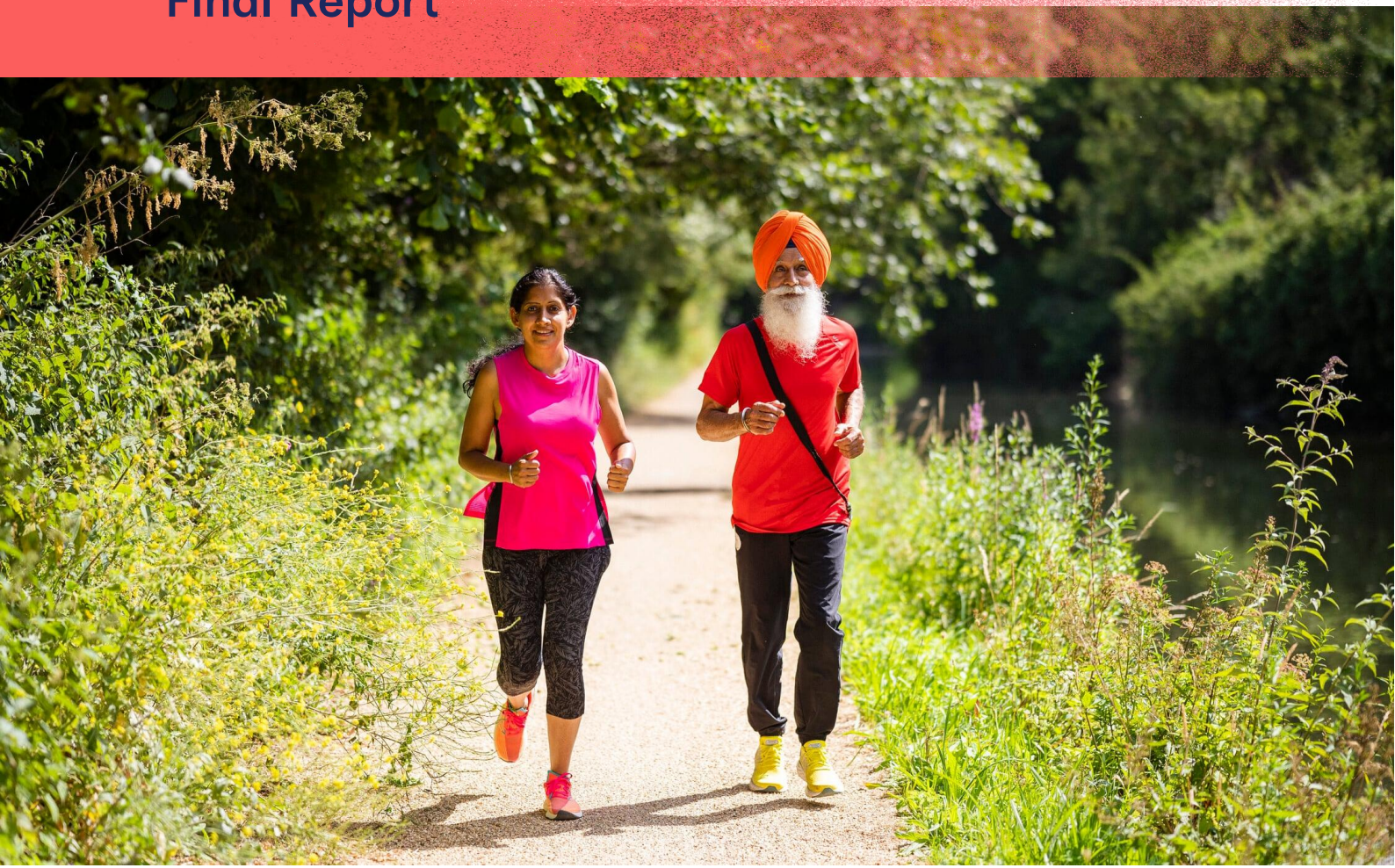
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NIHR Policy Research Unit: Healthy Ageing

Population-level interventions to promote physical activity among disadvantaged groups: a rapid systematic review

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Final Report



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Key messages

- A rapid review of evidence about the effectiveness of population level interventions to promote physical activity among disadvantaged groups was undertaken.
- Eleven studies were included, almost half of which (n=5) evaluated UK-based population level interventions.
- A programme of free access to leisure facilities coupled with community outreach activities (Blackburn with Darwen, UK), and a community-wide health promotion campaign targeting primarily older groups (Japan) appear promising for promoting physical activity among disadvantaged groups, with a low risk of widening health inequalities.
- Similar interventions evaluated in other locations and populations either did not show the same findings (community-wide health promotion for 40-79 year olds, Japan) or reported insufficient data to allow a clear judgement of effectiveness for disadvantaged groups (free leisure facilities, Leeds, UK).
- Cycling and walking routes may also be promising to promote walking, but did not appear to promote cycling, among the disadvantaged. This suggests that disadvantaged groups may find some types of physical activity easier to adopt than other types of activity.
- The above findings are mostly from single studies (rated moderate and low in quality). More research is needed to confirm socioeconomic patterns of effectiveness for these population-level approaches.
- Some of the interventions identified would result in physical activity outdoors; accessibility may be a consideration for older populations whose outdoor mobility is constrained by ill health, disability and other concerns (e.g. safety).
- The evidence in this review suggests there has been modest progress in incorporating equity considerations into evaluations of population-level interventions.
- This review signals a number of important considerations that are relevant to current policy developments relating to physical activity promotion, including issues of equity, hidden costs, the accessibility of outdoor exercise for some groups, and the need for ongoing monitoring and evaluation. The promising approaches identified by this review should be relevant to the NHS 10 Year Plan, and the drive to develop preventative, place-based strategies to health

Executive Summary

Background

To support policy efforts to widen uptake and engagement with physical activity among disadvantaged older groups, the NIHR Policy Research Unit in Healthy Ageing has undertaken two linked rapid evidence reviews. These reviews focus on evidence for interventions targeted at individuals (review 1), and populations (review 2). **This report details the methods and findings for the second review (population-level interventions).**

Aims

This review aimed to:

- Summarise evidence about the effectiveness of population-level interventions to promote physical activity among disadvantaged groups;
- Summarise evidence about the acceptability of, and barriers and facilitators to, population-level interventions to promote physical activity among disadvantaged groups.

Methods

To achieve the aims, a rapid systematic review was undertaken. Comprehensive searches were undertaken in four bibliographic databases and several sources of grey literature, with additional citation searching.

Eligible studies were those that evaluated population-level health interventions and reported a physical activity outcome, and/or a process evaluation outcome (e.g. acceptability of an intervention). We defined population level health interventions as those that aim to improve the health of defined local, regional or national populations, by targeting the determinants of health. Interventions for any adult age population were eligible. Whilst our typical purview is populations aged 50+ years, population-level interventions to promote physical activity are rarely limited to older age groups. Interventions targeted solely at children (<18 years) were excluded.

A key focus of this review was the effectiveness of interventions for disadvantaged communities. We focused solely on populations experiencing **socioeconomic** disadvantage. Whilst there are numerous other dimensions of disadvantage (e.g. based on gender, ethnicity), it was not possible to consider all of these within this rapid review. We included studies that compared the effectiveness of the intervention between socioeconomic groups (e.g. using sub-group, moderator analyses, stratification by a measure of socioeconomic status).

Study title and abstracts were screened in Rayyan, and the full texts of selected records retrieved and assessed against the review criteria. Both stages of screening were undertaken by two researchers independently, and disagreements resolved through discussion. Data were extracted and studies quality assessed, and a narrative synthesis applied.

Findings

After screening, 11 studies (reported in 12 publications) were included in the review. Most studies were from the UK (n=5); the remainder were from Japan (n=2), Australia (n=2), the US (n=1), and Germany (n=1). Interventions evaluated were improvements to cycling and/or

walking infrastructure (n=3), improvements to the environment and greenspace, such as park refurbishments (n=2), community wide health promotion campaigns (n=2), free access to leisure facilities (n=2), and investment in national sports programmes (n=1). A further study (n=1) reported evidence about the introduction of the minimum wage. This intervention was not designed to promote physical activity but the impact on such behaviour was evaluated. Three studies were rated moderate in quality, and the remainder were rated poor in quality.

Across the interventions identified, the most promising in terms of promoting physical activity among the most disadvantaged were: a programme offering free access to gym and swim facilities with supplementary health promotion components in the UK, and a community wide health promotion programme targeting primarily older adults in Japan. In the UK study, which was rated moderate in quality, improvements in physical activity were larger for the most disadvantaged compared to the most advantaged based on a measure of occupational status.[a] **This suggests this intervention poses a low risk of widening health inequalities.**

The community wide health promotion programme evaluated in Fujisawa, Japan, demonstrated similar findings. That is, increased physical activity between the 2 and 5 year follow up was greater for populations aged 65+ years with perceived poor economic status than those with perceived good economic status by around an average of 40 minutes per day. **This study was rated low in quality: important limitations to the study design warrant a cautious interpretation of these findings**.

A further potentially promising intervention is the programme of improvements to cycling and walking routes in the UK. In two studies (one moderate and one low in quality), a complex pattern of findings was demonstrated. Benefits to the most advantaged and disadvantaged varied depending on the outcome measure. However, there was evidence that increases in walking prevalence, and short-lived and sustained walking for transport[b] were greater amongst the most disadvantaged. In the Patterson study, the larger increase in walking prevalence for the most disadvantaged was considered modest. **This suggests there may be scope for this type of intervention to promote physical activity among the most disadvantaged. However, efforts to improve initial take up of walking among disadvantaged populations would be critical, to avoid widening health inequalities.**

Interventions where improvements to physical activity favoured the most advantaged groups were: the community-wide health promotion programme targeting populations aged 40-79 years in Unnan, Japan; and the planned neighbourhood to promote physical activity (US). This evidence suggests **such interventions may risk widening health inequalities between the most advantaged and disadvantaged.**

Interventions where risks to health inequalities could not be determined due to insufficient data and/or analyses, or because there was no clear impact on physical activity, were: a Park Refurbishment (Australia), free access to leisure facilities (Leeds-based programme, UK); and the national investment in sports (Participation) programme (Australia).

