The association between neighborhood walkability and cardiovascular diseases in older adults: a systematic review

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October 2023

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ABSTRACT

AIM: This systematic review aims to provide a comprehensive overview of the studies investigating the association between neighborhood walkability and cardiovascular diseases (CVDs) in older adults.

METHODS: PubMed was searched until 28 September 2023 for studies that met the following inclusion criteria: (1) observational or experimental original studies, (2) reporting some kind of composite walkability exposure measure, (3) reporting outcome data on CVD events or mortality due to CVD, (4) conducted in older adults (mean age above 65 years old and no adults younger than 50 years old included in the study). Only studies written in English were included. Screening, data extraction, and assessment of risk of bias was done by one reviewer.

RESULTS: Five studies met the inclusion criteria and were included in this systematic review. Four out of five studies were assigned to have a good quality, and one a fair quality. In three of the five studies, a higher walkability score was associated with a significant lower risk for CVD events, varying from a 22% lower risk for cardiometabolic mortality in older women (65-85 years old; hazard ratio [HR] = 0.78 [95% confidence interval (CI) 0.63-0.97]) and a 6% lower risk for CVD mortality in older adults (65-74 years old; HR = 0.94 [95% CI 0.89-0.98]). Two studies did not find a statistically significant association.

DISCUSSION: Although these results indicate a possible interaction between neighborhood walkability and CVDs in older adults, more research is needed to strengthen this evidence.

LAY SUMMARY

Cardiovascular diseases (CVDs) are a the number one reason of death worldwide. Age is an important risk factor for both the occurrence of heart diseases and death due to heart diseases. It is expected that the proportion of older people (above 65 years old) will grow and become an even larger part of the population. Therefore, it is important to know how the occurrence of CVDs can be prevented in older adults. Being more active has shown to lower the risk of CVDs in older people. Earlier studies have shown that a neighborhood that is more inviting to walk in, increases the amount of physical activity in older adults. In this review, we aim to describe the studies that report on the relationship between a neighborhood that is more walkable and the occurrence of CVDs.

We searched the literature using search terms for walkable neighborhoods, CVDs, and older people. After going through all the studies, we found five studies that investigated the relationship between walkable neighborhoods and CVDs in older people. Three studies reported that more walkable neighborhoods indeed lower the risk of CVDs. Among these three studies, neighborhoods that are more walkable lower the risk for different CVDs between 6 and 22%. However, the other two studies did not find a relationship between neighborhoods that are more walkable and CVDs. More research has to be done in older adults to see if a neighborhood that is more walkable can indeed lower the risk for CVDs.

INTRODUCTION

Cardiovascular diseases (CVDs), compromising a group of diseases affecting the heart and blood vessels, collectively remain the global leading cause of death resulting in 18.6 million deaths in 2019.[1,2] In the last 30 years the number of prevalent CVD cases have almost doubled to 523 million in 2019.[2] Also in Europe, CVDs were the main cause of death accounting for more than 40% of the deaths and more than 60 million potential years of life were lost due to CVD.[3-5] In addition to the individual impact, CVDs also impose an economic burden. It is estimated that CVDs cost the European Union (EU) €282 billion each year, including the direct healthcare costs as well as the indirect costs due to productivity losses.[6]

Age is an important risk factor for CVDs due to the decline in several physiological processes resulting from aging.[7] It is projected that the number of people above 65 years old will more than double to 1.5 billion and the number of people above 80 years old will even increase with almost a threefold to 426 million in 2050.[8] Next to an absolute increase in the number of older adults, the percentage of older adults in the total population will increase globally.[8] Both prevalence and mortality due to CVDs are higher among older adults. The prevalence of CVD (including coronary heart disease, heart failure, and stroke) gradually increases from 9% in people between 40 and 59 years old to 33-40% in people above 80 years old.[9] Furthermore, more than 75% of all deaths due to CVD in Europe occurred in people above 70 years old.[3] An understanding in the prevention of CVD in older adults is therefore crucial to bring an end to the growing global burden of CVDs.

