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Invited Perspective: Studying Walkability and Cancer Incidence—A Step in the Right Direction

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Walkability is a mixture of features of the built environment that provide opportunities to improve population health in myriad ways. First defined in the 1960s based on observations of sidewalks and safety in U.S. downtown areas,[1] *walkability*, or features that increase our propensity to walk, has become a cornerstone of urban planning. At the population level, living in more walkable neighborhoods is associated with higher levels of physical activity and lower adiposity.[2] Jeff Speck, a celebrated city planner who has worked with hundreds of American city mayors to improve the pedestrian experience, developed the General Theory of Walkability,[3] which suggests that walks should be useful, safe, comfortable, and interesting. Tobin et al.[4] quantified these attributes using geospatial data on land use mix, residential and business density, public transit, street connectivity, traffic calming measures, street trees, population density, and more. Walkable neighborhoods also tend to support active transportation and recreational physical activities, as well as social interactions. With the strengthening of evidence linking walkability with healthier body weight, epidemiologists have begun asking whether walkability reduces the risk of obesity-related chronic diseases (e.g., cancer) and mortality.[5,6]

In this issue of *Environmental Health Perspectives*, India-Aldana et al.[7] report findings that support the link between walkability and lower risks of obesity-related cancers. Their analysis used data from the New York University Women's Health Study (NYUWHS), a richly contextualized prospective cohort of women who were regularly followed over approximately three decades. The authors calculated annual walkability scores using census-tract population density and destination accessibility; they found that higher walkability was inversely associated with total obesity-related cancer after adjustment for covariates. Similarly, higher walkability was associated with a lower risk of postmenopausal breast cancer, endometrial cancer, multiple myeloma, and ovarian cancer and was suggestively associated with lower incidence rates for all other sites of obesity-related cancer except thyroid cancer. The inverse association with postmenopausal breast cancer was stronger among participants who were hormone receptor–positive rather than negative, further supporting the hypothesis that environmental factors affect risk of breast cancer, especially for those breast cancers influenced by physical activity.[8] Notably, this study was the first to assess the risk of incident cancers in relation to a time-weighted average walkability index based on regularly updated residential histories, over nearly 30 years of follow-up.

The variety in walkability exposures used in epidemiological studies reflects the complexity and lack of consensus on a conceptual definition.[4] Much of the operationalization of walkability exposure draws on the 3 D's—density (of population), diversity (of land use), and design (of street networks)—with varying levels of integration and diversity in data sources.[9–11] An ongoing trend in walkability exposure assessment is expansion of what the term encompasses. Notably, Ewing and Cervero[12] proposed expanding the 3 D's to 5 D's to include destination accessibility and distance to transit. Researchers acknowledge that walkability represents not only physical access but also a mixture of social and esthetic aspects that encompass the experience of traversing an environment.[13,14] Some measures have been added into studies to account for these complexities, such as the incorporation of vegetation data to assess "green walkability" and integration of perceived walkability measures that additionally draw on subjective assessments of traffic and crime safety levels.[15,16] An ongoing challenge of walkability exposure assessment is the lack of data that enable parameterization of each component of walkability, with the spatial and temporal range to support prospective study designs. In the context of cancer epidemiology, assessing walkability exposure over etiologically relevant time windows (e.g., decades) requires historical data sets.

In the new work by India-Aldana et al.,[7] the walkability score captures two components—the density of people and of businesses—thus excluding other components known to predict walking, such as density of intersections and public transit, which were included in a four-item walkability score that was validated within the NYUWHS by the authors[17] and used in their analysis of walkability and mortality.[5] The time-variant two-item score was correlated with the time-invariant four-item score assessed at study baseline (1990), but the utility of the findings for urban practitioners may be limited. In addition, risk estimates could be biased by residual confounding of the association between walkability and cancer incidence by unmeasured environmental and socioeconomic confounders not captured by the individual-level covariates or time-invariant neighborhood poverty confounder assessed only at study baseline. In comparison with a California study on obesogenic environments that assessed multiple environmental components in relation to postmenopausal breast cancer incidence,[18] this study lacked detailed quantification of neighborhood socioeconomic status, racial residential segregation, ethnic enclaves, distance to hospitals, green space, and street connectivity. To avoid overly simplistic translation into policy, it is crucial for walkability to be assessed holistically and rooted in context, which can be achieved by adequately examining socioeconomic and racial/ethnic neighborhood composition, environmental coexposures, and safety of walking spaces. Incorporation of context is question-specific (e.g., as modifiers or confounders), but context is indispensable for tackling not only overall cancer risk but also cancer disparities.[19]

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Exposure assessment is a critical issue in environmental epidemiology. Whereas evidence synthesis requires consensus around how an exposure is defined and consistency in the use of that definition, understanding mechanisms typically requires assessment of the joint and individual effects of well-defined exposure components. In a systematic review of 40 health impact assessments of walkability, Westenhöfer et al.[20] noted that the evidence was predominantly on active transport and public transport, which highlighted the lack of quantitative data on the relationship between other components of walkability (e.g., density, connectivity, land use, traffic safety, experience, community, greenspace) and increased physical activity, social interaction, and perceived safety and stress. Establishing clear connections between the components of walkability used in epidemiological studies and the implementation tools used by local governments is invaluable. For example, higher-density development, mixed land use, and transportation alternatives can be captured as walkability components and can also be captured in regulatory items in zoning ordinances.[21] Composite and component-specific walkability analyses pave the way for rapid translation of epidemiological research into policy.

