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GUIDE TO COMMUNITY PREVENTIVE SERVICES: REVIEW

Parks, Trails, and Greenways for Physical Activity: A Community Guide Systematic Economic Review

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Introduction: This systematic economic review examined the cost−benefit and cost-effectiveness of park, trail, and greenway infrastructure interventions to increase physical activity or infrastructure use.

Methods: The search period covered the date of inception of publications databases through February 2022. Inclusion was limited to studies that reported cost−benefit or cost-effectiveness outcomes and were based in the U.S. and other high-income countries. Analyses were conducted from March 2022 through December 2022. All monetary values reported are in 2021 U.S. dollars.

Results: The search yielded 1 study based in the U.S. and 7 based in other high-income countries, with 1 reporting cost-effectiveness and 7 reporting cost−benefit outcomes. The cost-effectiveness study based in the United Kingdom reported $23,254 per disability-adjusted life year averted. The median benefit-to-cost ratio was 3.1 (interquartile interval=2.9−3.9) on the basis of 7 studies.

Discussion: The evidence shows that economic benefits exceed the intervention cost of park, trail, and greenway infrastructure. Given large differences in the size of infrastructure, intervention costs and economic benefits varied substantially across studies. There was insufficient number of studies to determine the cost-effectiveness of these interventions.

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INTRODUCTION

Engagement in physical activity is known to improve physical health[1,2] and mental health.[3,4] However, inadequate physical activity continues to be a public health issue across the world,[5,6] including the U.S. On the basis of 2015−2021 data from the Behavioral Risk Factor Surveillance System,[7] about a quarter of U.S. adults did not engage in leisure-time physical activity. Only about half achieved the recommended minimum amount of physical activity.[8] Among U.S. adolescents, the percentage of students in Grades 9−12 who achieved the recommended amount of physical activity[8] was 19.4% in 2009 and 23.2% in 2019.[7]

Interventions that establish new or modify existing park, trail, and greenway infrastructure aim to increase physical activity and the use of the infrastructure for

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recreation and relaxation by the population that reside in their proximity. Green space is a common term in the literature, and this study defines green space as any piece of vegetated land or body of water that is managed and maintained for the use of everyone in a community. Parks, trails, and greenways are types of green space.

The Community Preventive Services Task Force (CPSTF) recently recommended park, trail, and greenway infrastructure interventions when combined with interventions to increase community engagement, awareness, programming, or access.[9] The recommendation was based on evidence from a systematic review that these infrastructure interventions increase physical activity and increase the use of the park, trail, or greenway. The evidence for increased physical activity was inconsistent when the interventions were implemented as infrastructure alone, but there was evidence of increased use of parks, trails, and greenways.

A separate systematic economic review of park, trail, and greenway infrastructure intervention was conducted following the CPSTF recommendation. On the basis of the results from the systematic economic review, the CPSTF found that the societal economic benefits exceed the cost of these infrastructure interventions when implemented alone.[9] There were not enough studies to assess the cost-effectiveness of the intervention, and there were no studies to examine the cost-effectiveness or cost−benefit when infrastructure improvements were combined with additional interventions. This study describes the methods, results, and conclusions from the systematic economic review.

METHODS

This review was conducted using established methods for systematic economic reviews developed by the Centers for Disease Control and Prevention and approved by the CPSTF.[10] The review team included subject matter experts on physical activity and infrastructure from various agencies, organizations, and academic institutions; members of the CPSTF; and experts in systematic economic reviews from The Community Guide Program at the Centers for Disease Control and Prevention. Two publications from the Organization for Economic Cooperation and Development were consulted for guidance on appropriate methodologies in the conduct of economic evaluations of environmental interventions.[11,12]

Park, trail, and greenway infrastructure interventions improve the built and natural environments by creating or enhancing public locations for physical activity, relaxation, social interaction, and enjoyment.[9] These infrastructure improvements may be combined with other interventions to increase community engagement, public awareness, programming opportunities for physical activity and social interaction, and community access. The detailed definition of the intervention is available on The Community Guide website.[9]

The review team developed an economic analytic framework identifying the intervention, population, and economic outcomes of interest (Figure 1). The framework identified components of each economic outcome and the drivers, which are the components that contribute substantially to the magnitude of their estimates. The following research questions were addressed by the review:

- What is the intervention cost?
- What are the economic benefits because of the intervention?
- How do economic benefits compare with cost (e.g., benefit-to-cost ratio)?
- Is the intervention cost-effective?

