# RELATIONSHIP BETWEEN PERCEPTIONS OF THE ENVIRONMENT AND PHYSICAL ACTIVITY IN COMMUNITY-DWELLING WOMEN

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## ABSTRACT

Few studies have assessed the relationship between environmental perceptions and objectively measured physical activity in older women. One hundred twenty-six women completed a questionnaire to assess environmental perceptions and wore an accelerometer during all waking hours for seven consecutive days. Participants engaged in 13.9±16.9 minutes of moderate-to-vigorous intensity physical activity per day when examining physical activity in bouts of at least ten minutes. Preliminary analysis indicates that the presence of destinations within walking distance of home are associated with physical activity participation among community-dwelling older women.

## INTRODUCTION

Investigators have documented that certain aspects of the physical environment are associated with participation in physical activity (Brownson, Baker, Housemann, Brennan and Bacak 2001; Brownson, Chang, Eyler et al. 2004; King, Toobert and Ahn et al. 2006; King, Belle, Brach, Simkin-Silverman, Soska and Kriska 2005; King, Brach, Bell, Killingsworth, Fenton and Kriska 2003; McCormack, Giles-Corti and Bulsara 2005) and these associations may differ between males and females (Bengoechea, Spence and McGannon 2005; De Bourdeaudhuj, Sallis and Saelens 2003; Humpel, Marshall, Leslie, Bauman and Owen 2004; Suminski, Poston, Petosa, Stevens and Katzenmoyer 2005). In addition to perceiving their environments differently (Brownson et al. 2001; Bengoechea et al. 2005; Humpel et al. 2004; Huston, Evenson, Bors and Gizlice 2003; Lee 2005), women tend to be less active than men across all ages, with older women being among the least active groups in the American population (Barnes and Heyman 2007; Centers for Disease Control and Prevention 2005). While studies have examined environmental correlates of physical activity solely in a population of older women (King, Castro, Wilcox, Eyler, Sallis and Brownson 2000; King et al. 2003; King et al. 2005; Morris, McAuley and Motl 2007; Taylor, Sallis, Lees et al. 2007; Wilcox, Castro, King, Housemann and Brownson 2000) few have utilized objective measures of physical activity (King et al. 2003; King et al. 2005; Morris et al. 2007).

King and associates (King et al. 2003; 2005) used pedometers to count the number of steps that older women accumulated daily, and Morris and associates (Morris et al. 2007) used

accelerometers, which provide more detailed information to enable discrimination of the duration and intensity of physical activity. King, Brach and associates (King et al. 2003) found that women who had two or more destinations within a twenty minute walk from home and those who rated their neighborhoods as being more walkable accumulated more daily steps than their peers. King and colleagues (King et al. 2005) observed that older women living within a twenty minute walk from a golf course or post office accumulated more daily steps than those who did not live within walking distance of these destinations. Morris and associates (Morris et al. 2007) demonstrated associations between total daily activity counts and street connectivity, walking/cycling facilities, and neighborhood aesthetics. They did not utilize the accelerometer data to determine intensity and duration of activity.

The national physical activity recommendation states that adults should accumulate either thirty minutes of moderate intensity aerobic physical activity on five or more days, twenty minutes of vigorous intensity aerobic physical activity on three or more days, or a combination of moderate and vigorous intensity aerobic activities weekly in bouts of at least ten minutes to improve health (Haskell et al. 2007). Regular participation in physical activity has numerous physical and psychological health benefits (Brown, Burton, and Rowman 2007; Goodwin 2003; Hu, Tuomilehto, Silventinen, Barengo, Peltonen, and Jousilahti 2005; Manson, Greenland, LaCroix et al. 2002; Warburton, Nichol, and Bredin 2006). As the risk of disease and disability increases with age, an active lifestyle may decrease the physical and economic burden that will occur with the aging of the population (Centers of Disease Control and Prevention 2007; Chenowith and Leutzinger 2006). Interventions that include modifications to the physical environment may be a means of promoting active lifestyles among older adults (CDC 2007).