Finally, interventions that appeared to have an adverse impact on physical activity were the introduction of the minimum wage (Germany), and the national investment in sports (Better

[a] Data for all occupational groups shown only in a graph, with data reported in text for only the most disadvantaged. Authors have been contacted to request full data.
[b] Defined by study authors as journeys made for commuting, business, study, shopping and personal business, and social activities.

Ageing) programme (Australia). For the investment in Better Ageing (Australia), the decline in physical activity was larger for the most disadvantaged group, suggesting **this approach may risk widening health inequalities**.

Implications for policy

Some population-level approaches (free leisure facilities and community-wide health promotion) may promote physical activity among disadvantaged groups whilst posing a low risk of widening health inequalities. Even so, the generalisability of these interventions to other contexts remains uncertain. Where these or similar approaches are adopted, policymakers may wish to consider population level data collection to monitor and evaluate impact within the local contexts such approaches are implemented. Use of the ADAPT framework, a process model developed to support implementation of effective interventions in new contexts, may also support adaption of these interventions for new contexts.

Costs are likely to be a key driver of the success of population-level interventions among disadvantaged groups. This is particularly important when there may be hidden costs associated with the initial take up of an activity. For example, interventions that aim to increase active transport via walking and cycling may require purchase of bicycles, cycling equipment or suitable walking shoes. Although the studies identified did not report any data on this, such hidden costs are an important consideration for planned investments in cycling infrastructure across the UK.

Some of the interventions evaluated (cycle and walking routes, greenspace improvements, walkable neighbourhoods) aim to increase outdoor physical activity. This may disadvantage certain subgroups within the population, including older people with sensory impairments, reduced mobility or living with frailty, and people with safety concerns about exercising and moving about outdoors. This should be an important consideration for policymakers if advocating for these population-level approaches.

Conclusion

There is some evidence to suggest that free access to leisure facilities and community-wide health promotion campaigns can increase physical activity among disadvantaged groups whilst posing a low risk of widening health inequalities. However, more research is needed to understand socioeconomic patterns of effectiveness, especially across different contexts. Evidence from cycling and walking route interventions suggests that disadvantaged groups may find some types of physical activity easier to adopt than others. The evidence in this review indicates there has been modest progress over the past ten years in incorporating equity considerations into evaluations of population-level interventions to promote physical activity.

Full Report

Background

Physical activity offers considerable benefits to older people's physical and mental health. However, activity levels remain low in older populations and are currently below the levels recommended by the UK Chief Medical Officers and the World Health Organization.[1,2] Opportunities to engage in physical activity are not equal across populations. Disadvantaged older groups face numerous barriers to engaging in regular physical activity, often due to a lack of resources (e.g., health, social, cultural, financial, environmental). Yet disadvantaged populations, who are more likely to experience poorer health and earlier onset of disability, are a key group for whom physical activity may offer the largest boost to their health and longevity. Supporting greater physical activity in disadvantaged older groups will likely require a range of approaches, targeting both individuals and populations.

The recently published Fit for the Future: 10 Year Health Plan for England recognises inequalities in activity rates across the country. To support the move to a place-based cross-Government Department approach to physical activity the NIHR Policy Research Unit in Healthy Ageing has undertaken two linked rapid evidence reviews. These reviews focus on evidence for interventions targeted at individuals (review 1), and populations (review 2) with the purpose to support government departments consider policy and future action to address physical inactivity. **This report details the methods and findings for the second review (population-level interventions).**

Aims

This review aimed to:

- Summarise evidence about the effectiveness of population-level interventions to promote physical activity among disadvantaged groups;
- Summarise evidence about the acceptability of, and barriers and facilitators to, population-level interventions to promote physical activity among disadvantaged groups.

Methods

To achieve the aims, a rapid systematic review was undertaken.[3] The methods are reported below according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[4] The protocol was registered on PROSPERO (CRD420251032624).

Criteria

The review criteria are summarised in table 1. Eligible studies were those that evaluated population-level health interventions and reported a physical activity outcome.

Intervention: For this work, we defined population level health interventions as those that aim to improve the health of defined local, regional or national populations, by targeting the determinants of health.[5] We adopted the intervention classification used by the US Community Preventative Services Taskforce (2021) and Heath et al. (2012)[6,7]: behavioural and social approaches, informational and campaign approaches, and environmental and policy approaches.

Behavioural and social approaches modify social environments or enhance behavioural management skills to enable change in lifestyles, in group settings. Information and

campaign approaches aim to enhance knowledge and modify attitudes. Environmental and policy approaches aim to improve the accessibility, safety and desirability of physical environments and community infrastructures. Eligible interventions did not need to be designed with the express aim of promoting physical activity. However, studies must have evaluated a physical activity outcome for inclusion in the review (see below).

Interventions that included both population-level and individual-level components, and where data were not reported solely for the population component, were excluded.

Population: Interventions for any adult age population were eligible. Whilst our typical purview is populations aged 50+ years, population-level interventions to promote physical activity are rarely limited to older age groups. Interventions targeted solely at children (<18 years) were excluded.

A key focus of this review was the effectiveness of interventions for disadvantaged communities. We focused solely on populations experiencing **socioeconomic** disadvantage. Whilst there are numerous other dimensions of disadvantage (e.g. based on gender, ethnicity),[8] it was not possible to consider all of these within this rapid review. Our pre-review scoping also indicated that operationalisations of disadvantage in population level intervention evaluations are typically based on a measure of socioeconomic status. We thus focused on socioeconomic status as the dimension where there is the most evidence, and which will likely have the greatest impact on policy relating to both physical activity and health inequalities. Eligible measures of socioeconomic disadvantage include those measuring an individual's disadvantage (e.g. occupational status, income) and area level measures (e.g. area deprivation, proportion of population within an area living under a poverty threshold).[c]

We included studies that compared the effectiveness of the intervention between socioeconomic groups (e.g. using sub-group/moderator analyses/stratification by a measure of socioeconomic status).

Outcomes: Eligible outcomes were measures of physical activity frequency, duration or intensity, rates of participation (including proxies, such as number of travel passengers), or the number and type of activities undertaken. Qualitative data relating to intervention acceptability, and barriers and enablers to engaging with an intervention, were also eligible.

Study design: We included studies using non-randomised and randomised evaluative designs. Non-randomised designs may include, but are not limited to, cohort studies (e.g. with a historical control group), time series, and before and after approaches with no control group.[9,10] Randomised designs include cluster and stepped-wedge approaches. Qualitative designs reporting process evaluations were also eligible.

A previous systematic review of population and individual level interventions to promote physical activity used a search period of 2005-2015.[11] This review is of high quality. To avoid duplicating this work, we included primary studies dated from 2015.

Search Strategy

A search strategy was developed, piloted and refined by an information specialist. Experts in the field of population health were consulted to ask for examples of interventions and

[c] We included area level deprivation as this is a common measure of socioeconomic status. However, evidence of effectiveness by area deprivation warrants a cautious interpretation due to the ecological fallacy argument. That is, patterns of socioeconomic status observed at a group level may not apply at an individual level.

terminology to inform the search strategy. Searches were conducted in Medline (OVID), Embase (OVID), CINAHL and TroPHI in April 2025 (2015-2025). We searched sources of grey literature, and undertook forward citation searching, and screened the reference lists, of two relevant systematic reviews.[11,12] Appendix A contains the search strategy applied to Medline, and all sources of grey literature searched.

Study selection

Titles and abstracts were screened for relevance, and the full texts of selected records retrieved and assessed against the review criteria. For both stages, all screening was undertaken independently by two reviewers, with disagreements resolved through discussion. Records were screened in Rayyan, an online platform to manage reviews.[13]

Risk of bias

Risk of bias for quantitative studies was assessed using the NIH quality assessment tools for the appropriate design.[14,15] These tools are not designed to provide a total score or rating. However, we applied our own rating system to be able to distinguish the poorer quality studies.

High quality studies were: randomised controlled trials with adequate blinding and concealment, and no major limitations; controlled before and after studies that use appropriate analyses, which adjust for relevant confounders, include sensitivity analyses and robustness checks to support judgements on causation, and have no other substantial limitations to study design.

Moderate quality studies were: randomised controlled trials with some limitations; controlled before and after designs that use appropriate analyses, which adjust for relevant confounders, include sensitivity analyses and robustness checks to support judgements on causation, but which include limitations to other aspects of study design such as substantial attrition at follow up, or unclear outcome measurement.

Low quality studies were: randomised designs with major limitations; controlled before and after studies with no appropriate analyses (e.g. descriptive reporting of results) or analyses that do not adjust for relevant confounders, and which have several other design limitations; before and after designs with no control group.

All assessments were checked by a second reviewer.

Data extraction

A data extraction form was developed using Excel, and piloted and refined. Study data were extracted by single reviewers and checked by a second reviewer.

Synthesis

A narrative synthesis was used to summarise evidence of effectiveness and risks to health inequalities, grouped by the type of intervention. To explore whether effectiveness was patterned, we also explored data by the type of socioeconomic status measure used in the study. Finally, we applied the Demands for Population Health Interventions (DEPTH) framework. This tool classifies the agentic demand of population level interventions.[16] The main components of the framework determine:

- Whether intervention recipients need to change their behaviour to come into contact with the intervention (Exposure: active/passive)

- The mechanism of action for each component of the intervention (socio-cultural, cognitive, financial, physical environment, biomedical)
- Whether intervention recipients need to be aware of or interact with the intervention component's mechanism of action in order to benefit (Engagement: active/passive)

We applied the framework to the interventions identified in our review as a descriptive aid.

Protocol amendment

Our original inclusion criteria specified that we would include studies that a) compare outcomes by levels of socioeconomic disadvantage (e.g. using sub-group, moderator analyses, stratification by a measure of socioeconomic status), *and* b) evaluate interventions solely in a group experiencing socioeconomic disadvantage. Studies that compare outcomes by levels of socioeconomic disadvantage are the most useful as they can reveal whether interventions pose a risk to widening health inequalities. To maximise the impact of this work, we therefore amended the review protocol by opting to include only studies that compare outcomes by levels of socioeconomic disadvantage. A bibliography of studies that evaluate population level interventions solely in disadvantaged groups is provided as a supplementary file for information.

