UC San Diego
UC San Diego Previously Published Works

Title
Priorities and Indicators for Economic Evaluation of Built Environment Interventions to Promote Physical Activity.

Permalink
https://escholarship.org/uc/item/4hv0x1vk

Journal
Journal of Physical Activity and Health, 18(9)

ISSN
1543-3080

Authors
Cradock, Angie L
Buchner, David
Zaganjor, Hatidza
et al.

Publication Date
2021-09-01

DOI
10.1123/jpah.2021-0191

Peer reviewed

Priorities and Indicators for Economic Evaluation of Built Environment Interventions to Promote Physical Activity

AL Cradock,

Harvard TH Chan School of Public Health, Department of Social and Behavioral Sciences; 677 Huntington Avenue, 7th Floor, Boston, MA, 02115

D Buchner,

University of Illinois at Urbana-Champaign, Urbana IL

H Zaganjor,

Social Marketing and Communications Department, FHI 360, Atlanta, GA

JV Thomas,

U.S. Environmental Protection Agency, Community Assistance, and Research Division, Washington, D.C.

JF Sallis,

Herbert Wertheim School of Public Health and Human Longevity Science, University of California, San Diego, La Jolla, CA and Mary MacKillop Institute for Health Research, Australian Catholic University, Melbourne, VIC, Australia

K Rose,

Division of Nutrition, Physical Activity, and Obesity, Centers for Disease Control and Prevention, Atlanta, GA

L Meehan,

Tennessee Department of Health, Commissioner's Office, Office of Primary Prevention, Nashville, TN

M Lawson,

Headwaters Economics, Bozeman, MT

R Lavinghouze,

Division of Nutrition, Physical Activity, and Obesity, Centers for Disease Control and Prevention, Atlanta, GA

M Fenton,

Tufts University Friedman School of Nutrition Science and Policy, Boston, MA

HM Devlin,

Corresponding Author: acradock@hsph.harvard.edu; phone: 617-384-8933.

Division of Nutrition, Physical Activity, and Obesity, Centers for Disease Control and Prevention, Atlanta, GA

SA Carlson,
Division of Nutrition, Physical Activity, and Obesity and Division of Population Health, Centers for Disease Control and Prevention, Atlanta, GA

T Bhattacharya,
Rails-to-Trails Conservancy, Washington, D.C.

JE Fulton
Division of Nutrition, Physical Activity, and Obesity, Centers for Disease Control and Prevention, Atlanta, GA

Abstract

Background.—Built environment approaches to promoting physical activity can provide economic value to communities. How best to assess this value is uncertain. This study engaged experts to identify a set of key economic indicators useful for evaluation, research, and public health practice.

Methods: Using a modified Delphi process, a multidisciplinary group of experts participated in (1) one of five discussion groups (n=21 experts), (2) a two-day facilitated workshop (n=19 experts), and/or (3) on-line surveys (n=16 experts).

Results: Experts identified 73 economic indicators, then used a 5-point scale to rate them on three properties: measurement quality, feasibility of use by a community, and influence on community decision-making. Twenty-four indicators were highly rated (3.9 on all properties). The 10 highest-rated "key" indicators were walkability score, residential vacancy rate, housing affordability, property tax revenue, retail sales per square foot, number of small businesses, vehicle miles traveled per capita, employment, air quality, and life expectancy.

Conclusion: This study identified key economic indicators that could characterize the economic value of built environment approaches to promoting physical activity. Additional work could demonstrate the validity, feasibility, and usefulness of these key indicators, in particular to inform decisions about community design.

Keywords

Background

Being physically active is one of the most important steps people can take for their health and wellbeing.[1] An evidence-based strategy for increasing physical activity is creating physical activity-friendly communities—places where people have infrastructure such as sidewalks, protected bike lanes, and public transportation on routes that connect homes, schools, parks, and workplaces.[2] The strategy is often referred to as using built environment approaches to promote physical activity.[2] By creating and/or modifying environmental

characteristics of a community, this approach increases access to opportunities for physical activity and makes physical activity easier.

The importance of built environment approaches to promote physical activity was endorsed by *STEP IT UP! The Surgeon General's Call to Action to Promote Walking and Walkable Communities*.[3] This *Call to Action* contains goals and strategies that promote walking and calls for, in particular, designing communities that are safe and easy to walk for people of all ages and abilities. [3] Additionally, the U.S. Centers for Disease Control and Prevention's "Active People, Healthy Nation Initiative"[4] supports activity-friendly routes to everyday destinations. Built environment approaches are also important for achieving health equity. Accordingly, the National Center for Chronic Disease Prevention and Health Promotion includes the built environment in its framework[5] for achieving health equity by addressing the social determinants of health.