As shown in Figure 1, park, trail, and greenway infrastructure interventions to increase physical activity include infrastructure (creation of new spaces or enhancements to existing spaces) with or without additional interventions, such as increased programming, access, promotion, and community engagement. The framework postulates that these interventions will increase community use of the infrastructure for physical activity, active transport, relaxation, and social interaction. The framework then proposes that these uses of the infrastructure would make the population more physically active, improve their physical and mental health and wellbeing, improve their quality of life, and improve environmental outcomes, thereby reducing morbidity and mortality. The economic review identified the capital cost and maintenance cost to be drivers of intervention cost. The cost of additional interventions for programming, access, promotion, and engagement would also be drivers of intervention cost when implemented. It is postulated that economic benefits derive from reduced healthcare costs due to improved physical and mental health, value of the infrastructure to users for recreation and relaxation, environmental improvements in air and water quality, and climate adaptability or biodiversity. The health-related benefits, the use value of the infrastructure, and the environmental effects are considered drivers of benefit. Use value is the subjectively valued monetary benefit that individuals place on the availability and use of the infrastructure. The framework also suggests that reduced morbidity and mortality due to improved physical and mental health would increase both quantity and quality of life years lived and avert disability-adjusted life years (DALYs) lived for the community's population. The

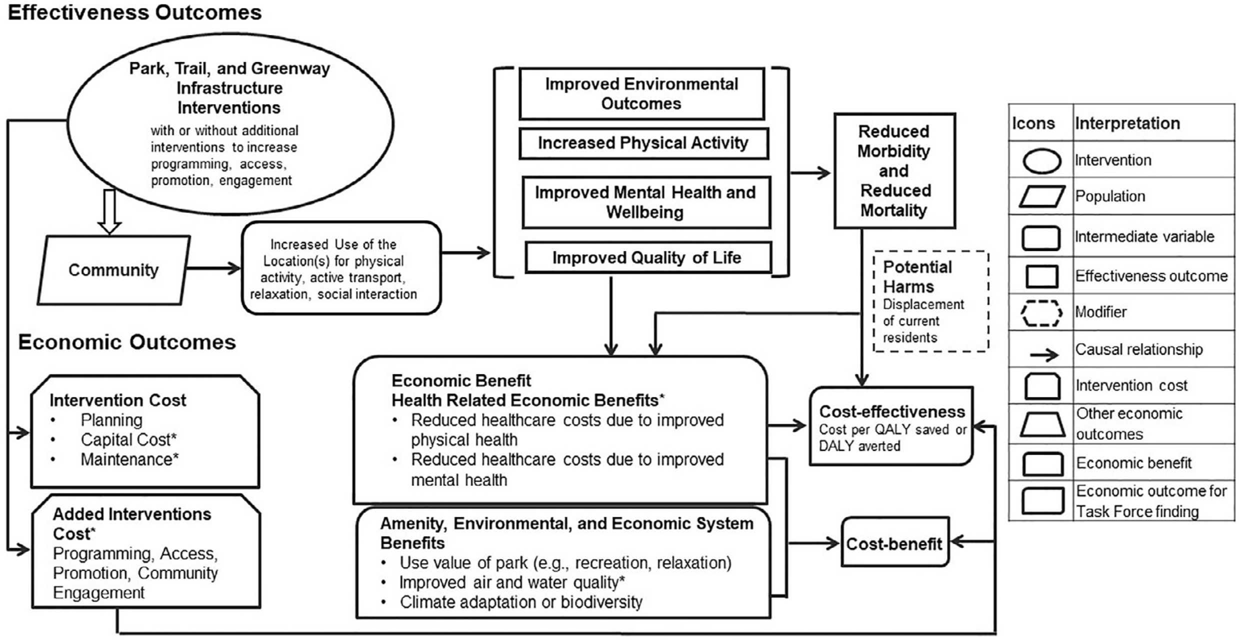

Figure 1. Analytic framework: park, trail, and greenway infrastructure interventions.
*Cost or benefit driver.
DALY, disability-adjusted life year; QALY, quality-adjusted life year.

framework conceptualizes summary economic outcomes as cost-effectiveness and cost−benefit. Cost-effectiveness is the net cost per additional quality-adjusted life year saved or DALY averted. Cost−benefit is the ratio of total intervention benefit to the intervention cost.