The purpose of this study was to assess the relationship between perceptions of the neighborhood environment with objectively monitored ambulatory activity in women aged 50-75 years. Specifically, the ability of the environmental factors to accurately predict physical activity was investigated.

## METHODS

### Participant Recruitment and Eligibility

Following approval by the institutional review board, participants were recruited from neighboring cities in the south-central United States using several methods. Advertisements were placed on university television and radio stations and in newsletters; mass emails were sent to university employees; announcements were made at community organization meetings; flyers were distributed at public facilities; and three short editorial items were published in area newspapers. Interested individuals were instructed to contact the re-

searchers via email or telephone to determine eligibility and to schedule an appointment to begin the study. Eligible participants were community-dwelling, apparently healthy women aged 50-75 years. Individuals were excluded from participation if they: (1) were pregnant, (2) were non-ambulatory, or (3) answered "Yes" to any questions on the Physical Activity Readiness Questionnaire (Canadian Society for Exercise Physiology 1994).

Two hundred sixty-eight individuals were prescreened for eligibility and 178 women met eligibility criteria. One hundred forty-three women scheduled appointments and completed the first visit.

**Instruments**

*Neighborhood Environment Walkability Scale-abbreviated (NEWS-A).* The *NEWS-A* is the abbreviated version of the *Neighborhood Environment Walkability Scale* (NEWS) (Saelens, Sallis, Black, and Chen 2003), which is used to assess perceptions of the immediate physical neighborhood environment specifically related to walking. *NEWS-A* consists of seven sections that evaluate residential density, diversity of land use mix, access to services, street connectivity, facilities for walking and cycling, neighborhood aesthetics, and neighborhood safety, and items from these sections are used to create 12 subscales (Saelens et al. 2003; Cerin, Saelens, Sallis, and Frank 2006; Saelens, and Sallis (n.d.)). Residential density asks respondents to report how common specific types of residences are within their immediate neighborhood. Diversity of land use mix asks respondents to indicate how long it would take to walk to each of 23 destinations. The other sections include items that are scaled from 1 (strongly disagree) to 4 (strongly agree), with higher scores generally representing a more positive perception of the neighborhood attribute.

Initial evaluation of the psychometric properties of NEWS demonstrated acceptable reliability (ICCs= 0.58-0.80) and construct validity for the individual subscales (Saelens et al. 2003). Validity of individual items measured against crime reports and rater reports in a separate study yielded correlations ranging from 0.21-0.93 (De Bourdeaudhuij et al. 2003). Concurrent validity of the *NEWS-A* with the *NEWS* resulted in strong correlations between subscales at the individual level ($r$= 0.82-0.94) (Cerin et al. 2006).

*Accelerometer.* The ActiGraph GT1M (ActiGraph, Pensacola, FL) is an updated version of the ActiGraph Model 7164, which has acceptable test-retest reliability (ICC= 0.80) (Welk, Schaben, and Morrow 2004) and validity with counts (the summation of the acceleration signals per cycle) significantly correlated with energy expenditure and relative oxygen consumption during ambulatory activity (Freedson, Lelanson, and Sirard 1998; Hendelman, Miller, Baggett, Debold, and Freedson 2000). The GT1M is a uniaxial accelerometer capable of storing more than 1MB of data, measuring 1.5x1.44x0.70in, and weighing 27g. The GT1M detects vertical accelerations ranging in

magnitude from 0.05-2.0g. The signal is digitized by a 12-bit analog-to-digital converter at a sampling rate of 30 samples per second and the digitized signal is then filtered so that signals within the frequency range of 0.25-2.5Hz are recorded. The resulting counts are summed over a user-specified interval of time (ActiGraph LLC 2006).

**Procedures**

Participants visited the lab twice. During the first visit, participants signed the informed consent and HIPAA forms and completed the prescreening items again to ensure eligibility. Researchers assessed participants' height with a portable stadiometer and weight with a physician's balance beam scale. Following these assessments, participants completed a demographic questionnaire and the *NEWS-A*. Participants then received a demonstration by the researchers on how to wear the accelerometer and were fitted with a belt that they used to attach the accelerometer to their body. Participants wore the accelerometer over their right iliac crest during all waking hours except during water activities for the next seven days. They also completed an accelerometer log sheet each evening when they removed the accelerometer. Participants were instructed to maintain their normal levels of physical activity during the week of monitoring.

