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Intrapersonal and Environmental Correlates of Bicycling in U.S. Adults

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Abstract

Introduction—Bicycling is a health promoting physical activity, but little is known about the factors that influence this behavior in the U.S. The objective of this cross-sectional study was to identify multilevel ecologic correlates of bicycling behaviors in a nationally representative sample of U.S. adults.

Methods—This analysis, conducted in 2016/2017, utilized data from the 2012 National Survey of Bicyclist and Pedestrian Attitudes and Behaviors ($n=7,509$; $N=246,155,593$). Weighted logistic regression models were utilized to examine the association between intrapersonal, perceived environment, and objective environment variables and total, recreation, and transportation bicycling.

Results—Significant differences were identified when bicyclists were compared with non-bicyclists. Respondents whose most recent ride was for recreation had significantly higher odds of being male, younger, white, and college educated, and significantly lower odds of being retired or a homemaker. Respondents who reported that their most recent ride was for transportation had significantly higher odds of being male, younger, and a student, and had significantly lower odds

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of being a high school graduate. Transportation riders also had significantly higher odds of perceived presence of a bike lane or path within one-quarter mile of their residence, and living in a slightly less urban area, and living in a more rural area.

Conclusions—In the U.S., recreation bicycling is a choice-based behavior, whereas transportation bicycling may be more influenced by the perceived and objective built environment. Interventions should consider how to make recreation and transportation bicycling more accessible and affordable to all individuals.

Introduction

Bicycling is a low-impact physical activity that provides significant health benefits.^{1–3} Previous research suggests that multilevel ecologic factors, including intrapersonal, interpersonal, environmental, and policy factors, may influence bicycle use.⁴ However, there is limited research on the factors associated with bicycling in the U.S.^{5–9} Further, evidence suggests that factors associated with bicycling behavior differ depending on domain, recreation, or transportation.^{10–12} To date, domain-specific bicycling and correlates have not been examined in U.S. adults using nationally representative data.

Improved understanding of the variables associated with recreation and transportation bicycling could provide valuable information for encouraging the adoption of bicycling behaviors in the U.S. The purpose of this study is to identify intrapersonal, perceived environment, and objective environment correlates of domain-specific bicycling among U.S. adults, using a nationally representative dataset.

Methods

Study Sample

This study was a secondary analysis of cross-sectional data from the 2012 National Survey of Bicyclist and Pedestrian Attitudes and Behaviors (NSBPAB). The NSBPAB was conducted via landline and cellular telephone interview for the National Highway Traffic Safety Administration from July to November of 2012. Non-institutionalized individuals aged 16 years were eligible to participate, with one respondent allowed per household. The NSBPAB had 7,509 respondents (N=246,155,593). Further information on the NSBPAB methodology are available elsewhere.^{13,14} The University of Texas Health Science Center at Houston IRB deemed this study exempt from review.

Measures

Respondents were classified as bicyclists if they self-reported having ridden a bicycle at least once within the past 30 days. Bicyclists were further classified for transportation or recreation bicycling, based on the reported main purpose of their last ride. Respondents who reported that the main purpose of their last ride was commuting to work or school, running errands, for their job, to drop off or pick up someone, or to visit a friend were classified as participating in transportation bicycling. Respondents who self-reported that the main purpose of their last ride was recreation or exercise/for health were classified as participating in recreation bicycling.

Intrapersonal characteristics included self-reported sex, household income, race/ethnicity, education, employment status, and age group; respondents aged <18 years were excluded from these analyses. One dichotomous perceived bicycling environmental variable was examined: self-reported availability of bicycle paths or lanes within one-quarter mile of the respondent's residence. NSPBAB developed one objectively measured built environment construct, urbanicity. Urbanicity was derived via a cluster analysis assessing residential density, parks and recreation areas, neighborhood land-use mix, and car traffic density within one-quarter mile of the respondent's residence.¹³ This urbanicity scale ranges from one (urban) to five (rural).