Physical inactivity is an important risk factor for CVD.[1] Previous studies have shown that an increase in physical activity (PA) led to a reduction in the cardiovascular risk – according to the Framingham score – and incident CVDs in older adults.[10-12] Despite the evidence for the health benefits from PA, still only 22.4% of the adults above 65 years old in the EU exercised more than the minimal advised 150 minutes per week.[13,14]

Recent reviews have shown that features of the built environment – defined as all characteristics of an individual's surroundings that are man-made or modified, such as parks, infrastructures, and accessibility of facilities like shops, hospitals or school[15] – can facilitate or hinder adults to be physically active.[16-19] Components that negatively influence PA in older adults are noise, barriers to walking and cycling, street lightning, among others. Examples of components that shown to have a positive influence on the amount of PA in older adults are street connectivity, land-use mix, and neighborhood walkability. Neighborhood walkability is a composite measure indicating how walkable an environment is. The walkability score or index is created by combining variables that predominantly promote walking like street connectivity, population density, land-use mix, sidewalk density, green space, and accessibility of public transport.[20] By doing so, the walkability score or index takes into account the fact that individuals are exposed to multiple factors at the same time, which is argued to be an advantage opposed to exposure to a single factor.[21]

The association between neighborhood walkability and cardiometabolic risk factors and CVDs has been studied in adults, with higher walkable environment being consistently associated with lower risk for cardiometabolic risk factors and CVDs.[22,23] However, the evidence for this association in older adults is still limited. Hence, this systematic review aims to summarize, describe, and assess the quality of the studies reporting on the association between neighborhood walkability and CVDs in older adults.

METHODS

Literature search

This systematic review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.[24] On 28 September 2023 the database Medical Literature Analysis and Retrieval System Online was searched using PubMed to identify studies on the association between neighborhood walkability and cardiovascular diseases (CVD) in elderly. The applied search string, including search terms on (1) walkability, (2) potentially relevant walkability components, (3) CVDs, and (4) older adults, can be found in the Supplementary Data (**Appendix 1**). Truncations, index terms (Medical Subject Headings terms), and Boolean operators ('AND', 'OR', and 'NOT') were used in the search. Furthermore, reference lists of the included studies were screened to identify additional studies that met the inclusion criteria.

Inclusion and exclusion criteria

Studies were included in this systematic review if they (1) were original observational (e.g. cohort, cross-sectional, case-control studies or derivatives of this) or experimental (randomized controlled trials) studies, (2) reported on a composite walkability exposure measure as an independent variable, (3) reported an association between the walkability exposure measure and CVD events or mortality, (4) reported that the study population had a mean age of 65 years or older and did not include participants younger than 50 or performed a subgroup analysis using these criteria, and (5) were written in English.

Studies were excluded if they were (1) editorials, letters to editors, guidelines, conference abstracts, or systematic reviews and (2) did not report a composite walkability exposure measure but looked at separate components often included in a walkability score (e.g. street connectivity, green space, and land-use mix).

Study selection and data extraction

All studies obtained from the database search were imported in the reference manager EndNote (version X9.3.3), which was also used for screening. All studies were independently screened for eligibility by one reviewer (FtH), first by title and abstract and subsequently by full-text. Reasons for exclusion based on full text were recorded.

Data extraction of the included studies was done by one reviewer (FtH) using a standardized Excel form. In this data collection form, information about the publication (i.e. first author, publication year, geographical location, study design, and sample size), study population (i.e. mean/median age, age range, and percentage females), independent variable (i.e. definition of walkability and if it was measured objectively using geographic information system [GIS] or subjective using self-report), dependent variable (i.e. type of CVD event and how measured), study outcome (i.e., effect measure [risk ratio (RR), hazard ratio (HR), or odds ratio (OR) and the corresponding 95% confidence interval (CI)]), and confounders were registered.

Risk of bias assessment

The risk of bias of the included studies was assessed by one reviewer using the Newcastle-Ottowa Scale (NOS) for cohort and case-control studies.[25] This scale uses a star system to score studies based on three domains: selection of study groups, comparability of the study groups, and the ascertainment of outcome (cohort studies) or exposure (case-control studies). The selection domain can receive a maximum of four stars, the comparability domain a maximum of two stars, and the outcome/exposure domain a maximum of three stars. An adjusted version of the NOS was used for the cross-sectional studies.[26] For cross-sectional studies, the selection domain can receive a maximum of five stars, the comparability domain a maximum of two stars, and the outcome domain a maximum of three stars.

