



Building safety into active living initiatives



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ABSTRACT

Objective. Efforts to promote environmental designs that facilitate opportunities for physical activity should consider the fact that injuries are the leading cause of death for Americans ages 1 to 44, with transportation-related injuries the most common cause. Drawing on the latest research and best practices in the field of injury prevention, the purpose of this article is to provide those working to promote physical activity with evidence-based recommendations on building in safety while designing active environments.

Method. A systematic review of the peer-reviewed and grey literature published from 1995 to 2012 was conducted to identify injury prevention strategies applicable to objectives in the *Active Design Guidelines* (ADG), which present design strategies for active living. Injury prevention strategies were rated according to the strength of the research evidence.

Results. We identified 18 urban design strategies and 9 building design strategies that promote safety. Evidence was strong or emerging for 14/18 urban design strategies and 7/9 building design strategies.

Conclusion. ADG strategies are often wholly compatible with well-accepted injury prevention principles. By partnering with architects and planners, injury prevention and public health professionals can help ensure that new and renovated spaces maximize both active living and safety.

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Introduction

Physical inactivity is one of the four key behavioral risk factors for the leading causes of death globally (Danaei et al., 2009; World Health Organization, 2011). Research is mounting on the important role that the built environment plays in supporting or creating barriers for physical activity. The U.S. Community Preventive Services Task Force recommends environmental and policy approaches to effectively increase physical activity (Ferdinand, 2012; Sallis et al., 2012; The Community Preventive Services Task Force). As a result, health entities, such as the New York City (NYC) Department of Health and Mental Hygiene, are working to make changes to the built environment (e.g., buildings, streets, neighborhoods) to increase physical activity. Success in these efforts depends on close collaborations among health agencies, other government agencies that have responsibilities for the built environments and their amenities, (e.g., Departments of City

Planning, Transportation, Parks and Recreation, Buildings, and Public Works), as well as organizations providing public information and education.

Efforts to create environments that facilitate opportunities for physical activity should also consider the fact that injuries are the leading cause of death for Americans ages 1 to 44, with transportation-related injuries being the leading cause of injury death in 2010 (U.S. Centers for Disease Control, Prevention, 2010). Although building and land use design decisions can affect injury risk, they have not been widely addressed in the health promotion literature (Pollack et al., 2012). We had an opportunity to address this gap as part of NYC's efforts to promote more active living through environmental redesign.

Our efforts resulted in a safety supplement to the NYC Active Design Guidelines (City of New York. Active Design Guidelines, 2010). This article describes its development and in doing so, aims to inform designers, planners, and other key stakeholders about the relationships between active living and injury prevention, and thereby help to increase the safety of future active living design strategies for buildings and urban spaces. Addressing these two issues together can impact concurrently two major public health problems—injuries and physical inactivity.

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Materials and methods/approach

In 2010, the City of New York published the *Active Design Guidelines* (ADG), a manual of evidence-based and best practice strategies for integrating physical activity-promoting factors into the design of the city's buildings, streets and neighborhoods (City of New York. *Active Design Guidelines*, 2010). Led by four city agencies—Health, Design and Construction, Transportation, and City Planning—and developed through the collaboration of 12 city agencies with additional inputs from non-government organizations and academic partners, over 25,000 copies of the ADG have been distributed to architects, urban planners and other built environment and health professionals globally. The ADG is divided into two major components—Urban Design and Building Design—and included within each are specific objectives and strategies to increase active transport, active recreation and human-powered movement in buildings. Thirteen Urban Design and 10 Building Design objectives were specified, and strategies to achieve each of the objectives were presented with strength of the evidence in support of their demonstrated ability to increase physical activity.

To explore how the ADG might be adapted to address injury prevention, with support from the U.S. Centers for Disease Control and Prevention (CDC), partners from the Society for Public Health Education, New York City Department of Health and Mental Hygiene, Johns Hopkins Center for Injury Research and Policy, and CDC developed a supplement to the ADG, *Promoting Safety*. This supplement provides evidence-based information that links safe design and active living design strategies—an area that has received scant attention in the extant literature (Johns Hopkins Center for Injury Research, Policy, 2012). *Promoting Safety* is free and can be downloaded at http://www.jhsph.edu/research/centers-and-institutes/johns-hopkins-center-for-injury-research-and-policy/publications_resources/CenterPubs/PromotingSafety.html.

