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

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

A DISSERTATION APPROVED FOR THE DEPARTMENT OF HEALTH AND EXERCISE SCIENCE

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ABSTRACT

Purpose: To assess the relationship between perceptions of the neighborhood environment with objectively monitored ambulatory activity and self-reported walking during leisure time and for transportation in women aged 50 to 75 years. **Methods:** One hundred twenty-six women [age: 59.9 ± 6.9 years; BMI: 26.2 ± 4.3 kg/m^2; 90.5% Caucasian] completed two physical activity questionnaires and a survey assessing perceptions of the neighborhood environment, and wore an accelerometer during all waking hours for 7 consecutive days. **Results:** Participants engaged in 72.5 ± 55.5 minutes of moderate and 77.5 ± 59.3 minutes of moderate-to-vigorous intensity physical activity per day, and 47.6% were meeting national recommendations when examining activity in bouts of at least 10 minutes via the accelerometer. Participants reported engaging in 120.0 (IQR = 180.0) minutes of leisure-time walking and 20.0 (IQR = 120.0) minutes of transportational walking on the *IPAQ*, and reported walking for 100.0 (IQR = 190.0) in the neighborhood in a usual week on the *NWS*. Lack of parking was associated with counts per minute ($\beta = -29.1$, $p = 0.03$; model $R^2 = 0.04$), total counts/day ($\beta = -26535$, $p = 0.03$; model $R^2 = 0.04$), and minutes of moderate-to-vigorous physical activity performed in 10-minute bouts ($\beta = -12.5$, $p = 0.04$; model $R^2 = 0.03$). The subscales of infrastructure and safety for walking (OR = 1.7, 95% CI: 1.02, 2.9) and traffic hazards (OR = 0.5, 95% CI: 0.3, 0.9) were associated with being a regular leisure-time walker as described on the *IPAQ*. The presence of a recreation center [OR = 10.0; 95% CI: 2.1, 48.6] and a bookstore [OR = 0.2; 95% CI: 0.03, 0.8] within walking distance of home were related to regular leisure-time walking, and an elementary school [OR = 0.2; 95% CI: 0.05, 0.6] and a bookstore [OR = 5.1; 95% CI: 1.4, 18.5] were related to regular transportational walking as described on the *IPAQ*. The presence of an elementary school was related to regular neighborhood walking for recreation as described on the *NWS* (OR = 0.3, 95% CI: 0.1, 0.8). **Conclusions:** Preliminary analysis indicates that there are factors in the physical environment that may influence physical activity participation, and walking in particular, among community-dwelling women aged 50 to 75 years.

CHAPTER I
INTRODUCTION

There is a positive relationship between physical activity and health. Regular participation in physical activity confers health benefits such as reduced risk of coronary heart disease, hypertension, type 2 diabetes, colon cancer, and depression.[1-3] In 2007, the American College of Sports Medicine (ACSM) and the American Heart Association (AHA) published an update[4] to the previous national physical activity recommendations.[2] Updated recommendations state that adults should accumulate at least 30 minutes of moderate intensity aerobic physical activity on 5 days, at least 20 minutes of vigorous intensity aerobic physical activity on 3 days, or a combination of aerobic activities weekly in order to achieve health benefits.[4] However, recent statistics demonstrate that 55 to 70% of American adults are not sufficiently active to attain health benefits, and levels of physical activity continue to decline with age.[5, 6] For the purpose of this study, physical activity is defined as any bodily movement that is performed by the skeletal muscles and results in energy expenditure.[7]

In recent years, the physical environment has been recognized as an important moderator of physical activity participation.[8-10] Studies of environmental correlates typically involve measurement of physical activity via means of self-report; few studies have utilized objective measures of physical activity.[11-16] Environmental characteristics have been examined as perceptions of study participants[17, 18] and more recently by using objective measures such as audit instruments that are used to inventory and assess physical environmental conditions and Geographic Information Systems (GIS).[13, 19] Studies of environmental attributes have shown differential relationships with physical activity participation according to gender,[8, 20, 21] and few studies have evaluated the relationship between environment and physical activity specifically in older women.[13-15, 18, 22, 23] To date, only one published study has investigated the relationship between physical activity as monitored with an accelerometer and environmental characteristics in older women.[15]

Among individuals who engage in leisure-time physical activity, walking is the most common type of activity performed.[24, 25] Studies have shown that walking is associated with reduced risk of coronary heart disease and mortality.[26, 27] Environmental attributes related to walking activity are believed to be specific to the purpose of walking.[20] Women who walk during their leisure time most often do so in their neighborhood streets.[28] While most women do not meet the public health recommendations for physical activity, studies have shown that more women over the age of 40 years may be accumulating sufficient time in lower-intensity walking in domains outside of leisure time.[24] Whitt and associates[29] observed that women did the majority of walking within the household and transportation domains, though this walking was typically low intensity, short duration, and intermittent. Environmental correlates specific to walking activity and to walking within the neighborhood warrant additional investigation.

Purpose of the Study

The purpose of this study was to assess the relationship between perceptions of the neighborhood environment with subjectively monitored neighborhood walking during leisure time and for transportation as well as with objectively monitored ambulatory activity in women aged 50 to 75 years. Specifically, the ability of the environmental factors to accurately predict physical activity and walking for particular purposes were investigated.