The quality of the study was judged to be either good, fair, or poor. Good quality studies had three or more stars in the selection domain, one or two stars in the comparability domain, and two or three stars in the outcome/exposure domain. Fair quality study received two stars in the selection domain, one or two stars in the comparability domain, and two or three starts in the outcome/exposure domain. Studies were assessed as having a poor quality if they received either one or less than one stars in the domains selection or outcome/exposure or if they received zero stars in the domain comparability. Detailed scales can be found in **Appendices 2** and **3**.

RESULTS

Literature search

The initial search identified 1609 studies, and one study was selected from the reference list of one of the studies assessed during full-text screening. After removing duplicates (n = five), the titles and abstracts of 1604 studies were screened. A total of 43 studies was eligible for full-text screening. During full-text screening 37 studies were excluded. Reasons for exclusion were (1) wrong exposure measurement (n = four), (2) wrong study population (n = 29), and (3) wrong outcome (n = five). Finally, five studies met the inclusion criteria and were included in this systematic review (**Figure 1**).[27-31]

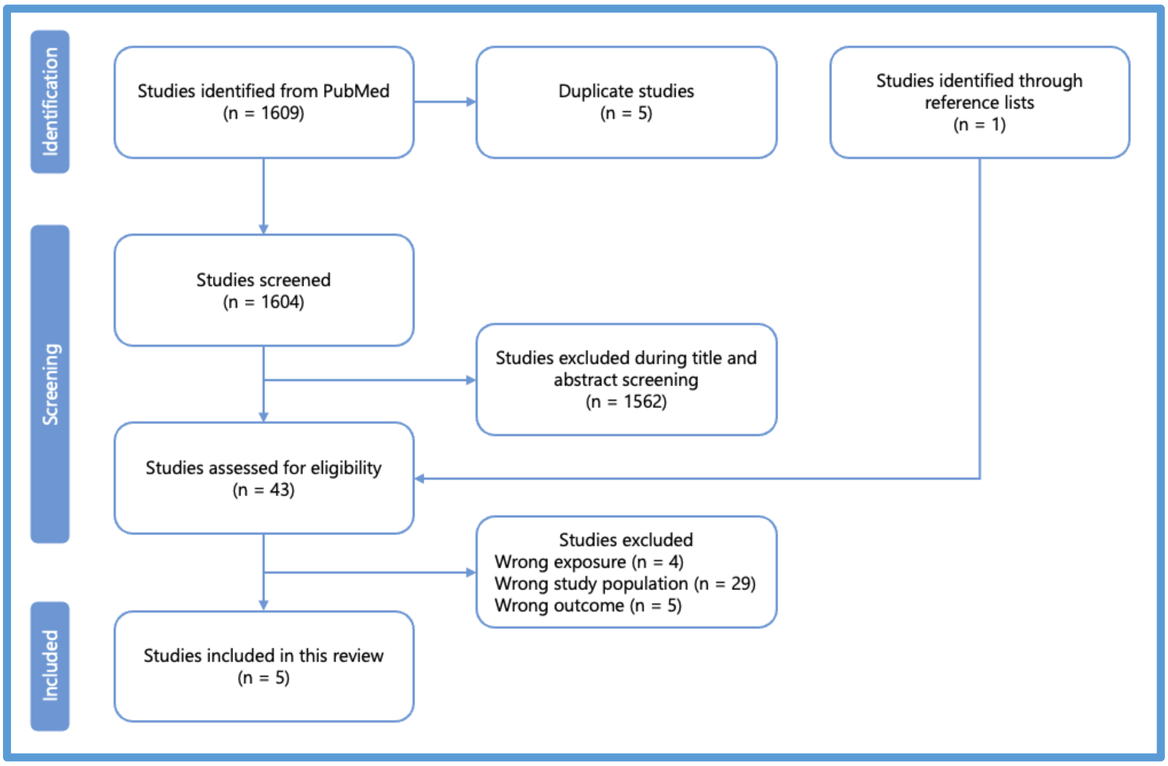

Figure 1 – Flowchart of the included studies

Study characteristics

The characteristics of all included studies are summarized in **Table 1**. Only the study by Liao et al.[29] had a cross-sectional design and included only older adults (≥65 years old), the remainder of the studies were cohort studies and also included adults younger than 65 years old.[27,28,30,31] Of these studies, data of the appropriate subgroups were extracted. The sample size of the included studies (and subgroups) ranged from 1052[29] to 320685[28]. The study by Yang et al.[31] did not share the total number of participants in the subgroup analysis of people ≥65 years old. The percentage females across the studies ranged from 49.9% to 100.0%. Two studies did not share the number of women in their subgroup.[28,31] The mean age of the study by Liao et al.[29] was 73 years old and the mean age of the study by Mah et al.[30] was 73.2 years old for the women and 71.3 years old for the men. Two studies were conducted in Canada[28,30], one in the USA[27], one in Taiwan[29], and one in China[31]. All studies were carried out in patients without any underlying known diseases and/or risk factors. Because of the observational nature of the included studies, all of them adjusted for a set of confounders which are listed in **Table 1**. All of the studies adjusted for age, sex (unless they only included women[27] or stratified by sex[30]), and the socioeconomic status of an individual via education or income.

Exposure assessment

