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## Geographic and Urban–Rural Differences in Walking for Leisure and Transportation

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#### Abstract

**Introduction:** Walking can serve many purposes, such as transportation (to get some place) or leisure (for fun, relaxation, or exercise); therefore, it provides many opportunities for people to be physically active. This study examines geographic and urban–rural differences in walking in the U.S.

**Methods:** Adult respondents (aged 18 years) to the 2015 National Health Interview Survey reported participation in and time spent (minutes per week) walking for transportation and leisure in the past week. In 2017, prevalence and time spent walking (among walkers) for any, leisure, and transportation walking were estimated by nine expanded regions and urban–rural designation.

**Results:** Prevalence of any walking ranged from 50.8% (East South Central) to 72.4% (Pacific); for leisure walking 43.9% (East South Central) to 60.6% (Pacific); and transportation walking 17.8% (East South Central) to 43.5% (New England). Among walkers, mean minutes spent walking per week ranged from 77.4 (East South Central) to 101.6 (Pacific); for leisure walking 70.5 (West South Central) to 85.9 (Mountain); and for transportation walking 47.4 (East South Central) to 66.4 (Middle Atlantic). Overall, there were urban–rural differences in prevalence of walking; however, differences depended on walking purpose and expanded region. Time spent walking was similar in urban and rural areas.

**Conclusions:** Regional differences in walking prevalence and time spent walking exist. Urbanrural differences in prevalence of walking differ based on region and purpose; however, rural areas had a lower prevalence of walking than urban areas regardless of purpose in southern regions. Opportunities exist to improve walking, particularly among southern regions with a focus on rural areas.

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SUPPLEMENTAL MATERIAL

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#### INTRODUCTION

Strong evidence exists that physical activity has substantial health benefits.<sup>1,2</sup> Despite these benefits, only one half of U.S. adults report levels of physical activity consistent with the aerobic physical activity guideline.<sup>1,3</sup> People can get the benefits of physical activity through brisk walking or by adding brisk walking to other activities.<sup>1,4</sup> Walking may also be a good way for people who are inactive to become active.<sup>1,5</sup> Walking provides many opportunities for people to be physically active because it can serve many purposes, such as transportation (to get some place) or leisure (for fun, relaxation, or exercise).

Some population groups are more likely to walk than others; however, this can differ by walking purpose.<sup>6–9</sup> Men are more likely to report transportation walking whereas women are more likely to report leisure walking.<sup>6–8</sup> Differences by age have been shown for both types of walking, although transportation walking has more consistently been shown to decrease with increasing age.<sup>6–8</sup> Similarly, although racial/ethnic differences have been reported for both types of walking, patterns differ.<sup>6,7,9</sup> For example, in U.S. adults the prevalence of transportation walking is highest among non-Hispanic blacks, but leisure walking is lowest in that group.<sup>6</sup> Differences by the four U.S. Census regions (i.e., Midwest, Northeast, South, West) have also been observed for both types of walking.<sup>6,10,11</sup> In U.S. adults, the lowest prevalence of transportation and leisure walking is in the South; however, adjustments for demographic characteristics attenuated regional differences especially when examining leisure walking.<sup>6</sup> Differences in walking done for transportation purposes have also been examined across smaller geographic levels (e.g., state, city)<sup>12,13</sup>; however, state-and city-level comparisons across the nation are lacking for estimates specific to leisure walking.

Transportation walking<sup>10,14</sup> and physical activity<sup>15,16</sup> have been found to be lower among residents of rural compared with urban areas. In addition, transportation walking is correlated with residing in communities with higher density, greater connectivity, and more land use mix,<sup>17,18</sup> which are often characteristics of urban areas. For physical activity, urban–rural differences depended upon the region of residence, with differences most pronounced in the south<sup>15,16</sup>; however, studies have not focused on whether urban–rural differences in walking differ by region. Residents of rural areas compared with those living in urban areas often experience poorer health.<sup>19,20</sup> A deeper understanding of urban–rural differences in health behaviors, such as walking, provides important information to better understand and prioritize health promotion strategies.

This study is unique because it uses a nationally representative sample to examine walking for both leisure and transportation purposes (combined and separately) by demographic characteristics and across multiple geographic levels. Additionally, it examines urban–rural differences in prevalence and duration of walking for multiple purposes and whether these differences are consistent across nine U.S. regions. Understanding how types of walking differ by population groups and smaller geographic units (e.g., by state, by nine expanded geographic regions [overall and by urban–rural status]) will allow resources to be targeted more precisely to populations and areas in greatest need. The addition of these finer-grain estimates of walking may allow national, state, and local agencies to identify and leverage

opportunities for cross-sectoral partnerships to help promote walking and support local-level changes to create more walkable communities.

#### METHODS

#### Study Sample

The National Health Interview Survey (NHIS) is a multistage probability sample survey of U.S. households conducted annually and designed to be representative of the civilian, non-institutionalized U.S. population. The NHIS collects basic health and demographic information from all family members and additional information, such as information about walking for leisure and transportation, from one randomly selected adult (aged 18 years) as part of the Cancer Control Supplement. In 2015, the sample adult response rate was 55.2% and the sample size was 33,672.<sup>21</sup> Further details about the survey can be accessed from the NHIS website.<sup>22</sup>

#### Measures

To assess transportation walking, respondents were asked if they walked *to get some place* that took 10 minutes in the past 7 days. To assess leisure walking, respondents were asked if during the past 7 days they walked for 10 minutes *for fun, relaxation, exercise, or to walk the dog.* For both transportation and leisure walking, respondents who answered *yes* were asked additional questions about the number of times in the past 7 days they walked and the average amount of time they spent walking during an instance. Time spent walking among adults reporting walking was estimated by multiplying the times in the past 7 days they walked by the average duration of a trip. Time spent in transportation and leisure walking were summed to calculate time spent in any walking.

