults engage in physical activity varies by individual sociodemographic characteristics (Holliday et al., 2017). Additionally, Gordon-Larsen and colleagues found that variability in the availability of built environment resources is associated with subsequent sociodemographic disparities in physical activity (Gordon-Larsen et al., 2006). The inconsistent evidence of variability in the availability of physical activity resources/opportunities by community sociodemographic characteristics found in this review highlights the need to further examine characteristics of opportunities, such as access, and subsequent population physical activity outcomes.

#### 4.1. Study limitations and strengths

A limitation of this review is that, due to the descriptive nature, the certainty of findings regarding the relationship between community sociodemographic characteristics and physical activity resources/opportunities cannot be assessed. However, the synthesis reveals areas for potential systematic reviews and meta-analyses to strengthen understanding of these relationships, such as a meta-analysis of the 17 studies assessing the number of physical activity facilities by community sociodemographic characteristics. Secondly, the review only included studies assessing the availability of physical activity resources/opportunities. While the inclusion criteria were established to manage the scope of the review and examine inequalities in the distribution of opportunities, excluded studies, such as those assessing access, are likely relevant. Included studies were limited to those published in English, creating the potential for selection bias. Further, extracted data was limited to information explicitly reported by the authors, and contacting authors for additional information was not attempted. Finally, the review does not assess why differences in the availability of physical activity opportunities may or may not exist across communities or community processes that produce these opportunities, highlighting another area for future research.

Despite these limitations, this is the first review to systematically search for and synthesize the literature examining relationships between community-level socioeconomic and racial/ethnic characteristics and the availability of community physical activity resources and opportunities, including both built environment resources and physical activity-related services, such as programs and activities. The review did not exclude studies based on publication date or study location. Further, the literature search process was comprehensive and well-constructed, as the search strategy was created by a medical librarian and supplemented by hand-searching.

## 5. Conclusion

The aim of this review was to synthesize the literature examining community-level variability in physical activity resources and opportunities by sociodemographic characteristics. Community physical

activity resources and opportunities have been shown to improve physical activity outcomes, and differences in the availability of these opportunities may aid in explaining geospatial and demographic variability in physical activity. However, variability in physical activity resources/opportunities by community sociodemographic characteristics was not consistently evident in the synthesized studies. This scoping review illustrates that existing studies have used a variety of approaches and indicators to characterize physical activity resources and opportunities, and quantitative syntheses of subsets of identified studies using similar approaches and indicators are warranted to further understand these relationships. Additional areas for future research include examining physical activity opportunities and variability by sociodemographic characteristics in rural communities and developing and evaluating indicators related to organized physical activity services. The present review provides a descriptive synthesis to inform future research and practice efforts around understanding and evaluating community physical activity resources and opportunities. Such efforts are necessary for understanding community conditions impacting physical activity outcomes, identifying inequalities in physical activity opportunities, and informing decision-making for improving physical activity outcomes.

#### CRedit authorship contribution statement

**Ann E. Rogers:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Data curation, Conceptualization. **Michaela A. Schenkelberg:** Writing – review & editing, Formal analysis, Data curation. **Peter Stoepker:** Writing – review & editing, Formal analysis, Data curation. **Danielle Westmark:** Writing – review & editing, Methodology, Data curation. **Deepa Srivastava:** Writing – review & editing, Formal analysis. **David A. Dziewaltowski:** Writing – review & editing, Supervision, Methodology, Conceptualization.

#### Declaration of competing interest

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

#### Data availability

No data was used for the research described in the article.

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Not applicable.

#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2024.102656>.

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