Gentrification can result if the improved infrastructure attracts higher-income individuals to the neighborhood, and this increased demand leads to rising rents, property values, and associated property tax. Increased housing costs can lead to displacement of current residents, that is, when they are forced to move out of the neighborhood owing to unaffordability.[13] The analytic framework postulates these effects as potential harms of the intervention.

The review team decided to include only economic studies that reported cost−benefit or cost-effectiveness estimates. Studies had to include creation or improvements in green space infrastructure and could not be model simulations. Furthermore, economic benefits must include benefits from physical activity or other use value of the green space infrastructure such as for recreation or relaxation. Evaluations for natural infrastructure such as large national parks (e.g., Yellowstone) were excluded because they are unlikely to contribute to regular physical activity opportunities for a well-defined local population or community. Also excluded were infrastructure related to urban agriculture or gardens, green walls, and green roofs because they are not freely accessible to everyone in the community or do not contribute to regular physical activity. Furthermore, evaluations of projects that cleared and maintained vacant lots to reduce violence and increase safety were not part of this review. A separate systematic review of this literature would be necessary to examine the economic merits of these projects.[14,15]

A search of the literature for economic evaluations was conducted with the inclusion and exclusion criteria described earlier along with the following additional criteria: met the definition of the intervention, conducted in a high-income country according to World Bank criteria,[16] written in English, and included ≥1 economic outcomes described in the research questions. The search was conducted in March 2022, and the period covered the date of inception of publications databases through February 2022. Peer-reviewed journal articles and papers presented at conferences were included as well as reports from government or quasi-government entities. Reference lists of included studies were screened, and subject matter experts were consulted for additional studies. The databases searched were Medline, CAB Abstracts, PsycINFO, Scopus, Cochrane Library, GreenFILE, EconLit, Environmental Science Collection, CRD York-NHS EED, CRD York-DARE, NTIS, CEA Registry, and Google Scholar. The detailed search strategy is available on The Community Guide website.[9]

Two reviewers independently screened the search yield and abstracted information from the included studies.

Unresolved disagreements between reviewers were taken to the full review team for majority consensus.

The infrastructures considered in this review have relatively long lives. The implementation requires an upfront cost of planning and construction followed by an annual cost for maintenance and repair. The literature generally assumes a useful life of 20−50 years before replacement becomes necessary. In this review, the upfront cost is referred to as the capital cost, and the annual cost is the maintenance cost. Benefits accrue owing to the infrastructure over the years of its useful life. The long time horizon necessitates discounting future values of both cost and benefit because a dollar now is valued more than a dollar in the future.[12] Values of 3%−5% have been recommended in the literature, and values >5% were considered excessive for the purpose of this review.[11]

Different methods are used in the literature to monetize benefits from greenspace infrastructure, as appropriate for the type of benefit.[11,12] Healthcare costs averted and DALY are estimated by modeling from increase in physical activity to diseases prevented such as cardiovascular disease, diabetes, and cancer. Healthcare cost is the cost of treatment for the diseases, and DALY is the sum of disutility weighted years of life lived with the diseases. Increased productivity at worksites is estimated from reduced absences and increased output due to improved health from physical activity and reduced stress. Reduced pollution due to the infrastructure leads to improved health and averted diseases, which in turn also reduces healthcare costs. Studies may fully model these economic outcomes or draw from estimates reported in the existing literature through the method of benefits transfer, where benefits previously calculated by another evaluation study are adapted to the current intervention and population.[12]

Mainly two methods are used in the literature to extract use value, which is the subjective monetary value that individuals place on the infrastructure. The methods are broadly classified as revealed preference and stated preference.[12] Revealed preference methods analyze the economic behavior of individuals to indirectly assess the value of the infrastructure to them. An example of revealed preference is the travel cost method, which computes the cost incurred to reach the infrastructure destination and the value of time spent in travel and in activities at the destination (usually at some wage rate per hour). Contingent valuation is a type of stated preference method that directly queries individuals through surveys/questionnaires to place a willingness to pay or monetary value on having the infrastructure versus not having it or versus some appropriate alternative. Hence, benefits of the intervention may be directly observed for or indirectly extracted from the population served by the infrastructure.