After wearing the accelerometer for seven consecutive days, participants revisited to the lab to return the accelerometer and log sheet. All individuals who participated in the study and wore the accelerometer as instructed received a physical activity and body composition report and a $10 gift card.

**Data Reduction**

Sixty-second epochs were used in this study. Both non-wear and wear time were calculated (Troiano, Berrigan, Dodd, Masse, Tilert, and McDowell 2008). Valid non-wear time consisted of bouts of at least sixty consecutive minutes of zero counts, with allowance for two consecutive minutes of counts between 1 and 100. After removing valid non-wear minutes, accelerometer wear time was determined by summing the remaining minutes. The accelerometer compliance requirements, determined *a priori* by the researchers, were that participants must have worn the device for at least 12 hours per day on four or more days (Masse, Fuemmeler, Anderson et al. 2005).

Each valid minute of wear was assigned to an intensity category using the following criteria: moderate intensity, 2020≤ counts/minute <5999; vigorous intensity, counts/minute ≥5999; moderate-to-vigorous intensity, counts/minute ≥2020 (Troiano et al. 2008). Counts per minute, total counts per day, and accumulated time spent engaging in moderate, vigorous, and moderate-to-vigorous physical activity were determined. Time spent engaging in 10-minute bouts of moderate, vigorous, and moderate-to-vigorous physical activity, with allowance for 1-2 minutes below threshold values, were also deter-

mined (Troiano et al 2008).

The percentage of participants meeting the physical activity recommendation as defined by accumulating, in bouts of at least 10 minutes, 30 minutes of moderate intensity activity on five or more days, 20 minutes of vigorous intensity activity on three or more days, or a combination of activities using accelerometer-derived data was assessed (Haskell et al. 2007). *NEWS-A* subscales were scored according to scoring procedures (Saelens et al. (n.d.)). The walking distances from home to each of 23 destinations listed in *NEWS-A* and the total number of destination within a 5-, 10-, and 20-minute walk from home were computed.

**Data Analysis**

Of the 143 volunteers who began the study, two women were unable to complete the study for personal reasons and accelerometers malfunctioned for seven women during the week of monitoring. Another eight women did not meet the *a priori* criteria of wearing the accelerometer for at least twelve hours per day on four or more days. The final sample of 126 women represents 88.1% of the participants who began the study. The majority of demographic characteristics were not different between participants who remained in the final sample ($n$=126) and those who did not ($n$=17; $p>0.05$), with the exception of weight (69.9 vs. 78.9kg, respectively; $p$=0.01) and BMI (26.2 vs. 29.1kg/m$^2$, respectively; $p$=0.01).

Participants ($n$=126) wore the accelerometer for 14.4±1.0 hours on 6.2±1.0 days, exceeding the *a priori* criteria for accelerometer wear time. Ninety-one percent of the participants ($n$=126) wore the accelerometer on at least one weekend day, and there were no differences in physical activity between those who wore the accelerometer on at least one weekend day and those who did not ($p>0.05$).

Descriptive statistics were calculated for all demographic, physical activity, and environmental subscale variables and the distributions were assessed. Because data from the *NEWS-A* subscales were skewed according to Shapiro-Wilk tests for Normality ($p<0.05$), median and interquartile ranges are presented for these data. Wilcoxon Rank Sum Tests were performed to assess differences in perceptions of the environment according to activity status (meeting versus not meeting the recommendation). Logistic regression was performed to assess the relationship between perceptions of the environment and meeting the physical activity recommendation. Data reduction and analysis was performed using SAS version 9.1 (SAS Institute Inc., 2002-2003).

## RESULTS

**Participant Characteristics**

Participants were aged 59.9±6.9 years, weighed 69.9±12.8kg, and measured 163.0±6.0cm in height. Their BMI was 26.2±4.3kg/m$^2$. The majority of participants were Caucasian, married, had a yearly household

income of at least $50,000, had received a post-secondary education, and were employed. A description of the participants' socio-demographic characteristics is presented in Table 1.