Community leaders and researchers alike have been interested in whether environmental changes to make a community activity-friendly also provide substantial benefits to local economies. [6] For example, emerging evidence of such "non-health" benefits has documented associations between creating physical activity-friendly and walkable communities and impacts on safety, local economic development, housing, employment, and real estate. These features of a walkable community—safer and pedestrian-friendly streets, mixed land use, and access to transit—can also be tied to economic benefits to the community that are separate from physical activity's direct health benefits. [7–11] Therefore, it is likely the outcomes considered as economic benefits of built environment interventions may include both health-related and non-health-related outcomes that may be more difficult to quantify in strictly economic terms.[3]

Prior research has identified non-health outcomes of physical activity promotion relevant to members of the public. Examples of non-health outcomes, including social participation, increased participation in the workforce, and productivity, were prioritized as relevant to the social environment or to society as a whole.[12] Notably, municipal stakeholders also identify economic development and revitalization as important priorities in their job responsibilities. [13,14]

The public's interest in non-health outcomes highlights the importance of making an economic case for improvements in the built environment, so as to foster local action.[15] There is limited research, however, identifying the specific kinds of economic evidence that decision-makers want to support and inform their choices regarding improvements to a community's built environment. Of course, what one community prioritizes as economically valuable may differ from another, and the metrics that are most informative for decision-makers will vary accordingly. Therefore, there is a need to identify and prioritize key "non-health" economic indicators as the basis for: (1) informing a strategic research agenda; (2) developing tools and guidance for communities in collecting data on economic indicators; and (3) ultimately supporting future decisions on community investments in built environment approaches to promoting physical activity.

To address this need, the National Collaborative on Childhood Obesity Research (NCCOR) led a project that convened a scientific workgroup. NCCOR is a public-private partnership among the Centers for Disease Control and Prevention (CDC), the National Institutes of Health, the Robert Wood Johnson Foundation, and the U.S. Department of Agriculture, along with collaboration for this project from the National Park Service. The workgroup then engaged a variety of experts to identify a set of key economic indicators useful for evaluation, research, and public health practice. This project had three objectives: (1) to identify priority economic indicators useful in measuring non-health-related economic benefits of built environment strategies to promote physical activity in community settings, and in measuring the extent that economic benefits are equitably distributed among community residents; (2) to characterize three properties (i.e., quality, feasibility, and influence) of these priority economic indicators related to their usefulness for decision-makers; and (3) to use expert feedback to prioritize a subset of key indicators for further study and development.

Methods

Introduction to the project organization and goals

Two groups advised and carried out project activities to develop a list of priority indicators; a Steering Committee and a Workshop Planning Group. These groups included members from government, academia, and non-governmental agencies (Appendix A). The Workshop Planning Group comprised of 14 members used a modified Delphi technique to engage experts from relevant fields in a series of activities to inform the selection of indicators.[16,17] These activities included formative research with five discussion groups to develop the candidate list of indicators, two days of virtual workshops with subject matter experts that incorporated multiple rounds of voting and discussion, and an on-line follow-up survey to finalize ratings for all priority indicators. Notable modifications from a traditional Delphi process included the use of online surveys for anonymous voting, holding a virtual (and not anonymous) discussion opportunity, and the determination of criteria for consensus after the conclusion of voting based on data rather than prior to the voting process. This project was determined to be not human subjects research by the Office of International Ethics at FHI 360.

Discussion groups

The Steering Committee comprised of 16 members identified participants for formative research discussion groups tasked with developing a draft list of indicators that would be used for further project activities. Participants were selected by the Steering Committee based on their expertise in the areas of public health or economic research, public policy and service, housing and real estate, environmental health, and community development. See Appendix A for a list of participants. Prior to the discussion sessions, participants received information on the purpose of the discussion groups and examples of potentially relevant economic indicators derived through literature reviews. The discussion group facilitator followed a protocol, and project staff prepared verbatim transcripts of the calls. Key considerations and prospective indicators within key domains (Table 1) were extracted for review. Domains were defined as aspects of the built environment that were relevant to

physical activity and theoretically subject to change in the built environment. Indicators were defined as areas within a given domain that could be measured as part of research or implementation tracking using a framework adapted from the Institute of Transportation Engineers.[18,19]

Virtual workshops

The format of the workshops was virtual due to COVID-19 restrictions. In preparation, the Workshop Planning Group convened a team of seven core expert advisors to inform the meeting structure, plan facilitation and workshop activities, and identify additional subject matter experts to engage. All subject matter experts were identified from their work or research activities in the domains of interest. Prior to the meeting, subject matter experts reviewed the draft list of economic indicators derived from the discussion groups and literature review for each domain related to their expertise. Within those domains, subject matter experts were asked to select up to five ideal indicators based on their professional experience and suggest additional (i.e., missing) indicators for consideration during the workshop via an on-line survey.

The subject matter experts were invited to engage in one of four non-simultaneous breakout sessions to consider topics that best fit their professional experience. Some subject matter experts participated in more than one breakout session. The workshop organizers assigned three or four indicator domain topic areas to each breakout session for discussion (Table 1). Three domains (equity, sustainability, and livability) were assigned to more than one breakout session to gather diverse input on these important and overlapping topic areas. Breakout sessions lasted one hour each. The core expert advisors facilitated breakout sessions using a structured guide developed by the Workshop Planning Group. The virtual workshops used video conferencing software with polling features that allowed for real-time (but anonymous) voting feedback. During the breakout sessions, the subject matter experts in each session (1) reviewed and discussed the list of top indicators based on the pre-workshop survey, (2) proposed and discussed additional indicators not previously listed, and (3) voted to determine the indicators of the highest priority based on the discussion among subject matter experts. The workshop organizers suggested that each expert vote for their top five indicators in each domain and for the breakout group to designate their top five "vote-getters" as the priority indicators for that domain. Experts in some breakout groups voted for more than five indicators on some domains. Experts were asked to base priority rankings on their expertise while considering each indicator's overall utility and importance in guiding local decisions about built environment infrastructure. Votes were tabulated in real-time. The prioritized indicators by domain were discussed in a closing plenary session that allotted time for additional feedback and suggestions from the participants on opportunities for advancing a relevant research and practice agenda.