Statistical Analysis

Data were analyzed using sampling weights and strata.¹⁴ Weighted percentages were utilized to describe the study population. Weighted bivariate and multivariable logistic regression models were conducted to identify the ecologic characteristics associated with bicycling in the past 30 days. A multinomial logistic regression was used to identify the ecologic characteristics associated with each domain (recreation and transportation) of bicycling, as compared with non-bicyclists. Collinearity was assessed via variance inflation factors; a variance inflation factor >10 indicated the variables were collinear. All analyses were conducted in 2016/2017 using Stata, version 13.1.

Results

After excluding respondents aged <18 years ($n=140$, 1.9%) and those with missing data ($n=658$, 8.9%), the final analytic sample was 6,711 ($N=222,694,946$). Descriptive characteristics of the study sample are presented in Table 1.

The bivariate and multivariable logistic models of any bicycling versus no bicycling in the past 30 days are reported in Table 2. In the multivariable model, bicyclists had significantly higher odds of being male, younger, white, having an income $\geq \$75,000$, and had significantly lower odds of being retired or a homemaker. Bicyclists also had significantly higher odds of perceived presence of a bike lane or path within one-quarter mile of their residence, and living in a slightly less urban area.

The multinomial logistic model of recreation and transportation bicycling versus no bicycling in the past 30 days is depicted in Figure 1. As compared with non-bicyclists, transportation bicyclists had significantly higher odds of being male (AOR=2.22, 95% CI=1.74, 2.82), younger (18–34 years AOR=4.72, 95% CI=3.23, 6.91; 35–54 years AOR=2.41, 95% CI=1.65, 3.51), a student (AOR=1.61, 95% CI=1.07, 2.44), and had significantly lower odds of being high school educated (AOR=0.63, 95% CI=0.41, 0.97). Transportation bicyclists also had significantly higher odds of perceived presence of a bike lane or path within one-quarter mile of their residence (AOR=1.73, 95% CI=1.33, 2.25), and living in a slightly more rural area (AOR=1.79, 95% CI=1.22, 2.62).

As compared with non-bicyclists, recreation bicyclists had significantly higher odds of being male (AOR=1.72, 95% CI=1.44, 2.05), younger (18–34 years AOR=1.80, 95% CI=1.36, 2.38; 35–54 years AOR=2.02, 95% CI=1.60, 2.55), white (AOR=1.51, 95% CI=1.08, 2.10)

college educated (some college/associates degree AOR=1.65, 95% CI=1.05, 2.59; four year college graduate and above AOR=1.93, 95% CI=1.23, 3.04), higher income (\$30,000 to < \$75,000 AOR=1.55, 95% CI=1.19, 2.03; \$75,000 AOR=2.26, 95% CI=1.71, 2.99). Recreation bicyclists also had significantly lower odds of being retired or a homemaker (AOR=0.74, 95% CI=0.57, 0.96).

Discussion

In 2012, in the U.S. population 21% reported bicycling in the past 30 days. Multilevel ecologic factors, including intrapersonal, perceived bicycling environment, and objective built environment variables, were associated with bicycling. Bicyclists had higher odds of being male, younger, white, and higher income. These findings held true for the most part for those who reported recreation bicycling on their most recent bicycling trip. By contrast, those who reported transportation bicycling on their most recent bicycling trip had lower odds of being a high school graduate, and had higher odds of being a student. These results are generally consistent with previous research on the topic.^{6,8,15,16}

This study found that perceived access to bicycle lanes or paths was positively associated with bicycling in the past year, and with transportation bicycling. Previous research on this topic has been mixed, with some studies finding a positive association between perceived access to bicycle infrastructure and bicycling behaviors,⁷ and others finding none or even an inverse association.^{8,17} The way these concepts are operationalized, as well as differences by locale, may explain in part these discrepant findings.

In this study, lower urbanicity was associated with being a bicyclist generally, as well as being a transportation bicyclist; no association was seen for recreation bicycling. Urban form is a widely discussed topic when conceptualizing the influence of the built environment on bicycling behaviors.^{18–20} This somewhat counterintuitive finding may indicate that individual aspects of urban environments, such as traffic density or population density,¹⁹ may nondifferentially promote or hinder transportation bicycling. This nuance would not be captured with a general “urbanicity” variable, as was available in this analysis.