Assessment of the change in property value provides an indirect measurement of the value that individuals place on greenspace infrastructure. Properties that are geographically proximate to the infrastructure may increase in value owing to greater appeal. Property value is usually measured as the purchase price found in sales data maintained by local tax authorities. It is assumed that the annual property tax increases as the assessed property value increases. The increase in property value may be considered a benefit in terms of wealth and a cost in terms of tax burden for the property owner. Rental units that are proximate to the infrastructure may experience increase in rent owing to greater appeal for renters and owing to increased property tax for owners. Therefore, whether an increase in property value is a benefit or harm is a question of distribution of costs and benefits and depends on the context of the individuals impacted.

The overall economic merit of the intervention is summarized with cost−benefit or cost-effectiveness estimates. An intervention is cost-beneficial when the benefit-to-cost ratio >1, that is, where benefits > cost. An intervention is cost-effective if the net cost per DALY averted is less than the per capita gross domestic product of the country where the intervention was implemented.[17]

A tool for quality assessment of economic evidence was developed for the scope and objective of this study and is available as Appendix Material (available online). Two raters used the tool to independently assign and later reconcile points that indicate limitations in the quality of the estimates for variables related to intervention cost, healthcare cost, DALY, and net cost per DALY averted. Each estimate was scored as good, fair, or limited in quality of capture on the basis of inclusion of components deemed to be drivers of magnitude for the estimate. Each estimate also was scored as good, fair, or limited in quality of measurement on the basis of the appropriateness of analysis and methods used to derive the estimate. The final quality score for an estimate is the lower of the quality assessed for capture and quality assessed for measurement. The quality score assigned to an estimate that is a combination of other estimates, such as net cost, is the lower of the quality scores assigned to intervention cost and change in healthcare cost estimates. Estimates that received a limited quality score were removed from further consideration.

Cost−benefit analysis seeks to be comprehensive in coverage of what it considers to be costs and benefits of an intervention, and this comprehensiveness can lead to overlap across some estimates.[11,12] For example, there can be significant overlap between the value of a

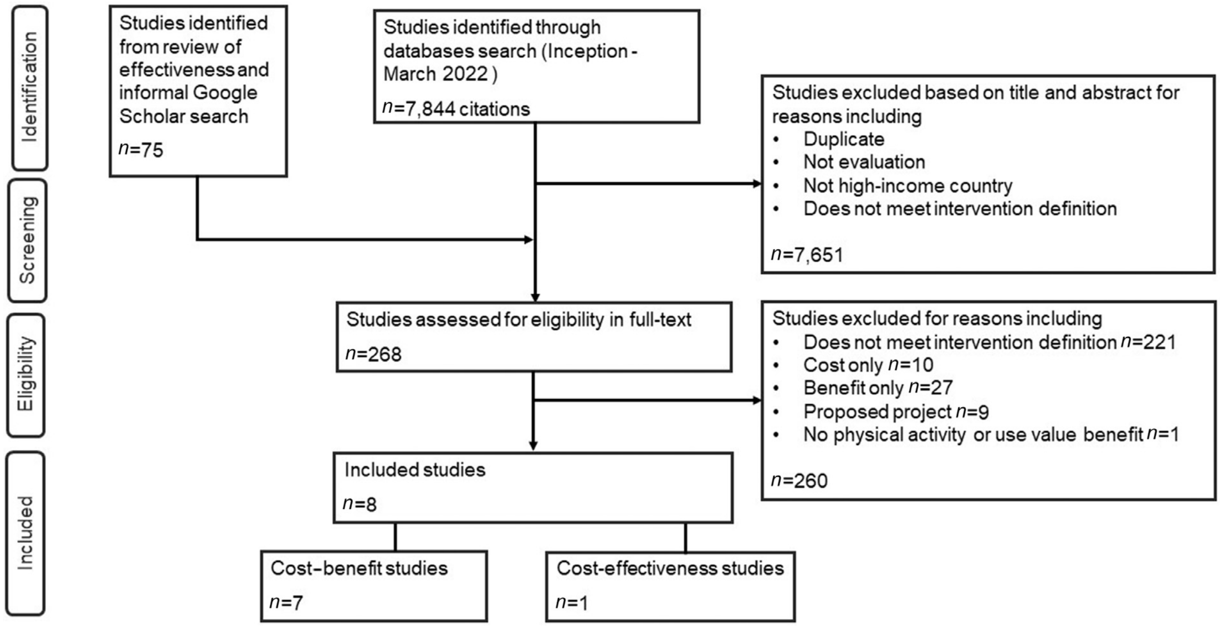

Figure 2. Search yield and included studies.