Findings

After screening, 11 studies (reported in 12 publications) were included in the review (Figure 1, table 2).[17-28] Studies were from the UK (n=5),[17,18,20,22,23,26] Japan (n=2),[25,27] Australia (n=2),[24,28] Germany (n=1)[19] and the US (n=1).[21]

Table 3 summarises the interventions evaluated, including their classification according to the population intervention framework adopted by the US Community Preventative Services Taskforce (2021) and Heath et al. (2012)[6,7] Interventions evaluated were improvements to cycling and/or walking infrastructure (n=3), improvements to the environment and greenspace, such as park refurbishments (n=2), community wide health promotion campaigns (n=2), free access to leisure facilities (n=2), and investment in national sports programmes (n=1). A final study (n=1) reported evidence about the introduction of the minimum wage. This intervention was not designed to promote physical activity but the impact on such behaviour was evaluated.

Three studies were rated moderate in quality,[19,20,23] and 8 low in quality (Table 4).[18,21,22,24-28] Of the moderate quality studies, these used controlled before and after designs with strong analytical approaches that adjusted for relevant confounders and undertook robustness and sensitivity checks. The moderate rating for these studies was applied due to other minor study limitations that may introduce some degree of bias. The lower quality studies used either pre-post evaluation designs, or controlled before and after designs with important limitations to methods.

In the following sections, we report a summary of evidence by the type of intervention.

Improvements to cycling and/or walking infrastructure

Three studies reported evidence about the impact of improvements to cycling and/or walking infrastructures on physical activity (Appendix B, Table B1).[22,23,26]

Two evaluations reported data for the Cycling Demonstration Towns (CDT) and Cycling City and Towns (CCT) programmes in the UK (implemented 2005-2011). Of the two studies, one study was rated moderate in quality,[23] and one poor in quality.[22] We therefore prioritised the

findings from the moderate-quality rated study (Patterson et al. 2023), as this is likely to offer the most reliable evidence.

The CDT and CCT programmes improved take up of cycling and walking among both those with (most advantaged) and without (most disadvantaged) a university degree, although the effect size was larger for groups with a degree.[23] However, take up of cycling improved for those in areas of high deprivation, but not those living in areas of low deprivation. Overall cycling prevalence did not change as a result of the intervention, for either the most advantaged or disadvantaged groups. Maintenance of cycling among active commuters at baseline was demonstrated for the most advantaged, but not the most disadvantaged.

Prevalence of both walking and cycling, or walking alone, did not change by level of area deprivation. An increase in the prevalence of walking, and both walking and cycling combined, was demonstrated for those without a university degree, but not groups with a university degree. Maintenance of walking, and both walking and cycling combined, for active commuters at baseline improved for both those with and without a degree, but the effect was larger for those with a degree.

The third evaluation was of Connect2, a UK programme to improve cycling and walking routes. This study was rated low in quality.[22] Take up of walking was demonstrated mainly for the most advantaged groups (those with higher levels of education or income). However, short term increases and sustained increases in physical activity were more likely among the most disadvantaged (lowest education and income). Changes in time spent walking for recreation following the intervention were not patterned on any measure of socioeconomic status. No cycling-related outcome data were reported.

Community-wide health promotion

Two studies evaluated community-wide health promotion interventions in Japan (Appendix B, Table B2).[25,27] One targeted primarily older adults but was evaluated in adults aged 20 years and over in the city of Fujisawa, and the second targeted adults aged 40-79 years in the city of Unnan. Both studies were rated low in quality.

Both community-wide health promotion interventions improved physical activity among advantaged and disadvantaged groups. However, the Fujisawa intervention demonstrated larger improvements in the most disadvantaged groups, but only for adults aged 65+.[20,25] The same pattern was not observed for adults aged 20-64 years. For the intervention targeting adults 40-79 years, improvements in physical activity favoured the most advantaged populations.[27]

National investment in two sports programmes

One low quality study evaluated the impact of a large-scale national investment in two sports programmes, in Australia (Appendix B, Table B3).[24] One programme, *Participation*, was intended for all ages, and the second, *Better Ageing*, was intended for populations aged 65 years and over.

The *Participation* programme had no impact on physical activity for either the most advantaged or disadvantaged groups. An improvement in physical activity was only demonstrated for people living in areas with the second highest deprivation quartile. The *Better Ageing* programme was associated with a reduction in physical activity, although the reduction was larger for the most disadvantaged. The authors hypothesise this may have been due to a disproportionate impact of COVID-19 on physical activity in the most disadvantaged groups.

Free leisure facilities

Two studies (reported over three publications) evaluated the impact of providing free access to leisure facilities, both in the UK (Leeds, and Blackburn with Darwen) (Appendix B, Table B4).[17,18,20] The Blackburn with Darwen intervention included free access to gym and swim facilities for adults, supplemented by health trainer outreach, community and taster events and buddy schemes, and a marketing campaign to promote the programme.[20] The Leeds-based intervention offered free access to off-peak exercise classes (mostly gym and swim sessions). Sessions were offered to all residents in Leeds but were provided by leisure centres located in the most deprived areas of the city. The programme was preceded by a six-month marketing campaign to raise awareness of the free facilities.[17,18]

The Blackburn with Darwen-based intervention was reported in one publication, rated moderate in quality. The Leeds-based intervention was reported in two publications, both of which were rated low in quality.[d]

The Blackburn with Darwen-based intervention improved swim and gym participation, and participation in moderate intensity physical activity, among the most advantaged and disadvantaged groups. Improvements in these outcomes were larger for most disadvantaged.[20]

In the Leeds-based intervention, take up of the free leisure programme was relatively low among the most disadvantaged.[18] Programme participation drop-off was more likely among those living in the most disadvantaged areas. The proportion of inactive registered programme users fell over the study period. This drop in inactive users was slightly larger among populations living in the 20% most deprived areas than populations living in the remaining city areas. The proportion of active programme users increased over the study period. This increase was smaller among populations living in the 20% most deprived city areas compared to populations living in the remaining city areas.[17] No tests of difference were applied to these data on physical activity change by area deprivation, and these findings should be treated with caution.

Improvements to green space and environment infrastructures

Two studies reported evaluations of improvements to environment infrastructures (Appendix B, Table B5). These improvements were a) a park refurbishment in a low socioeconomic neighbourhood[e] in Australia;[28f] and b) a planned neighbourhood designed to promote physical activity in Austin, Texas.[21] Both studies were rated low quality (park refurbishment and planned neighbourhood).[21,28]

The walkable neighbourhood in Texas increased physical activity but the improvements were larger for the most advantaged groups.[21,28] There was no consistent pattern of findings about improvements for advantaged versus disadvantaged groups for the park refurbishment in Australia.[28]

Introduction of minimum wage

One moderate quality study evaluated the impact of the introduction of the minimum wage in Germany on physical activity (Appendix B, Table B6). No improvements in physical activity

[d] A further evaluation of the Leeds-based intervention was identified that reported cost outcomes and QALY, which was not eligible for inclusion in this review as it did not report physical activity outcomes.
[e] Although delivered in a low socioeconomic neighbourhood, outcome data were reported stratified by educational level and occupational status.
[f] The Australian study of a park refurbishment was also reported in other publications that were not included in this review because they did not report eligible outcomes by socioeconomic status.

were demonstrated. A reduction in weekly physical activity was recorded for both those in higher occupations and those with low education attainment.

Evidence of acceptability, barriers and facilitators

No studies were identified that reported evidence about acceptability, barriers and facilitators for disadvantaged groups in receipt of the interventions evaluated.

Which interventions promote physical activity in disadvantaged populations, without posing risks to widening health inequalities?

Table 5 summarises which interventions increased physical activity in the most disadvantaged, and the risks posed by interventions to widening health inequalities.

Across the interventions identified, the most promising in terms of promoting physical activity among disadvantaged groups were: a programme offering free access to gym and swim facilities with supplementary health promotion components, in the UK,[20] and a community wide health promotion programme targeting primarily older adults in Japan.[25] In the UK study, which was rated moderate in quality, improvements in physical activity were larger for the most disadvantaged compared to the most advantaged on a measure of occupational status.[g] **This suggests this intervention poses a low risk of widening health inequalities.**

The community wide health promotion programme evaluated in Fujisawa, Japan, demonstrated similar findings. That is, improvement in physical activity between the 2 and 5 year follow up was greater for populations aged 65+ years with perceived poor economic status than those with perceived good economic status by around an average of 40 minutes per day. **This study was rated low in quality, and important limitations to the study design warrant a cautious interpretation of these findings**. These limitations included potential biases in the outcome measure, a lack of clarity about the representativeness of the study population, and the absence of a baseline measurement of the outcome.

A further potentially promising intervention is the programme of improvements to cycling and walking routes in the UK. In two studies (one moderate and one low in quality),[22,23] a complex pattern of findings was demonstrated. Benefits to the most advantaged and disadvantaged varied depending on the outcome measure. Take up of cycling or walking improved across the most and least advantaged groups but tended to be higher among the most advantaged. This pattern was demonstrated when disadvantage was measured using educational attainment; a less consistent picture was demonstrated by a measure of area deprivation.

There was no socioeconomic difference in change in overall cycling prevalence. Maintenance of cycling and walking among those considered to be active commuters at baseline was demonstrated for the most advantaged following the intervention, but not the most disadvantaged. This suggests a risk that these interventions could widen health inequalities. However, there was evidence that walking prevalence,[23] and short-lived and sustained increases in walking for transport,[22] improved more so for the most disadvantaged. In the Patterson study, the larger increase in walking prevalence for the most disadvantaged was considered modest. **This suggests there may be some scope for this type of intervention to promote physical activity among the most disadvantaged.**

[g] Data for all occupational groups shown only in a graph, with data reported in text for only the most disadvantaged. Authors have been contacted to request full data.

However, to avoid the risk of widening health inequalities, efforts to improve initial take up of walking among disadvantaged populations would be critical.