**Time Engaging in Physical Activity**

Participants engaged in 12.0±15.1 minutes of moderate, 1.3±4.3 minutes of vigorous, and 13.9±16.9 minutes of moderate-to-vigorous intensity physic-

**Table 1.** ***Socio-demographic Characteristics of the Participants, N=126.***

| Variable | Count (%) |
|---|---|
| Race/Ethnicity: count (%) | |
| Caucasian | 114 (90.5) |
| Other | 12 (9.5) |
| Marital Status: count (%) | |
| Married | 87 (69.0) |
| Other | 39 (31.0) |
| Education | |
| Some high school | 2 (1.6) |
| Grade 12/GED or some college/technical school | 40 (31.7) |
| College graduate or graduate school | 84 (66.6) |
| Employment Status[a] | |
| Employed for wages or self-employed | 88 (61.9) |
| Other | 47 (37.3) |
| Household Income[b] | |
| Less than $10,000 | 2 (1.6) |
| $10,000 to less than $35,000 | 16 (12.8) |
| $35,000 to less than $50,000 | 26 (20.6) |
| $50,000 or more | 78 (61.9) |

[a] No response from one participant.
[b] No response from four participants.

**Table 2.** ***Objectively Measured Physical Activity of Participants, N=126.***

| Variable | Mean ± SD |
|---|---|
| Counts/minute | 286.1 ± 122.7 |
| Total counts/day | 247,857.6 ± 109,980.7 |
| Daily minutes of moderate physical activity | |
| Accumulated | 20.6 ± 17.8 |
| 10-minute bouts | 12.0 ± 15.1 |
| Daily minutes of vigorous physical activity | |
| Accumulated | 1.5 ± 4.4 |
| 10-minute bouts | 1.3 ± 4.3 |
| Daily minutes of moderate-to-vigorous physical activity | |
| Accumulated | 22.1 ± 19.3 |
| 10-minute bouts | 13.9 ± 16.9 |

cal activity per day when examining activity in bouts of at least 10 minutes. Participants accumulated more minutes of moderate, vigorous, and moderate-to-vigorous physical activity when summing all minutes within each intensity category without the constraint of the minimum 10-minute bout (Table 2).

**Meeting Physical Activity Recommendations**

Seventeen participants (13.5%) were meeting the current physical activity recommendation, defined as accumulating thirty minutes of moderate intensity physical activity on at least five days, twenty minutes of vigorous intensity activity on at least three days, or a combination of the two intensities of activity in bouts of at least ten minutes during the seven day monitoring period. Another twelve participants were accumulating the minimum quantity of physical activity, though not in ten minute bouts.

**Perceptions of the Environment**

The residential density subscale asked respondents to report how common specific types of residences are within their immediate neighborhood. A score of 177 reflects a neighborhood consisting only of detached, single-family homes and a score of 475 reflects a neighborhood consisting exclusively of apartments or condos more than 13 stories high. Ninety-four (74.6%) participants reported that their immediate neighborhood consisted solely of detached single-family homes, and another 19 (15.1%) reported that single-family homes were the most common type of home in their neighborhood, though other types of homes were present. One participant's immediate neighborhood consisted solely of townhomes or row homes, and two participants reported apartment or condominium buildings 1-3 stories high to be the only type of home in their neighborhood. No one reported the presence of apartments or condos higher than six stories in their immediate neighborhood.

The diversity of land use mix subscale asked respondents to indicate how long it takes to walk to each of 23 destinations, with scores ranging from 1 (more than 30 minutes) to 5 (1-5 minutes). The median subscale score for diversity of land use indicates that, overall, destinations were a 21-30 minute walk from home. Participants described 1.7±3.3, 5.0±6.0, and 8.1±7.0 destinations to be within a 5-, 10-, and 20-minute walk from home, respectively. The most commonly reported destinations within walking distance from home were parks and small convenience/grocery stores.