neighborhood park in terms of increased property values in its proximity and the result of a survey of area residents for what monetary value they place on the park. Although the expectation is that studies will exercise care in avoiding double counting,[11,12] this systematic review identified studies and estimates for closer examination that may have a problem of double counting. In addition, double counting of benefits is one of the criteria by which a limitation point may be assigned during quality scoring of estimates. A strictly conservative approach would be to include only 1 source of benefit when there is a possibility that benefits from different sources overlap, but this approach may be overly cautious and risk underestimation.

All monetary values are in 2021 U.S. dollars, adjusted for inflation using the Consumer Price Index from the Bureau of Labor Statistics[18] and converted from foreign currency denominations using purchasing power parities from the World Bank.[19] Summaries of estimates are reported as medians for continuous variables (along with interquartile intervals [IQIs] when there are ≥4 estimates) and as frequencies for categorical variables. All analyses were conducted using Microsoft EXCEL from March 2022 through December 2022.

RESULTS

Figure 2 shows the search yield. Screening resulted in the inclusion of 7 cost−benefit studies[20−26] and 1 cost-effectiveness study.[27] Table 1 provides intervention and population characteristics from the studies. In terms of geographic location, 1 study was based in the U.S.[21]; 2 were based in the United Kingdom[22,27]; 2 were based in Australia[23,25]; and 1 each was based in Spain,[20] Italy,[26] and the Czech Republic.[24] The 2 studies from the United Kingdom evaluated the same intervention for cost-effectiveness[27] and for cost−benefit.[22] The studies were based in large (n=3),[21,23,25] medium (n=4),[20,22,24,27] and small (n=1)[26] urban areas, with 3[21,22,25,27] placed in economically disadvantaged communities. Parks were developed as parks alone (n=1)[23] and as parks within larger infrastructure of wetlands to manage stormwater (n=3).[20,24,26] The 3 infrastructures that included greenways or trails were developed from an unused railway track as a transit corridor (n=1),[21] as part of urban redevelopment (n=2 studies from 1 intervention),[22,27] and as part of a creek rehabilitation to its natural state (n=1).[25] Increased physical activity was estimated and included as an economic benefit in 4 studies,[21,22,25,27] and increased value from use for the purpose of recreation or relaxation was included as economic benefit in 5 studies.[20,23−26]

Table 2 provides the intervention cost, intervention benefit, and the summary outcomes of cost−benefit and cost-effectiveness reported by each study. The types of benefits monetized in each study are identified as well as brief descriptions of methods used to derive the estimates. There were 6 good-quality estimates[20,21,24−27] and 2 fair-quality estimates[22,23] for intervention cost. The most frequent reason for assignment of limitation points was the absence of either capital cost or maintenance cost. Of the 7 studies[20−26] that monetized

Table 1. Intervention and Study Characteristics (n=8 Studies)

Study type of economic outcome	Location city, country size of city	Project name	Type of infrastructure size of infrastructure	Catchment residents	Includes benefits from physical activity	Includes benefits from use value
Alfranca et al.[20] Cost−benefit	Granollers, Spain Medium	Can Cabanyes Park	Park within wetland 8 hectares	17,760 visitors over 8 months	No	Yes
Atlanta BeltLine[21] 2020 Cost−benefit	Atlanta, GA Large	Atlanta BeltLine Southside Trail	Rail track conversion to greenway and trail as transit corridor 3.1 miles	5,119 within 1 mile	Yes	No
Dallat et al.[27a] Cost-effectiveness	Belfast, UK Medium	Connswater Community Greenway	Greenway and urban redevelopment 12 miles	87,500 within 1 mile	Yes	No
Hunter et al.[22a] Cost−benefit	Belfast, UK Medium	Connswater Community Greenway	Greenway and urban redevelopment 12 miles	87,500 within 1 mile	Yes	No
Lockwood and Tracy[23] Cost−benefit	Sydney, Australia Large	Centennial Park	Park 220 hectares	1.2 million households	No	Yes
Macháč et al.[24] Cost−benefit	Brno, Czech Republic Medium	Park Pod Plachtami - Brno	Park within wetland 32 hectares	11,500	No	Yes
Mekala et al.[25] Cost−benefit	Melbourne, Australia Large	Stony Creek Rehabilitation – Brimbank	Park within creek renewal 0.8 miles	973 households	Yes	Yes
Reynaud et al.[26] Cost−benefit	Gorla Maggiore, Italy Small	Gorla Maggiore Water Park	Park within wetland 4.5 hectares	2,045 households	No	Yes

