NEW YORK RESTORATION PROJECT

THE HAVEN PROJECT
MOTT HAVEN/PORT MORRIS

Supporting evidence-based investment in public spaces: A literature review

COLUMBIA UNIVERSITY | MAILMAN SCHOOL of PUBLIC HEALTH EPIDEMIOLOGY

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2/13/2015

This research synthesis has been tailored to support the efforts of New York Restoration Project and their partners in The Haven Project. A master plan is being developed to renovate a network of open spaces in Mott Haven and Port Morris in the South Bronx. The Haven Project aims to demonstrate measurable health and social outcomes resulting from an improved physical environment at the neighborhood scale. This literature review has developed in parallel to the design planning process and community engagement efforts. We would like to thank the New York Restoration Project for their leadership of this effort, the Haven Project planning team, and Richa Gupta of Columbia University for guidance on framing and refining this review. Special thanks to the John S. and James L. Knight Foundation and the Doris Duke Charitable Foundation for funding the planning phase of The Haven Project. More online: www.nyrp.org/about/programs/the-haven-project

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Introduction and Overview

People are drawn to cities to pursue opportunities. More than half of the human population is now living in urban environments.[1,2] Our challenge in an era of urbanization is to make sure cities are living up to their full potential, providing possibilities for the old and young, for equity, for access, for sustainability, and for health.[3] New York City (NYC) has been leading the way in looking for strategies to support public health through multi-sectoral municipal action,[4] yet further attention is needed to address remaining barriers to health and health equity.

Local and community-informed efforts have the potential to not only improve health, but also to enhance social activity and enjoyment in public spaces. In the southern sections of the Bronx, an ongoing construction project has provided a catalyst for rethinking how the local environment can better support South Bronx residents. A bicycle and pedestrian pathway will soon connect the Mott Haven and Port Morris neighborhoods of the South Bronx with more than 300 acres of park land on Randall's Island. Randall's Island was previously hard to access despite its proximity because of a narrow water body, the Bronx Kill. With the expected completion of the Randall's Island connector in the spring of 2015, Mott Haven residents will have convenient access to a large green space and recreational facilities.

Yet even with this Connector, the residents of the Mott Haven and Port Morris in the Bronx face health threats on a daily basis. The Haven Project is looking to the physical environment for opportunities to ameliorate these health threats. This review, therefore, focuses on health outcomes and design elements related to public spaces and the route from homes and schools to the Randall's Island Connector. The goal is to support informed action to maximize health benefits for residents of Mott Haven and Port Morris.

Public Spaces and Public Health

Aspects of the built environment, including landscape, green space, transportation systems and urban street design, have been shown to impact well-being.[5,6] Healthy behaviors, such as physical activity, can be made more convenient and attractive through upgrades to the environment.[7,8] Other contributors to general health, such as air quality and pedestrian safety, could also be improved through investments in transportation systems and streetscapes.[9,10] Many of the enhancements to public space that promote health could bring additional benefits through strengthening of social cohesion and the local economy. Urban trees, for instance, have been linked not only to physical activity,[11,12] but also to higher property values and retail revenue.

Thus, the built environment provides an area of opportunity for improving human health and supporting other social and economic activities. Nevertheless, the relationships between environmental factors and outcomes of interest are complex[13] and a cautious interpretation of the research is necessary. People make individual and collective decisions on how to construct or modify the built environment and how to locate themselves within that environment.[14] The local built environment in turn offers opportunities and constraints for individual behavior and social interactions.[15] A comprehensive and critical assessment of the available evidence can help to guide actions toward the most effective strategies as The Haven Project moves forward with a community-informed process of planning public space enhancements in the NYC neighborhoods of Mott Haven and Port Morris in the South Bronx.

The following literature review has been structured to focus first on selected health-related outcomes that are of particular concern in Mott Haven. For the outcome sections on physical activity, clean air, and pedestrian safety, we review the key drivers, particularly those in the local physical environment. We also highlight measurement issues that may require attention in the context of monitoring these outcomes. Next, we evaluate selected aspects of the physical environment identified as having a role in The Haven Project design planning. For each of these design elements, we review previous efforts to understand the range of potential benefits and circumstances required for maximizing those benefits. Finally, we briefly discuss literature on the process of neighborhood change. We look ahead to how The Haven Project can add to the health of the community and how an evaluation can be designed to document this effort.