Participants' median subscale scores for aesthetics, street connectivity, traffic hazards, crime, lack of cul-de-sacs, hilliness, and physical barriers indicated more walkable neighborhoods according to *NEWS-A* criteria, while scores for lack of parking denoted less walkable neighborhoods. Median subscale scores for land use mix-access and infrastructure and safety for walking were in the middle of the possible range of scores, indicating neither more nor less

**Table 3. *Participants' NEWS-A Subscale Scores.***

| Subscale | Median (IQR) | Participants' Ranges |
|---|---|---|
| Residental Density (*n*=125) | 177.0 (0.0) | 173.0-261.0 |
| Land Use Mix: | | |
| Diversity (*n*=117) | 1.9 (1.5) | 1.0-4.7 |
| Access (*n*=126) | 2.3 (2.0) | 1.0-4.0 |
| Street Connectivity (*n*=125) | 3.0 (1.5) | 1.0-4.0 |
| Infrastructure and Safety for Walking (*n*=122) | 2.5 (1.3) | 1.0-4.0 |
| Aesthetics (*n*=126) | 3.5 (0.8) | 1.8-4.0 |
| Traffic Hazards[a] (*n*=126) | 2.0 (1.0) | 1.0-4.0 |
| Crime[a] (*n*=124) | 1.0 (0.3) | 1.0-3.3 |
| Lack of Parking (*n*=126) | 1.0 (1.0) | 1.0-4.0 |
| Lack of Cul-de-sacs (*n*=126) | 3.0 (3.0) | 1.0-4.0 |
| Hilliness[a] (*n*=126) | 1.0 (1.0) | 1.0-4.0 |
| Physical Barriers[a] (*n*=126) | 1.0 (1.0) | 1.0-4.0 |

[a] Higher scores indicate lower walkability.

Note: Residential density subscale scores can range from 177 to 473. Scores for the other subscales generally range from 1 to 4, with land use mix-diversity ranging from 1 to 5.

walkability. Data for each of the 12 *NEWS-A* subscales is presented in Table 3.

*Environmental Perceptions and Meeting the Current Physical Activity Recommendation*

Comparisons of median *NEWS-A* subscale scores were made for those participants who were meeting the current physical activity recommendation by accumulating activity in 10-minute bouts and those who were not (Table 4). No differences were observed between the groups. Logistic regression was then performed to determine if relationships existed between each of the twelve subscales of *NEWS-A* and meeting the current physical activity recommendation. Again, no associations were evident ($p>0.05$).

Logistic regression was performed to assess the relationship between proximity of destinations and meeting the current physical activity recommendation. The mean number of destinations within a 5-, 10-, and 20-minute walk from home were not significant predictors of whether participants were meeting the current physical activity recommendation. However, there were associations between several specific destinations and meeting the recommendation (Table 5). The presence of a clothing store, a post office, a video store, a salon/barber shop, and a gym/fitness facility within a five minute walk from home increased the odds that participants were meeting the physical activity recommendation. Fewer destinations were associated with increased odds of meeting the

**Table 4.** ***Comparison of Median (IQR) NEWS-A Subscale Scores by Recommendation Status.***

| | Meeting Physical Activity Recommendation *n*=17 | Not Meeting Physical Activity Recommendation *n*=109 | *p*-value |
|---|---|---|---|
| Residental Density | 177.0 (0.0)[b] | 177.0 (0.0) | 0.44 |
| Land Use Mix: | | | |
| Diversity | 2.2 (1.5)[d] | 1.8 (1.5)[c] | 0.14 |
| Access | 2.7 (1.3) | 2.3 (2.0) | 0.15 |
| Street Connectivity | 3.0 (0.5)[b] | 3.0 (1.5) | 0.74 |
| Infrastructure and Safety for Walking | 2.5 (1.3)[c] | 2.5 (1.2)[b] | 0.20 |
| Aesthetics | 3.8 (1.0) | 3.5 (0.8) | 0.50 |
| Traffic Hazards[a] | 2.0 (1.3)[b] | 2.0 (1.0) | 0.38 |
| Crime[a] | 1.0 (0.0)[b] | 1.0 (0.3)[b] | 0.10 |
| Lack of Parking | 1.0 (1.0) | 1.0 (1.0) | 0.86 |
| Lack of Cul-de-sacs | 2.0 (2.0) | 3.0 (3.0) | 0.81 |
| Hilliness[a] | 1.0 (1.0) | 1.0 (1.0) | 0.92 |
| Physical Barriers[a] | 1.0 (0.0) | 1.0 (1.0) | 0.06 |

[a] Higher scores indicate lower walkability.
[b] Missing data from one participant.
[c] Missing data from three participants.
[d] Missing data from six participants.