[a]Dallat et al.[27] and Hunter et al.[22] evaluated the same intervention but reported cost-effectiveness and cost-benefit, respectively.
UK, United Kingdom.

economic benefits, 4 reported good-quality estimates[21,22,24,25] for benefits, and 3 reported fair-quality estimates.[20,23,26] The driver of economic benefits that was most frequently missing was averted healthcare cost.[20,23,24,26] The most frequent reasons for limitation points assigned to benefit estimates included lack of sensitivity analysis[20,21,23−25] and the possibility of double counting benefits.[21,22,24,25] There were 3[21,24,25] good-quality and 4[20,22,23,26] fair-quality estimates for cost−benefit. The single cost-effectiveness estimate was of good quality.[27]

Table 2 provides the economic outcomes reported in the included studies. The median capital cost for the infrastructure projects was $8.7 million (IQI=$3.3−$29.6 million) on the basis of 7 estimates from 7 studies.[20−22,24−27] The median annual cost of maintenance was $34,570 (IQI=$14,377−$116,070) on the basis of 7 estimates from 7 studies.[20,21,23−27] None of the studies reported implementation or cost of additional interventions to increase programming, access, promotion, or community engagement.

The median annual benefits due to intervention was $994,000 (IQI=$166,837−$4.7 million) on the basis of 7 estimates from 7 studies.[20−26] One cost-effectiveness study reported a $6,525 annual benefit from averted healthcare cost and 8.8 annual DALYs averted owing to the infrastructure, modeled from cardiovascular disease and cancers averted because of increased physical activity and improved environmental quality.[27] Table 2 shows various types of benefits monetized by the studies: reduction in crime (n=1),[22] improved air or water quality or carbon sequestration or biodiversity (n=5),[21,22,24−26] improved physical or mental health (n=4),[21,22,25,27] injuries prevented (n=1),[21] increased productivity of workers (n=1),[22] increased property value (n=4),[21,22,24,25] reduced stormwater and runoff or flooding (n=1),[22] and increased use value for recreation or relaxation (n=7).[20−26] Studies employed multiple methods to monetize benefits, including revealed preference methods such as travel cost,[20,23] stated preference methods such as contingent valuation,[22,23,26] benefits transfer through literature review,[22,24,25,27] and methods and inputs stipulated by a funding agency.[21]

Suspicion of double counting of benefits arose in 4[21,22,24,25] studies, particularly where the estimate for increased property value could have overlapped with estimates for recreation,[21] crime and pollution,[22] recreation and pollution,[24] and recreation.[25] The benefit estimates from these studies were examined closely. Appendix Table 1 (available online) shows the percentage contribution of each benefit to the reported total benefit. Double counting of consequences was only possible in the case of 1 study[21] because property value

Table 2. Cost–Benefit and Cost-Effectiveness (n=8 Studies)