A Note on Literature Review Methods

This narrative review has been developed in parallel with The Haven Project design plan. We have prioritized and highlighted previous prospective evaluations of local change strategies where identified, as these may offer more compelling and relevant evidence then more common cross-sectional studies on the same topic. In addition, research done locally within the NYC environment has centrally informed this narrative literature review. However, systematic searches of the literature from across the US have also been carried out for a related project, funded by the Robert Wood Johnson Foundation program on Active Living Research, and studies from this and other sources are also incorporated. Finally, in recognition of the notion that many of these studies have formalized common sense notions, we underscore several unexpected findings. Such surprises are of value in helping to direct our attention away from strategies that have not worked, and towards better strategies and new research questions that can help us decide how to move ahead.

In addition to peer-reviewed publications, we identified key resources that have been developed for non-academic audiences, focused on translating the research to action. Among these were the Guide to Community Preventive Services (The Community Guide)[16] and the County Health Rankings & Roadmaps program, a collaboration between the Robert Wood Johnson Foundation and the University of Wisconsin Population Health Institute.[17] The New York Academy of Medicine's compendium on proven evidence-based strategies was used to identify implemented community programs in health areas like physical activity and asthma.[18] The Center for Disease Control's Designing and Building Health Places initiative also provided information on research in focus areas such as designing parks and trails to support physical activity. The CDC summarized the results of health impact assessments that were referred to in this review for program evidence.[19] Internationally, a study by the World Health Organization's City Action Group on Healthy Urban Planning was reviewed.[20] Finally, we draw on 2012 estimates from the NYC Department of Health and Mental Hygiene based on reports through their Environment and Health Data Portal to offer context on the magnitude of local public health threats; these generally draw on available data sources which could be analyzed to provide adjusted estimates and confidence intervals as part of a future evaluation effort. All of the above resources were used as a base from which to identify further resources relevant to this narrative literature review.

Outcomes that Matter

Three key health concerns in the context of The Haven Project have been identified through expert discussion and community engagement. These outcomes are inter-related and potentially amenable to modifications to the physical environment: physical activity, clean air, and pedestrian safety from traffic. Opportunities for enjoying outdoor spaces in the South Bronx neighborhoods of Mott Haven and Port Morris are limited by their geographical adjacency to some of NYC's busiest highways: the Bruckner, Major Deegan, and Cross Bronx Expressways. Further, there are commercial truck routes and industrial land uses adjacent to the Randall's Island Connector, limiting opportunities for neighborhood residents to safely and conveniently access the park's recreational resources.

If current levels of physical inactivity, air pollution, and traffic danger to pedestrians are allowed to continue, their sequelae are expected to include cardiometabolic illness, respiratory disease, disability, and death. In this section of the review, physical activity, air quality, and pedestrian safety from traffic are each considered in turn, with a focus on leverage points within the local environment that could support improvements in these outcomes.

Why and How to Design for Physical Activity

Physical activity influences many chronic health conditions. Physical inactivity, usually defined by a self-reported lack of participation in any moderately or vigorously intensity exercise, appears to contribute to risk of coronary health disease, stroke, diabetes, cancer and premature death.[21,22] Insufficient levels of physical activity may also increase risk for mental health conditions, especially depression.[23] Vulnerability of inactive individuals is further multiplied by the fact that inactivity influences chronic disease risk factors including obesity, high blood pressure, and high cholesterol.[24-26] Finally, exercise also influences susceptibility to injury, as load-bearing exercises play a role in preserving bone health and preventing osteoporosis.[27] From intervention studies, there is strong evidence that increasing physical activity levels improves cardiovascular, respiratory, and muscular fitness in both children and adults.[28] There is also strong evidence that greater activity in children promotes bone health and in adults reduces weight gain and diabetes.[28] For adults to see health benefits from physical activity, the United States Department of Health & Human Services recommends at least 150 minutes a week of moderate-intensity exercise; examples could include a brisk 30 minute walk on 5 days each week.[28] Children are advised to exercise at that intensity for about an hour each day.[28]

Despite this clear picture of health benefits from physical activity, 27% of adult residents in Hunts Point/Mott Haven report that they have not participated in *any* exercise in the past 30 days, according to estimates from the New York City Department of Health and Mental Hygiene (DOHMH).[29] This is higher than the 22% reporting no recent exercise across the city. Only a small fraction of those reporting any exercise are expected to achieve recommended levels of physical activity.[30] However, walking and biking for transportation are common in Mott Haven/Port Morris (82%) and comparable to levels across the city (82%),[29] a health-promoting lifestyle that can be further supported in this urban context.