The National Center for Health Statistics provided state of residence as part of the restricted data set (i.e., accessible only in the Research Data Center). State of residence was used to categorize individuals as living in one of nine expanded regions: New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific. Expanded regions were based on subdivisions of the four U.S. Census regions into nine Census divisions<sup>23</sup>; however, similar to other analyses, the nine Census subdivisions were modified by moving Delaware, the District of Columbia, and Maryland into the Middle Atlantic region from the South Atlantic.<sup>24,25</sup>

Each respondent's residence was classified as urban or rural based on 2010 Census urbanrural designation and provided on the data set as a restricted variable. Detailed methods have been previously published.<sup>26</sup> Briefly, urban areas were identified as Census tracts with 1,000 people/mile<sup>2</sup> and adjacent tracts with 500 people/mile<sup>2</sup>. In addition, a select number of non-residential urban land uses and non-continuous urban developments were identified as urban. Any areas not identified as urban were designated as rural.

Information about demographic characteristics was reported during the interview. Age was categorized (18–24, 25–34, 35–44, 45–64, and 65 years) using reported age. Educational attainment was assessed in terms of the highest grade or year of school completed and categorized into four levels (less than high school, high school graduate, some college, and

college graduate). To assess race/ethnicity, respondents identified whether they consider themselves Hispanic or Latinx. All respondents then selected what race or races they consider themselves from a list and for people who choose more than one race, a question was asked about the one race that "best" describes them. Adults were classified into four race/ethnic groups (white, non-Hispanic; black, non-Hispanic; Hispanic; and other, non-Hispanic).

#### Statistical Analysis

For any walking and for each purpose (i.e., leisure, transportation), walking was examined using two measures: prevalence (proportion reporting walking for 10 minutes at a time during the past 7 days) and time spent walking among adults reporting walking. Given the study's focus on geographic differences, these two measures for any walking, leisure walking, and transportation walking were examined by nine expanded regions and urban-rural designation. Sample size constraints within states did not allow the authors to examine state-level estimates of time spent walking, therefore state-level estimates were limited to prevalence.

Multiple logistic regression models were used to examine the association between urban– rural designation X expanded region with walking prevalence. Because the interaction term between urban–rural designation X expanded region was significant in each model (any, leisure, and transportation), models stratified by expanded region were used to estimate prevalence ratios to examine the association between urban–rural designation X walking prevalence before and after adjustment for demographic characteristics. The distribution of weekly time spent walking among walkers was found to be approximately log normal. Multiple linear regression on log-transformed weekly minutes of time spent walking was used to obtain estimates of mean walking time by urban–rural designation and expanded region with and without adjustment for demographic characteristics. All pairwise tests for both measures were conducted with adjusted Wald tests with a Bonferroni correction for pairwise comparisons.

In 2017, analyses were performed in Stata, version 13, using survey commands to account for the complex survey design and weighting. Statistical tests were deemed significant at p < 0.05.

#### RESULTS

Survey participants with missing data on walking (n=1,902); demographic characteristics (n=134); or both (n=14) were excluded. In addition, adults who reported being unable to walk when responding to the walking question were excluded (n=886). The final analytic sample included 30,736 adults. In 2015, a total of 63.2% of U.S. adults reported any walking for 10 minutes. Walking for leisure was reported by 52.1% of adults, and 31.7% reported walking for transportation (Table 1).

The statewide prevalence of any walking ranged from 43.2% (Mississippi) to 87.0% (Washington DC; Figure 1, color coded by quintile, Appendix Table 1, available online). Similarly, state-level estimates varied for leisure walking, ranging from 36.0% (Arkansas) to

66.4% (Alaska), and for transportation walking, ranging from 14.5% (Mississippi) to 78.4% (Washington DC; Figure 2, Appendix Table 1, available online).

Walking varied by nine expanded regions for any (p < 0.001); leisure (p < 0.001); and transportation walking (p < 0.001; Table 1). Prevalence of any walking ranged from 50.8% (East South Central) to 72.4% (Pacific). Similarly, prevalence of leisure walking ranged from 43.9% (East South Central) to 60.6% (Pacific). Prevalence of transportation walking ranged from 17.8% (East South Central) to 43.5% (New England).

Walking prevalence also varied by urban–rural designation. Overall, the prevalence of any walking, leisure walking, and transportation walking was lower among adults residing in rural compared with urban areas. The magnitude of the urban–rural difference was less pronounced for leisure compared with transportation walking (Table 1). Adjustment for demographic characteristics attenuated urban–rural differences in walking prevalence in all domains; after adjustment, the overall urban–rural difference in leisure walking was no longer significant.

For any walking, a significant interaction (unadjusted: p=0.035, adjusted: p=0.045) was observed between expanded region X urban–rural designation. Urban–rural differences in walking prevalence before and after adjustment for demographic characteristics reached significance in three of the nine expanded regions (South Atlantic and East and West South Central).