Note: All comparisons were made by Wilcoxon Rank Sum Test.

**Table 5.** ***Univariate Logistic Regression between Destinations and Recommendation Status.***

| Destination | Odds Ratio | 95% Confidence Interval |
|---|---|---|
| Within a 5-minute walk from home: | | |
| Clothing store | 16.5 | 2.7-98.8 |
| Post office | 5.6 | 1.1-27.8 |
| Video store | 6.4 | 1.5-26.9 |
| Salon or barber shop | 8.1 | 1.8-36.2 |
| Gym or fitness facility | 5.6 | 1.1-27.8 |
| Within a 10-minute walk from home: | | |
| Clothing store | 4.6 | 1.3-16.1 |
| Post office | 3.2 | 1.03-9.8 |
| Video store | 3.4 | 1.01-11.2 |
| Salon or barber shop | 3.5 | 1.2-10.2 |
| Within a 20-minute walk from home: | | |
| Clothing store | 3.1 | 1.1-9.0 |

Note: Reference for each analysis is 'not within specified walking distance.'

recommendation when the walking distance to the destination was increased to be a ten minute walk from home (clothing store, a post office, a bookstore, and a salon or barber shop). A clothing store is the only destination within a twenty minute walk from home that was related to meeting the recommendation.

## DISCUSSION

This study was conducted to determine if specific factors within the neighborhood environment were associated with objectively measured physical activity in a sample of women aged 50-75 years. Results of this study indicated that the presence of specific destinations within close proximity to home was related to participants' meeting the current physical activity recommendation. Other factors of the neighborhood environment, such as residential denssity and aesthetics, were not associated with activity status.

Participants generally perceived the characteristics of their neighborhood environments to be supportive of walking activity. They described their neighborhoods as being aesthetically pleasing and having good street connectivity with few hills and cul-de-sacs. Participants also reported a lack of crime, traffic hazards, and physical barriers. On the other hand, almost 75% of participants reported living in neighborhoods that consisted solely of detached, single family homes. Participants indicated poor diversity of land use mix, with few stores and other facilities in the neighborhood. They described most facilities as being a 21-30 minute walk from home, with fewer than two facilities being within a five minute walk from home. They noted that there was plenty of parking available at local shopping areas, thus making walking or cycling to shopping areas un-necessary.

Participants who were meeting the physical activity recommendation did not perceive their neighborhood environments differently than those who were not meeting the recommendation. These findings conflict with Saelens and colleagues (Saelens et al. 2003), who observed that individuals living in walking-friendly neighborhoods and reporting more positive perceptions of their neighborhood environment accumulated more time engaging in moderate-intensity physical activity as measured by an accelerometer when compared to those in less walking-friendly neighborhoods.

The *NEWS-A* was developed as a short questionnaire to assess how supportive respondents believed their neighborhoods to be for walking and cycling. The current study found no associations between subscales of *NEWS-A* and meeting the physical activity recommendation, which was unexpected considering other studies have shown associations between environmental characteristics measured by NEWS and walking (Cerin et al. 2007; De Bourdeaudhuij et al. 2003; King et al. 2006; Saelens et al. 2003), self-reported moderate and vigorous physical activity (Atkinson, Sallis, Saelens, Cain, and Black 2005; De Bourdeaudhuij et al. 2003; King et

al. 2006; Saelens et al. 2003), and objectively measured physical activity (Atkinson et al. 2005; Morris et al. 2007; Saelens et al. 2003). For example, De Bourdeaudhuij and colleagues (DeBourdeaudhuij et al. 2003) observed a positive relationship between diversity of land use mix and walking (semipartial $r$=0.15) and accessibility of land use mix and moderate intensity physical activity (semipartial $r$=0.16). In a multi-site study, King and colleagues (King et al. 2006) observed that residential density was associated with self-reported time spent engaging in at least moderate intensity activity, while residential density, street connectivity, and accessibility of land use mix were associated with self-reported weekly minutes of walking. Atkinson and co-workers (Atkinson et al. 2005) demonstrated that residential density correlated with both self-reported ($r$=0.35) and objectively measured ($r$=0.39) vigorous physical activity, and street connectivity correlated with objectively measured vigorous ($r$=0.25) and moderate-to-vigorous ($r$=0.21) physical activity.