Interventions where improvements to physical activity favoured the most advantaged groups were: the community-wide health promotion programme targeting populations aged 40-79 years in Unnan, Japan;[27] and the planned neighbourhood to promote physical activity (US);[21] This evidence suggests **such interventions may risk widening health inequalities between the most and least advantaged. Both studies were rated low in quality, and a cautious interpretation is warranted.**

Interventions where risks to health inequalities could not be determined due to insufficient data and/or analyses, or because there was no clear impact on physical activity, were: the Park Refurbishment (Australia),[28] free access to leisure facilities (Leeds-based programme, UK);[17,18] and the national investment in sports (*Participation*) programme (Australia).[24]

Finally, interventions that appeared to have an adverse impact on physical activity were: the introduction of the minimum wage (Germany),[19] and the national investment in sports (*Better Ageing*) programme (Australia).[24] For the investment in *Better Ageing* (Australia), the decline in physical activity was larger for the least advantaged group, suggesting **this approach may risk widening health inequalities**.

Depth Framework

Appendix C summarises the application of the DEPTH framework to the intervention components. Most of the interventions' components were classified as requiring Active Exposure and Active Engagement from recipients. That is, they require intended recipients to notice and respond to the intervention's core features. Only one intervention component was classed as having Passive Exposure and Passive Engagement (introduction of the minimum wage). However, this was not an intervention designed to promote physical activity. Overall, there was no clear pattern as to whether any exposure-engagement combinations were linked to intervention effectiveness.

Discussion

Evidence suggests that promising population level approaches to promote physical activity among disadvantaged groups include free access to leisure facilities coupled with community outreach activities (UK), and community-wide health promotion campaign (Japan). Similar interventions evaluated in different locations and populations either did not show the same findings (community-wide health promotion for 40-79 year olds, Japan), or reported insufficient data to allow a clear judgement of effectiveness for disadvantaged groups (free leisure facilities, Leeds, UK). Cycling and walking routes may also be promising to promote walking, but do not appear to promote cycling, among disadvantaged groups.

For these approaches, improvements tended to favour disadvantaged groups, suggesting these interventions may pose a low risk of widening health inequalities. Other interventions identified either favoured advantaged groups or had no impact on physical activity. For a small number of studies, the data reported were insufficient to inform a judgement on effectiveness by levels of disadvantage.

The effectiveness of free access to leisure facilities (Blackburn with Darwen, UK) among disadvantaged groups fits with broader evidence about the need to offer low-cost options to facilitate physical activity among low-income populations.[29] Even so, other interventions

identified in the review also included elements of free or low-cost exercise opportunities, and did not show the same pattern of findings. This may reflect other, subtle differences in the interventions, how the interventions were implemented, and the contexts in which they were delivered.

Evidence from cycling and walking route interventions suggests that disadvantaged groups find some types of physical activity easier to adopt than others. Walking for transport favoured disadvantaged groups in one study, whereas walking for recreation did not, and cycling tended to favour the more advantaged across studies. This may reflect time and cost barriers to physical activity faced by disadvantaged groups.[30] In contrast, walking for transport may offer opportunities to save on day-to-day travel costs, and could incentivise the use of walking routes when implemented.

In two studies, a reduction in physical activity following the intervention was demonstrated. These interventions included the investment in sports programmes (Australia) and the introduction of the minimum wage (Germany). For the investment in sports programmes, the mechanisms underpinning the reduction in physical activity are likely to be wide-ranging and complex. For the minimum wage, the study authors note that this policy did not increase overall income due to a reduction in average working hours in response to the hourly wage increase. Cost-related barriers may therefore be one factor accounting for this finding, although again, this is likely to be just one part of a more complex picture about the barriers to engaging in physical activity.

Some of the interventions identified shared common components, although these did not clearly underpin the observed patterns of effectiveness and risks to widening inequalities. For example, free leisure facilities were the core components of two interventions (the Blackburn with Darwen and the Leeds Let's Get Active programmes) and a component of the community health campaign targeting 40-79 year old adults in Unnan, Japan. All interventions increased physical activity in disadvantaged groups. However, only the Blackburn and Darwen intervention posed a low risk of widening health inequalities; the community health intervention demonstrated larger benefits in the most advantaged, whilst for the Leeds intervention, the data were insufficient to determine risk.

The community health promotion intervention targeted primarily older people in Fujisawa, Japan, was the only other intervention identified able to increase physical activity in disadvantaged groups whilst posing a low risk of widening health inequalities. This intervention shared similar components to the low risk Blackburn and Darwen free leisure facilities intervention (which included community outreach elements), and the high risk community health promotion campaign in Unnan, Japan.

A further consideration here is that for some of the interventions identified, the nature of what exactly was delivered remains ambiguous. For example, the two community health campaigns in Japan involved supporting communities to develop their own programmes, whilst the Sports Australia investment funded various programmes delivered across localities. The nature of these resulting programmes are not reported but are likely to be unique and responsive to local needs. Ultimately, it is challenging to identify which exact components of interventions may be most promising or underpin success. The effectiveness and low risk of the (Blackburn with Darwen, UK, and Fujisawa, Japan) interventions most likely reflect a broader set of factors relating to the intervention as a whole and the context in which it is delivered.

Some studies reported physical activity outcomes between the most and least advantaged people across multiple measures of socioeconomic status. In some studies, patterns of

effectiveness varied by the measure used for socioeconomic status within a single study (either in terms of effect size, or overall direction of effect). This may be partly explained by the sensitivity of the measure, and how well it captures differences in disadvantage within a population. For example, in the evaluation of cycling routes by Panter et al. (2017), outcomes varied by income and car ownership, but not employment status. However, employment status in this study was operationalised as i) working/student, ii) retired, and iii) home/sick; such categories are unlikely to capture variation in levels of disadvantage.

When considering outcomes by socioeconomic status measure across all studies, there was no pattern to suggest effectiveness consistently varied on one particular measure(s). Nonetheless, the role of different aspects of disadvantage may be important within the context of the intervention delivered and the recipient population. A better understanding of this may help to inform the development of population-level approaches that can fully mitigate the impact of material disadvantage, and successfully support physical activity among disadvantaged groups.

Previous reviews have identified important gaps in evidence about the effectiveness of physical activity interventions by levels of socioeconomic disadvantage.[11] The evidence in this review suggests there has been modest progress in incorporating equity considerations into evaluations of population-level interventions. Whilst most studies reported analyses by socioeconomic status, a minority reported only descriptive data (e.g. proportions active at baseline and follow up by educational attainment). Such data offer little value without a robust analysis adjusting for relevant confounders, especially in non-randomised evaluations. Where retrospective evaluations use population surveys, which usually include measures of socioeconomic status, failure to consider effectiveness by levels of advantaged is a missed opportunity. For example, we found an evaluation of the UK CDT and CCT programme using the Active People Survey, but which did not report effectiveness by socioeconomic status.[31,32] Evidence on this topic would be substantially enhanced if future evaluations routinely incorporated robust analytical approaches to address the socioeconomic equity of interventions.

Finally, whilst the quality of studies was mostly poor, it is important to balance this judgement against a pragmatic perspective on what sort of designs are feasible to evaluate population level approaches. Randomised designs, using cluster or stepped wedge methods, are possible. However, these methods bring numerous feasibility challenges alongside considerable costs. In contrast, retrospective evaluation studies using opportunistic controls and population surveys are likely to offer a more feasible and low-cost evaluative option. Whilst such study designs lack the rigour of randomised methods, strong analytical approaches supplemented by robustness and sensitivity checks can support causal inference.

Implications for policy

Increasing physical activity is a major policy goal as part of a wider shift to preventative models of healthcare. The recently published Fit for the Future 10 Year Plan for England recognises that activity rates are unequal across the country, signals the investment in places and that Department for Culture, Media and Sport will set out more detail on the strategy for physical activity [in due course]. . Successful approaches are especially needed for disadvantaged groups, who face numerous barriers to engaging in physical activity.

The evidence in this review suggests some approaches (free leisure facilities and community-wide health promotion) may be promising and pose a low risk of widening health inequalities. This is likely to be an important message for policy makers seeking

opportunities to embed prevention into place-based health strategies in line with the 10 Year Plan. The core component of the free-leisure facilities also locates action upstream, tackling important social determinants of health.

Even so, the generalisability of these interventions to other contexts remains uncertain. Inevitably, contexts and populations vary from place to place, and the replicability of an intervention's success is not guaranteed. Where these or similar approaches are adopted, policymakers are advised to consider population level data collection to monitor and evaluate impact within the contexts such interventions are developed and delivered. Use of the ADAPT Framework guidance for adapting interventions to new contexts could also aid policy implementation and evaluation.[33] ADAPT was developed in response to the challenges of replicating interventions with evidence of effectiveness into new contexts, especially where contextual factors may shape success. The framework guides users to consider a range of factors relating to who will drive adaptation of the intervention, the intervention-context fit, the costs, resources and materials needed, and ongoing evaluation and monitoring of delivery and impact.

Costs are likely to be a key driver of the success of population-level interventions among disadvantaged groups. For interventions that aim to improve walking and cycling paths, there may be hidden costs associated with the initial take up of activity (e.g. purchase of bicycles and cycle equipment or suitable walking shoes). This is an important policy consideration for the planned £616 million investment in cycling and walking infrastructure to support active travel in England.

For some of the interventions evaluated (cycle and walking routes, greenspace improvements, walkable neighbourhoods), any resultant physical activity would likely occur outdoors. Important policy considerations for these approaches include the needs of older people experiencing mobility and frailty difficulties, who may find outdoor exercise challenging,[34] and groups who may have concerns about the safety of exercise or moving around outdoors.

Strengths and limitations

Our rapid review used standard, robust methods and a comprehensive search strategy including a range of grey literature sources. We limited our searches to 2015 to 2025 to avoid duplicating a previous review on this topic,[11] and thus ensuring our findings reflect contemporary, up-to-date evidence. Pre-review engagement with a range of public health experts was particularly beneficial to optimise our search strategy.