Different kinds of objectively measured walkability exposure measures were used across the studies. In all studies, a higher score meant higher walkability. The Walk Score® website (www.walkscore.com) was used in the study by Liao et al.[29] The Walk Score® measure is created by giving a score to a geographic region based on the distance to certain walking destinations (Points of Interest (POI), amenities like grocery shops, parks, schools, etc.) and it takes measures for pedestrian friendliness into consideration (intersection density and block length).[32] The study by Yang et al.[31] also used the Walk Score® to assess area-level

Table 1 – Characteristics of the included studies

First author and year	Country	Study design	Entire study sample includes older adults	Sample size	Age (y)	Women (%)	Follow-up in years	Walkability score + components	Outcome	Confounders	NOS score
Griffin et al., 2013[27]	USA	Cohort	No; subgroup analyses of people aged 65-70, 70-75, and ≥75 years old was performed	22882¥	NR¥	100	7.5*	Rutgers-Cornell MSA-level index (1) Residential density (2) Mixed land use (3) Street connectivity (4) Centeredness	(1) CHD death (2) CHD death or MI (3) CHD event	Age, year enrolled, race/ethnicity, education, income, marital status, family history of MI, study arm, and neighborhood socio-economic status	8
Lang et al., 2022[28]	Canada	Cohort	No; subgroup analyses of people aged 65-74 and 75-89 years old were performed	320685£	NR£	NR£	15.5	Can-ALE index (2006 version) (1) Intersection density (2) Dwelling density	CVD mortality	Age, sex, Indigenous identity, education, marital status, employment status, Canadian Marginalization index variables (neighborhood dependency, deprivation, instability, ethnic concentration), greenness and $PM^{2.5}$	9
Liao et al., 2019[29]	Taiwan	Cross-sectional	Yes	1052	73*	49.9	NA	Walk Score® (1) Points of interest (2) Intersection density (3) Block density	Prevalent CVD	Age, sex, education, occupation, marital status, living status, total PA, total SB, eating behavior, alcohol use, and smoking	6
Mah et al., 2020[30]	Canada	Cohort	No; subgroup analyses of older women (65-85 years old) and older men (65-81 years old)	91330±	♀ 73.2±* ♂ 71.3±*	61.2±	♀ 4.8** ♂ 4.5**	Can-ALE index (2016 version) (1) Intersection density (2) Points of interest (3) Dwelling density	Cardiometabolic mortality	Age, education, area-level income, survey cycle, obesity, and the presence of two or more chronic conditions	8
Yang et al., 2022[31]	China	Cohort	No, subgroup analysis of people ≥65 years old was performed	NR≠	NR≠	NR≠	4.08**	Chinese adaptation of the Walk Score® (1) Points of interest (2) Intersection density (3) Block density	(Non)fatal ischemic stroke	Age (time scale), sex, BMI, education, occupation, household income, smoking, alcohol use, sleep quality, history of hypertension, diabetes, dyslipidemia and ischemic heart disease	8