Though analyses demonstrated no relationships between subscales of *NEWS-A* and meeting the recommendation, the presence of specific destinations within walking distance of home increased the likelihood that participants were meeting the physical activity recommendation. Studies have demonstrated that destinations within close proximity of the home are related to physical activity (Duncan, Spence and Mummery 2005; King et al. 2003; King et al. 2005; McCormack et al. 2008) particularly walking for transportation (Cerin et al. 2007; McCormack et al. 2008; Suminski et al. 2005). In the current study, participants reported fewer than two facilities to be within a five minute walk from home. However, those who reported a clothing or video store, post office, salon or barber shop, or gym or fitness facility to be within five minutes' walking distance from home were at least five times more likely to engage in health-promoting activity. The relationships became weaker as the walking distance increased to ten minutes, and almost all disappeared when the distance was increased further. The only facility within a twenty minute walk from home to be associated with activity status was a clothing store.

That more health-promoting activity would be performed when a gym or fitness facility is in close proximity to the home makes intuitive sense; participants may attend the facility for exercise purposes. The lack of relation between activity status and a park or recreation center was unexpected, because it seems that individuals would be more active if they had easy access to such facilities. Brownson and associates (Brownson et al. 2001) found that individuals who indicated accessibility of places to exercise, trails, parks, and indoor gyms were more likely to be meeting physical activity recommendations. De Bourdeaudhuij and colleagues (De Bourdeaudhuij et al. 2003) observed that convenience of places to be active was positively correlated with vigorous activity among both men and women.

Likewise, King and associates (King et al. 2003) observed that older women living within a twenty minute walk of a biking/walking trail or park accumulated more daily steps as measured by a pedometer On the other hand, Hoehner and co-workers (Hoehner, Ramirez, Elliot, Handy and Brownson 2005) and McCormack and colleagues (McCormack et al. 2008) noted few associations between perceived and objective measures of recreational facilities and self-reported physical activity.

Participants in this study were more likely to be obtaining the recommended dose of physical activity if a post office was nearby. This finding could be explained if it is considered that participants may walk to the post office, which would not be unusual if individuals were unencumbered by large packages. In fact, King and colleagues (King et al. 2005) found that the presence of a post office within a twenty minute walk from home was related to a greater accumulation of steps per day in a sample of women aged 52-62 years. Associations between activity status and the other types of facilities (e.g., clothing, video store) are not easily explained. However, Cerin and colleagues (Cerin et al. 2007) found that individuals more frequently walked to a retail store than a post office, and McCormack and co-workers (McCormack et al. 2008) demonstrated increased odds of individuals walking for transportation if they lived within a quarter-mile of a shopping mall. King and colleagues (King et al. 2003) demonstrated that older women living within walking distance of a department, discount, or hardware store accumulated more daily steps than those who did not live within walking distance of these places. When assessing destinations grouped as general types rather than individually, Cerin and colleagues (Cerin et al. 2007) observed a positive relationship between the number of different types of destinations, and specifically with commercial destinations, within a five minute walk from home and weekly minutes of walking for transportation purposes. McCormack and associates (McCormack et al. 2007) demonstrated that the presence of utilitarian destinations such as convenience stores and shopping malls within 400-1500 meters of home were related to greater odds of walking for transportation.

