Changes in Physical Activity and Travel Behaviors in Residents of a Mixed-Use Development

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Background: Mixed-use developments may be especially promising settings for encouraging walking and other types of physical activity.

Purpose: This study examined the physical activity and travel behaviors of individuals before and after they relocated to Atlantic Station, a mixed-use redevelopment community in metropolitan Atlanta.

Methods: A survey study was conducted to compare the behaviors, experiences, and attitudes of Atlantic Station residents before and after moving to a mixed-use neighborhood. Data were collected in 2008 and 2009 and analyzed in 2010. Key dependent variables were self-reported physical activity and travel behaviors including walking for recreation and transport, automobile use, and use of public transportation.

Results: Study participants included 101 adult residents of Atlantic Station, most of whom were female, young, and well educated. There were significant increases in walking for recreation or fitness (46%–54%; \( p < 0.05 \)) and walking for transportation (44%–84%; \( p < 0.001 \)) after moving into the mixed-use development. Respondents also reported reduced automobile travel and increased time spent using public transportation after moving to Atlantic Station. Because this study used individuals as their own controls, there is more control over confounding lifestyle variables compared to cross-sectional studies of individuals living in different neighborhoods.

Conclusions: Adults who move to a denser, mixed-use neighborhood increase their levels of walking for both recreation and transportation, decrease their automobile travel, and increase their use of public transportation.


Background

Developing neighborhood settings that encourage walking or other forms of physical activity may be an effective strategy for decreasing overweight and obesity.1–3 Research4–8 from the fields of public health, city planning, and architecture have established associations of neighborhood design with physical activity and travel behaviors. However, many of the studies9–12 published to date are cross-sectional and compare the behaviors of residents living in neighborhoods that provide varying levels of walkability and mixed use. This raises the question of self-selection because those more likely to engage in physical activity may choose more walkable settings. To address the problem of self-selection, several studies13–16 have used longitudinal study designs to determine whether physical activity and travel behaviors change when people move between neighborhoods of varying levels of walkability.

A survey was used with a combined cross-sectional and retrospective study design to examine the physical activity and travel behaviors of individuals before and after they relocated to Atlantic Station, a mixed-use development in metropolitan Atlanta. The design treats individuals as their own “controls.” Atlantic Station has a mix of residential, commercial, and recreational land uses; activity centers with destinations that attract people; good

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walking and bicycling routes; accessible mass transit; and pleasing streetscapes and public spaces.\textsuperscript{17–20} The current study tests the hypothesis that relocation to a dense, walkable residential environment promotes physical activity and pedestrian-oriented travel behaviors.

**Methods**

**Study Site**

Atlantic Station is a 138-acre mixed-use development located in Midtown Atlanta, Georgia. In 2008, Atlantic Station had 2250 residential units (single-family homes, condominiums, lofts, and apartments) and two small parks. The 1.4 million ft\(^2\) of office space included medical, dental, and financial offices and the 1.5 million ft\(^2\) of retail space supported shops, restaurants, a grocery store, and large retail stores. Residential units are located over or adjacent to the retail area.

Use of alternative transportation is promoted at Atlantic Station by free shuttles to a nearby transit station, and assistance is available to help with car or van pools and guaranteed rides home. Public buses provide service to the site. Bicycle lanes and sidewalks are on all surface streets throughout Atlantic Station.

**Study Design and Recruitment**

In the original design of this research, subjects were to be studied in their pre-move location and again several months after moving to Atlantic Station. Because of the downturn in the housing market in 2008, the design was modified to collect pre-move recall data and post-move data from those who had already moved to Atlantic Station. Therefore, a survey with recall was used to analyze the pre- and post-move behaviors of current Atlantic Station residents.