For leisure walking, a significant interaction (unadjusted p=0.002, adjusted p=0.005) was observed between expanded region X urban–rural designation. Urban–rural differences in leisure walking prevalence before and after adjustment for demographic characteristics were significant with a negative association for rural residence in three of the nine expanded regions (South Atlantic and East and West South Central).

For transportation walking, a significant interaction (unadjusted p=0.026, adjusted p=0.024) was also observed between expanded region X urban–rural designation. Urban–rural differences in transportation walking prevalence before and after adjustment for demographic characteristics were significant for seven of the nine expanded regions (New England, Middle Atlantic, East North Central, South Atlantic, East South Central, West South Central, and Pacific).

Among adults reporting walking, mean minutes of time spent walking was not significantly associated with urban–rural designation for any (p=0.07); leisure (p=0.96); and transportation walking (p=0.06). Mean weekly minutes of time spent walking among adults reporting walking significantly varied by nine expanded regions for any (p < 0.001); leisure (p < 0.001); and transportation walking (p < 0.001; Table 2), and this variation remained significant after adjusting for demographic characteristics. Unadjusted mean weekly minutes of any walking (among adult walkers) ranged from 77.4 (East South Central) to 101.6 minutes (Pacific). Mean weekly minutes of leisure walking among adult leisure walkers ranged from 70.5 (West South Central) to 85.9 minutes (Mountain); among transportation walkers, mean minutes ranged from 47.4 (East South Central) to 66.4 minutes (Middle

Atlantic). Adjustment for demographic characteristics had little effect on the estimates of time spent walking.

#### DISCUSSION

Substantial regional variation in the self-reported prevalence of walking and time spent walking exist. Urban–rural variation in walking prevalence differed based on the purpose of walking and region of residence, though differences did not exist in time spent walking among adults who walk. Urban–rural differences existed in prevalence of transportation walking for most regions with the exception of the Mountain and West North Central regions, whereas for leisure walking urban–rural differences existed only for three southern regions (South Atlantic and East and West South Central). Opportunities exist to increase walking, particularly among southern regions with a focus on rural areas.

Previous studies examining geographic differences in walking found results consistent with this study; however, data sources used in other studies did not allow for examination of leisure and transportation walking separately and combined. When examining estimates of the prevalence of transportation walking, specifically walking to work, from the 2008–2012 American Community Survey by four Census regions, the Northeast had the highest prevalence and the South had the lowest.<sup>10</sup> In addition, within each of the U.S. Census regions walking to work was more prevalent in large cities than small or mediumsized cities.<sup>10</sup> Estimates from the 2009 National Household Travel Survey showed that the prevalence of any walking for at least 30 minutes per day was higher for urban areas (9.1%) compared with rural areas (4.4%); however, this study did not explore whether this finding was consistent across regions or purposes.<sup>14</sup> Finally, a study using 2010 NHIS data found similar results, with prevalence of walking (any, leisure, and transportation) lowest in the South region compared with the other three Census regions.<sup>6</sup>

Findings further highlight the geographic differences that exist in walking. Southern regions, particularly the East and West South Central, had lower levels of participation in any walking and time spent walking when compared with most other regions. This is consistent with previous studies that have found southern regions of the U.S. to have higher levels of many chronic disease risk factors and diseases, such as physical inactivity, obesity, heart disease, and stroke.<sup>16,27,28</sup> Several community-level factors may contribute to regional differences in walking, including differences in the presence of community supports and barriers to walking. Adults living in southern regions report less access to community supports for walking (e.g., infrastructure supports, destinations to walk to).<sup>29,30</sup> Also, some safety-related barriers (e.g., dogs or other animals) to walking are more prevalent in the South Census region versus other regions.<sup>29</sup> Finally, policies supportive of walking (e.g., Complete Streets policies) that can serve as levers for improving community supports for walking are less likely to be adopted in southern municipalities.<sup>31</sup>

Urban–rural differences in the prevalence of walking differed based on purpose. Urban–rural differences were found in prevalence of transportation walking in most regions; however, urban–rural differences in the prevalence of leisure walking were present only in southern regions (i.e., South Atlantic and East and West South Central). In general, adjusting

prevalence ratios for demographic characteristics attenuated the urban–rural differences, but it did not change the interpretation. Urban–rural differences in transportation walking were found to be relatively consistent across regions. Walking for transportation has been more closely associated than leisure walking with selected built environment attributes, such as destinations to walk to, transit stops, and pedestrian infrastructure,<sup>29,32,33</sup> and these attributes are more commonly reported by adults residing in urban than rural areas.<sup>29,34</sup> Another reason may be that adults who are interested in walking for transportation choose to live in more urban areas.<sup>35,36</sup> It is unclear why urban–rural differences in the prevalence of leisure walking were observed only in southern regions; however, this finding is consistent with another study that concluded urban–rural differences in leisure-time physical activity levels were most striking in the South Census region and absent in other regions.<sup>15</sup>