Current research suggests that socioeconomic status, self-efficacy, and the built environment are among the factors that affect physical activity.[31] Walking is the most common form of physical activity.[16] Urban form may play a key role in walking behavior since high residential density, transit connectivity, and nearby commercial businesses make walking for transportation more feasible and convenient.[32] Research indicates that neighborhood factors like good sidewalk conditions (e.g., even surface) and proximity to trails may lead to more physical activity and a healthier BMI.[33] Yet multi-site and multi-country investigations have reported that the observed associations of the built environment with physical activity vary by context.[34-37]

In many US contexts low-income groups have fewer available places for exercise in their communities (both outdoor and indoor).[38-40] Compounding that are the perceived safety barriers to walking or outdoor activity due, for instance, to local traffic conditions, as well as cultural barriers and time constraints that may be more common in economically disadvantaged populations.[41-44] For physical activity opportunities to result in health benefits, it may be crucial to consider how people choose where to spend time, perceive those places, overcome obstacles, and balance multiple health and other goals.[14]

To evaluate the effect of local infrastructure investment on physical activity, attention to measurement is crucial. Objectively measured activity levels (usually based on accelerometer or pedometer) are recommended in order to reliably capture total ambulatory (walking/running)

physical activity.[45] Seasonal and weather-related fluctuations in physical activity should be considered when planning data collection.[46] Travel diaries, ecological momentary assessment, and concurrent use of GPS loggers are useful for capturing the context of physical activity recorded by activity monitors.[47-49] Devices such as accelerometers or GPS loggers may raise concerns in low-income contexts, including prominent concerns about real-time activity monitoring and accountability should a device be stolen or damaged, and qualitative research has informed the development of brochures to address such concerns up front.[50] Questionnaires have also been commonly used, though these have known problems related to social desirability bias (due exaggerating adherence to recommended physical activity levels or otherwise telling researchers what they want to hear).[51]

In 2011, for example, the NYC DOH conducted the Physical Activity and Transit (PAT) survey, which consisted of both a questionnaire and use of an accelerometer. In the study, participants from all five boroughs answered questions about activity level (transportation, recreation, housework) and also neighborhood characteristics. Several hundred of the participants additionally were asked to wear accelerometers and carry GPS devices for seven days. The accelerometers captured their total minutes of moderate and vigorous physical activity.[52] The PAT survey highlighted feasibility of this approach in the context of NYC, and catalyzed the enhancement of local capabilities to clean and analyze the resulting spatiotemporal data.

Physical Activity Key Points:

- Regular physical activity is important for healthy aging and can prevent many chronic health conditions, including heart disease, diabetes and depression.[28]
- Research suggests a relationship exists between physical activity and elements of the built environment, though which elements of the built environment matter appears to vary by context[34-37]
- Providing venues for physical activity and protecting pedestrians from dangerous traffic conditions may help to overcome barriers to physical activity commonly reported in low-income areas.[41-43]

Selected Online Resources for Learning More:
What Works for Health: places for physical activity roadmap
www.countyhealthrankings.org/policies/access-places-physical-activity

Physical Activity Guidelines for Americans
www.health.gov/paguidelines/guidelines

Why and How to Design for Clean Air

Air pollutants cause damage not only to the environment but also to human health, and such exposures have been central to the environmental justice movement. Short and long-term exposure to ambient pollutants, particularly those particles small enough to deeply penetrate the lungs (PM 2.5), have been shown to cause or worsen chronic conditions including heart failure, coronary heart disease, asthma, emphysema, and chronic obstructive pulmonary disease.[53-57] Likewise, ground-level ozone has been linked to a many of these same chronic disease outcomes.[36,37] In addition, local air pollution may be linked to a broader range of outcomes including obesity[58,59] and cognitive decline.[60] Vulnerable groups, including infants, older adults, and people with existing lung or heart issues are at elevated risk from local air pollution. In addition, susceptibility to harms from air pollution may be increased in areas with other risk factors including poverty, obesity, diabetes, and smoking.[19,55,61,62] One other multiplier of the health effects of pollutants is that they may be especially problematic for individuals who exercise or work outdoors.[63,64] Strenuous outdoor physical activity with heavy exertion requires more rapid and deeper breathing, thus leading to the intake of more particles.[65] This is significant as physical activity is important in reducing obesity and cardiovascular disease, but local air quality problems may keep active individuals from getting the full benefits of their healthy lifestyle. Furthermore, the majority of physical activity, particularly in low-income areas, takes the form of walking outdoors.[16]