We focused on socioeconomic disadvantage for this review. Whilst there are numerous other dimensions of disadvantage (e.g. based on gender, ethnicity),[8] considering all such dimensions was not feasible. This is an important limitation but does not undermine the conclusions of our work. Critically, the intersecting nature of socioeconomic disadvantage with gender and ethnicity means that our findings have relevance across diverse populations.

Eligible outcomes related to physical activity, and process evaluation outcomes, such as acceptability. Other health-related benefits of the identified interventions, as well as cost-effectiveness outcomes, are therefore missed in this review. We are aware that some of the studies we included had associated publications reporting other outcomes (for example, Candio et al., 2021[35]). This is not a major shortcoming, and simply reflects the policy focus of our work.

Finally, we opted to include only studies that could tell us something about whether the identified interventions worked better, worse, or the same across disadvantaged and advantaged groups. This decision was to ensure that we could make a judgement about whether effective interventions in disadvantaged groups risk widening health inequalities by demonstrating larger benefits in the most advantaged. To achieve this, studies that reported the effectiveness of interventions only in disadvantaged (i.e. low socioeconomic) populations were excluded. We identified thirteen studies that met this criterion: a bibliography of these studies is provided as a supplementary file, for information. A limitation of this decision is that our review misses a section of evidence about what works to promote physical activity in disadvantaged groups. However, given the substantial socioeconomic inequalities in physical activity, disability and healthy life expectancy in the UK,[36-38] it is crucial to prioritise evidence that conveys the inequalities risks posed by health interventions.

Conclusion

There is some evidence to suggest that free access to leisure facilities and community-wide health promotion campaigns can increase physical activity among disadvantaged groups whilst posing a low risk to widening health inequalities. These approaches may be promising for policy makers seeking opportunities to embed preventative, place-based approaches to health. However, this evidence is far from conclusive. More research is needed to understand socioeconomic patterns of effectiveness, especially across different contexts. Evidence from cycling and walking route interventions may suggest that disadvantaged groups find some types of physical activity (i.e. walking) easier to adopt than other types of activity. The evidence in this review indicates there has been modest progress in incorporating equity considerations into evaluations of population-level interventions to promote physical activity.

Table 1. Review Criteria

	Include	Exclude
Population	Interventions targeting adults (18+ years). Populations experiencing socioeconomic disadvantage.	Interventions targeted at children (<18 years); or adults and children where data are not reported separately for 18+ populations.
Intervention	Any population-level intervention. Population-level interventions must target whole populations (local, regional, national). See table 2 for examples.	
Comparator	Non-disadvantaged groups, or no comparator (see below).	
Outcome	Any measure of physical activity participation that assesses change in frequency of participation (e.g. days per week), duration of physical activity (e.g. time spent engaging in activity/time spent sedentary), rates of participation (e.g. number of trail path users), or number and type of physical activities participated in. These may be collected through e.g. self- or interview-administered questionnaires (e.g. CHAMPS or PASE), activity diary/log, or device (e.g. smartwatches; pedometers, accelerometers), administrative datasets and surveys. Any measure of change in intensity of physical activity (e.g. Light, Moderate or Vigorous Physical Activity). This may be indicated by Metabolic Equivalents (METs) and related measures such as oxygen consumption (VO2 max), calorie consumption, or heart rate. Any process evaluation outcomes (e.g. adherence, acceptability, barriers and enablers to intervention engagement and uptake) if reported alongside a physical activity outcome.	Outcomes related to physical function (e.g. gait speed, muscle function), and physical or mental health outcomes not directly related to exercise intensity.
Study design	Any evaluation study design, including randomised and non-randomised approaches. Qualitative data collected as part of a process evaluation are also eligible. Primary studies published from 2015, in English language.	Qualitative data not linked to an evaluation of an intervention.

Table 2. Summary of included studies

Author, date, country	Intervention	PA Outcome(s)	Study design	Measure(s) of socioeconomic disadvantage	Data source	Sample size	Follow up
Moderate quality studies							
Dallmeyer, 2024 Germany	Introduction of minimum wage	PA frequency Weekly PA frequency	Controlled before/ after	Occupational status Educational attainment	German Socio-Economic Panel Survey	2,258 (before), 2,448 (after)	2-4 years
Patterson, 2023 UK	Cycling infrastructure	Cycling commuting prevalence Cycling uptake Cycling maintenance	Controlled before and after	Educational level IMD	Office for National Statistics Longitudinal Survey	25,747	10 years (2001-2011)
Higgerson, 2018 UK	Free access to leisure centres (Re:Fresh)	Gym and swim attendances, gym/swim participation, participation in any moderate-intensity sport or recreation.	Controlled before and after	National Statistics Socioeconomic Classification (NS-SEC)	Leisure Management System, and Active People Survey (APS)	6,160 (intervention),1,550,403 (control)	10 years (2005 - 2015)
Low quality studies							
Candio, 2020, 2022 UK	Leeds Let's Get Active. Free universal access to off-peak exercise classes to all city residents.	PA frequency, population reach	Non-controlled before/ after	IMD	Primary data collection	51,874	Not reported
Panter, 2017 UK	Walking and cycling routes (Connect2)	Weekly time spent walking Time spent walking for recreation	Non-controlled before/ after	Educational level, annual household income, employment status	Primary data collection	1,304	1 and 2 years
Saito, 2021 Japan	Community wide health promotion.	Daily duration of PA	Non-controlled before/ after	Perceived household economic status	Primary data collection	1,411	2 and 5 years

Tsuzuki, 2024 Japan	Community wide health promotion intervention	Prevalence of regular physical activity	Non-controlled before and after	Employment status	Primary data collection	3,718	2 years
Sloman, 2017 UK	Cycling infrastructure	Any cycling in a typical week	Time Series	Social class (A, B, C1, C2, D, E)	Primary data collection	9,000	6 year ITS
Rose, 2022 Australia	$56 million investment by Sport Australia into two funding streams, the Participation (all ages) and Better Ageing (BA, over 65 years)	Meeting PA guidelines	Non-controlled before and after	Area deprivation	Primary data collection	4,761	6 months
Lee, 2023 US	Relocation to a walkable, mixed-use development.	Moderate-to-vigorous physical activity (MVPA)	Controlled before and after	Income	Primary data collection	115	12 months
Veitch, 2018, Australia	Park refurbishment	Adult park visitation	Controlled before and after	Low SES (not otherwise specified) Education Employment	Primary data collection	Not reported	12 and 24 months

Table 3. Summary of interventions

Author	Date	Target population	Intervention summary	Population-level intervention classification[6,7]		
				Behavioural and social approaches	Informational and campaign approaches	Environmental and policy approaches
Dallmeyer	2024	All employed adults in Germany	Introduction of minimum wage			þ
Candio	2022, 2020	Adults in Leeds	Leeds Let's Get Active. Free universal access to off-peak exercise classes to all city residents. Free sessions available to all residents but were provided in leisure centres located in the most deprived areas of the city. Mass media campaign to advertise the offer in six months prior.		þ	þ
Panter	2017	Adults in three regions of the UK	Introduction of Connect2, a programme to make local walking and cycling journeys easier by constructing or improving routes at sites around the UK			þ
Saito	2021	Older adults, but evaluated in adults aged >20 years in Fujisawa city in Japan	Community wide health promotion intervention, comprised of delivering information about national PA guidelines and supporting communities to set up their own PA programmes.	þ	þ	
Tsuzuki	2024	All adults in Unnan City aged 40-79 years	Community wide health promotion intervention, comprising (1) city-wide information delivery (cable television and city newsletters), (2) citywide initiative of a peer-led muscle-strengthening program, the Unnan Kou-un (Happiness in Unnan) Exercise (promoted through the city-wide leaflets), (3) trained volunteers as community exercise leaders in all communities, (4) restoration of existing swimming pool facility open to all residents in the city.	þ	þ	þ

Patterson Sloman	2023 2017	All residents in cycling demonstration towns in the UK	Cycling City and Towns Demonstration Programme. Involved improvements in cycle infrastructure; development of town-wide signed networks of cycle routes; branding and marketing of those routes; work with employers, universities, schools and other organisations to help them encourage cycling and improve facilities for cycling at their premises. Cycling Demonstration Towns (CDT) programme ran from October 2005 to March 2011, and involved six medium-sized towns. The Cycling City and Towns (CCT) programme ran from July 2008 to March 2011, and involved one city, one small town, and ten medium-sized towns.		þ	þ
Rose	2022	All residents (Participation funding) and over 65s (Better Ageing)	$56 million investment by Sport Australia into two funding streams, the Participation (all ages) and Better Ageing (BA, over 65 years), to support creation and implementation of programmes in various localities.			þ
Lee	2023	Adults moving into Mueller, a planned, walkable neighbourhood in Austin, Texas	Relocation to a walkable, mixed-use development featuring environmental attributes that support lifestyle physical activity. Higher density and land-use mix, complete sidewalk coverage, a network of parks and trails, 20% of land as public open spaces, 5 miles of hiking and biking trails.			þ
Veitch	2018	Residents in high deprivation neighbourhood	Park refurbishment, main component of which was introduction of a playscape for children.			þ
Higgerson	2018	All residents, workers, and GP-registered individuals aged 16 and over in Blackburn with Darwen,	Core intervention is universal access to gym and swimming facilities for adults (16+) in Blackburn with Darwen. Supporting components: ‣ Health Trainer outreach – behavioural support for inactive adults ‣ Healthy Communities Partnership – taster sessions, buddy schemes, and community events ‣ Marketing and promotion – local media and publicity materials to raise awareness	þ	þ	þ