Implementing community strategies where people live, learn, work, and play can help promote walking. For example, communities can enhance the design of their streets to make walking safer and easier or they can offer programs to support and encourage walking.<sup>4</sup> Regional, as well as urban–rural differences exist in walking, and it is important to account for these differences when developing and implementing community strategies to promote walking. Importantly, proven strategies are not limited in scope to urban areas. Case studies of what small towns and rural communities in different regions are doing to promote walking and walkability are available and may help these communities get started.<sup>37–39</sup> For example, the Department of Transportation's publication, *Small Town and Rural Multimodal Networks*, is a design resource and idea book to help small towns and rural communities support active travel.<sup>37</sup>

#### Limitations

This study is subject to a number of limitations. First, information related to the reliability and validity of the walking measure is not available and the analysis is based on self-report. Second, information about walking for bouts less than 10 minutes was not collected and this may especially influence the estimates of transportation walking that is often done in shorter bouts.<sup>11</sup> If participation in these short bouts differs by region or urban–rural designation, then patterns observed may have changed if these shorter bouts were captured. For example, trips may be shorter in urban areas; therefore, omitting these shorter bouts may have diluted urban–rural differences. Third, the urban–rural designation used was rather broad and did not allow for examination of differences across finer levels of urbanization. Fourth, the survey response rate was 55.2%, and this could contribute to response bias if nonresponders differed systematically from responders. However, survey weights may help to reduce the influence of nonresponse. Finally, about 6% of respondents dropped out prior to completing the Cancer Control Supplement and were therefore missing data on walking.

This study also has a number of strengths. It is based on a nationally representative survey, and the large sample size and the richness of the data collected enable multiple and stratified analysis of walking among U.S. adults based on a large number of covariates. In addition, by doing analysis at the Research Data Center it was possible to obtain estimates for geographic units finer than the four U.S. Census regions and to examine differences by urban–rural designation.

#### CONCLUSIONS

Substantial regional differences in walking prevalence and time spent walking exist. Urbanrural differences in the prevalence of walking differ based on walking purpose; however, rural residents in southern regions had a lower prevalence of walking than urban residents regardless of purpose. Opportunities exist to improve walking particularly among southern regions of the U.S. with a focus on rural areas.

#### **Supplementary Material**

Refer to Web version on PubMed Central for supplementary material.

#### ACKNOWLEDGMENTS

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

#### REFERENCES

- 1. HHS. 2008 Physical Activity Guidelines for Americans. Washington, DC: HHS; 2008.
- 2. Physical Activity Guidelines Advisory Committee. Physical Activity Guidelines Advisory Committee Report. Washington, DC: HHS, 2008.
- 3. HHS. Healthy People 2020: Data 2020. www.healthypeople.gov/2020/data-search/. Accessed July 13, 2017.
- 4. HHS. Step It Up! The Surgeon General's Call to Action to Promote Walking and Walkable Communities. Washington, DC: HHS, Office of the Surgeon General; 2015.
- Morris JN, Hardman AE. Walking to health. Sports Med. 1997;23(5):306–332. 10.2165/00007256-199723050-00004. [PubMed: 9181668]
- Paul P, Carlson SA, Carroll DD, Berrigan D, Fulton JE. Walking for transportation and leisure among U.S. adults—National Health Interview Survey 2010. J Phys Act Health. 2015;12(suppl 1):S62–S69. 10.1123/jpah.2013-0519. [PubMed: 25133651]
- Kruger J, Ham SA, Berrigan D, Ballard-Barbash R. Prevalence of transportation and leisure walking among U.S. adults. Prev Med. 2008;47(3):329–334. 10.1016/j.ypmed.2008.02.018. [PubMed: 18445507]
- Lee C, Moudon AV. Correlates of walking for transportation or recreation purposes. J Phys Act Health. 2006;3(suppl 1):S77–S98. 10.1123/jpah.3.s1.s77. [PubMed: 28834524]
- Tudor-Locke C, Ham SA. Walking behaviors reported in the American Time Use Survey 2003– 2005. J Phys Act Health. 2008;5(5):633–647. 10.1123/jpah.5.5.633. [PubMed: 18820341]
- McKenzie B Modes Less Traveled—Bicycling and Walking to Work in the United States: 2008– 2012. New York: U.S. Census Bureau; 2014.
- Yang Y, Diez-Roux AV. Walking distance by trip purpose and population subgroups. Am J Prev Med. 2012;43(1):11–19. 10.1016/j.amepre.2012.03.015. [PubMed: 22704740]
- Polzin S, Pisarski A. Commuting in America 2013: The National Report on Commuting Patterns and Trends. Washington, DC: American Association of State Highway and Transportation Officials; 2015.
- 13. U.S. Department of Transportation, Federal Highway Administration, 2009. National Household Travel Survey. http://nhts.ornl.gov/tools.shtml. Accessed May 4, 2018.
- Pucher J, Buehler R, Merom D, Bauman A. Walking and cycling in the United States, 2001–2009: evidence from the National Household Travel Surveys. Am J Public Health. 2011;101(suppl 1):S310–S317. 10.2105/AJPH.2010.300067. [PubMed: 21551387]
- Martin SL, Kirkner GJ, Mayo K, et al. Urban, rural, and regional variations in physical activity. J Rural Health. 2005;21(3):239–244. 10.1111/j.1748-0361.2005.tb00089.x. [PubMed: 16092298]