Multicomponent definitions of walkability can inform policy on walking, cycling, and public transit infrastructure,[22] which can help reduce vehicle emissions and mitigate climate change, with extensive concomitant health benefits.[23] Future triangulation of evidence on the association of walkability with obesity-related cancers from prospective cohort studies (with negative controls), interventions, and natural experiments, as well as detailed exploration of interactions of components, will further strengthen policy-relevant evidence on walkability. In addition, mobile technologies will be useful for evaluating walkable environments and quantifying time spent away from residential addresses to reduce exposure measurement error, which could limit bias in health effect estimates.[24–26]

Each city includes walkable land that has evolved from the socioeconomic conditions and decisions of the people who live, and have lived, there. This mutability of cities offers opportunities for epidemiological research and motivates the translation of research findings into actionable interventions for shaping built environments with the aim of population-level promotion of health. Within the role of the built environment in the etiology of cancer, studies linking walkability exposure to key risk factors for cancer, such as physical activity, provide a mechanistic rationale. The natural next step is to begin disentangling the mechanisms that drive associations between walkability and cancer, with a future vision of leveraging population-wide walkability exposure to contribute to cancer prevention. Urban practitioners have been debating optimal density for decades.[27,28] It is therefore crucial that epidemiologists tackle the complexity of walkability, which can be informatively assessed as joint and individual components when placed in context.