Table 4. Summary of quality assessment

Author, date	Summary of appraisal	Rating
Sloman, 2017 UK	A before and after study using a representative cohort survey. Major limitation is that the data of interest for this review (PA outcome by SES) is descriptive and was not subject to robust analysis.	Low
Patterson, 2023 UK	Controlled before and after study with strong DiD analysis, adjusting for a range of confounders and with robustness checks. Overall, this is a well conducted study, but with the limitations of a non-randomised design and the absence of blinding. There is a lack of reporting around attrition of data at follow up of linked data, giving some uncertainty around this as a potential source of bias. Another limitation is that the intervention allocation was not coterminous with the local authority areas used to identify participants. Authors suggest there may be some residual error measurement, although sensitivity analyses indicates consistency of findings. There is a lack of detail about potential contamination of other interventions occurring in the intervention sites.	Moderate
Panter, 2017 UK	A before and after study with some important limitations regarding representativeness of the sample and loss to follow up. It is unclear if other local changes took place during the intervention at community level that would have impacted the outcome measures, which the authors acknowledge.	Low
Higgerson, 2017 UK	Controlled before and after study with strong DiD analysis, adjusting for a range of confounders and performing sensitivity analyses on the SES stratified analysis (by removing 'never worked'). Outcome measures may be subject to bias due to potentially missing swipe card data, or due to self-report, although the authors compared PA levels in the survey with other survey data (HSE) and found comparable levels. There is a lack of detail about potential contamination of other interventions occurring in the intervention sites. The authors note that they were not able to distinguish the effect of the media campaign from the free leisure centre access, so it is not possible to ascertain which (or if both) contributed most to the positive impact on PA. Follow up data rates are not reported, which is an important omission. Whilst reporting quality is generally good, data for the middle and higher categories of NSSEC are not explicitly reported, except as a figure (author contacted for clarification). Finally, authors note that 7.4% of SES data was excluded due to not being classifiable, which may lead to skewed estimates, although by how much is uncertain.	Moderate

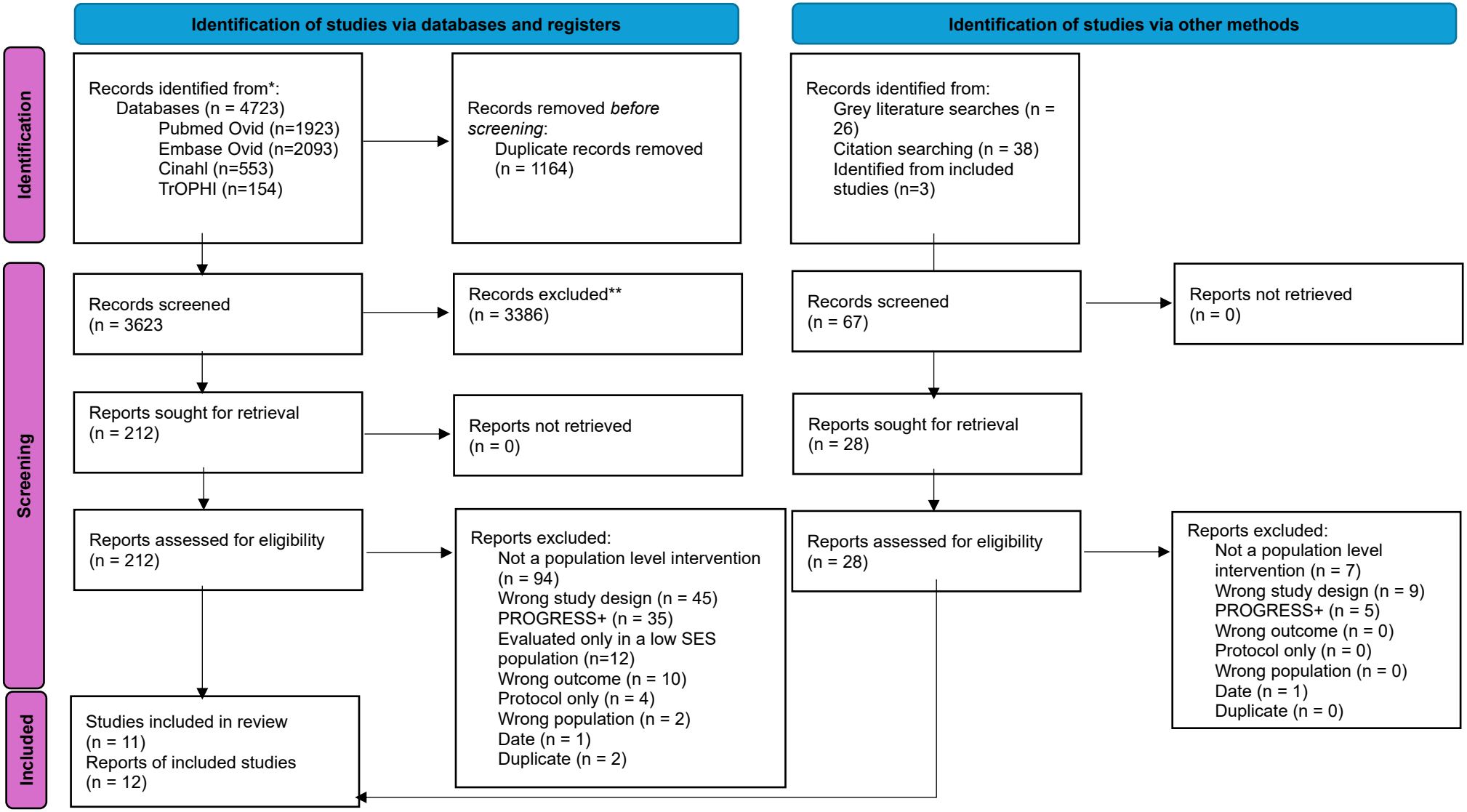
Candio, 2022, 2020 UK	2022: The data of relevance to this review is a comparison of reach and programme participation drop off between two IMD profiles, without before and after comparison. Only descriptive data are available for reach, with no analysis of difference. Appropriate test of difference used for programme drop off. Other important sources of bias include sample representativeness. 2020: A before and after study. The data relevant to this review are descriptive and not subject to robust analysis. There are other important limitations including substantial differences in study population between initial registration data and post survey data, and a lack of clarity about the representativeness of the data.	Low
Dallmeyer, 2024 Germany	Controlled before and after study with strong DiD analysis, adjusting for a range of confounders and with robustness checks. Issues relating to adherence and presence of other confounding schemes not applicable as this was a national policy directly impacting certain people. Potential important biases may include an outcome measure that was too broad to detect changes in intensity of PA.	Moderate
Saito, 2021 Japan	A before and after study with some important limitations regarding representativeness of the sample, and the absence of a baseline measure (with change assessed between 2 and 5 years after the intervention introduced). It is unclear if other local changes took place during the intervention at community level that would have impacted the outcome measure. Other aspects of the study were not reported, with some potential risks of bias unclear.	Low
Tsuzuki, 2024 Japan	A before and after study with the associated limitations, including a potentially non-representative sample. Attrition bordered on 20%, but further analysis indicated this may be unlikely to introduce substantial bias.	Low
Droomers, 2017 Netherlands	Controlled before and after study with strong DiD analysis, adjusting for a range of confounders and with robustness checks. There is a lack of detail about potential contamination of other interventions occurring in the intervention sites. Authors note the potential of non-survey response as a potential source of bias, although no details are reported on rate of non-response on key items.	Moderate
Lee, 2023 US	A controlled before and after study using DiD analysis adjusting for relevant covariates, but with significant limitations in terms of small sample size, no reporting of attrition, or numbers excluded after matching.	Low
Veitch, 2018 Australia	A controlled before and after study, a major limitation of which is that the data of relevance to this review is descriptive and not subject to robust analysis. Control site was substantially different in SES profile, making comparison between intervention and control in terms of PA subject to important biases. There is a lack of detail about potential contamination of other interventions occurring in the intervention sites.	Low
Rose, 2022 Australia	A before and after study with limitations to the outcome measures and data collection. Follow up at 6 months was short, and one might expect the nature of the intervention would take longer to 'embed'. Some items unclear, which makes overall risk of bias for this study unclear.	Low

Table 5. Summary of interventions, effectiveness for most and least advantaged, and risk posed to health inequalities

Study, country and intervention	Increased physical activity in least advantaged?	Did the intervention favoured the most or least advantaged?[a]	Potential risk posed by intervention to widening health inequalities?[b]	Quality rating
Higgerson 2017; Free access to leisure facilities + community health promotion components, UK	Yes	Least advantaged (size of difference varied between two outcomes)	Low	Moderate quality
Candio 2020, 2022; Free access to leisure facilities, UK	Yes	Insufficient analyses to determine	Unable to determine	Low quality
Panter 2017; Walking and cycling routes, UK	Yes	Both, depending on outcome measure	Unable to determine	Low quality
Patterson 2023; Walking and cycling routes, UK	Yes	Both, depending on outcome measure	Unable to determine	Moderate quality
Sloman 2017; Walking and cycling routes, UK	No	Insufficient analyses to determine	Unable to determine	Low quality
Saito 2021; Community wide health promotion (for older adults but evaluated in 20+ year adults), Japan	Yes	Least advantaged	Low	Low quality
Tsuziki 2024; Community wide health promotion (40-79 years), Japan	Yes	Most advantaged	High	Low quality
Dallmeyer 2024; Minimum wage, Germany	No	Neither	Unable to determine	Moderate quality
Lee 2023; Planned neighbourhood, US	Not reported	Most advantaged	High	Low quality
Rose 2022; Investment in two sports programmes, Australia	No	Neither, but reduction in physical activity greater for least advantaged on one programme	Potentially high	Low quality
Veitch 2018; Park refurbishment, Australia	Inconsistent findings	Insufficient analyses to determine	Unable to determine	Low quality

[a] Judged by whether improvements in PA were greater for most or least advantaged; [b] High risk=intervention favoured most advantaged, Low risk=intervention favoured most disadvantaged

Figure 1. PRISMA Flowchart



Appendix A. Search Strategies

Medline strategy

Database(s): Ovid MEDLINE(R) ALL 1946 to April 15, 2025 – Date of Search 16/04/2025
Search Strategy:

#	Searches	Results
1	((promot* or encourag* or boost* or elevat* or develop* or increas* or improv*) adj3 (physical activit* or exercis* or fitness or biking or cycling or walk* or running or active commut* or commut* or physical health or active transport* or cyclist* or bik* or bicycl* or cyclist or active travel* or physically active or mobility* or swim* or sport* or gym* or physical health or active transport* or human powered transport*)).ti,kf.	17345
2	Exercise/ or Sports/ or Swimming/ or Running/ or Jogging/ or Walking/	267653
3	1 or 2	276915
4	("socially disadvantaged" or "general population" or "Population Level" or "disadvantaged" or "marginali?ed" or "poverty" or "less income" or "low income" or "poor" or "less access" or "low access" or "Low-Income Population" or "Low-Income Populations" or "Inadequate Income" or "Low personal income" or "Disadvantaged Populations" or "Underprivileged" or "Social Marginali?ation*" or "Financially poor" or "Economic deprivation" or "Severe lack of money" or "Living in poverty" or "economic hardship" or "socioeconomic" or bankrupt* or "economic insufficiency" or ghetto* or impoverish* or insolven* or "lack of income" or "lack of money" or "no income" or "no money" or slum or slums or unemploy* or "low ses").kf,tw.	1253240
5	exp Socioeconomic Factors/	534829
6	4 or 5	1643704
7	(population based or population?based or population health or community?based or public health or community care or communit* or local communit* or outreach or local administ* or local authorit* or population level*).kf,tw.	1445102
8	exp Health Promotion/ or health education/ or public health/ or population health/ or Community Health Services/	270946
9	7 or 8	1594651

10	((physical activit* or PA or physical health) adj20 (intervention* or effect* or affect or efficac* or random effect* or random-effect or random-effects or active recreation or active travel* or pedestrian activit* or fall prevention* or mobili* or mobility goal* or health effect* or health?system or health system* or health gain* or inequit* or health equity or equit* or environmental impact* or health effect* or health impact* or policy approach* or active transport* or socioeconomic inequities or socioeconomic inequalities or health disparit* or health inequalities or health promotion* or campaign or media or banner* or "participation rates" or "number of users on cycle paths " or "Take up of cycling" or "Moderate intensity activity" or "Counts of trail users" or "Number of exercise sessions per week" or "active transport to park" or "park visitation" or "leisure facilit*" or "leisure time exercise" or "active transportation" or "number of walks" or "bike trip*" or "self reported walking or cycling" or "Walking for transportation or leisure" or "Walking for transport" or "Number of cyclist*" or mobility limitation* or "Total daily physical activit*" or "Recreational physical activit*" or "Traffic volume of pedestrian*" or "pedestrian count*" or "Traffic volume of cyclist*" or "health inequalitie*" or "Change in walking" or "PA not otherwise specified" or "Walking one hour daily" or "Intention to be active" or "Change in exercise" or "Days a week of VPA" or "self-reported physical activity" or streetscape or self-explaining road* or self explaining road* or neighb?hood or physical environment* or urban environment* or suburban environment* or built environment* or community environment* or travel environment* or street environment* or road environment* or shared space* or traffic calm* or smart growth or new urbanism or urban form or urban design or walkability or residential density or community design or city planning or environment design or urban renewal or sidewalk or footpath or green space* or recreational facilit* or public transit or public transport* or block size* or street connectivity or open space* or woonerf or sustainable safety or cycleway or (cycl* and trail*) or (bik* and trail*) or (bicycle* and trail*) or (walk* and trail*) or (pedestrian* and trail*) or (route and school) or (bik* and (path* or lane*)) or (bicycle* and (path* or lane)) or (cycl* and (path* or lane)))).kf,tw.	90545
11	exp clinical trial/ or Treatment Outcome/ or Delivery of Health Care/ or Health Inequities/ or Health Impact Assessment/	2166359
12	10 or 11	2242819
13	Humans/ not (Animals/ and Humans/)	20304359
14	3 and 6 and 9 and 12 and 13	3280
15	((child or adolescent) not (adult or elderly)).kf,tw.	601755
16	14 not 15	2971

17	limit 16 to yr="2015-Current"	1923

Grey Literature Sources

- Association of Directors for Public Health https://www.adph.org.uk/
- Royal Society for Public Health https://www.rsph.org.uk/
- Northern Ireland Public Health Agency https://www.publichealth.hscni.net/
- European Public Health Association https://eupha.org/
- DEFRA https://randd.defra.gov.uk/
- Sustrans https://www.sustrans.org.uk/
- UK Government Social Research & Evaluation page https://www.gov.uk/government/collections/social-research-and-evaluation#cycling,-wheeling-and-walking
- Active Travel England https://www.activetravelengland.gov.uk/
- Transport Action Network https://transportactionnetwork.org.uk/
- Movement for Health https://www.movementforhealth.scot/
- Sports England https://www.sportengland.org/funding-and-campaigns/moving-healthcare-professionals
- International Society for Physical Activity and Health https://ispah.org/
- European Network for Workplace Health Promotion https://www.enwhp.org/
- World Health Organization www.who.int
- Local Government Association www.local.gov.uk
- UK Active https://www.ukactive.com/
- The King's Fund Database https://koha.kingsfund.org.uk/

Appendix B. Data summary tables for included studies

Table B1. Data summary table for interventions improving cycling and walking paths

Author	Date	Outcome	SES groups compared	Estimate and CIs by SES group	p value
Panter[22]	2017	Uptake of walking for transport	(Ref: tertiary) Secondary school or higher Lower than secondary	1.0 0.50 (0.31 to 0.82) 0.76 (0.45 to 1.29)	p<0.05
		Short lived increase in walking for transport	(Ref: tertiary) Secondary school or higher Lower than secondary	1.0 1.61 (0.72 to 3.58) 1.36 (0.54 to 3.44)	p<0.05
		Sustained increase in walking for transport	(Ref: tertiary) Secondary school or higher Lower than secondary	1.0 1.15 (0.52 to 2.58) 3.21 (1.48 to 6.94)	p<0.01
		Uptake of walking for recreation	(Ref: tertiary) Secondary school or higher Lower than secondary	1.0 0.66 (0.41 to 1.07) 0.34 (0.20 to 0.60)	p<0.001
		Short lived increase in walking for recreation	(Ref: tertiary) Secondary school or higher Lower than secondary	1.0 0.59 (0.29 to 1.21) 0.59 (0.26 to 1.31)	NS
		Sustained increase in walking for recreation	(Ref: tertiary) Secondary school or higher Lower than secondary	1.0 1.20 (0.62 to 2.33) 1.55 (0.73 to 3.28)	NS
		Uptake of walking for transport	(Ref: any car) No car	1.0 1.24 (0.54 to 2.85)	NS
		Short lived increase in walking for transport	(Ref: any car) No car	1.0 4.77 (2.42 to 9.42)	p<0.001
		Sustained increase in walking for transport	(Ref: any car) No car	1.0 5.35 (2.58 to 11.08)	p<0.001
		Uptake of walking for recreation	(Ref: any car) No car	1.0 0.68 (0.37 to 1.25)	NS

		Short lived increase in walking for recreation	(Ref: any car) No car	1.0 0.51 (0.15 to 1.70)	NS
		Sustained increase in walking for recreation	(Ref: any car) No car	1.0 1.18 (0.51 to 2.72)	NS
		Uptake of walking for transport	(Ref: >40 000) 20 001–40 000 ≤20 000	1.0 1.17 (0.71 to 1.93) 0.74 (0.42 to 1.31)	NS
		Short lived increase in walking for transport	(Ref: >40 000) 20 001–40 000 ≤20 000	1.0 1.92 (0.69 to 5.33) 3.43 (1.26 to 9.33)	p<0.01
		Sustained increase in walking for transport	(Ref: >40 000) 20 001–40 000 ≤20 000	1.0 2.41 (1.00 to 5.82) 3.79 (1.55 to 9.26)	p<0.01
		Uptake of walking for recreation	(Ref: >40 000) 20 001–40 000 ≤20 000	1.0 0.63 (0.37 to 1.08) 0.49 (0.28 to 0.85)	p<0.05
		Short lived increase in walking for recreation	(Ref: >40 000) 20 001–40 000 ≤20 000	1.0 0.59 (0.28 to 1.26) 0.63 (0.29 to 1.40)	NS
		Sustained increase in walking for recreation	(Ref: >40 000) 20 001–40 000 ≤20 000	1.0 1.11 (0.58 to 2.12) 0.58 (0.25 to 1.33)	NS
		Uptake of walking for transport	(Ref: working/student) Retired Unemployed/other/sick	1.0 1.10 (0.60 to 2.00) 1.15 (0.46 to 2.85)	NS
		Short lived increase in walking for transport	(Ref: working/student) Retired Unemployed/other/sick	1.0 2.59 (0.96 to 6.95) 0.84 (0.19 to 3.74)	NS

		Sustained increase in walking for transport	(Ref: working/student) Retired Unemployed/other/sick	1.0 2.85 (1.10 to 7.40) 1.94 (0.70 to 5.38)	NS
		Uptake of walking for recreation	(Ref: working/student) Retired Unemployed/other/sick	1.0 0.67 (0.33 to 1.35) 0.74 (0.33 to 1.65)	NS
		Short lived increase in walking for recreation	(Ref: working/student) Retired Unemployed/other/sick	1.0 1.60 (0.68 to 3.75) 1.05 (0.30 to 3.63)	NS
		Sustained increase in walking for recreation	(Ref: working/student) Retired Unemployed/other/sick	1.0 1.59 (0.68 to 3.76) 0.21 (0.03 to 1.59)	NS
Sloman[26]	2017	Proportion of respondents reporting any cycling in a typical week in the previous year	Social class AB 2006 Social class AB 2009 Social class AB 2011	32% 37% 36%	NR
			Social class C1 2006 Social class C1 2009 Social class C1 2011	28% 31% 32%	NR
			Social class C2 2006 Social class C2 2009 Social class C2 2011	26% 29% 30%	NR
			Social class DE 2006 Social class DE 2009 Social class DE 2011	16% 18% 16%	NR
Patterson[23]	2023	Change in cycling prevalence	Low deprivation High deprivation	0.91 (1.19 to 0.69) 1.06 (1.37 to 0.83)	NR