Study Country	Intervention capital cost Intervention annual maintenance cost (quality of estimate)	Annual intervention benefit (quality of estimate)	Components of intervention benefit[b]	Methods of benefit estimation	Cost–benefit or cost-effectiveness Time horizon in years (quality of estimate)
Alfranca et al.[20] Spain	$154,417 $34,570 (good)	$121,252 (fair)	U	Travel cost survey	Cost–benefit 3.45 20 (fair)
Atlanta BeltLine[21] U.S.	$75,320,401 $179,848 (good)	$5,809,095 (good)	E, H, I, Pv,[d] U[d]	Valuation of reduced traffic injuries, reduced automobile use, increased recreational use, reduced healthcare cost, increased property value based on U.S. DOT guidelines (NCHRP 552 Report) and local data	Cost–benefit 2.93 30 (good)
Dallat et al.[27a] UK	$8,938,820 $52,291 (good)	$6,525[c] DALY 8.8 (good)	DALY, H	Reduced healthcare costs due to averted colon cancer, breast cancer, heart disease, and stroke based on benefits transferred from a systematic review of link from physical activity to disease state (assumed 2% increase). DALY from Global Burden of Disease.	Cost per DALY averted $23,254[e] 41 (good)
Hunter et al.[22a] UK	$50,169,617 NR (fair)	$3,608,629 (good)	C, E, H, Pd, Pv,[d] S, U[d]	Willingness to pay and cost for visitors, reduced healthcare cost from physical activity, increased productivity from major local employers, increased property value, reduced crime, reduced pollution, and reduced flooding. Benefits transfer based on a review of local or European studies and local data.	Cost–benefit 2.88 40 (fair)
Lockwood and Tracy[23] Australia	NR $8,179,219 (fair)	$34,897,999 (fair)	U	Travel cost survey, contingent valuation survey	Cost–benefit 4.27 1 (fair)
Macháč et al.[24] Czech Republic	$5,368,211 $20,863 (good)	$994,000 (good)	E, Pv,[d] U[d]	Property value from local data, benefits transfer from meta-analyses for environmental benefits and recreational value.	Cost–benefit 8.61 50 (good)
Mekala et al.[25] Australia	$8,679,850 $7,891 (good)	$104,184 (good)	E, H, Pv,[d] U[d]	Property value from local data, benefits transfer from national and European studies for healthcare cost, environmental benefits, and willingness to pay for use value.	Cost–benefit 0.59 50 (good)
Reynaud et al.[26] Italy	$1,281,056 $5,124 (good)	$212,422 (fair)	E, U	Contingent valuation that included recreational and environmental attributes and alternatives.	Cost–benefit 3.12 20 (fair)

(*continued on next page*)

Table 2. Cost−Benefit and Cost-Effectiveness (n=8 Studies) (*continued*)

Study Country	Intervention capital cost Intervention annual maintenance cost (quality of estimate)	Annual intervention benefit (quality of estimate)	Components of intervention benefit[b]	Methods of benefit estimation	Cost−benefit or cost-effectiveness Time horizon in years (quality of estimate)
Summary Median (IQI) or frequency (number of studies)	Capital cost: $8,679,850 ($3,324,633 −$29,554,218) Annual Maintenance Cost: $34,570 ($14,377− $116,070) Good=6, Fair=2	Annual benefit: $994,000 ($166,837− $4,708,862) Good=5, Fair=3	C (1), DALY (1), E (5), H (4), I (1), Pd (1), Pv (4), S (1), U (7)	NA	Cost−benefit: 3.1 (2.9−3.9) Good=3, Fair=4 Cost-effectiveness: $23,254 per DALY averted Good=1

[a]Dallat et al.[27] and Hunter et al.[22] evaluated the same intervention but reported cost-effectiveness and cost−benefit, respectively.
[b]C, reduction in crime; E, improved air or water quality or carbon sequestration or increased biodiversity; H, improved physical or mental health; I, injuries prevented; Pd, increased productivity of workers; Pv, increased property value; S, reduced stormwater and runoff or flooding; and U, increased use value for recreation or relaxation.
[c]Not included as a benefit in calculating median and IQI.
[d]Possible double counting of benefits.
[e]Per capita GDP of the UK in 2021 was $49,000.
DALY, disability-adjusted life year; GDP, gross domestic product; IQI, interquartile interval; NA, not applicable; NCHRP, National Cooperative Highway Research Program; NR, not reported; UK, United Kingdom.

contributed 12.7% and use value contributed 70.7% of the total estimated benefit. In the other 3 studies,[22,24,25] either property value or the other benefits where double counting may be an issue were small percentages of the total benefit.

Cost−benefit and cost-effectiveness outcomes that summarize the economic merits of the interventions are provided in Table 2. The median benefit-to-cost ratio was 3.1 (IQI=2.9−3.9) on the basis of 7 estimates from 7 studies.[20−26] The benefit-to-cost ratios indicate that the sum of economic benefits exceeded the cost to implement and maintain the infrastructure interventions. One cost-effectiveness study based in the United Kingdom reported $23,254 per DALY averted.[27] The estimate indicates that the infrastructure intervention was cost-effective because it was less than the per capita gross domestic product of the United Kingdom in 2021 ($49,525).[28]

The included studies did not report any estimates for economic harms associated with gentrification and displacement. Additional details on this topic from the broader literature are presented in the discussion section.