References

1. Jacobs J. 1961. *The Death and Life of American Great Cities*. New York, NY: Random House.
2. Sarkar C, Webster C, Gallacher J. 2017. Association between adiposity outcomes and residential density: a full-data, cross-sectional analysis of 419562 UK Biobank adult participants. Lancet Planet Health 1(7):e277–e288, PMID: 29851626, https://doi.org/10.1016/S2542-5196(17)30119-5.
3. Speck J. 2012. *Walkable City: How Downtown Can Save America, One Step at a Time*. New York, NY: Farrer, Straus and Giroux.
4. Tobin M, Hajna S, Orychock K, Ross N, DeVries M, Villeneuve PJ, et al. 2022. Rethinking walkability and developing a conceptual definition of active living environments to guide research and practice. BMC Public Health 22(1):450, PMID: 35255841, https://doi.org/10.1186/s12889-022-12747-3.
5. India-Aldana S, Rundle AG, Zeleniuch-Jacquotte A, Quinn JW, Kim B, Afanasyeva Y, et al. 2021. Neighborhood walkability and mortality in a prospective cohort of women. Epidemiology 32(6):763–772, PMID: 34347687, https://doi.org/10.1097/EDE.0000000000001406.
6. Lang JJ, Pinault L, Colley RC, Prince SA, Christidis T, Tjepkema M, et al. 2022. Neighbourhood walkability and mortality: findings from a 15-year follow-up of a nationally representative cohort of Canadian adults in urban areas. Environ Int 161:107141, PMID: 35183941, https://doi.org/10.1016/j.envint.2022.107141.
7. India-Aldana S, Rundle AG, Quinn JW, Clendenen TV, Afanasyeva Y, Koenig KL, et al. 2023. Long-term exposure to walkable residential neighborhoods and risk of obesity-related cancer in the New York University Women's Health Study (NYUWHS). Environ Health Perspect 131(10):107001, https://doi.org/10.1289/EHP11538.
8. Fortner RT, Brantley KD, Tworoger SS, Tamimi RM, Rosner B, Farvid MS, et al. 2023. Physical activity and breast cancer survival: results from the Nurses' Health Studies. JNCI Cancer Spectr 7(1):pkac085. PMID: 36477805, https://doi.org/10.1093/jncics/pkac085.
9. Cervero R, Kockelman K. 1997. Travel demand and the 3Ds: density, diversity, and design. Transp Res D Transp Environ 2(3):199–219, https://doi.org/10.1016/S1361-9209(97)00009-6.
10. Herrmann T, Gleckner W, Wasfi RA, Thierry B, Kestens Y, Ross NA. 2019. A pan-Canadian measure of active living environments using open data. Health Rep 30(5):16–25, PMID: 31091332, https://doi.org/10.25318/82-003-x201900500002-eng.
11. Sallis JF, Cerin E, Conway TL, Adams MA, Frank LD, Pratt M, et al. 2016. Physical activity in relation to urban environments in 14 cities worldwide: a cross-sectional study. Lancet 387(10034):2207–2217, PMID: 27045735, https://doi.org/10.1016/S0140-6736(15)01284-2.
12. Ewing R, Cervero R. 2010. Travel and the built environment. J Am Plann Assoc 76(3):265–294, https://doi.org/10.1080/01944361003766766.
13. Lo RH. 2009. Walkability: what is it? J Urban 2(2):145–166, https://doi.org/10.1080/17549170903092867.
14. Shields R, Gomes da Silva EJ, Lima e Lima T, Osorio N. 2023. Walkability: a review of trends. J Urban 16(1):19–41, https://doi.org/10.1080/17549175.2021.1936601.
15. Roscoe C, Sheridan C, Geneshka M, Hodgson S, Vineis P, Gulliver J, et al. 2022. Green walkability and physical activity in UK Biobank: a cross-sectional analysis of adults in Greater London. Int J Environ Res Public Health 19(7):4247, PMID: 35409927, https://doi.org/10.3390/ijerph19074247.
16. Zhu J, Kodali H, Wyka KE, Huang TT-K. 2023. Perceived neighborhood environment walkability and health-related quality of life among predominantly Black and Latino adults in New York City. BMC Public Health 23(1):127, PMID: 36653809, https://doi.org/10.1186/s12889-022-14973-1.
17. Rundle AG, Chen Y, Quinn JW, Rahai N, Bartley K, Mooney SJ, et al. 2019. Development of a neighborhood walkability index for studying neighborhood physical activity contexts in communities across the U.S. over the past three decades. J Urban Health 96(4):583–590, PMID: 31214976, https://doi.org/10.1007/s11524-019-00370-4.
18. Conroy SM, Clarke CA, Yang J, Shariff-Marco S, Shvetsov YB, Park S-Y, et al. 2017. Contextual impact of neighborhood obesogenic factors on postmenopausal breast cancer: The Multiethnic Cohort. Cancer Epidemiol Biomarkers Prev 26(4):480–489, PMID: 28143808, https://doi.org/10.1158/1055-9965.EPI-16-0941.
19. Gomez SL, Shariff-Marco S, DeRouen M, Keegan THM, Yen IH, Mujahid M, et al. 2015. The impact of neighborhood social and built environment factors across the cancer continuum: current research, methodological considerations, and future directions. Cancer 121(14):2314–2330, PMID: 25847484, https://doi.org/10.1002/cncr.29345.
20. Westenhöfer J, Nouri E, Reschke ML, Seebach F, Buchcik J. 2023. Walkability and urban built environments—a systematic review of health impact assessments (HIA). BMC Public Health 23(1):518, https://doi.org/10.1186/s12889-023-15394-4.
21. Jepson EJ, Haines AL. 2014. Zoning for sustainability: a review and analysis of the zoning ordinances of 32 cities in the United States. J Am Plann Assoc 80(3):239–252, https://doi.org/10.1080/01944363.2014.981200.
22. Kärmeniemi M, Lankila T, Ikäheimo T, Koivumaa-Honkanen H, Korpelainen R. 2018. The built environment as a determinant of physical activity: a systematic review of longitudinal studies and natural experiments. Ann Behav Med 52(3):239–251, PMID: 29538664, https://doi.org/10.1093/abm/kax043.
23. Filigrana P, Levy JI, Gauthier J, Batterman S, Adar SD. 2022. Health benefits from cleaner vehicles and increased active transportation in Seattle, Washington. J Expo Sci Environ Epidemiol 32(4):538–544, PMID: 35288650, https://doi.org/10.1038/s41370-022-00423-y.
24. Pak B, Verbeke J. 2013. Walkability as a performance indicator for urban spaces. Crowdsourcing and Sensing 1:423–432. https://papers.cumincad.org/data/works/att/ecaade2013_178.content.pdf.
25. Wang J, Zhang X, Chai Y, Kwan M-P. 2023. A context-based approach for neighbourhood life circle delineation and internal spatial utilization analysis based on GIS and GPS tracking data. Appl Spat Anal Policy, https://doi.org/10.1007/s12061-023-09527-w.
26. James P, Wilt GE, Jimenez MP. 2022. Invited perspective: can my smartphone assess my exposure? The potential to retroactively estimate personalized exposures using smartphone location data. Environ Health Perspect 130(11):111304, PMID: 36356209, https://doi.org/10.1289/EHP12237.
27. Lynch K. 1964. *The Image of the City*. Cambridge, MA: MIT Press.
28. Parolek DG. 2020. *Missing Middle Housing: Thinking Big and Building Small to Respond to Today's Housing Crisis*. Washington, DC: Island Press.