¥ Numbers reported in the table are from the relevant age subgroups, the entire cohort had 45376 study participants and no mean or median age was reported for the entire cohort
£ Numbers reported in the table are from the relevant age subgroups, the entire cohort had 1786610 participants, no mean of median age was reported, and the percentage females in was 53.5%
± Numbers reported in the table are from the relevant age subgroups, the entire cohort had 249420 participants, no mean of median age was reported, and the percentage females in was 56.3%
≠ Numbers reported in the table are from the age subgroup, the entire cohort had 27375 participants, the mean age was 63.1 years, and the percentage females was 59.2%
* mean, ** median; BMI = body mass index; Can-ALE = Canadian Active Living Environments; CHD = coronary heart disease; CVD = cardiovascular disease; MI = myocardial infarction; MSA = metropolitan statistical area; NA = not applicable; NOS = Newcastle-Ottowa Scale; NR = not reported; PA = physical activity; PM = particulate matter; SB = sedentary behavior; USA = United States of America

walkability. However, they adapted the Walk Score® to better suit the Chinese population. Amenities used in the original Walk Score® like libraries or coffee shops are not frequently visited by Chinese residents on a daily basis, therefore they adapted the original score to include amenities better suited for the Chinese context (e.g. fresh markets, supermarkets, and metro entrances).[33]

The studies by Lang et al.[28] and Mah et al.[30] used the Canadian Active Living Environments (Can-ALE) index as the walkability measure. This Can-ALE index was created with the use of GIS. The difference between the two Can-ALE walkability scores that were used in the two different studies was the lack of POIs in the Can-ALE index version from 2006 used by Lang et al.

Urban compactness, assessed by the Rutgers-Cornell Metropolitan Statistical Area (MSA)-level index, was used in the study by Griffin et al.[27] to indicate the level of walkability. The level of urban compactness for a MSA was based on the following four components: (1) residential density, (2) mixed land use, (3) street connectivity, and (4) centeredness.

In three studies, the walkability score was based on the participants address.[28,30,31] In the study by Liao et al.[29] the Walk Score® was based on the residential neighborhood. In the study by Griffin et al.[27], the MSA in which the participant resided was used.

Outcomes across the studies

Outcomes reported in the included studies include prevalent CVDs, incident coronary heart disease (CHD), myocardial infarction (MI), and ischemic stroke, CHD mortality, CVD mortality, and cardiometabolic mortality (including deaths due to metabolic disorders next to CVDs). In all but one of the studies, the CVD events or deaths were obtained via registry linkage[28,30,31] or examination of medical records.[27] In the study by Liao et al.[29], outcomes were self-reported.

Risk of bias assessment

All included cohort studies were assigned to have a good quality. One study received the maximum number of stars (nine stars)[28] and the other cohort studies received eight stars.[27,30,31] Downgrading of the selection domain occurred in the study by Griffin et al.[27] because they did not exclude women who had experienced a CHD event prior. The other two studies did not have a long enough follow-up time (shorter than 5 years), which resulted in a downgrade of the outcome domain.[28,31]

The cross-sectional study by Liao et al.[29] was assigned a poor quality and received sx stars. Downgrading of this study was due to the lack of representativeness of the study participants (selection domain) and because of the self-reported outcome (outcome domain). Selection and recruitment of the study participants was based on a telephone survey, which meant that older adults needed to have access to a household phone. As not all older adults have access to a house telephone, the study participants might not be representative.[29,34] Detailed NOS scales can be found in **Appendices 2** and **3.**

Associations between walkability and CVD across the studies

Figure 2 shows the associations reported in the included studies. Significant associations between walkability and CVD were found in three studies.[28,30,31] A 10-unit increase in the adapted Walk Score® led to a hazard ratio (HR) of 0.92 (95% confidence interval [CI] 0.87-0.97) for (non)fatal ischemic stroke.[31]