On-line surveys to rate indicators

Following the workshops, the Workshop Planning Group adapted a rating system [20] to allow subject matter experts to rate the priority indicators identified during the workshops in each domain (Appendix B). The rating system survey was administered on-line (Appendix C). Experts rated indicators on three properties using a 5-point scale (1 = low and 5 = high): (1)

measurement quality, (2) feasibility of use by a community, and (3) influence on community decision-making (Table 1). These properties were designed to prioritize indicators that had some level of evidence and promise for being applied in practice. The subject matter experts were instructed to submit ratings for indicators for all domains within their area of expertise. The Workshop Planning Group used these ratings to identify areas of consensus on the *highest-rated indicators* (those that had a mean rating across the three properties of at least 4.5) and highly-rated indicators (i.e., those that had two property ratings of 4.0 or higher and a third property rating at 3.9 or higher). Experts were also invited to report which type of stakeholder audiences the indicator may have the most relevance for (e.g., government administrator, the general public, planners, and researchers) and the community types for which the indicator could be relevant (e.g., rural, small town, city).

Results

Discussion groups

Five discussion groups were convened. The 21 discussants (ranging between two and six per group) reviewed potential indicators and suggested additional indicators of the economic impacts of physical activity-promoting built environment interventions they thought relevant for a range of decision-makers and community-types (defined by metropolitan status). In addition to identifying potential indicators, other key themes that emerged from these groups included the need for more research on non-health-related economic benefits related to the built environment and that the metrics that are chosen may depend on the local context. Contextual considerations could include the geographic scale of measurement, the audience for information, and the framing of data comparisons. Discussants identified barriers to this work, including the lack of capacity to conduct economic evaluations in smaller communities. Indicators themselves were noted as sometimes imperfect if they did not have face validity or broad resonance. Discussants identified the value of using economic data as part of multi-faceted assessments of built environment interventions that might help decision-makers compare and choose among investment options.

Virtual workshops

Nineteen invited subject matter experts participated in one or more of the four workshops. Between six and ten experts participated in each workshop. Workshop participants included a subset of participants from the initial discussion groups and others engaged due to their expertise in specific topic areas. In total, experts discussed 73 indicators across 11 domains during the workshop sessions (Appendix B). At the end of the workshop, taking into account that three domains were discussed by two breakout groups, experts had identified between four and 11 "top vote-getters" across domains. Experts used a broad framework in considering the 'economic' aspects of indicators, which project organizers outlined in Figure 1. Proposed "economic indicators" included traditional economic output measures like jobs, income, and tax revenue as well as more expansive or longer-term measures such as life expectancy and quality of life, which may directly impact a community's economic wellbeing and could be monetized in economic evaluations or via economic modeling.[21] Experts pointed to the importance of indicators that may allow for tracking or evaluating equity in both the distribution of project benefits and the impacts on groups that have been

marginalized within a given community. Experts prioritized indicators in the transportation domain above indicators pertaining to recreation and considered both health and non-health-related indicators important. In some instances, the same or closely related indicators were proposed and then prioritized by experts in multiple domains.

On-line surveys to rate indicators

Overall, 16 of the 19 experts completed the rating survey for at least one domain (Appendix B). Twenty-four indicators were highly rated (3.9 or higher on all properties). A subset of 10, highest-rated, "key" indicators (4.5–5.0 average rating) were identified. Members of the Planning Group assigned each to a single domain. The twenty-four indicators included five from the transportation domain, four each from housing/real estate and local economic development, three each from the livability and public health domains, two each from tourism and employment/workforce, and one from environmental health (Table 2). Of the 24 highly rated indicators, 10 were rated highest priority, with three from the housing/real estate domain, two from local economic development, and one each from the livability, transportation, employment/workforce, environmental health, and public health domains. The 10 highest-rated "key" indicators were: walkability score, residential vacancy rate, housing affordability, property tax revenue, retail sales per square foot, number of small businesses, vehicle miles traveled per capita, employment, air quality, and life expectancy. However, several indicators within domains scored well on one or more of the criteria for consideration and may be useful in future development work.

The indicators identified through this process can be represented as a series of logically connected short, intermediate, and distal outcomes. Figure 1 shows a conceptual framework for exploring the multiple potential pathways through which a built environment intervention may impact outcomes related to indicators that experts rated highly in this project. This conceptual framework could be refined and adapted for specific economic evaluation studies. Experts identified most indicators as relevant to elected officials, the general public, and transportation planners (Appendix B). However, some indicators were judged as relevant to every audience group by at least some experts, and most indicators were considered applicable to all community types (categorized as rural, small city, medium city, large city) (data not presented).