In Mott Haven and Port Morris, concerns about air quality arise from the local traffic patterns and transportation infrastructure. In particular, industry and trucking are present along with the Cross Bronx, Bruckner, and Major Deegan Expressways. Nonetheless, the DOHMH outdoor exposure estimates show the Hunts Point/Mott Haven area as having estimated PM 2.5 and ozone levels only slightly higher than the city-wide estimates (10.9 vs 10.6 μg/m3 for PM 2.5, and 27.7 vs 27.0 ppb for ozone).[66] Mott Haven residents have notably higher rates of childhood asthma and adult respiratory hospitalizations compared to other sections of the Bronx and NYC as a whole, and these conditions may increase susceptibility to the effects of air pollution.[66] Reconciling the pollution data with a high burden of asthma and cardiovascular disease may require better temporal resolution, attention to indoor exposures during cooking or other activities,[67,68] and exploration of aspects of local topography that affect how quickly air pollution moves away from its source and disperses.

The built environment has an impact on local levels of air pollution.[69] These influences can be thought of as relating either (1) to the sources (including vehicle traffic, industry, residential heating) or (2) to the structures and topography that affect air flow and thus dispersion of particles. High wind conditions tend to decrease the concentration of any particles, such that at a short distance away from the source the particles are too dispersed to threaten human health. Particle pollution and ground level ozone can come from a variety of sources, and have been a long-standing topic of investigation in NYC.[70] Particulate matter is known to come from industrial sites, construction zones, power plants, cars, trucks, buses, and other sources of combustion.[71] Ground level ozone, in contrast, is formed by reactions between the molecules in those emissions and sunlight.[65] Therefore, neighborhood design elements and other infrastructure that reduce traffic or other combustion, or those that shift to cleaner burning fuels, will likely have a large effect on the level of pollutants, which are subsequently inhaled by local residents. Policy changes such as transit investments, rezoning, or congestion pricing that reduce

driving may have the added benefit of increasing pedestrian safety[72] and physical activity.[9,73] Yet caution and awareness of unintended effects are warranted. As an illustration, it has been seen that driving restrictions based on license plates have the potential to increase the number of vehicles in use, and particularly the high emission vehicles, as drivers attempt to work around the restriction; this was noted in Mexico City where older secondary vehicles allowed many drivers to continue daily driving despite the restriction intended to restrict driving to alternate days.[74] Particles near a source have the potential to reach human lungs unless they are deposited, deflected, or dispersed. Deposition involves contact with the ground or other surface, and depending on the characteristics of that surface the particles may be resuspended (returned to circulating in the air) when disturbed. Vegetation in particular has been seen as offering promising deposition surfaces, with small modeled benefits to regional air quality.[75,76] Alternatively, solid barriers such as walls have been used to deflect the flow of combustion products (and sound) from sources to local homes and streets.[77] While modeling of pollution dispersion continues to develop, experiments suggest that pollution levels are elevated when low wind conditions or obstacles (including vegetation and buildings) slow the dispersal of particles from their source. Thus, strategies to address air pollution through enhancing the urban forest or other green spaces may not have the anticipated benefits[78] and by serving as a pollen source may contribute to allergy and related conditions.[12,79,80]

For evaluation of design efforts to improve air quality, it will be important to leverage local monitoring efforts such as the New York City Community Air Survey (NYCCAS) monitoring network and their predictive models.[69,81] For example, New York City launched a sustainability project called PlaNYC in 2007 with the goal of improving air quality by reducing emissions from a number of sources. As part of this effort, a NYCCAS monitoring campaign was launched, and was the basis for noting that areas with a high density of residential buildings burning residual fuel oil also had high levels of hazardous air particulates. The city addressed this by launching a clean heat program, requiring many buildings to switch to cleaner heating over the coming decades. Passive, personal, and environmental approaches such as leaf sampling may complement city-wide data collection campaigns.[82,83] Citizen science approaches enabling local residents to monitor their exposures[84] also merit attention, given the local awareness of pollution sources from highways in Mott Haven, like the Major Deegan and Bruckner Expressways.