Information sources and search

The research team brainstormed an initial list of injury prevention strategies known through their work in the field, and search terms were developed. The list of strategies was limited to the ones that were relevant to strategies in the ADG (City of New York. *Active Design Guidelines*, 2010). Search terms were organized according to relevance to Urban Design and/or Building Design (Table 1). Using these search terms, a systematic review of the literature, including journal publications, grey literature, conference papers, government guidelines and reports, and news reports, in the U.S. and internationally, was conducted to identify injury prevention strategies applicable to the ADG objectives and to determine the strength of the evidence for each. Articles published between 1995 and April 2012 were identified from PubMed, Scopus, Google, LexisNexis All News, PsycINFO, and Google Scholar. Seminal publications prior to 1995 were also included. Abstracts were reviewed to determine if data were available on the effectiveness of the strategies in preventing or reducing injuries, and those that did were included in the analysis. A total of 110 abstracts were reviewed to determine the strength of the evidence.

Eighteen strategies for Urban Design and 9 strategies for Building Design were identified, and the evidence in support of their ability to reduce injury risk related to active living (e.g., falls, pedestrian-vehicle collisions, bicycle-related crashes) was reviewed. One potential strategy from the initial list, red

light cameras, was removed since there were no published data on their effect on pedestrians and bicyclists.

Rating the strength of the evidence

Promoting Safety used the same rating scale and process as the ADG (City of New York. *Active Design Guidelines*, 2010; Johns Hopkins Center for Injury Research, Policy, 2012). The research team reviewed the evidence for each of the selected strategies, and through consensus, assigned the appropriate rating to each strategy. Strategies were rated as having “strong evidence” if there was a consistent pattern from longitudinal or cross-sectional studies of a strong relationship between the strategy and a reduction in injury risk. Strategies included in federal agency recommendations were also considered to have strong evidence. Strategies were rated as having “emerging evidence” if the existing evidence was not yet definitive, but studies suggested that the strategy would likely lead to reduced injury risk. Strategies were rated as “best practice” if they lacked a formal evidence base but were supported by principles of injury prevention theory, well-established understanding of human behavior, and experience from existing practice. Further details on the ratings are in the Introduction to *Promoting Safety* (Johns Hopkins Center for Injury Research, Policy, 2012). A brief summary of the evidence was written for each strategy and included in *Promoting Safety*. Transportation, recreation, code, and injury prevention experts reviewed the draft document so that any missing evidence would be identified.

Aligning ADG objectives with injury prevention strategies

The research team identified the ADG objectives to which each injury prevention strategy can be applied. These objectives are listed in the document for each strategy. Additionally, for each injury prevention strategy, there is a directive to designers and planners of what they can do to reduce injury risk. NYC's Departments of Transportation, Parks and Recreation, Buildings, and Mayor's Office of People with Disabilities, as well as others in the injury prevention field, reviewed drafts of *Promoting Safety* to create a final version. The final publication includes a summary of the strategy and the evidence, evidence rating, visuals, and a matrix to illustrate how the safety-promoting strategy is related to the active living design objectives.

Results

Eighteen urban design strategies and 9 building design strategies were identified that promote both safety and physical activity. Evidence supporting injury prevention effects was strong or emerging for 14/18 urban design strategies and 7/9 building design strategies (Table 2). Research evidence was strongest for playground equipment and surfaces for indoor and outdoor play areas, fencing for pools and elevated play areas, traffic calming, pedestrian refuge islands, placement of bus stops and bus lanes, multi-way (all way) stop sign control, traffic signals, crime prevention through environmental design, stair features, window guards and balcony railings, and sprinklers. Best practices identified as

Table 1

Search terms used to identify the evidence for each reviewed active design guideline objective, for urban and building design strategies.