Dichotomization of the Can-ALE index (class 1-3, less walkable, vs. class 4-5, more walkable) resulted in a significant HR of 0.78 (95% CI 0.63-0.97) for cardiometabolic mortality in older women.[30] However, this significant association was not found in older men (HR = 1.13 [95% CI 0.90-1.41]). The study by Lang et al.[28] did not dichotomize the Can-ALE score. In adults between 65 and 75 years old, a higher walkability was significantly associated with a lower risk for cardiometabolic mortality only when classes 2 until 4 were compared with class 1 but not when class 5 was compared with class 1 (class 2; HR = 0.94 (95% CI 0.89-0.98), class 3; HR = 0.93 (95% CI 0.88-0.98), class 4; HR = 0.92 (95% CI 0.86-0.98), class 5; HR = 0.96 (95% CI 0.89-1.04)). In adults between 75 and 89 years old, a higher walkability was significantly associated with a lower risk for cardiometabolic mortality only when classes 3 until 5 were compared with class 1 but not when class 2 was compared with class 1 (class 2; HR = 0.98 (95% CI 0.94-1.02), class 3; HR = 0.91 (95% CI 0.88-0.95), class 4; HR = 0.91 (95% CI 0.86-0.95), class 5; HR = 0.89 (95% CI 0.84-0.94)).

The study by Liao and colleagues did not indicate that higher walkability was significantly associated with a higher or lower odds of prevalent CVD.[29] Furthermore, in the study by Griffin et al.[27], no significant association was found between walkability and CHD events, CHD death, or CHD death or MI in the age groups 65 to 70, 70 to 75, and above 75 years old.