Air Quality Key Points:

- Harmful air pollutants come from traffic, heating, and other combustion sources.[70]
- Air pollutants play a role in the development or worsening of heart and lung disease.[53-57]
- Pollutants can be reduced at the source, or through deposition, deflection, or dispersion.[69]

Selected Online Resources for Learning More:
Learn About Air from the US EPA
www2.epa.gov/learn-issues/learn-about-air

Air Pollution and the Health of New Yorkers
www.nyc.gov/html/doh/downloads/pdf/eode/eode-air-quality-impact.pdf

Why and How to Design for Pedestrian Safety from Traffic

Motor vehicle accidents are a leading cause of injury and death in the United States, especially for individuals under 35.[85] In NYC, and globally through the UN's Decade for Action for Road Safety, the VisionZero approach has brought pedestrian safety to the foreground of transportation planning.[86] VisionZero addresses the problem of pedestrian/automobile injury through street design (e.g., speed bumps and other traffic calming devices), enforcement of speed limits and signal violations, media campaigns, and community engagement, all of which are already in progress in NYC's neighborhoods.

Pedestrians are the most physically vulnerable of road users. Evidence suggests this is especially true in urban areas, where approximately ¾ of all US pedestrian fatalities occur.[85] Research also suggests that low-income populations most likely make up a large percentage of pedestrian road accidents. Low-income groups are less likely to own an automobile and thus many have little alternative to walking for transportation. Households without a motor vehicle make about 60% of their trips via public transit, and even transit trips usually involve walking to and from transit stops.[87] Although driving puts individuals at risk for an accident, pedestrians are over 30 times more likely to be involved in a *fatal* accident, and thus the high percentage of low-income groups traveling on foot makes them more vulnerable[85] despite potential long-term benefits of transportation physical activity.

In Hunts Point/Mott Haven, pedestrian injuries cause 114 emergency room visits and 32 hospitalizations per 100,000 residents annually, as compared with rates of 111 and 26 across NYC.[29] Bicycle injuries, on the other hand, are somewhat lower than city-wide levels (76 vs 90 emergency room visits and 7 vs 10 hospitalizations per 100,000 residents annually).[29]

Having a high number of pedestrian fatalities in a neighborhood has a reverberating effect on other healthy behaviors. Research indicates that feeling unsafe with regard to traffic injury discourages active transportation, like walking, running and biking, and outside play for children.[11,88,89]

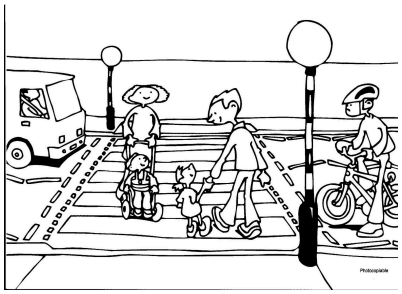
There are many built environment factors that the literature suggests affect the occurrence of motor vehicle/pedestrian accidents. In urban areas, which have the highest percentage of motor-vehicle accidents involving pedestrians, high speed, high volume arterial roads are especially problematic. Traffic density is a significant predictor of pedestrian crashes, and traffic speed strongly impacts injury severity.[90] Street design elements, like traffic signals, lighting, and signage, may help to prevent collisions and enhance perceived safety.[91,92] Yet these associations remain controversial. In a carefully controlled study, crosswalks appeared to increase pedestrian injury risk.[93] Arguments for complete streets with clearly marked pedestrian spaces compete with those for "naked streets" without such demarcation that may require more careful attention on the part of drivers.[94,95] There is, perhaps, need for multiple strategies to protect pedestrians, with tailoring to the specifics of the targeted intersection and neighborhood.

For evaluation of design on pedestrian safety, existing registers such as the Fatality Analysis Reporting System (FARS) (http://www.nhtsa.gov/FARS), can be tapped for severe injuries and deaths. A key challenge is the selection of a denominator for injury or fatality rates. Reporting of less severe injuries is likely to be incomplete, and to vary systematically across demographic

and socioeconomic groups. Likewise, the volume of pedestrians is generally not known, often approximated by the count of local residents.