Opportunities identified for research and practice

The experts identified several key opportunities that exist for collaboration between researchers and practitioners to facilitate further research and use of tools and practices that incorporate these indicators. These opportunities and actions were summarized from discussions, including discussion groups and final sessions of the virtual workshops, responses to summary documents shared with experts, and consultation with the Workshop Planning Group members. Table 3 presents an overview of these opportunities and actions to enable economic evaluation of built environment interventions. Four key areas of opportunity include the need to: 1) further outline key properties of economic indicators within domains of interest, 2) develop tools and resources for use in research and practice, 3) support activities that can increase knowledge about the potential for built environment

interventions to impact local economies, and 4) identify economic indicators that may promote or assess the equity of built environment interventions.

Discussion

This project identified key economic indicators that could characterize the economic value of built environment approaches to promoting physical activity. Twenty-four indicators were highly rated. Of these 24, ten indicators were highest-rated and designated "key" indicators. The indicators fell within several domains, including transportation, housing and real estate, economic development, and public health. This project was an early step to foster actions to increase understanding of the non-health-related economic benefits of implementing built environment interventions to support physical activity. And in seeking this understanding, it was also recognized that equity considerations were cross-cutting and important across all domains, including how indicators can be used or modified to capture the value of reducing disparities in opportunity. However, additional work is needed to demonstrate how the use of these key indicators to assess such economic value can be valid, feasible, and useful.

Several of the opportunities identified by experts align with national initiatives and prior research. For example, the Surgeon General has highlighted a need for economic research and evaluation on community design for physical activity.[3] Previous research suggested the importance of revenue generation for local government as a priority area for evaluations. [3,6] Here, experts' interests centered on the need for economic indicators in areas such as housing and real estate, local economic development, and employment. A focus on areas that generate revenue and economic development could also be related to this study's timing, conducted amid a pandemic. Communities may wish to implement economically feasible responses, as during the pandemic, they have experienced increased demands for safe walking and bicycling space and the need for strategies to reduce motor vehicle traffic speeds while managing strained municipal and state budgets.[22] Experts also noted the limited funding available at the federal, state, and local levels for active transportation investments.

Consistent with other research,[15] experts also counseled the importance of understanding how, for whom, and in which contexts tools and resources to measure economic impacts of built environment strategies could be most useful. For example, an important step could be tailoring tools for local elected officials to use in decision-making discussions regarding economic development or as they consider improvements near schools, parks, or housing. Experts agreed that the application of the indicators should explicitly incorporate equity across all domains. Experts suggested that equity performance indicators and strategies for their use to assess economic impacts could be devised to examine metrics across groups that have been marginalized and to inform practice, action, and evaluation at the local level. These recommendations could build upon efforts identified to address equity as a process and an outcome in planning by sharing strategies, practices, and resources to promote equity for specific audiences.[23]

Additional actions may help demonstrate how and whether a relatively small set of key indicators used to assess such economic value can help to advance more physical

activity-friendly built environments. Further efforts are needed to understand the indicators' measurement specifics, identify the most relevant data sources, and clarify the intervention types for which priority indicators will be useful. It is also important for indicators to provide utility when data or local planning capacity is limited. Prior studies have identified the lack of standardized data collection and locally available data on relevant economic measures as two key barriers in the economic evaluation of Complete Streets projects conducted in 31 cities.[9] Other researchers suggest the identification and use of multiple data sources for key economic indicators and quasi-experimental analytic strategies that support causal inference could also strengthen the production of relevant evidence.[24]

There are few currently available tools and resources that enable communities to produce valid economic estimates of the impact of built environment interventions in practice. Two available web-based tools focus on longer-term health and environmental impacts of changes in walking and cycling [25] and changes in regional transportation mode share.[26] While these tools can be useful in conducting health impact assessment regionally,[27] neither tool produces estimates for economic development impacts or revitalization that this project's participating experts considered central to local municipal leader's roles.[13,14] Developing a shared understanding of relevant economic indicators, a better understanding of the causal pathways that connect these indicators, the appropriate standards for their measurement and use, and strategies to address identified inequities constitute timely recommended actions for research and practice.

Work in this area needs to be guided by a well-developed agenda. The identification of priority economic indicators arranged in a conceptual framework (Figure 1) may further the community's understanding of how built environment interventions may relate to economic factors. Community leaders and evaluators can select from the highly-rated economic indicators this project identified and refine the proposed conceptual framework (Figure 1) for their context and questions to better understand the pathways by which built environment interventions may relate to the economic outcomes they find most meaningful. This proposed conceptual framework could help communities and evaluators identify relevant research questions and undertake data collection activities to build and inform the current evidence base. This sort of conceptual framework has been useful for evaluation in other areas of public health evaluation.[28]

This study has timely implications. Recently, CDC launched the Active People, Healthy Nation initiative[4] and released the Active Communities Tool (ACT): An Action Planning Guide and Assessment Modules to Improve Community Built Environments to Promote Physical Activity.[29] The practice-based ACT is designed for use by communities to select and monitor built environment approaches to increasing physical activity. Providing communities considering built environment investments with relevant economic indicators, information on available data sources, and guidance for using the results could facilitate local economic evaluations of these strategies. Synthesizing the findings from such evaluations could broaden knowledge of how specific built environment strategies may impact the local economies in communities of different sizes or regions. Training and technical assistance opportunities for using these economic metrics and methods may also result in their expanded use. For example, common measurement tools along with

technical assistance for evaluation were used to facilitate pedestrian and bicyclist road safety assessments in 56 communities across the U.S.[30] Similarly, an outcome indicator framework, logic model, and detailed indicator profiles have been applied and found to be instrumental in advancing state- and national-level tobacco control program strategic planning and evaluation.[28] Similar strategies and activities, including training institutes and learning labs for local communities, could support common economic measures and systems to facilitate more systematic data collection and evaluation at local levels.