Recruitment letters and e-mails were sent to 2053 Atlantic Station addresses. Residents were excluded if they were aged <18 years, unable to understand and speak English, were pregnant, had physical impairments that limited their ability to walk, or had lived at Atlantic Station for less than 3 months or more than 2 years. One adult per household participated in the study. Follow-up phone calls were conducted with 428 people, of whom 106 refused to participate. Of the remaining 322, there were 117 (36.3\%) eligible to participate and 205 (63.7\%) ineligible. Sixteen recruits withdrew, for a final study sample of 101 (86.3\% of those screened and eligible).

All consent forms and surveys were completed onsite at Atlantic Station in 2008 and 2009. The 148-item self-administered survey was divided into two sections: (1) questions about neighborhood characteristics and activities before moving to Atlantic Station (pre-move recall data); and (2) similar questions after moving to Atlantic Station. Items included physical activity and travel behaviors, health status, and demographics. Individuals completed both sections of the survey in one sitting. The survey was constructed carefully to minimize confusion and spillover of pre-move information into the post-move survey sections, and staff explained the survey structure when distributing the survey. Most survey questions came from validated instruments such as the Neighborhood Environment Walkability Scale (NEWS)\textsuperscript{9} and the International Physical Activity Questionnaire (IPAQ).\textsuperscript{21}

**Dependent and Independent Variables and Potential Covariates**

Categorical physical activity outcomes included prevalence of walking for recreation and engagement in moderate or vigorous physical activity. Categorical travel outcomes included the prevalence of walking for transportation, travel by automobile, and travel by public transportation. Continuous physical activity outcomes included the number of days and minutes per week residents walked for recreation and the number of days and minutes per week residents engaged in weekly vigorous or moderate levels of physical activity. Continuous pre- and post-move travel outcomes included the number of days and minutes per week residents walked for transportation and traveled by car or by public transportation. Independent variables and covariates included demographic variables (e.g., age, gender, race); health status (self-reported health and fitness status); and pre-move neighborhood type.

**Statistical Analysis**

The Wilcoxon Signed Rank Paired Test was used for continuous variables because of the non-normal distribution of pre- and post-move variables. For categorical variables, McNemar’s chi-squared test and matched ORs were used. Chi-squared and Fisher’s exact tests were used to test associations between categorical variables. The Kruskall-Wallis nonparametric test of significance was used to assess associations between categorical demographic and continuous physical activity variables. All analyses were conducted in 2009 and 2010.

**Results**

Of the 101 study participants, most were female (67\%); aged ≤34 years (64\%); white (47\%) or black (33\%); did not have children (92\%); had household incomes of $60,000 or more (75\%); and had completed college or some graduate education (77\%). Most moved to Atlantic Station from urban (47\%) or suburban (41\%) neighborhoods.

Mean days of recreational walking per week increased significantly (from 2.1 days to 3.0 days, \(p<0.02\)), but no other recreational walking or physical activity measures differed between pre- and post-move settings. Walking for transportation purposes and use of public transportation increased after subjects moved to Atlantic Station (Table 1). Study participants were almost twice as likely to report walking for transportation (84\% vs 44\%; \(p<0.001\)) and 1.5 times more likely to use public transportation at Atlantic Station compared to their pre-move neighborhood (42\% vs 24\%; \(p<0.005\)). Both mean number of days per week (4.52 vs 2.76; \(p<0.0001\)) and mean minutes per week of transportation-related walking (85.5 vs 46.1; \(p<0.0001\)) increased after individuals moved to Atlantic Station.

Mean days per week of automobile travel decreased (5.5–4.7 days; \(p<0.0001\)) as did mean minutes per week of automobile travel (636–328 minutes; \(p<0.0001\)). However, other measures of public transportation use did not differ. Covariate analyses showed that the only variable that explained minutes per week of travel by car in the post-move
neighborhood was income. Those making $60,000–$90,000 in household income traveled more minutes per week (435.2 minutes) than any of the other income categories (less than $40,000, 163.8 minutes; $40,000 to 59,999, 175.6 minutes; more than $90,000, 365.4 minutes; p<0.02).