Beyond the rates of injury or death, perceptions of safety also should be monitored, as such perceptions shape individual behaviors and route choices and may contribute independently to health.[96] For instance, children are more likely to walk on streets that feel safe, as indicated by sidewalks, traffic speed, and distance removed from traffic.[17] Seniors also worry about inadequate intersection crossing time.[17] Such concerns warrant attention given implications for chronic stress and health behaviors, even though the correlations with more objective safety measures have generally been low.[97,98] Questionnaires and ecometric approaches are used for measurement of perceived safety,[99,100] and increasingly virtual information is being used to capture characteristics with potential relevance to perceived safety such as physical disorder.[101,102]

Pedestrian/Traffic Safety Key Points:



- Motor vehicle accidents involving pedestrians are a leading cause of injury and death.[85] This is particularly true in low-income populations.
- Feeling unsafe because of automobile traffic reduces the likelihood that individuals will choose actives form of transportation and outdoor play.[11,88,89]
- Conversely, having many pedestrians tends to make roads safer for walking, as drivers increasingly anticipate and watch out for pedestrians.[72]
- High volume roads, which are prevalent in urban areas and high-speed traffic increase the number of pedestrian collisions and fatalities.[90]
- Signage and traffic signals may reduce pedestrian/motor vehicle collisions, while street trees and lighting may improve perceived safety.[91,92]

Selected Online Resources for Learning More:
What Works for Health roadmap on supporting active travel
http://bit.ly/1zXTVaC

Pedestrian Safety Program Strategic Plan from the UNC Highway Safety Research Center
http://safety.fhwa.dot.gov/ped_bike/pssp/background/background092010.pdf

Local Environment Characteristics that Matter

Clearly, transportation and urban form elements have potential relevance to each of the preceding health outcomes. We now turn to selected aspects of the local environment: parks, trees, and pedestrian path enhancements. We hope to guide rational design decisions by exploring for each of these the range of potential benefits which includes health and also extends outside of health, the circumstances that can maximize such benefits, and any known cautions.

Which Parks Attract Activity?

A systematic review of international studies[103] found evidence for a range of health benefits, as well as ecological and economic benefits, attributable to parks. For example, in a recent New York City study the amount of neighborhood space dedicated to parks was significantly correlated with lower body mass index (BMI) after controlling for sociodemographic factors.[104] Some studies in low income areas do suggest that living closer to parks increases physical activity. For instance, in a low-income neighborhood in Los Angeles, individuals were more likely to visit a park and to exercise if they lived within a mile of the park.[105] A NYC study of preschool aged children from low-income families likewise found that a nearby park was associated with more physical activity.[11] However, there remains inconsistency in the methods used and the conclusions reached by research on this topic across the US.[106,107]

Beyond park proximity, park characteristics may predict park use. For example, large parks in NYC have been linked to a lower body mass index.[108] The importance of large parks has been echoed by research in other settings as well.[109] The relationship between parks and BMI does not appear as consistent for small parks.[108] However there has not been systematic evaluation of the threshold for what should define large parks. Neither park cleanliness nor recreational facilities, such as sports fields, have been consistently shown to be associated with BMI in NYC.[104,108] Thus while physical activity may be influenced by such factors as ease of access and size of green space,[107] patterns may be obscured by different measurement approaches and populations.

In summary, the evidence suggesting this relationship for park density, park proximity, park cleanliness or recreational facilities within the park was less conclusive than for total acreage of park in the vicinity. Yet this literature is largely cross-sectional. An illustrative exception evaluated park improvements prospectively in 5 intervention parks, as compared with 5 matched comparison parks.[111] Park use and observed physical activity in the parks declined for both groups, although perceptions of park safety improved more in the intervention parks. A clearer success story comes from Chennai, India, where a community education and empowerment intervention resulted in residents coming together to construct a public park with their own funds.[110] Regular physical activity (defined as more than three times per week) increased from 14% to 59%. Though there was no comparison group, retention of the participants was excellent. Thus, the available prospective studies point to the importance of social engagement.

Park Key Points:

- Research has provided mixed and mostly cross-sectional evidence linking parks to physical activity,[106,107] though parks may offer ecological and economic benefits.[103]
- Larger parks seem particularly promising for supporting greater physical activity and a healthy weight.[108,109]
- Available research indicates the amenities and cleanliness within a park do not consistently affect physical activity levels of area residents.
- A successful intervention in Chennai, India points to the role of community engagement and ownership[110]

Selected Online Resources for Learning More:
CDC Healthy Places, Parks and Trails Health Impact Assessment Toolkit
www.cdc.gov/healthyplaces/parks_trails/default.htm

How Do Trees Affect Human Health?