Limitations

Although sampling weights and strata were used, it is possible that these findings are not representative of the U.S. population. Bicycling behaviors were identified for respondents who rode at least once in the past 30 days, excluding less frequent bicyclists that could have contributed useful information. As a result of the secondary nature of this analysis, more detailed information on domain-specific bicycling behavior or environmental measures were not available. Finally, because of the cross-sectional design, temporality cannot be assessed.

Conclusions

In the U.S., recreation bicycling participation appears to be an activity that is engaged in primarily by individuals who have the financial means and inclination to do so (i.e., choice driven). By contrast, transportation bicycling participation may be more influenced by the perceived and built environment. More research is needed to better understand these

bicycling behaviors and their influences. Interventions should consider how to make both recreation and transportation bicycling more accessible and affordable to all individuals.

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References

1. Zander A, Passmore E, Mason C, Rissel C. Joy, exercise, enjoyment, getting out: a qualitative study of older people's experience of cycling in Sydney, Australia. *J Environ Public Health*. 2013; 2013:547453. <https://doi.org/10.1155/2013/547453>. [PubMed: 23864869]
2. Maizlish N, Woodcock J, Co S, Ostro B, Fanai A, Fairley D. Health cobenefits and transportation-related reductions in greenhouse gas emissions in the San Francisco Bay area. *Am J Public Health*. 2013; 103(4):703–709. <https://doi.org/10.2105/AJPH.2012.300939>. [PubMed: 23409903]
3. Giles-Corti B, Foster S, Shilton T, Falconer R. The co-benefits for health of investing in active transportation. *N S W Public Health Bull*. 2010; 21(5–6):122–127. <https://doi.org/10.1071/NB10027>. [PubMed: 20637168]
4. Pucher J, Dill J, Handy S. Infrastructure, programs, and policies to increase bicycling: An international review. *Prev Med*. 2010; 50(Suppl 1):S106–S125. <https://doi.org/10.1016/j.ypmed.2009.07.028>. [PubMed: 19765610]
5. Van Dyck D, Cerin E, Conway TL, et al. Perceived neighborhood environmental attributes associated with adults' transport-related walking and cycling: Findings from the USA, Australia and Belgium. *Int J Behav Nutr Phys Act*. 2012; 9:70. <https://doi.org/10.1186/1479-5868-9-70>. [PubMed: 22691723]
6. Fan JX, Wen M, Kowaleski-Jones L. An ecological analysis of environmental correlates of active commuting in urban U.S. *Health Place*. 2014; 30:242–250. <https://doi.org/10.1016/j.healthplace.2014.09.014>. [PubMed: 25460907]
7. Moudon A, Lee C, Cheadle A, et al. Cycling and the built environment, a U.S. perspective. *Transport Res D Transp Environ*. 2005; 10(3):245–261. <https://doi.org/10.1016/j.trd.2005.04.001>.
8. Sallis JF, Conway TL, Dillon LI, et al. Environmental and demographic correlates of bicycling. *Prev Med*. 2013; 57(5):456–460. <https://doi.org/10.1016/j.ypmed.2013.06.014>. [PubMed: 23791865]
9. Sener I, Eluru N, Bhat C. Who are bicyclists? Why and how much are the bicycling? *Transp Res Rec*. 2009; 2134:63–72. <https://doi.org/10.3141/2134-08>.
10. Ransdell LB, Mason SG, Wuerzer T, Leung KM. Predictors of cycling in college students. *J Am Coll Health*. 2013; 61(5):274–284. <https://doi.org/10.1080/07448481.2013.799479>. [PubMed: 23768225]
11. Zlot AI, Schmid TL. Relationships among community characteristics and walking and bicycling for transportation or recreation. *Am J Health Promot*. 2005; 19(4):314–317. <https://doi.org/10.4278/0890-1171-19.4.314>. [PubMed: 15768927]
12. Heesch KC, Giles-Corti B, Turrell G. Cycling for transport and recreation: associations with socioeconomic position, environmental perceptions, and psychological disposition. *Prev Med*. 2014; 63:29–35. <https://doi.org/10.1016/j.ypmed.2014.03.003>. [PubMed: 24625925]
13. Schroeder, P., Wilbur, M. volume 2: Findings report Vol Report No DOT HS 811 841 B. Vol. 2013. Washington, DC: National Highway Traffic Safety Administration; 2012. National survey of bicyclist and pedestrian attitudes and behavior.
14. Schroeder, P., Wilbur, M. volume 3: Methodology report Vol Report No DOT HS 811 841 C. Vol. 2013. Washington, DC: National Highway Traffic Safety Administration; 2012. National survey of bicyclist and pedestrian attitudes and behavior.