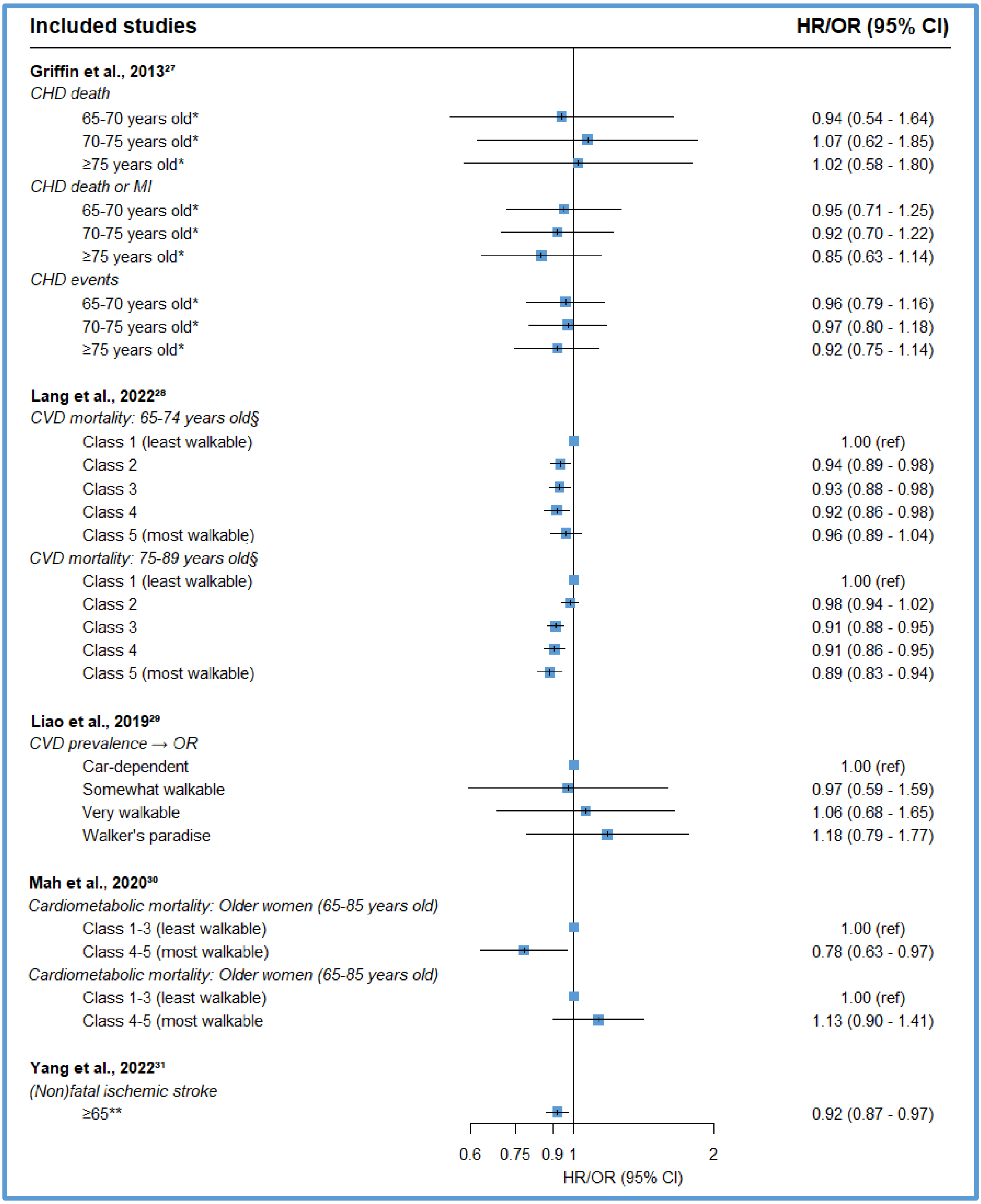

*Figure 2 – Results of the association between neighborhood walkability and different CVD outcomes reported in the included studies. * The associations shown are of a standard deviation increase in the walkability score. ** The association shown is of a 10-unit increase in the walkability score. § The data shown in this figure was obtained through contacting the corresponding author. CHD = coronary heart disease; CI = confidence interval; CVD = cardiovascular disease; HR = hazard ratio; MI = myocardial infarction; OR = odds ratio*

DISCUSSION

The aim of this systematic review was to provide an overview of the available literature on the association between neighborhood walkability and CVDs in older adults, and to assess the quality of the existing literature on this topic. Five studies were deemed to fit the inclusion criteria, and the majority of these papers was assigned to have a good quality. Among the included studies no consistent clear association was found between walkability and the prevalence or incidence of CVDs and CVD mortality in older adults. The studies that found a significant association all assessed walkability in the direct environment of the study participants by using their residential address.[28,30,31] Significant associations were not observed when walkability was assessed at the level of the neighborhood[29] or MSA[27], which is a less spatially detailed level. As older adults often experience mobility impairments, this lack of association could possibly be contributed to the fact that the walkability scores did not capture the walkability of the participants immediate surrounding.[35]

The studies that observed statistical significant associations found that a 10-point increase in the Walk Score® was associated with a 8% reduction in the risk for (non)fatal ischemic stroke for people above 65 years old[31]. In addition, women between 65 and 85 years old living in neighborhoods that were more walkable had a 22% lower risk for cardiometabolic mortality than women residing in less walkable neighborhoods[30]. Furthermore, adults between 65 and 75 years old residing in the second, third, and fourth least walkable neighborhoods had a 6%, 7%, and 8% reduced risk for cardiovascular mortality when compared with the least walkable neighborhood (the most walkable neighborhoods did not show a significant association)[28]. And at last, the previous association was even stronger in adults between 75 and 89 years old; residing in the third, second, and most walkable neighborhood reduced the risk for cardiovascular mortality with 9%, 9%, and 11%

when compared to the least walkable neighborhood (the second least walkable neighborhood did not show a significant association).[28] The latter might indicate that at an even older age, older adults are more reliant on their surroundings than younger older adults. This could possibly be contributed to even larger mobility impairments among the older group.

Strengths and limitations

A strength of the current systematic review is the broad search string that was developed and applied. In addition to search terms related to composite walkability exposure measures, the search string also incorporated single components often included in a walkability index to identify as much relevant studies as possible. Another important strength is that this review includes an extensive quality assessment of all included studies.