Urban landscape has been shown to produce social and economic benefits to communities.[112,113] Health benefits have also been found in some studies, particularly those focused on physical activity or psychological benefits.[114] Research in NYC indicates that street tree density is positively associated with physical activity and lower BMI.[11,32,115,116] These associations are also supported in other settings.[117] The link is proposed to act through urban design dimensions relevant to pedestrian comfort and interest.[118,119] Yet, the relationship between tree density and BMI may only be detectable within highly walkable neighborhoods.[32,120] If a key role of street trees is to provide shade, one might expect stronger associations between local trees and physical activity in the warmer months, but this hypothesized interaction was not supported when tested in a preschool-based NYC population.[11]

Psychological restoration in urban environments is proposed to be supported by local vegetation,[121] with consequences for human well-being, equity, and mortality.[122] The link to stress restoration is through views of natural environments or care for local vegetation. Prospective evidence from a clever natural experiment supports a link between tree deaths and human deaths.[123] Yet the deaths of trees may be expected to provide a more sudden change to the physical environment than tree planting efforts. A study of new street trees has linked the social environment of humans to street tree survival.[124] Furthermore, urban tree canopy may promote better birth outcomes, with more trees in close proximity reducing preterm and small births, outcomes previously linked to maternal distress.[125,126]

Despite the positive association between tree density and some health outcomes, urban trees may not be universally beneficial to health and the environment.[127] It has been hypothesized that more urban tree canopy coverage would reduce local exposure to air pollution, and thus lower asthma rates. Yet a prospective study in NYC did not support a protective effect of trees on respiratory health.[12] This study analyzed all trees (street, parks, and private property) within 250 meters of a child's home, found no support for the hypothesized role in preventing childhood asthma. However, children who lived in areas of high tree density early in life were more likely to show allergic sensitization to tree pollen by age seven on a blood test. This work and other temporal patterns[54,79,128,129] suggest the possibility that pollen production should be considered as part of species selection strategies to avoid adverse health effects.

Trees Key Points:

- Trees and other forms of urban landscape may be associated with physical activity and lower BMI.[11,32,115,116]
- Stress recovery has been proposed as an explanation for correlations of local vegetation with lower mortality[120,121] and better birth outcomes.[125,126]
- Respiratory health benefits have been proposed but not supported.[12]

Selected Online Resources for Learning More:
Literature Synthesis conducted for the Sacramento Tree Foundation
http://www.sactree.com/assets/GreenRx_Literature_Synthesis_April2012.pdf

Urban Forestry and Human Benefits fact sheets compiled by Kathleen Wolf
http://www.naturewithin.info/urban.html

Which Path Enhancements Support Active Living?

The enhancement of paths, including their connectivity, has the potential to improve safety and increase physical activity in communities. Much evidence points to neighborhood streetscape design as an important element in creating lively urban spaces and supporting physical activity.[130] Disconnected paths make it more difficult to walk safely to stores, schools, parks, and other local venues.[16] Research has explored the particular design components of paths thought to increase the likelihood of their use.

Common criteria for a walkable neighborhood include connectivity of the path network, public transportation linkage, varied land use patterns, residential density, and path quality.[131-133] Criteria for quality of the path have included width, paving, landscaping, signing, and lighting.[134] Qualitative research points to desired features to support walking activity, such as benches for older adults.[135] Path characteristics that enhance pedestrian comfort may have additional benefits related to mental health and social engagement.[136] Nevertheless, there are inconsistencies across the literature on whether the infrastructure developed to support of pedestrian activity is universally related to physical activity. Though studies have found the connection between environment factors and walkability for Caucasian and high socioeconomic status neighborhoods, there is less evidence among minority and higher poverty populations.[38,137]

In this largely cross-sectional literature, a few efforts at prospective evaluation provide key opportunities to understand the consequences of path enhancement. One such study evaluated a six-block path enhancement in New Orleans, Louisiana, as compared with a school playground and two comparison groups. While reported physical activity increased in all groups, the only clear intervention effect was to shift where people engaged in physical activity in the intervention area. Other prospective studies have utilized a natural experiment design, but with limitations in their ability to address the original research question about urban form due to logistical difficulties. [138] In summary, the available prospective evidence does not offer clear guidance as to which elements of path enhancement would be most effective.