15. de Geus B, Degraeuwe B, Vandenbulcke G, et al. Utilitarian cycling in Belgium: a cross-sectional study in a sample of regular cyclists. *J Phys Act Health*. 2014; 11(5):884–894. <https://doi.org/10.1123/jpah.2012-0200>. [PubMed: 23676351]
16. Nehme EK, Pérez A, Ranjit N, Amick BC, Kohl HW. Sociodemographic Factors, Population Density, and Bicycling for Transportation in the United States. *J Phys Act Health*. 2016; 13(1):36–43. <https://doi.org/10.1123/jpah.2014-0469>. [PubMed: 25898366]
17. Ma L, Dill J. Associations between the objective and perceived built environment and bicycling for transportation. *J Transp Health*. 2015; 2(2):248–255. <https://doi.org/10.1016/j.jth.2015.03.002>.
18. Cervero R, Duncan M. Walking, bicycling, and urban landscapes: evidence from the San Francisco Bay Area. *Am J Public Health*. 2003; 93(9):1478–1483. <https://doi.org/10.2105/AJPH.93.9.1478>. [PubMed: 12948966]
19. Fraser SD, Lock K. Cycling for transport and public health: a systematic review of the effect of the environment on cycling. *Eur J Public Health*. 2011; 21(6):738–743. <https://doi.org/10.1093/eurpub/ckq145>. [PubMed: 20929903]
20. Winters M, Teschke K, Brauer M, Fuller D. Bike Score®: Associations between urban bikeability and cycling behavior in 24 cities. *Int J Behav Nutr Phys Act*. 2016; 13:18. <https://doi.org/10.1186/s12966-016-0339-0>. [PubMed: 26867585]

Figure 1.

ORs and 95% CIs examining intrapersonal, perceived bicycling environment, and objective built environment variables associated with riding a bicycle for (A) transportation, and (B) recreation versus no bicycling in the past 30 days, among U.S. adults, 2012 National Survey of Pedestrian and Bicyclist Attitudes and Behaviors.

Notes: Reference groups are as follows: ^aFemale ^b55+ ^cLess than high school graduate; GED stands for General Educational Development, HS stands for high school ^dLess than \$30,000 ^eRetired/homemaker; other employment includes disabled, something else, and I don't know ^fBlack; other race includes American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, Other, and I don't know ^gNo ^h3

Table 1
Descriptive Characteristics of the Study Sample, 2012 NSPBAB (n=6,711; N=222,694,946)