DISCUSSION

This systematic economic review found that total societal benefits exceed the cost of establishing parks, trails, and greenways. The evidence came from studies that reported cost−benefit estimates comparing the monetized values for benefits from improved health, environment, or wealth of the communities due to green space infrastructure interventions with the cost to implement the changes to the infrastructure.

None of the included studies reported the cost and benefit of additional interventions to increase engagement, awareness, programming, or access. This contrasts with the review of effectiveness, which found 21 studies of infrastructure plus additional interventions and 17 studies of infrastructure alone.[29] It is unclear whether additional interventions were absent or the economic studies did not evaluate the additions whose costs were likely to be minimal compared with capital cost such as for programming or whether larger costs such as for access enhancements were incorporated into capital cost but not reported separately.

Postindustrial economies such as the U.S.[30−33] present opportunities to embed parks and green spaces in tracts previously used for other purposes that are no longer in demand.[34] Such opportunities also exist when public investments are made to redevelop tracts that are in a state of decline owing to secular economic trends and transitions. Furthermore, environmental infrastructure improvements can incorporate green spaces to promote physical activity and recreational use and thereby take advantage of health-related cobenefits along with traditional environmental benefits.[35] The studies in this review included these scenarios, ranging across smaller environmental projects to manage streams and stormwater,[20,24−26] rail-to-trail conversion for transit improvement,[21] and urban redevelopment.[22,27]

All community members deserve equitable; accessible; and well-maintained parks, trails, and greenways and safe opportunities to be physically active.[36] These investments have the potential to improve health equity when planners and decision makers engage the community, incorporate access considerations, provide programs, increase community awareness, and guard against unintended harms such as displacement due to gentrification.

Recent literature has raised concerns about gentrification that may result from green space projects,[37,38] where gentrification is defined as the transformation of the financial and cultural profile of a low-income community after the influx of higher-income individuals and families.[39] Studies have found an association between some large park and greenway infrastructure projects and increases in property values in the proximate area of the projects.[40,41] This review developed a framework to identify plausible economic harms due to gentrification and displacement as a consequence of parks, trails, and greenway infrastructure. The framework and detailed description are available in Appendix Figure 1 (available online). The framework identified current low-income residents within the community where the project is implemented as the population of interest in determining whether economic harms occurred. These economic harms can occur for individuals such as homeowners, renters, consumers, business owners, employees, or retirees. Displacement may result when the cumulation of harms forces long-time residents to move elsewhere. Because none of the studies included in this systematic review assessed or reported economic harms due to the interventions, informal searches in Google Scholar and PubMed were conducted to identify relevant studies from the broader literature. The search produced no additional studies of green space projects beyond those previously mentioned that reported increases in property value.[40,41] Property value increases can be a harm if the annual property tax becomes prohibitive for owners. Rent can increase owing to higher property tax, which is directly related to property value. Rent can also increase owing to improved attractiveness of the neighborhood. Other studies found in the search either did not report monetized harms or were research on gentrification from all causes and not triggered by purely green space projects.[13,39] This paucity of research on the economic harms of green space projects does not imply the absence of harms, and strategies to ameliorate possible harms from green space infrastructure projects have been compiled in recent research.[42,43]

Limitations

Cost-effectiveness assessments are appropriate for evaluations focused on the public health aspects of parks, trails, and greenways. There was only 1 study that reported cost-effectiveness on the basis of net cost per DALY averted, and more such research is warranted.

One study based in Australia did not provide the capital cost for the infrastructure and computed cost−benefit as the ratio of an annual willingness to pay to the annual maintenance cost of the infrastructure. The reported cost−benefit ratio may be an overestimate.

The overestimation of benefits due to double counting may be possible in the case of 1 study: the Atlanta BeltLine.[21] However, even if property value's contribution to the benefit of 12.7% were entirely excluded in this study, the cost−benefit ratio of 2.56 would still be far above the cost−beneficial threshold of 1.

There is a small body of literature that draws a quantified link between the introduction of green spaces and gentrification. Gentrification resulting in displacement of residents may constitute costs or harms of the intervention, but none of the reviewed studies provided quantitative estimates for displacement costs and associated harms.

CONCLUSIONS

The systematic economic review found that economic benefits exceed the cost for park, trail, and greenway infrastructure interventions. The research presented in this paper can help inform communities and decision makers about the economic merits of these infrastructure projects to improve public health.

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SUPPLEMENTAL MATERIAL

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