Limitations and Strengths

Several limitations of this work merit discussion. There were few higher-quality studies on the economic impacts of some types of built environment interventions available to guide this work.[6,24,31] Experts rated the indicators without explicit details on data sources used for indicator measurement or measure properties such as reliability, validity, responsiveness, or interpretability. As such, additional details might have influenced the ratings in multiple ways that we cannot quantify. The modified Delphi process used may have excluded some indicators due to the cutoffs selected or the measurement scales. While the need for and potential opportunities for developing future tools using these indicators were discussed, the potential audiences for those tools (e.g., elected officials) were not participants during this process. The process initially planned for face-to-face discussion sessions and breakout groups, and modifications required for a virtual workshop format and use of on-line tools and procedures for voting may have influenced discussion or decisions in unknown ways. These findings were generated from a US perspective. Because economic systems and the built environment infrastructure vary considerably, we do not know whether these indicators are generalizable to other regions of the world. The process used to identify these indicators may be of interest to researchers or practitioners in other countries. The virtual format afforded opportunities for sustained participation from multiple diverse experts across multiple project stages. It also facilitated objective and structured anonymous feedback using a modified Delphi process to move toward consensus on key indicators. Thus, the virtual format provided an opportunity for balanced and sustained participation from group members, the results of which may lead to new and innovative areas of study and practice. These aspects are key strengths of this work.

Summary

This expert-informed process identified ten highly-rated priority indicators within domains including transportation, housing and real estate, economic development, and public health that can be used to assess the economic value of built environment approaches to increase physical activity. This project was a requisite step to foster actions to increase understanding of the non-health-related economic benefits of implementing built environment interventions to support physical activity. Opportunities exist for collaboration between researchers and practitioners to facilitate further research and use of tools and practices that incorporate these indicators. Such tools and practices may broaden our understanding of the ways that the built environment shapes our health, equity, and our economy and the implications that this has for decision making regarding community design.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

References

1. US Department of Health and Human Services. Physical Activity Guidelines for Americans, 2nd edition. Washington, DC: US Department of Health and Human Services;2018.

2. Community Preventive Services Task Force. Physical Activity: Built Environment Approaches Combining Transportation System Interventions with Land Use and Environmental Design. Atlanta, GA: US Department of Health and Human Services;2016.

3. US Department of Health and Human Services. Step It Up! The Surgeon General's Call to Action to Promote Walking and Walkable Communities. Washington, DC: Office of the Surgeon General, US Department of Health and Human Services;2015.

4. Active People, Healthy Nation. Centers for Disease Control and Prevention,. https://www.cdc.gov/physicalactivity/activepeoplehealthynation/index.html. Published 2020. Accessed Feb 4, 2021.

5. Social Determinants of Health. Centers for Disease Control and Prevention,. https://www.cdc.gov/chronicdisease/programs-impact/sdoh.htm. Published 2020. Accessed Feb 2, 2021.

6. Kornas K, Bornbaum C, Bushey C, Rosella L. Exploring active transportation investments and associated benefits for municipal budgets: a scoping review. Transport Reviews. 2017;37(4):465–487.

7. US Environmental Protection Agency. Smart Growth and Economic Success: Benefits for Real Estate Developers, Investors, Businesses, and Local Governments. Washington, DC: US Environmental Protection Agency;2012.

8. US Environmental Protection Agency. Smart Growth and Economic Success: Strategies for Local Governments. Washington, DC: US Environmental Protection Agency;2014.

9. Smart Growth America, National Complete Streets Coalition. Safer Streets, Stronger Economies: Complete Streets Project Outcomes from Across the Country. Washington, DC: Smart Growth America;2015.

10. Sallis JF, Spoon C, Cavill N, et al. Co-benefits of designing communities for active living: an exploration of literature. Int J Behav Nutr Phys Act. 2015;12:30. [PubMed: 25886356]

11. Jacob V, Chattopadhyay SK, Reynolds JA, et al. Economics of Interventions to Increase Active Travel to School: A Community Guide Systematic Review. Am J Prev Med. 2021;60(1):e27–e40. [PubMed: 33341185]

12. Benning TM, Alayli-Goebbels AF, Aarts MJ, et al. Exploring Outcomes to Consider in Economic Evaluations of Health Promotion Programs: What Broader Non-Health Outcomes Matter Most? In: BMC Health Serv Res. Vol 15.2015:266. [PubMed: 26169779]

13. Zwald ML, Eyler AA, Goins KV, Brownson RC, Schmid TL, Lemon SC. Understanding Municipal Officials' Involvement in Transportation Policies Supportive of Walking and Bicycling. J Public Health Manag Pract. 2017;23(4):348–355. [PubMed: 25319080]