Limitations of this systematic review were that only one database (PubMed) was searched to identify the studies due to time constraints. In addition, both screening and data extraction (including quality assessment of the studies) was performed by one person and not in duplicate. Furthermore, the definition for older adults set beforehand might have led to exclusion of some potential relevant studies. In a cross-sectional study by Jia et al.[36] the association between walkability and the prevalence of CVD (CHD and stroke) in adults above 60 years old was examined in their subgroup analysis. Objectively measured walkability – using the Walk Score® - resulted in a 0.72 lower odds for CHD (95% CI 0.52-0.90). Subjectively measured walkability – using the Neighborhood Environment Walkability Scale questionnaire – resulted in a 0.82 lower odds for stroke (95% CI 0.75-0.89).

Besides these methodological limitations, one of the included studies examined the occurrence of cardiometabolic mortality.[30] Next to deaths due to CVDs, also deaths due to certain metabolic conditions – such as death due to diabetes, lipoprotein deficiencies, and obesity – were included in their outcome. This might lead to more mortality cases and therefore an stronger association found than when only CVD mortality would be used as an outcome.

Underlying mechanisms

Although the results might indicate a possible positive association between how walkable someone's surrounding is and the incidence of CVDs in older adults, the mechanisms underlying this association remain unclear. In previous research the association between area-level walkability and cardiometabolic/cardiovascular risk factors – such as atherosclerosis, diabetes, hypertension, and hyperlipidemia – has been investigated in older adults (adults older than 60 years old), but no significant associations were found.[29,36-40] However, just like the studies included in this review, the majority of these studies performed a subgroup analysis with older adults instead of focusing entirely on older adults.[36-39]

Higher neighborhood walkability has been shown to increase the amount of PA in older adults.[16-19] Subsequently, higher levels of PA have also shown to lower the risk for CVDs in older adults.[10,11] The mechanism by which higher neighborhood walkability reduces the risks for CVDs could possibly be accounted to increases in PA.

Future research

Only five studies reported on the associations of walkability with CVD events in older adults, and therefore could be included in this review. Of these five, only one study focused specifically on older adults, opposed to reporting an age subgroup analysis.[29] As the number of people above 65 years old is expected to grow and becomes a larger proportion of the study population, there is a need for more research on the effect of components of the built environment on the cardiovascular health in older adults.[8] This is needed to reduce the burden of CVDs as both prevalence of and mortality due to CVDs is highest among older adults.[3,9]

One of the included studies stratified their analysis based on sex.[30] They reported that being in a more walkable neighborhood (compared to a less walkable neighborhood) reduced the risk for cardiometabolic mortality with 22% in older women. However, the opposite was found for older men. In this group, being in a more walkable neighborhood (compared to a less walkable neighborhood) increased the risk, although not significant, with 13% (95% CI 0.90-1.41). What caused this difference between older men and women remains unclear and future research is needed to investigate the possible effects of sex on the association between neighborhood walkability and CVDs in older adults.

Another important factor to take into account when looking at walkability is the interaction with other objectively and perceived built and environmental exposures, such as air pollution. Previous research has shown that neighborhoods that are more walkable, are also exposed to higher levels of air pollution.[41] Ambient air pollution has shown te increase the risk of CVD and CVD mortality.[42] Future research is needed to better understand the interplay between the effects of walkability and exposure to air pollution on the health of older adults.

Age-friendly cities

It is important to understand which components of a neighborhood are important to increase the walkability for older adults. The concepts "age-friendly cities" developed by the

World Health Organization provides a framework for making cities more age-friendly.[43] With the use of focus groups, factors contributing to age-friendly outdoor spaces and buildings were identified. Important factors to increase walkability for older adults are (1) clean environments, (2) availability of green spaces, (3) availability of resting places, (4) availability of sidewalks and crossings that are age-friendly and save to use for older people, (5) accessibility of amenities, and (6) safety of the neighborhood. In the included studies, the majority of these factors were not included in their walkability score.[27-31] Accessibility to amenities is included in some of the walkability scores.[29-31] Future research on the effects of walkability on CVDs (or other outcomes) in older adults might need to adapt their walkability score to include components that are important for making a neighborhood more walkable for older adults.

CONCLUSION

This systematic review has summarized the existing evidence on the association between neighborhood walkability and CVDs in older adults. To conclude, even though three of the five studies have found a positive interaction between higher walkability and CVDs in older adults, more research is needed to strengthen the evidence. Evidence of this association, especially in older adults, and the possible mechanisms behind this association is scarce.

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