Discussion

Adults who moved to a denser, mixed-use neighborhood increased their levels of walking for transportation, decreased their automobile travel and increased their use of public transportation. As in other studies, the increases in walking were more for transportation rather than recreation purposes. There were no significant associations between demographic or health status characteristics and walking for transportation after moving to Atlantic Station, suggesting that the post-move changes are not limited to any specific subgroup. The idea of “engineering” utilitarian walking back into people’s daily lives could contribute to reducing obesity and chronic disease.

Because the study design used individuals as their own controls, there was more control over confounding lifestyle variables than in previous cross-sectional studies of individuals living in different neighborhoods. However, these findings are exploratory rather than definitive, because of the relatively small sample size, generally affluent and well-educated study participants, and the skewed distribution of physical activity data. The use of recall-based pre-move data introduces important limitations, as does the lack of a control group. The planned design would have made a stronger “natural experiment” but could not be implemented because of non-study-related external events. Given the implausibility of randomly assigning people to live in different environments, this research makes important strides toward a research design that can help rule out alternative explanations for changes in walking and travel behaviors.

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Table 1. Walking, physical activity, and travel behaviors in the pre- and post-move neighborhoods (N=101), % or M (SD)

<table>
<thead>
<tr>
<th></th>
<th>Pre-move neighborhood</th>
<th>Post-move neighborhood</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking for transportation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yesa</td>
<td>44</td>
<td>84</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Days/weekb</td>
<td>2.76 (5.19)</td>
<td>4.52 (4.50)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Minutes/weekb</td>
<td>46.1 (131.4)</td>
<td>85.5 (140.5)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Walking for recreation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yesa</td>
<td>46</td>
<td>54</td>
<td>n.s.</td>
</tr>
<tr>
<td>Days/weekb</td>
<td>2.09 (4.11)</td>
<td>2.96 (4.63)</td>
<td>&lt;0.02</td>
</tr>
<tr>
<td>Minutes/weekb</td>
<td>98.5 (236)</td>
<td>105.9 (204)</td>
<td>n.s.</td>
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<tr>
<td>Moderate physical activity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yesa</td>
<td>28</td>
<td>25</td>
<td>n.s.</td>
</tr>
<tr>
<td>Days/weekb</td>
<td>0.62 (1.26)</td>
<td>0.57 (1.17)</td>
<td>n.s.</td>
</tr>
<tr>
<td>Minutes/weekb</td>
<td>45.6 (105.8)</td>
<td>34.5 (84.5)</td>
<td>n.s.</td>
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<tr>
<td>Vigorous physical activity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yesa</td>
<td>53</td>
<td>56</td>
<td>n.s.</td>
</tr>
<tr>
<td>Days/weekb</td>
<td>1.84 (2.13)</td>
<td>1.87 (2.04)</td>
<td>n.s.</td>
</tr>
<tr>
<td>Minutes/weekb</td>
<td>123.6 (187.3)</td>
<td>109.1 (161.3)</td>
<td>n.s.</td>
</tr>
<tr>
<td>Automobile travel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yesa</td>
<td>90</td>
<td>88</td>
<td>n.s.</td>
</tr>
<tr>
<td>Days/weekb</td>
<td>5.52 (2.38)</td>
<td>4.66 (2.65)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Minutes/weekb</td>
<td>635.6 (653.6)</td>
<td>327.6 (435.0)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Public transportation</td>
<td></td>
<td></td>
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<tr>
<td>Yesa</td>
<td>24</td>
<td>42</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>Days/weekb</td>
<td>0.97 (2.05)</td>
<td>1.24 (1.98)</td>
<td>n.s.</td>
</tr>
<tr>
<td>Minutes/weekb</td>
<td>53.8 (145.2)</td>
<td>83.5 (275.4)</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

aMcNemar’s test
bWilcoxon signed rank test
n.s., not significant (p>0.10)
Ross Brownson, Christy Hoehner, Cheryl Carnoske, Brian Leary, and Peter Curnyn.

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References


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