- Reis JP, Bowles HR, Ainsworth BE, et al. Nonoccupational physical activity by degree of urbanization and U.S. geographic region. Med Sci Sports Exerc. 2004;36(12):2093–2098. 10.1249/01.MSS.0000147589.98744.85. [PubMed: 15570145]
- Saelens BE, Sallis JF, Frank LD. Environmental correlates of walking and cycling: findings from the transportation, urban design, and planning literatures. Ann Behav Med. 2003;25(2):80–91. 10.1207/S15324796ABM2502\_03. [PubMed: 12704009]
- Saelens BE, Handy SL. Built environment correlates of walking: a review. Med Sci Sports Exerc. 2008;40(suppl 7):S550–S566. 10.1249/MSS.0b013e31817c67a4. [PubMed: 18562973]
- Anderson TJ, Saman DM, Lipsky MS, Lutfiyya MN. A cross-sectional study on health differences between rural and non-rural U.S. counties using the County Health Rankings. BMC Health Serv Res. 2015;15(1):441. 10.1186/s12913-015-1053-3. [PubMed: 26423746]
- Singh GK, Siahpush M. Widening rural-urban disparities in life expectancy, U.S., 1969–2009. Am J Prev Med. 2014;46(2):e19–e29. 10.1016/j.amepre.2013.10.017. [PubMed: 24439358]
- 21. Centers for Disease Control and Prevention (CDC), National Center for Health Statistics, 2015. Survey description, National Health Interview Survey. ftp://ftp.cdc.gov/pub/Health\_Statistics/ NCHS/Dataset\_Documentation/NHIS/2015/srvydesc.pdf. Published 2016. Accessed July 13, 2017
- 22. Centers for Disease Control and Prevention (CDC), National Center for Health Statistics. National Health Interview Survey. www.cdc.gov/nchs/nhis/index.htm. Accessed July 17, 2017.
- 23. U.S. Department of Commerce Economics and Statistics Administration, U.S. Census Bureau. Census Regions and Divisions of the United States. Published 2013.
- 24. Cohen RA, Martinez ME, Zammitti EP. Health Insurance Coverage: Early Release of Estimates from the National Health Interview Survey, 2015. National Center for Health Statistics; 2016.
- 25. Holahan J, Buettgens M, Carroll C, Dorn S. The cost and coverage implications of the ACA Medicaid expansion: national and state-bystate analysis. http://kaiserfamilyfoundation.files.wordpress.com/2013/01/8384.pdf. Published 2012. Accessed September 25, 2017.
- Ratcliffe M, Burd C, Holder K, Fields A. Defining rural at the U.S. Census Bureau: American Community Survey and Geography Brief. U.S. Department of Commerce Economics and Statistics Administration, U.S. Census Bureau; 2016.
- Go AS, Mozaffarian D, Roger VL, et al. Heart disease and stroke statistics–2014 update: a report from the American Heart Association. Circulation. 2014;129(3):e28. 10.1161/01.cir.0000441139.02102.80. [PubMed: 24352519]
- Myers CA, Slack T, Martin CK, Broyles ST, Heymsfield SB. Regional disparities in obesity prevalence in the United States: a spatial regime analysis. Obesity. 2015;23(2):481–487. 10.1002/ oby.20963. [PubMed: 25521074]
- Paul P, Carlson SA, Fulton JE. Walking and the perception of neighborhood attributes among U.S. adults, 2012. J Phys Act Health. 2017;14(1):36–44. 10.1123/jpah.2015-0685. [PubMed: 27775464]
- Whitfield GP, Carlson SA, Ussery EN, et al. Environmental supports for physical activity, National Health Interview Survey—2015. Am J Prev Med. 2018;54(2):294–298. 10.1016/ j.amepre.2017.09.013. [PubMed: 29246673]
- Carlson SA, Paul P, Kumar G, et al. Prevalence of Complete Streets policies in U.S. municipalities. J Transp Health. 2017;5:142–150. 10.1016/j.jth.2016.11.003.
- 32. Sugiyama T, Neuhaus M, Cole R, Giles-Corti B, Owen N. Destination and route attributes associated with adults' walking: a review. Med Sci Sports Exerc. 2012;44(7):1275–1286. 10.1249/ MSS.0b013e318247d286. [PubMed: 22217568]
- Karsch H, Hedlund J, Tison J, Leaf W. Review of studies on pedestrian and bicyclist safety, 1991–2007 (Report No. DOT HS 811 614). Washington, DC: National Highway Traffic Safety Administration; 2012.
- Carlson SA, Watson KB, Paul P, Schmid TL, Fulton JE. Understanding the demographic differences in neighborhood walking supports. J Phys Act Health. 2017;14(4):253–264. 10.1123/ jpah.2016-0273. [PubMed: 28032804]

- Boone-Heinonen J, Gordon-Larsen P, Guilkey DK, Jacobs DR Jr., Popkin BM. Environment and physical activity dynamics: the role of residential self-selection. Psychol Sport Exerc. 2011;12(1):54–60. 10.1016/j.psychsport.2009.09.003. [PubMed: 21516236]
- 36. Myers D Peak millennials: three reinforcing cycles that amplify the rise and fall of urban concentration by millennials. Hous Policy Debate. 2016;26(6):928–947. 10.1080/10511482.2016.1165722.
- 37. U.S. Department of Transportation, Federal Highway Administration. Small Town and Rural Multimodal Networks; 2016.
- 38. National Physical Activity Society. Stories from Small Towns: America Paves the Way for Connected Citizens, Health, and Town Pride. Atlanta, GA; 2016.
- Loh TH, Walljasper J, Sonenklar D, Mills K, Levinger D. Active Transportation Beyond Urban Centers: Walking and Bicycling in Small Towns and Rural America. Washington, DC: Rails-to-Trails Conservancy; 2012.