14. Wang ML, Goins KV, Anatchkova M, et al. Priorities of Municipal Policy Makers in Relation to Physical Activity and the Built Environment: A Latent Class Analysis. J Public Health Manag Pract. 2016;22(3):221–230. [PubMed: 26079657]

15. Fazli GS, Creatore MI, Matheson FI, et al. Identifying mechanisms for facilitating knowledge to action strategies targeting the built environment. BMC Public Health. 2017;17(1):1. [PubMed: 28049454]

16. McMillan SS, King M, Tully MP. How to use the nominal group and Delphi techniques. Int J Clin Pharm. 2016;38(3):655–662. [PubMed: 26846316]

17. Diamond IR, Grant RC, Feldman BM, et al. Defining consensus: a systematic review recommends methodologic criteria for reporting of Delphi studies. J Clin Epidemiol. 2014;67(4):401–409. [PubMed: 24581294]

18. Seiff C, Weissman D. Putting Active Transportation Performance Measures into Practice. ITE Journal. 2016;86:28–33. http://cdn.coverstand.com/19175/292025/3ace92fc8c2cb1b91dec718d4a81e7539c91f17c.9.pdf.

19. Fehr & Peers. Active transportation performance measures. Walnut Creek, CA: Fehr & Peers;2020.

20. Starr G, Rogers T, Schooley M, Porter S, Wiesen E, Jamison N. Key Outcome Indicator for Evaluating Comprehensive Tobacco Control Programs. Atlanta, GA: Centers for Disease Control and Prevention;2005.

21. Sanders GD, Neumann PJ, Basu A, et al. Recommendations for Conduct, Methodological Practices, and Reporting of Cost-effectiveness Analyses: Second Panel on Cost-Effectiveness in Health and Medicine Inadequate physical activity and health care expenditures in the United States. JAMA. 2016;316(10):1093–1103. [PubMed: 27623463]

22. National Association of City Transportation Officials. COVID-19: Transportation Response Center. NACTO. https://nacto.org/program/covid19/. Published 2020. Accessed November 17, 2020.

23. Sandt L, Combs T, Cohn J. Pursuing Equity in Pedestrian and Bicycle Planning. Chapel Hill, North Carolina: Pedestrian and Bicycle Information Center;2016.

24. Liu Jenny H. and Shi Wei. Understanding Economic and Business Impacts of Street Improvements for Bicycle and Pedestrian Mobility – A Multicity Multiapproach Exploration. NITC-RR-1031/1161. Portland, OR: Transportation Research and Education Center (TREC), 2020.

25. Kahlmeier S, Götschi T, Cavill N, et al. Health Economic Assessment Tool (HEAT) for Walking and for Cycling: Methods and User Guide on Physical Activity, Air, Pollution, Injuries and Carbon Impact Assessments. Copenhagen, Denmark: World Health Organization;2017.

26. Maizlish N The ITHIM Tool: Health Impacts of Travel Scenarios in the United States. Maizlish Neil. http://cal-ithim.org/ithim/#RunITHIM. Published 2020. Accessed December 17, 2020.

27. Nicholas W, Vidyanti I, Caesar E, Maizlish N. Routine Assessment of Health Impacts of Local Transportation Plans: A Case Study From the City of Los Angeles. Am J Public Health. 2019;109(3):490–496. [PubMed: 30676792]

28. Fulmer E, Rogers T, Glasgow L, Brown S, Kuiper N. Evaluating Comprehensive State Tobacco Prevention and Control Programs Using an Outcome Indicator Framework. Health Promot Pract. 2019;20(2):214–222. [PubMed: 29566575]

29. Evenson KR, Porter AK, Day KL, et al. Developing the Active Communities Tool to Implement the Community Guide's Built Environment Recommendation for Increasing Physical Activity. Prev Chronic Dis. 2020;17:E142. [PubMed: 33180689]

30. US Department of Transportation. U.S. Department of Transportation Pedestrian and Bicyclist Road Safety Assessments. Washington, DC: US Department of Transportation;2015.

31. New York City Department of Transportation. The Economic Benefits of Sustainable Streets. New York: New York City Department of Transportation;2013.

32. Smart Growth and Transportation. US Environmental Protection Agency. https://www.epa.gov/smartgrowth/smart-growth-and-transportation. Published 2020. Accessed Jan 20, 2021.

33. Walk Score. Walk Score. https://www.walkscore.com/. Published 2021. Accessed Jan 20, 2021.

34. American Housing Survey (AHS). United States Census Bureau. https://www.census.gov/programs-surveys/ahs.html. Accessed Jan 20, 2021.

35. Demand Data - Rental Affordability. Office of Policy Development and Research (PD&R). https://www.huduser.gov/portal/ushmc/hd_rai.html. Accessed Jan 20, 2021.

36. Demand Data - Homeownership Affordability. Office of Policy Development and Research (PD&R). https://www.huduser.gov/portal/ushmc/hd_hsg_aff.html. Accessed Jan 20, 2021.

37. Housing Affordability Index. National Association of REALTORS. https://www.nar.realtor/research-and-statistics/housing-statistics/housing-affordability-index#:~:text=The%20Monthly%20Housing%20Affordability%20Index,monthly%20price%20and%20income%20data.&text=Thus%2C%20NAR%20projects%20income%20levels%20for%20later%20than%202016. Published 2021. Accessed Jan 22, 2021.