Urban design	Building design
All-way stop, balcony railings, bicycle helmet access and storage, bicycle helmet innovation, bicycle lanes, bicycle parking, bicycle storage, bike boxes, bike-sharing, bus lane placement, bus lanes, bus stop design, bus stop placement, complete streets, crime and recreational parks, crime prevention in existing parks, crime prevention in new parks, crime prevention through environmental design (CPTED), drowning prevention, electronic surveillance, escalator safety, fencing, folding helmets, four-way stop, handrails, helmet sanitation covers, helmet vending machines, injury AND urban design, injury prevention AND urban design, in-pavement flashing lights, lighting, lighting outdoors, mitigating risk of parking far and walking, outdoor pools, outdoor stair risk, painted bicycle crossings, painted lanes, park safety, parking safety, pedestrian lighting, pedestrian overpasses, pedestrian refuge islands, placement of bus stops, playground equipment, playground surfaces, playgrounds, red light camera, road reflectors, safety AND urban design, security escort services, sign/age, stair characteristics, stair design, stair features, stair surfaces, stairs, stop sign control, street calming, street closures for safe play areas, surfaces, surveillance systems, temperature safe surfaces for outdoor facilities, traffic calming, traffic light, traffic signals, traffic signs, vehicular lighting, violence prevention AND urban design.	Balcony railings, bicycle helmet access and storage, bicycle parking, bicycle storage, closed-circuit television, crime prevention through environmental design (CPTED), drowning prevention, effectiveness AND building design, electronic surveillance, elevator safety, escalator safety, exercise equipment, fitness room surfaces, handrails, indoor fitness equipment, indoor gym surfaces, indoor pool safety, indoor sign/age, indoor sport facilities, indoor stair risk, injury AND building design, injury prevention AND building design, lighting, lighting indoors, metal detectors, parking safety, safety AND building design, shower surfaces, sprinklers, stair characteristics, stair design, stair features, stair surfaces, stairs, surfaces in indoor play areas, surveillance systems, violence prevention AND building design, window guards, window stops.

Table 2
Summary of the strength of the injury prevention evidence for each reviewed active design guideline objective, for urban and building design strategies.

	Strong evidence	Emerging evidence	Best practice
Urban design strategies that promote safety (n = 18)	<ul style="list-style-type: none"> • Playground equipment and surfaces (e.g., use materials that align with the ASTM^a standards) • Fencing • Street calming • Pedestrian refuge islands • Placement of bus stops and bus lanes • Four-way (multiway) stop sign control • Traffic signals • Crime prevention through environmental design (CPTED) 	<ul style="list-style-type: none"> • Complete streets • In-pavement flashing lights • Lighting • Pedestrian overpasses • Painted, designated bicycle lanes/boxes/crossings • Stair features (e.g., avoid risers that are too great) 	<ul style="list-style-type: none"> • Street closures for creating safe play areas • Bicycle-sharing systems • Bicycle and bicycle helmet storage • Signage (e.g., install signs such as “yield to cyclist”)
Building design strategies that promote safety (n = 9)	<ul style="list-style-type: none"> • Stair features (e.g., use a larger horizontal distance between two consecutive nosings) • Surfaces in indoor play areas • Window guards and balcony railings • Sprinklers • CPTED 	<ul style="list-style-type: none"> • Indoor pool safety • Lighting 	<ul style="list-style-type: none"> • Bicycle and bicycle helmet storage • Signage (e.g., use signage with signal words such as “Danger” or “Caution” to alert people to potential risks)

^a American Society for Testing and Materials.

important were street closures for creating safe play areas, bicycle-sharing systems, bicycle and bicycle helmet storage, and signage.

Discussion

Advances in the science of injury prevention have led to established principles that guide efforts to enhance safety. Several of these are particularly relevant to promoting active living in both urban environments and buildings. First, separating people from hazards is always a goal when designing environments in which people work, live, and play. This principle is exemplified by properly built bike lanes that separate bicyclists from cars. Second, because injuries result when energy forces are applied to the human body in amounts that exceed the body's tolerance, the principle of reducing energy exposure is also important. Installing energy-absorbing surfaces where there is potential for falls from heights (such as on playgrounds) is one example of applying this principle in urban design. Finally, designers must always consider the ways in which people, especially the most vulnerable, will use newly designed space, whether in buildings or in the urban environment. For instance, when planning trails and paths, designers should consider how older adults, people with physical limitations, families with strollers, and bicyclists can all safely use the space. In addition, separating each of these various road users, especially pedestrians and cyclists from cars, and pedestrians from bicyclists, can be an effective design strategy for maximizing safety.