#### Figure 1.

Prevalence of any walking in the past 7 days among adults by state, National Health Interview Survey 2015.





#### Figure 2.

Prevalence of leisure and transportation walking in the past 7 days among adults by state, National Health Interview Survey 2015.

## Table 1.

Prevalence of Walking Among Adults by Expanded Region and Urban-Rural Designation, NHIS 2015.

		By urban-rura	l designation <sup>b</sup>	Prevalence ra	ntio (95% CI) (ref: urban)
Walking type by expanded region $a$	Overall, % (95% CI) <sup>c</sup>	Urban, % (95% CI)	Rural, % (95% CI)	Unadjusted	Adjusted for demographics <sup>d</sup>
Any walking	63.2 (62.3, 64.0)	65.0 (64.1, 65.9)	55.3 (53.3, 57.3)	0.85 (0.82, 0.88)	0.92 (0.88, 0.95)
New England	$70.3 (66.7, 74.0)^{W.X}$	70.6 (66.3, 74.5)	69.1 (61.2, 76.0)	0.98 (0.86, 1.10)	0.97 (0.85, 1.09)
Middle Atlantic	$64.9~(62.7,~67.0)^{W,Y}$	65.6 (63.2, 68.0)	60.5 (54.9, 65.8)	0.92 (0.83, 1.01)	0.98 (0.88, 1.07)
East North Central	$60.4~(58.2, 62.6)^{Y,Z}$	61.4 (59.1, 63.7)	56.2 (51.2, 61.1)	0.92 (0.83, 1.00)	0.96 (0.87, 1.05)
West North Central	62.8 (59.9, 65.7) <sup>W.Y.Z</sup>	64.3 (60.8, 67.6)	59.9 (55.5, 64.1)	0.93 (0.86, 1.00)	0.97 (0.90, 1.04)
South Atlantic	$60.0 (57.3, 62.6)^{Y,Z}$	62.5 (59.8, 65.2)	51.4 (46.5, 56.3)	0.82 (0.74, 0.90)	0.85 (0.77, 0.93)
East South Central	50.8 (46.2, 55.3)	57.4 (52.5, 62.3)	40.2 (35.3, 45.4)	0.70 (0.61, 0.80)	0.78 (0.69, 0.88)
West South Central	$59.1~(56.9, 61.3)^Z$	60.8 (58.6, 63.0)	51.2 (45.2, 57.2)	0.84 (0.74, 0.94)	0.86 (0.76, 0.96)
Mountain	$64.1 \ (61.1, \ 67.1)^{W,Y,Z}$	64.3 (61.3, 67.1)	63.0 (53.5, 71.7)	0.98 (0.84, 1.12)	0.99 (0.83, 1.15)
Pacific	72.4 (70.3, 74.4) <sup>X</sup>	72.9 (70.8, 74.9)	65.7 (57.4, 73.1)	0.90 (0.79, 1.01)	0.90 (0.79, 1.00)
Leisure walking	52.1 (51.2, 53.0)	53.0 (52.0, 53.9)	48.3 (46.1, 50.5)	0.91(0.87, 0.95)	0.97 (0.92, 1.02)
New England	$53.0~(49.0, 57.0)^{W}$	53.0 (48.7, 57.3)	52.8 (44.8, 60.7)	1.00 (0.84, 1.16)	0.97 (0.80, 1.14)
Middle Atlantic	49.9 (47.6, 52.2) <sup>W.X</sup>	49.2 (46.8, 51.7)	53.7 (48.0, 59.4)	1.09 (0.96, 1.22)	1.09 (0.95, 1.22)
East North Central	50.5 (48.2, $52.7$ ) <sup><math>W,X</math></sup>	50.6 (48.3, 52.8)	49.9 (43.9, 55.8)	0.99 (0.86, 1.11)	1.02 (0.90, 1.15)
West North Central	$53.6\left(50.2,56.9 ight)^W$	54.4 (50.6, 58.1)	51.9 (46.7, 57.2)	0.96 (0.85, 1.06)	1.00 (0.90, 1.09)
South Atlantic	$50.6(47.9, 53.3)^{W.X}$	51.9 (49.0, 54.8)	46.1 (41.3, 50.9)	0.89 (0.79, 0.98)	0.90 (0.80, 0.99)
East South Central	$43.9~(40.2, 47.6)^X$	49.3 (45.6, 53.1)	35.3 (30.5, 40.5)	0.72 (0.61, 0.82)	0.80 (0.71, 0.90)
West South Central	$49.6(47.1, 52.1)^{W,X}$	51.1 (48.6, 53.6)	42.7 (35.7, 49.9)	0.83 (0.69, 0.98)	0.85 (0.71, 0.99)
Mountain	$52.9$ $(49.9, 55.9)^{W}$	52.9 (49.9, 55.8)	53.2 (44.8, 61.4)	1.01 (0.85,1.17)	1.00 (0.83, 1.17)
Pacific	60.6 (58.5, 62.6)	60.5 (58.5, 62.6)	60.8 (51.7, 69.2)	1.00 (0.86, 1.15)	$0.99\ (0.85,1.13)$
Transportation walking	31.7 (30.8, 32.5)	34.1 (33.1, 35.0)	21.1 (19.4, 22.8)	0.62 (0.57, 0.67)	0.71 (0.65, 0.77)