38. Quarterly Summary of State and Local Tax Revenue Methodology. United States Census Bureau. https://www.census.gov/programs-surveys/qtax/technical-documentation/methodology.html. Published 2020. Accessed Jan 20, 2021.

39. Monthly Retail Trade. United States Census Bureau. https://www.census.gov/retail/index.html. Accessed Jan 20, 2021.

40. Statistics of U.S. Businesses (SUSB). United States Census Bureau. https://www.census.gov/programs-surveys/susb.html. Accessed Jan 20, 2021.

41. HUD Aggregated USPS Administrative Data on Address Vacancies. Office of Policy Development and Research (PD&R). https://www.huduser.gov/portal/datasets/usps.html. Accessed Jan 20, 2021.

42. VMT Per Capita. US Department of Transportation. 2015. https://www.transportation.gov/mission/health/vmt-capita. Accessed Jan 20, 2021.

43. National Household Travel Survey. Federal Highway Administration, US Department of Transportation. https://nhts.ornl.gov/ Accessed Jan 20, 2021.

44. Texas Transportation Institute. 2019 Urban Mobility Report. 2019. https://mobility.tamu.edu/umr/. Accessed 6/15/20.

45. Transportation Economic Trends. US Department of Transportation, Bureau of Transportation Statistics. Cost of Transportation: Costs Faced by Households Web site. https://data.bts.gov/stories/s/Transportation-Economic-Trends-Transportation-Cost/5h3f-jnbe/. Published 2020. Accessed Jan 20, 2021.

46. Mauri A Chapter 2. Hotel Performance Metrics. In: CDC Arti Grafiche, ed. Hotel Revenue Management: Principles and Practices. Milan-Turin, Italy: Pearson; 2012:27–38.

47. Longitudinal Employer-Household Dynamics. United States Census Bureau. https://lehd.ces.census.gov/. Accessed Jan 20, 2021.

48. Commuting (Journey to Work). United States Census Bureau. https://www.census.gov/topics/employment/commuting.html. Accessed Jan 20, 2021.

49. Air Data: Air Quality Data Collected at Outdoor Monitors Across the US. US Environmental Protection Agency. https://www.epa.gov/outdoor-air-quality-data. Published 2020. Accessed Jan 20, 2021.

50. National Vital Statistics System: Life Expectancy Centers for Disease Control and Prevention, US Department of Health and Human Services. https://www.cdc.gov/nchs/nvss/life-expectancy.htm. Published 2020. Accessed Jan 20, 2021.

51. Carlson SA, Fulton JE, Pratt M, Yang Z, Adams EK. Inadequate physical activity and health care expenditures in the United States. Prog Cardiovasc Dis. 2015;57(4):315–323. [PubMed: 25559060]

52. Carlson SA, Adams EK, Yang Z, Fulton JE. Percentage of Deaths Associated With Inadequate Physical Activity in the United States. Prev Chronic Dis. 2018;15:E38. [PubMed: 29602315]

53. Property Working Group of the United Nations Environment Programme Finance Initiative. Sustainability Metrics: Translation and Impact on Property Investment and Management. Geneva: United Nations Environment Programme;2014.

54. WHO Regional Office for Europe, OECD. Economic cost of the health impact of air polution in Europe: Clean air, health, and wealth. In. Copenhagen: WHO Regional Office for Europe; 2015:66.
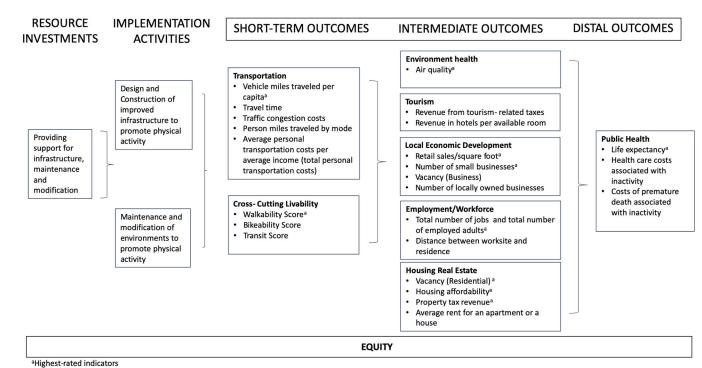
Figure 1:
Example Logic Pathway for Built Environment Intervention Evaluation

Table 1.

Domains for Indicator Identification and Definitions of Rating Criteria Considerations

Topic	Definition of Terms
Domains	*Indicators may cover aspects related to:*
Equity	The fair distribution of improvements and funding
Livability	The aspects of communities or neighborhoods that may make them desirable places to live, play, and work
Housing/Real Estate	The site and location, the building as well as management and operating processes with the potential to impact (directly or indirectly) on a real estate asse s lettability and marketability
Tourism	The aspects of economic performance due to tourist spending
Employment/Workforce	The availability of jobs and level of employment
Local Economic Development	The economic performance within different sectors of the economy (e.g., business, retail, tourism, tax revenue)
Transportation	The access to and mobility for different types of users and the infrastructure that is available to facilitate movements
Safety/Security	The wellbeing of individuals and their property
Sustainability	The environmental, economic, or social resource balance capable of meeting population needs
Public Health	The physical and mental health of the population
Environmental Health	The health of the physical environment
Properties	*Considerations for indicator rating [1] :*
Quality	The extent that an indicator may have a reliable and valid measurement method(s); be replicable and appropriate for comparisons over time; is well-accepted in scientific publications and evaluations
Feasibility	The difficulty in collecting and analyzing data on the indicator such as data for a relatively small geographic area; minimal challenges to primary data collection or restrictions on data use; low cost of obtaining data; data analysis does not require advanced statistical methods
Influence	The extent that an indicator may have face validity to potential users; importance among a broad range of stakeholder groups; be commonly used in deliberations about project selection and funding