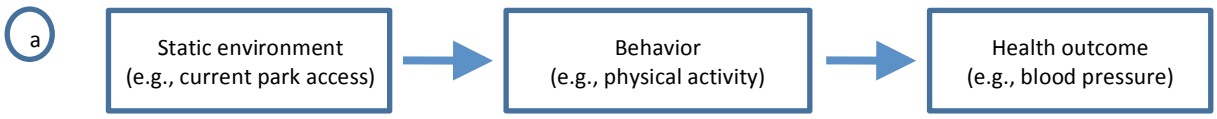
Path Enhancement Key Points:

- Research suggests that the connectivity, condition and context of paths affects the likelihood of using those paths for physical activity.[131-133]
- Certain path elements such as benches have been identified by local residents as desirable through qualitative research
- Limited prospective evidence is available to disentangle the effects of particular path enhancements on physical activity.

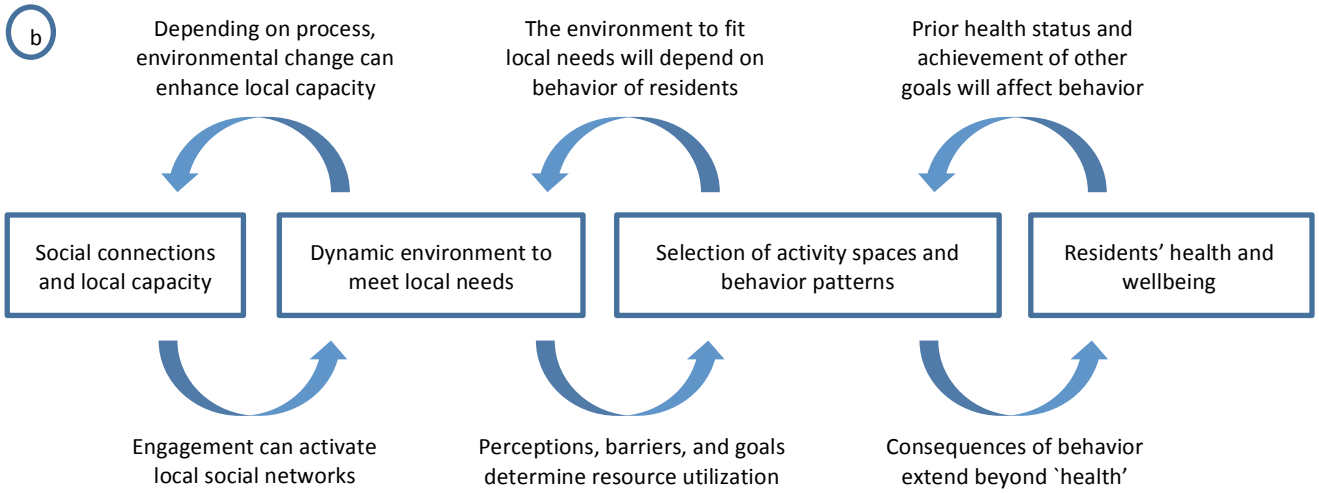
Selected Online Resource for Learning More:
What Works For Health, Roadmap for Improved Streetscape Design
www.countyhealthrankings.org/policies/improve-streetscape-design

Process Matters

Local changes may have benefits that depend on local ownership of ideas and spaces. Rapidly restructuring a neighborhood may not be as health-supportive as incremental improvements and decision-support grounded in community engagement.[139] In particular, the social benefits of design changes may depend on the process of change and how those changes are understood by local residents.[14,140] Population health improvements can be sought by setting the local conditions to support health and healthy choices, but fundamental causes of health such as educational and employment opportunities may still be lacking.[141,142]



Simplifying assumption that causal relationships are automatic and uniform has facilitated interpretation of cross-sectional studies



Complexity and social context are recognized, requiring awareness of the role of human agency

Action to Research

Governments, community groups, and other organizations make decisions that have lasting impact on the homes, neighborhoods, lifestyles, and health of populations. Investments, initiatives, and infrastructure improvements with goals that include health promotion are distinct from medical interventions, in that non-health economic, social, and aesthetic goals are also central. In many situations, there may be tradeoffs or co-benefits with ecological, economic, and social goals. As decisions are made that have lasting structural and system-level implications for urban environments, the best currently available evidence can and should be leveraged to limit harmful effects and optimize health benefits. But that knowledge must also continue to grow through prospective evaluations of local change, with attention to proximate and distal outcomes.

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