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		By urban-rura	l designation	Prevalence ra	atio (95% CI) (ref: urban)
Walking type by expanded region <sup>a</sup>	Overall, % (95% $\mathrm{CI})^{c}$	Urban, % (95% CI)	Rural, % (95% CI)	Unadjusted	Adjusted for demographics
New England	$43.5\ (39.0,48.0)^{W}$	$46.0\ (41.1, 51.0)$	32.8 (24.9, 41.9)	0.71 (0.51, 0.92)	0.76 (0.56, 0.96)
Middle Atlantic	$39.6(37.1, 42.1)^W$	42.3 (39.5, 45.2)	23.1 (18.2, 28.9)	0.55 (0.41, 0.68)	0.68 (0.51, 0.84)
East North Central	$28.6 (26.5, 30.7)^X$	30.9 (28.7, 33.3)	19.0 (15.8, 22.6)	0.61(0.50, 0.73)	0.70 (0.56, 0.83)
West North Central	$28.4~(25.8, 31.0)^X$	30.0 (26.7, 33.4)	25.2 (21.1, 29.9)	0.84 (0.67, 1.02)	0.91 (0.73,1.10)
South Atlantic	$27.3 (25.2, 29.4)^X$	29.3 (27.1, 31.6)	20.4 (16.1, 25.5)	0.70 (0.53, 0.86)	0.77 (0.59, 0.95)
East South Central	17.8 (14.7, 20.9)	21.1 (17.4, 25.4)	12.6 (9.7, 16.3)	$0.60\ (0.41,\ 0.79)$	0.70 (0.45, 0.94)
West South Central	$25.6(23.6, 27.7)^X$	26.9 (24.8, 29.0)	20.1 (15.6, 25.5)	0.75 (0.56, 0.93)	0.76 (0.57, 0.94)
Mountain	30.5 (27.4, 33.6) <sup>X</sup>	31.0 (27.9, 34.3)	27.0 (20.0, 35.3)	0.87 (0.62, 1.12)	0.90 (0.63, 1.17)
Pacific	$39.1\ (36.9, 41.4)^W$	40.6 (38.2, 43.1)	22.1 (17.1, 28.1)	$0.54\ (0.40,\ 0.69)$	0.57 (0.42, 0.71)
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*Note*: Boldface indicates statistical significance (p < 0.05).

<sup>a</sup>Expanded region was categorized as New England (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont); Middle Atlantic (Delaware, Washington DC, Maryland, New Jersey, New York, and Pennsylvania); East North Central (Illinois, Indiana, Michigan, Ohio, and Wisconsin); West North Central (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota); weighted population distribution by expanded region is as follows: New England, 4.3%; Middle Atlantic, 15.6%; East North Central, 15.6%; West North Central, 6.6%; South Atlantic, 16.9%; East South Louisiana, Oklahoma, and Texas); Mountain (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming); and Pacific (Alaska, California, Hawaii, Oregon, and Washington). The South Atlantic (Florida, Georgia, North Carolina, South Carolina, Virginia, and West Virginia); East South Central (Alabama, Kentucky, Mississippi, and Tennessee); West South Central (Arkansas, Central, 5.6%; West South Central, 11.9%; Mountain, 6.7%; Pacific, 16.7%

<sup>b</sup>The weighted percentage of the population residing in an area designated as urban is 81.3%. Percentage by region: New England, 81.1%; Middle Atlantic, 85.9%; East North Central, 80.5%; West North Central, 66.3%; South Atlantic, 77.1%; East South Central, 61.2%; West South Central, 81.9%; Mountain, 87.5%; Pacific, 92.0%.

 $c_{\rm S}$  Superscript letters (W,X,Y,Z) indicate non-significant differences: within subgroups, values that share a letter are not significantly different (Bonferroni corrected p 0.05).

 $^{d}_{\rm ddjusted}$  models include sex, age group, race/ethnicity, education level, and urban-rural designation.

NHIS, National Health Interview Survey.

Table 2.

Mean Minutes of Walking Among Adults by Urban-Rural Designation and Expanded Region, NHIS 2015