Note: Domains were defined as areas of influence theoretically subject to change with modification or intervention in the built environment. Indicators were defined as areas within a given domain that could be measured as part of research or implementation tracking using an adaptation of an existing framework.

[2] See Appendix B and C for additional source references consulted for definitions used during the project process.

Table 2.

Economic Indicators Highest or Highly Rated on Quality, Feasibility, and Influence

Indictor Domain	Indicator	Potential Working Definition and Source
Livability	Walkability Score[a,b]	The quality of walking conditions, including safety, comfort, and convenience[32,33]
	Bikeability Score[b]	The quality of biking conditions including safety, comfort, and convenience[33]
	Transit Score	How well a location is served by public transit[32]
Housing/Real Estate	Vacancy rate (residential)[a]	The measure of the percent of residential property that is unoccupied[34]
	Housing affordability[a]	The cost of housing as a percentage of income[35–37]
	Real estate property tax revenue[a]	State or local taxes on real property levied for general public welfare[38]
	Average rent for an apartment or house	The mean or median rent in a community (including utilities), and may be categorized by size (square feet) or bedrooms.[35]
Local Economic Development	Retail sales per square foot[a]	Total retail sales divided by total square feet of retail space.[39,40]
	Number of small businesses[a]	The number of businesses meeting criteria definitions for small businesses.[40]
	Vacancy rates (business)	The measure of the percent of business property that is unoccupied[41]
	Number of locally owned businesses	The number of businesses meeting criteria definitions for locally-owned businesses[40]
Transportation	Vehicle miles traveled per capita[a]	The total annual miles of vehicle travel divided by the total population in a state or in an urbanized area[42]
	Travel time	Average time spent in travel per person, often divided into time commuting to work and other travel time[43]
	Traffic congestion costs	The value of delay time and wasted fuel by all vehicles due to congestion[44]
	Person miles traveled by mode	The number of miles a person travels by various modes of transportation[43]
	Average personal transportation costs per average income / Total personal transportation costs[b]	Personal transportation costs for various transportation outlays related to the individual's household income /total transportation costs paid by an individual household[45]
Tourism	Collection of resort/visitor tax	Tax revenue from resort and visitor taxes levied on tourism-related goods and services[38]
	Revenue per available room index	Revenue from hotel guestrooms divided by the total number of guestrooms[46]
Employment/ Workforce	Total number of jobs and total number of employed adults[a]	Total number of jobs. Total number of employed adults.[47]
	Travel distance between worksite and residence	Average commute distance to work for employed community residents[48]
Environmental Health	Air quality[a]	The extent which air breathed by community residents contains pollutants[49]
Public Health	Life expectancy[a, b]	The average time a person is expected to live (i.e. life expectancy at birth)[50]
	Health care costs associated with inactivity	Medical care costs associated with physical inactivity [51]
	Costs of premature death associated with physical inactivity	The number of deaths associated with physical inactivity translated into an economic cost of premature mortality[52]

[a] Indicators are regarded as highest-rated indicators, while all 24 indicators in the table are highly-rated

[b] Indicators were proposed, considered, and rated by experts within multiple domains

Table 3.

Opportunities and Actions to Enable Economic Evaluation of Built Environment Interventions

	Potential Actions	
Opportunity	**Research**	**Practice**
Further outline the properties of indicators within domains	• Conduct an evidence/ literature review for priority indicators • Identify data sources and availability (e.g., public or private domain, the geography of coverage, data collection timeline) • Define intervention types for which indicators may be most useful	• Query practitioners in diverse fields/domains (e.g., transportation, planning real estate) on the collection of/use of indicators for planning or performance monitoring • Identify other metrics that may not yet be feasible to measure but yet are highly relevant (develop the evidence base)
Develop tools and resources related to priority indicators for use in research and practice	• Develop a "compendium" of indicators including detailed local and regional data and data sources	• Consider multiple audiences including local and state decision-makers, public health, advocates • Involve intended users in the development of tools and resources • Create a series of case studies for different types of communities • Convene a working group to evaluate different data needs/resources by community type
Support activities that will increase the evidence and knowledge about the effects of the built environment on local economies	• Translate scientific findings into practical guidance for key audiences • Provide training institutes, learning lab, webinars, resources useful for researchers • Conduct research to better understand the causal pathways connecting indicators	• Provide training institutes, learning lab, webinars, resources useful for local communities and practitioners
Identify indicators and strategies for their use that may promote or assess equity	• Establish standards and protocols to look at metrics across sub-groups relevant to local communities (social or economic strata, geography, etc.)	• Establish equity performance metrics and evaluate the impact of built environment interventions to inform practice and action