		Change in walking prevalence	Degree No degree	1.19 (1.53 to 0.93) 1.16 (1.31 to 1.03)	NR
		Change in walking prevalence	Low deprivation High deprivation	1.15 (1.37 to 0.97) 1.10 (1.33 to 0.91)	NR
		Change in walking or cycling prevalence	Degree No degree	1.18 (1.44 to 0.97) 1.13 (1.26 to 1.02)	NR
		Change in walking or cycling prevalence	Low deprivation High deprivation	1.09 (1.26 to 0.93) 1.09 (1.27 to 0.94)	NR
		Take up cycling	No degree Degree	1.31 (1.04, 1.64) 1.84 (1.31, 2.59)	NR
		Take up cycling	Low deprivation High deprivation	1.34 (0.98, 1.82) 1.42 (1.04, 1.95)	NR
		Take up walking	No degree Degree	1.24 (1.08, 1.42) 1.57 (1.20, 2.04)	0.03 <0.001
		Take up walking	Low deprivation High deprivation	1.19 (0.98, 1.44) 1.23 (0.99, 1.52)	0.087 0.056
		Take up walking or cycling	No degree Degree	1.20 (1.05, 1.36) 1.85 (1.48, 2.31)	0.006 <0.001
		Take up walking or cycling	Low deprivation High deprivation	1.24 (1.03, 1.48) 1.25 (1.04, 1.51)	0.021 0.020
		Maintenance of cycling	No degree Degree	1.07 (0.76, 1.51) 1.81 (1.01, 3.26)	NR
		Maintenance of cycling	Low deprivation High deprivation	1.17 (0.71, 1.92) 1.26 (0.78, 2.01)	NR
		Maintenance of walking	No degree Degree	1.21 (1.00, 1.48) 1.89 (1.20, 2.96)	0.053 0.006
		Maintenance of walking	Low deprivation High deprivation	1.26 (0.96, 1.65) 1.35 (0.96, 1.89)	0.100 0.080
		Maintenance of walking or cycling	No degree Degree	1.32 (1.12, 1.56) 1.71 (1.21, 2.41)	0.001 0.002

		Maintenance of walking or cycling	Low deprivation High deprivation	1.28 (1.01, 1.61) 1.41 (1.08, 1.84)	0.039 0.012

Table B2. Data summary table for community wide health promotion interventions

Author	Date	Outcome	SES groups compared	Estimate and CIs	p value
Saito[25]	2021	Mean difference of change in PA minutes/day between groups x economic status (ANOVA interaction) for 20-64 years	Perceived economic status (poor/very poor v average/good/excellent)	-3.3 mins/day	p=0.657
		Mean difference of change in PA minutes/day between groups x economic status (ANOVA interaction) for 65+ over	Perceived economic status (poor/very poor v average/good/excellent)	40.9 mins/day	p=0.001
Tsuzuki[27]	2024	Adjusted change in prevalence of regular physical activity from baseline to follow up (%)	Employed Unemployed	+9.5%pt (7.0, 12.1) +5.2%pt (1.9, 8.5)	NR
		Difference in adjusted change (baseline to follow up) in PA between employed/unemployed) (%)	NA	+4.4%pt (0.09, 8.6)	<0.05

Table B4. Data summary table for free leisure facility interventions

Author	Date	Outcome	SES groups compared	Estimate and CIs	p value
Candio[18]	2022	IMD profile of residents reached (proportion of total number of adult residents who signed up to the programme over 39 months of implementation), comparing with Leeds city profile	IMD (top 20% deprived versus remaining 80%)	The programme reached a smaller proportion of those living in the top 20% most deprived areas of the city (19.5% living in top 20% most deprived areas of the city reached by programme, compared to 33% of population living in top 20% most deprived areas of the city)	NR
Candio[17]	2021	% of participants inactive at baseline	IMD non-deprived IMD deprived	28.1 32.8	NR
		% participants inactive post-registration survey	IMD non-deprived IMD deprived	7.6 5.8	
		% of participants insufficiently active at baseline	IMD non-deprived IMD deprived	37.6 34.9	NR
		% participants insufficiently active post-registration survey	IMD non-deprived IMD deprived	32.7 30.2	
		% of participants moderately active at baseline	IMD non-deprived IMD deprived	21.7 20.1	NR
		% participants moderately active post-registration survey	IMD non-deprived IMD deprived	41.9 46.5	

		% of participants active at baseline	IMD non-deprived IMD deprived	12.6 12.2	NR
		% participants active post-registration survey	IMD non-deprived IMD deprived	17.8 17.4	
Higgerson[20]*	2017	Self-reported gym/swimming (≥30 mins in past 4 weeks)	Routine/manual Intermediate Managerial and Professional	+4.7% (4.4 to 5.0) Data not reported Data not reported	NR
		Self-reported moderate PA (≥30 min on ≥12 days in past 4 weeks)	Routine/manual Intermediate Managerial and Professional	+3.6% (3.3 to 3.8) Data not reported Data not reported	NR

*Data for routine and manual reported in text, data for intermediate and managerial/professional reported in graph only. In the text, the effect for participation in 30 minutes of moderate swim or gym activity for the lowest occupational group is 4.7% (CI 4.4-5.5); the effect for participation in 30 minutes moderate PA on at least 12 days for the lowest occupational group is 3.6% (CI 3.3-3.8). However, the estimates as show in the figure appear to be different - with the 4.7% effect for participation in 30 minutes moderate PA on 12 days, and the 3.6% effect for 30 minutes of moderate swim or gym activity. We have reported the data as detailed in the text (rather than the figure) of the publication. Study authors were contacted for clarification.

Table B5. Data summary table for greenspace and built environment interventions

Author	Date	Outcome	SES groups compared	Estimate and CIs	p value
Veitch[28]	2018	% Adult park visitation during study period Intervention T1	Working full time Working part time Unemployed Retired	36.8 27.8 22.9 12.5	NR
		% Adult park visitation during study period Intervention T3	Working full time Working part time Unemployed Retired	38.9 19.7 23.9 17.5	NR
		% Adult park visitation during study period control T1	Working full time Working part time Unemployed Retired	33.6 29.2 23.9 13.3	NR
		% Adult park visitation during study period control T3	Working full time Working part time Unemployed Retired	31.2 29.8 20.7 18.4	NR
		% Adult park visitation during study period Intervention T1	No formal qualifications Year12/apprentice/diploma University degree/ higher degree	14.6 34.0 51.4	NR
		% Adult park visitation during study period Intervention T3	No formal qualifications Year12/apprentice/diploma University degree/ higher degree	14.2 35.2 50.6	NR
		% Adult park visitation during study period control T1	No formal qualifications Year12/apprentice/diploma University degree/ higher degree	5.2 25.7 69.1	NR

		% Adult park visitation during study period control T3	No formal qualifications Year12/apprentice/diploma University degree/ higher degree	7.4 20.3 72.3	NR
Lee[21]	2023	Change in daily MVPA (SE)	Income <50k Income 50-100K Income 100k+	Ref 1.525 (6.019) 13.367* (5.732)	<0.05

Table B6. Data summary table for introduction of the minimum wage

Author	Date	Outcome	SES groups compared	Estimate and CIs	p value
Dallmeyer[19]	2024	Total PA frequency	Blue collar pre intervention Blue collar post intervention White collar pre intervention White collar post intervention	-0.119 (0.174) -0.206 (0.204) -0.410 (0.157) -0.049 (0.157)	Blue collar=NS White collar=p<0.01
		Weekly PA frequency	Blue collar pre intervention Blue collar post intervention White collar pre intervention White collar post intervention	-0.073 (0.674) -0.108 (0.082) -0.182 (0.060) -0.021 (0.063)	Blue collar=NS White collar=p<0.01
		Total PA frequency	High education pre intervention High education post intervention Low education pre intervention Low education post intervention	-0.253 (0.181) 0.032 (0.242) -0.184 (0.137) 0.011 (0.138)	NS
		Weekly PA frequency	High education pre intervention High education post intervention Low education pre intervention Low education post intervention	-0.097 (0.052) -0.031 (0.055) -0.139 (0.068) -0.023 (0.089)	High=p<0.10 Low=p<0.05

Table B3. Data summary table for sports investment intervention

Author	Date	Outcome	SES groups compared	Estimate and CIs	p value
Rose[24]	2022	Participation funding stream: Adjusted odds of meeting physical activity guidelines between pre and post follow up	Employed Unemployed Student Pension/welfare	1.07 (0.74, 1.55) 0.39 (0.12, 1.22) 1.26 (0.71, 2.21) 3.29 (1.75, 6.2)	NR
		Better ageing funding stream: Adjusted odds of meeting physical activity guidelines between pre and post follow up	Employed Unemployed Student Pension/welfare	0.76 (0.53, 1.08) 0.39 (0.23, 0.65) NA for student 0.93 (0.51, 1.71)	NR
		Participation funding stream: Adjusted odds of meeting physical activity guidelines between pre and post follow up	SEIFA 1 (most disadvantaged) SEIFA 2 SEIFA 3 SEIFA 4 (least disadvantaged)	1.16 (0.72, 1.88) 1.96 (1.10, 3.50) 1.01 (0.59, 1.70) 1.06 (0.63, 1.78)	NR
		Better ageing funding stream: Adjusted odds of meeting physical activity guidelines between pre and post follow up	SEIFA 1 (most disadvantaged) SEIFA 2 SEIFA 3 SEIFA 4 (least disadvantaged)	0.31 (0.17, 0.56) 0.68 (0.47, 0.98) 0.90 (0.67, 1.22) 0.59 (0.45, 0.76)	NR

Appendix C. Components of included interventions classified by the DEPTH Framework[16]

Exposure	Engagement	Mechanism(s) of action				
		Socio-cultural	Cognitive	Financial	Physical environment	Biomedical
Active	Active	Supporting communities to create their own PA programmes[25] City-wide muscle strengthening programme[27] Working with local organisations to support cycling and promote awareness of routes[23,26,31]	Lectures in local organisations[25]	Universal leisure facilities[17,18,20]	Cycling/walking routes[22,23,26,31] Park refurbishment[28] Planned, walkable neighbourhood[21] Swimming pool restored and available to all residents[27]	
	Passive					
Passive	Active		Marketing campaign to raise awareness of intervention[23,25-27,31] Disseminating PA-related information/health promotion[25,27]			
	Passive			Introduction of minimum wage[19]		

We were unable to classify the National Investment Programme (Rose et al., 2022), due to the absence of detail of the sports programmes that resulted from the investment.

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