Promoting Safety was created to provide additional information for those implementing active living strategies in urban and building design. The key finding from this review was that designs for safety and active living are often complementary and synergistic, which increases the need for these strategies to be implemented together. An example is properly built bike lanes that offer good street connectivity and are supported with appropriate, well-displayed signage and traffic controls. We also found that multiple active design strategies can often be enhanced by incorporating a single injury prevention strategy. For example, improved timing of traffic signals benefits pedestrians, bicyclists, and transit users. It is also important to note that motor vehicle drivers and passengers will also be better protected when active living design strategies that reduce crash risk for all road users, such as traffic calming, are implemented. Finally, for several of the ADG objectives reviewed, evidence is lacking on the ways in which injury outcomes are impacted, and further research is needed. For example, while red light cameras have demonstrated utility in reducing motor vehicle crashes, it is unclear if pedestrians and bicyclists have benefitted from the technology; more refined data collection to understand these

impacts is needed. As active living features become more common, evaluation efforts should include injuries as one of the outcomes measured.

We also want to emphasize that as greater attention is devoted to the importance of built environments and active living, partnerships and involvement by a broad array of stakeholders are critical. While researchers provide the evidence base for safety-oriented interventions, public health practitioners and decision-makers must then use such evidence to improve health and safety within their communities. Architects, urban planners, engineers and designers as implementers of ADG are critical end users of this guidance, and therefore must be involved in the process. In developing *Promoting Safety*, we included sufficient time to ensure that all relevant parties had a chance to provide input throughout the process.

Conclusions

The results of this research highlight the benefits of injury prevention professionals working with active living professionals, architects, planners, and recreation and transportation professionals to ensure that new and renovated spaces maximize opportunities for both active living and safety.

Conflicts of interest statement

The authors declare that there are no conflicts of interest.

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References

- City of New York. Active Design Guidelines, 2010. Promoting Physical Activity and Health in Design. NY, NY: City of New York, (Available at: http://herg.gatech.edu/Files/Projects/Active%20living/NY%20City%20Active%20living/ADG_NYC_guidelines.pdf)

- (free downloads) and <http://a856-citystore.nyc.gov/2/Municipal-Publications/12/Surveys-Reports/90/Active-Design-Guidelines> (hardcopy)).
- Danaei, G., Ding, E.L., Mozaffarian, D., Taylor, B., Rem, J., Murray, C.J., Ezzati, M., 2009. The preventable causes of death in the United States: comparative risk assessment of dietary, lifestyle and metabolic risk factors. *PLoS Med.* 6 (4), e1000058.
- Ferdinand, A., Sen, B., Rahurkar, S., Engler, S., Menachemi, N., 2012. The relationship between built environments and physical activity: a systematic review. *Am. J. Public Health* 102 (10), e7–e13.
- Johns Hopkins Center for Injury Research, Policy, 2012. NYC Department of Health and Mental Hygiene, and Society for Public Health Education. Active Design Supplement: Promoting Safety. NY, NY: City of New York, (Available at: http://www.jhsph.edu/research/centers-and-institutes/johns-hopkins-center-for-injury-research-and-policy/publications_resources/CenterPubs/PromotingSafety.html).
- Pollack, K.M., Kercher, C., Frattaroli, S., Peek-Asa, C., Sleet, D., Rivara, F., 2012. Toward environments and policies that promote injury-free active living—it shouldn't hurt. *Health Place* 18 (1), 106–114.
- Sallis, J.F., Floyd, M., Rodriguez, D.A., Saelens, B.E., 2012. Role of built environments in physical activity, obesity, and cardiovascular disease. *Circulation* 125 (5), 729–737.
- The Community Preventive Services Task Force. *The Guide to Community Preventive Services: What Works to Promote Health*. Increasing Physical Activity: Environmental and Policy Approaches. <http://www.thecommunityguide.org/pa/environmental-policy/index.html>.
- U.S. Centers for Disease Control, Prevention, 2010. WISQARS (Web-based Injury Statistics Query and Reporting System). US Department of Health and Human Services, CDC, Atlanta, GA, (Available at <http://www.cdc.gov/injury/wisqars>. Accessed February 24, 2014).
- World Health Organization, 2011. Global Status Report on Noncommunicable Diseases 2010. World Health Organization, Geneva, (http://www.who.int/nmh/publications/ncd_report_summary_en.pdf).