Variable	n	%	Weighted %
Rode a bicycle in the past 30 days			
No	5,345	79.7	79.1
Yes	1,366	20.4	20.9
Mode in the past 30 days			
Transportation	470	34.4	39.4
Recreation	898	65.6	60.6
Intrapersonal			
Sex			
Female	3,706	55.2	52.9
Male	3,005	44.8	47.1
Age, years			
18–34	1,612	24.0	32.6
35–54	2,372	35.3	35.8
>55	2,727	40.6	31.6
Race			
White	5,088	75.8	70.5
Black	747	11.1	13.2
Hispanic	381	5.7	8.7
Other ^b	495	7.4	7.6
Education			
Less than high school/I don't know	538	8.0	13.7
High school graduate/General	1,698	25.3	29.6
Educational Development (GED)			
Some college/Associates Degree	1,884	28.1	30.8
Four-year college graduate and above	2,591	38.6	25.9
Income			
<\$30,000	2,010	30.0	36.0
\$30,000 to <\$75,000	2,342	34.9	33.8
>\$75,000	2,118	31.6	25.8
I don't know	241	3.6	4.4
Employment			
Unemployed	410	6.1	7.4
Employed (part or full time)	3,748	55.9	57.3
Retired/homemaker	1,914	28.5	23.7
Student	272	4.1	5.5
Other ^a	367	5.5	6.1
Perceived bicycling environment			
Have bike lanes or paths within ¼ mile of residence			
Yes	3,546	47.2	54.7

Variable	n	%	Weighted %
No/I don't know	3,165	52.8	45.3
Objective built environment			
Urbanicity of residence			
1 (urban)	2,583	38.5	40.6
2	554	8.3	8.8
3	1,508	22.5	20.5
4	906	13.5	14.3
5 (rural)	1,160	17.3	15.8

^aOther employment includes disabled, something else, and I don't know

^bOther race includes American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, Other, and I don't know

Table 2
Weighted Bivariate and Multivariable Logistic Regression of Ecological Variables
Associated With Bicycling (n=6,711, N=222,694,946)

Variable	Bivariate OR (95% CI)	Multivariable AOR (95% CI)
Intrapersonal		
Sex		
Female	1	1
Male	2.06 (1.79, 2.38)	1.90 (1.64, 2.21)
Age, years		
18-34	3.16 (2.63, 3.80)	2.61 (2.07, 3.30)
35-54	2.59 (2.18, 3.08)	2.12 (1.73, 2.61)
55+	1	1
Race		
White	1.52 (1.18, 1.95)	1.48 (1.13, 1.94)
Black	1	1
Hispanic	1.22 (0.83, 1.78)	1.17 (0.79, 1.74)
Other ^b	1.14 (0.79, 1.63)	0.98 (0.68, 1.42)
Education		
Less than high school/ I don't know	1	1
High school graduate/ General Education Development (GED)	0.92 (0.67, 1.25)	0.78 (0.57, 1.08)
Some college/ Associates Degree	1.45 (1.08, 1.95)	1.10 (0.80, 1.52)
Four-year college graduate and above	1.96 (1.47, 2.61)	1.36 (0.98, 1.87)
Income		
<\$30,000	1	1
\$30,000 to <\$75,000	1.24 (1.03, 1.50)	1.13 (0.92, 1.39)
>\$75,000	2.11 (1.76, 2.53)	1.68 (1.35, 2.10)
I don't know	0.82 (0.53, 1.26)	0.81 (0.53, 1.26)
Employment		
Unemployed	1	1
Employed (full or part-time)	1.08 (0.81, 1.44)	0.85 (0.62, 1.15)
Retired/homemaker	0.41 (0.29, 0.56)	0.64 (0.45, 0.93)
Student	1.44 (0.97, 2.15)	1.12 (0.74, 1.69)
Other ^a	0.54 (0.34, 0.86)	0.65 (0.40, 1.05)
Perceived bicycling environment		
Have bike lanes or paths within ¼ mile of residence		
Yes	1.44 (1.25, 1.67)	1.34 (1.14, 1.57)
No	1	1
Objective built environment		
Urbanicity of residence		
1 (urban)	1.06 (0.88, 1.28)	1.02 (0.83, 1.26)
2	0.73 (0.54, 1.00)	0.99 (0.71, 1.39)
3	1	1

Variable	Bivariate OR (95% CI)	Multivariable AOR (95% CI)
4	1.28 (1.01, 1.62)	1.36 (1.06, 1.74)
5 (rural)	0.89 (0.71, 1.12)	1.10 (0.86, 1.40)

^aOther employment includes disabled, something else, and I don't know

^bOther race includes American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, Other, and I don't know