	<u>Mean minutes per week a</u>	mong walkers (95% CI) <sup>b</sup>
Walking type by urban-rural designation and expanded region ${}^{a}$	Unadjusted	Adjusted <sup>c</sup>
Any walking	92.6 (90.7, 94.5)	93.1 (91.2, 95.0)
Urban-rural designation		
Urban	93.5 (91.5, 95.5) <sup>W</sup>	93.5 (91.4, 95.5) <sup>W</sup>
Rural	$88.1 \ (82.8, 93.4)^W$	$91.0\ (85.3, 96.6)^W$
Expanded region d		
New England	$92.6(84.1,101.1)^{W,X,Y,Z}$	$91.8 (83.4, 100.1)^{W,X,Y,Z}$
Middle Atlantic	$100.3 (94.9, 105.7)^{W}$	$100.1 \ (94.7, 105.5)^{W,X}$
East North Central	$87.5 (82.5, 92.4)^{X,Y,Z}$	$88.4 \ (83.4, 93.3)^{W,Y,Z}$
West North Central	$84.2~(79.7, 88.7)^{X,Y}$	$84.8\ (80.1,\ 89.5)^{V,Z}$
South Atlantic	$94.5 (89.2, 99.7)^{W,Y,Z}$	94.8 (89.6, 100.0) $^{W,X,Y}$
East South Central	77.4 (70.8, 83.9) $^{X}$	78.9 (72.2, 85.5) <sup>Z</sup>
West South Central	$80.5 (76.4, 84.5)^X$	$80.9 \left(76.8, 85.0\right)^Z$
Mountain	$99.4~(93.8, 104.9)^{W,Z}$	99.6 (94.1, 105.1) $^{W,X}$
Pacific	$101.6(96.5,106.7)^W$	$101.2 (95.9, 106.5)^X$
Leisure walking	79.8 (78.2, 81.4)	80.4 (78.8, 82.0)
Urban-rural designation		
Urban	$79.8~(78.0, 81.5)^{W}$	80.4 (78.6, 82.2) <sup>W</sup>
Rural	79.9 (75.2, 84.6) <sup>W</sup>	80.5 (75.6, 85.4) <sup>W</sup>
Expanded region d		
New England	$81.2(73.1, 89.4)^{W.X}$	79.3 $(71.6, 87.1)^{W,X}$
Middle Atlantic	83.9 (79.3, 88.5) <sup>W</sup>	83.6 (79.0, 88.2) <sup>W</sup>

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	<u>Mean minutes per week a</u>	mong walkers (95% CI) $^{b}$
Walking type by urban–rural designation and expanded region	Unadjusted	Adjusted <sup>c</sup>
East North Central	77.7 (73.6, 81.8) <sup>W.X</sup>	78.7 (74.6, 82.8) <sup>W.X</sup>
West North Central	72.3 (68.0, 76.7) <sup>X</sup>	72.1 (67.7, 76.5) <sup>X</sup>
South Atlantic	83.7 (79.6, 87.9) <sup>W</sup>	84.1 (80.0, 88.2) <sup>W</sup>
East South Central	72.9 (66.0, 79.7) <sup>W.X</sup>	74.5 $(67.5, 81.5)^{W,X}$
West South Central	$70.5 (66.8, 74.3)^X$	$71.8 (67.9, 75.7)^X$
Mountain	$85.9~(80.9, 90.9)^{W}$	86.4 (81.5, 91.3) <sup>W</sup>
Pacific	$83.0\ (78.9,\ 87.1)^W$	83.9 (79.6, 88.2) <sup>W</sup>
Transportation walking	59.4 (57.6, 61.1)	59.6 (57.8, 61.3)
Urban-rural designation		
Urban	$60.0~(58.1,~61.8)^{W}$	59.8 (58.0, 61.7) <sup>W</sup>
Rural	55.3 (50.8, 59.7) <sup>W</sup>	57.9 (53.0, 62.7) <sup>W</sup>
Expanded region d		
New England	$57.4 (51.1, 63.6)^{W,X,Y,Z}$	$58.6(52.0, 65.1)^{W,X,Y,Z}$
Middle Atlantic	$66.4 \ (61.8, \ 71.1)^W$	66.5 (61.8, 71.2) <sup>W</sup>
East North Central	$54.8 (50.2, 59.5)^{X,Y,Z}$	$55.7 (51.1, 60.3)^{W,X,Y,Z}$
West North Central	$53.8 (49.7, 57.9)^{X,Y,Z}$	$55.4 (51.1, 59.8)^{X,Y,Z}$
South Atlantic	$60.6 (55.6, 65.5)^{W,Y,Z}$	$60.8 (55.8, 65.8)^{W,Y,Z}$
East South Central	$47.4 \ (41.5, 53.2)^X$	$48.0 (42.0, 54.1)^X$
West South Central	$52.0~(46.9, 57.0)^{X,Y}$	51.7 (46.7, 56.7) <sup>X.Y</sup>
Mountain	$64.4~(58.9,~69.8)^{W,Z}$	65.1 (59.5, 70.6) <sup>W,Z</sup>
Pacific	$61.9(57.8, 66.0)^{W,Y,Z}$	$61.3 (57.1, 65.5)^{W,Y,Z}$

b Superscript letters (<sup>W,X,Y,Z</sup>) indicate non-significant differences: within subgroups, values that share a letter are not significantly different (Bonferroni corrected p 0.05).

 $^{a}$ Number of walkers: any, 19,219; leisure, 15,715; transportation, 9,881.

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 $^{\mathcal{C}}$ djusted models include sex, age group, race/ethnicity, education level, urban-rural designation, and expanded region.

d Expanded region was categorized as New England (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont); Middle Atlantic (Delaware, Washington DC, Maryland, New Jersey, New York, and Pennsylvania); East North Central (Illinois, Indiana, Michigan, Ohio, and Wisconsin); West North Central (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota); South Atlantic (Florida, Georgia, North Carolina, South Carolina, Virginia, and West Virginia); East South Central (Alabama, Kentucky, Mississippi, and Tennessee); West South Central (Arkansas, Louisiana, Oklahoma, and Texas); Mountain (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming); and Pacific (Alaska, California, Hawaii, Oregon, and Washington).

NHIS, National Health Interview Survey.