The current study is one of the few studies assessing environmental correlates of physical activity that have utilized accelerometers to objectively measure activity levels in a sample of older women (King et al. 2003; King et al. 2005; Morris et al. 2007). That no environmental subscales from *NEWS-A* were significantly related to objectively monitored physical activity was unexpected considering the many advantages of using an objective measure of physical activity. An accelerometer worn at the hip, as was done in this study, monitors the duration and intensity of ambulatory activity. Accelerometers are non-invasive, unobtrusive, and are not subject to reporting errors, which is a concern with using questionnaires to

gather physical activity information (Janz 2006). In addition, the researchers utilized progressive methods of managing the accelerometer data in order to provide more accurate estimates of time spent engaging in moderate and vigorous physical activity (Troiano et al. 2008). However, participants in this study wore the accelerometer for all waking hours, thus capturing physical activity performed at home, at work, during leisure time, and for transportation. It is possible that perceptions of the neighborhood environment do not relate to the total amount of physical activity that is performed by an individual, but rather is related to the activity that is performed solely in and around the neighborhood.

**Strengths and Limitations**

There are several strengths to this study. The relative homogeneity of the sample may have reduced the existence of potential confounders such as race and socioeconomic status. The use of an objective monitor of physical activity reduces possible respondent biases that can occur with self-report. Also, the Actigraph GT1M is the latest in accelerometer technology and is extremely useful as an objective measure of physical activity. The use of progressive methods to determine wear time and bouts of physical activity enabled more accurate estimations of objectively monitored physical activity (Troiano et al. 2008). Use of the *NEWS-A*, a comprehensive instrument that assesses many environmental factors and that has been used by other researchers, was also a strength in this study.

Limitations existed in this study. First, participants were healthy volunteers and thus may have been more willing to participate and comply with the study protocol. Second, the majority of participants were Caucasian, highly educated, had a household income of more than $50,000, and were relatively physically active, and may not be representative of the average female aged 50-75 years. Third, participants had very similar perceptions of their neighborhood environments, making it difficult to distinguish differences between groups. Fourth, accelerometers do not capture all types of physical activity, and the cut-points used to categorize accelerometer minutes into intensity categories may not accurately describe the intensity of activity. Fifth, although the *NEWS-A* is a comprehensive measure, it may not sufficiently describe all factors of the physical environment that are related to physical activity. For example, the hilliness subscale consists of a single item that is asking two questions, thus making it difficult for participants to accurately respond to the item. Two items inquiring about sidewalks are difficult to answer when participants do not have sidewalks in their neighborhood. Also, other destinations could be included in the land use mix-diversity subscale, such as biking/walking trails and department or discount stores.

**Recommendations Future Research**

Evaluation of the influence of

physical environmental factors on physical activity has been an important area of research in the past decade. There exists a plethora of information with much contradiction, and differences that are evident based on the population of interest. Advances could be made in this area of research by standardizing assessment instruments, particularly those used to evaluate environmental perceptions. Further assessment of *NEWS-A* as a valid and reliable measure across age groups and populations should be performed. Similarly, the use of a standardized method of quantifying physical activity would enable more meaningful analyses and comparisons across studies. Use of an objective measure of physical activity, such as an accelerometer, would reduce potential respondent biases that are common with self-report measures. If the activity of interest is neighborhood physical activity participation, perhaps asking respondents to wear the device when they are engaging in any physical activity outside of their home but within their neighborhood would enable a better representation of neighborhood physical activity participation. In addition, the neighborhood should be defined for enhanced clarification. Finally, most studies of environmental perceptions and physical activity are cross-sectional, descriptive studies. Researchers cannot state whether individuals are more active in their neighborhoods because their environment motivated them to be active, or if individuals moved to their environment because it was a place that was conducive to their already active lifestyle. Thus, longitudinal studies that evaluate changes in physical activity in conjunction with changing neighborhood environments may help to answer such questions.

**Summary and Implications**

Engaging in moderate-to-vigorous intensity physical activities on a regular basis can provide health benefits (Haskell et al. 2007). Researchers have demonstrated correlations between environmental factors and physical activity, though there are differences in environmental perceptions, activity level, and the relationship between the two from one population to the next. Findings of the current study indicate that the presence of specific destinations within close proximity of home are associated with objectively measured physical activity among women aged 50-75 years. Although preliminary, findings suggest aspects of the environment that may be key when designing future communities that are supportive of participation in health-promoting physical activity.

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