Research Questions

The following research questions were asked for the purposes of this study:

1. How physically active are healthy community-dwelling women?
    a. Are study participants meeting physical activity recommendations?
    b. How much recreational walking do study participants engage in on a weekly basis?
    c. How much walking for transportation do study participants engage in on a weekly basis?
2. Is there a difference in perceptions of the neighborhood environment based on physical activity level?
3. What is the relationship between environmental attributes defined on the *NEWS-A* and physical activity?
4. What is the relationship between environmental attributes defined on the *NEWS-A* and walking activity?

Hypotheses

The following hypotheses will be made for the purposes of this study:

1. Less than 50% of participants will be meeting current national physical activity recommendations.
2. Less than 50% of participants will engage in at least 30 minutes of recreational walking on five or more days weekly.

3. Less than 50% of participants will engage in at least 30 minutes of walking for transportation on five or more days weekly.
4. Individuals who report walking regularly in their neighborhoods will have positive perceptions of their neighborhood environment compared to those who walk less or do not walk in their neighborhood.
5. The subscales on *NEWS-A* will be able to predict individuals who engage in regular physical activity.
6. The subscales on *NEWS-A* will be able to predict individuals who engage in recreational walking.
7. The subscales on *NEWS-A* will be able to predict participants who engage in walking for transportation.
8. The presence of destinations within a 20-minute walk from home will be able to predict individuals who engage in regular physical activity.
9. The presence of destinations within a 20-minute walk from home will be able to predict individuals who engage in recreational walking.
10. The presence of destinations within a 20-minute walk from home will be able to predict participants who engage in walking for transportation.

Significance of the Study

The risk for disease and disability increases with older age.[30] It is estimated that the number of individuals who are aged 65 years and older will constitute 20% of the total American population by the year 2030.[30] With health care costs being three to five times greater for an older compared to a younger individual,[31] the United States economy will experience a shift in health care expenditures in the coming years. The health benefits that are associated with regular participation in physical activity could offset the worsening health effects that seem to coincide with aging. Unfortunately, declining levels of regular physical activity participation also appear to coincide with aging, just as the proportion of those who do not engage in any leisure-time physical activity rises.[5, 32, 33]

Older adults, especially older women, are among the least physically active groups in the American population. According to recent statistics, only 45.5% of women aged 45 to 64 years and 36.3% of women aged 65 years and older participate in regular physical activity during their leisure time,[6] and these numbers are even smaller for women aged 65 to 74 years (20.9%) and 75 years and older (13.9%) from a separate national survey.[5] Physical activity interventions that target the individual may not be sufficient to produce changes that will improve the health indices of the population. Interventions targeting larger social units and entire populations would better induce population-level behavior change.

Interventions that have the potential to impact larger social units include environmental interventions.[10] In recent years, investigators have documented that certain aspects of the physical environment affect participation in physical activities such as walking activity.[19-21, 34] During this time, it became evident that gender differences with respect to perceived environmental influences on physical activity existed.[8, 35, 36] Although older women are among the least active groups of the population and women tend to perceive their environment in a different manner than their male counterparts, few studies have examined environmental correlates of physical activity solely in a population of older women.[13-15, 18, 22, 23] Only three studies targeting older women objectively monitored physical activity.[13-15] Researchers used a pedometer in two of these studies,[13, 14] which is a small device that counts the number of steps accumulated during a specified time period. Morris, McAuley et al[15] used an accelerometer, which provides more detailed information to enable discrimination of the duration and intensity of ambulatory physical activity. However, Morris, McAuley and associates[15] did not utilize the accelerometer data to determine intensity and duration of activity.

Delimitations

The following delimitations existed in this study:

1. The study population included healthy, ambulatory women aged 50 to 75 years who lived in Norman, Oklahoma City, and surrounding areas.
2. Participants were excluded if they were pregnant or were non-ambulatory.
3. Participants were excluded if they had a pacemaker, were taking medication to treat blood pressure or a heart condition, or had a heart condition.
4. Participants were excluded if they had a bone or joint problem that could have been made worse by engaging in physical activity.

Limitations

The following limitations existed in this study:

1. Participants were apparently healthy volunteers, which may restrict the generalizability of the results to others in the same age range.
2. The ActiGraph GT1M accelerometer was waist-worn and monitored ambulatory activity. External loads and movements of the upper body were not detected.
3. The ActiGraph GT1M accelerometer is not waterproof and must be removed during water activity; thus, water activity was not objectively monitored.

4. Data collected in this study may not represent all the possible patterns of physical activity or perceptions of environmental attributes.
5. The study design limited the discussion to associations rather than claims regarding temporal relationships.

Assumptions

The following assumptions were made in this study:

1. Participants were able to accurately recall past-week and usual physical activity.
2. Participants were able to accurately and honestly respond to items regarding demographics and perceptions of environmental attributes.
3. Participants complied with the researchers' instructions regarding wearing the accelerometer and completing the accelerometer log.
4. Participants maintained their normal levels of physical activity.

Operational Definitions

The following terms used in this study are defined below:

1. Physical activity – any bodily movement performed by the skeletal muscles that results in energy expenditure.[7]
2. MET - estimate of the absolute energy expenditure of an activity. One MET is equal to the resting metabolic rate of an individual, which is defined as 3.5 ml of oxygen per kilogram body mass per minute.[37]
3. Moderate intensity – intensity that requires energy expenditure of at least 3.0 but less than 6.0 METs.[2]
4. Vigorous intensity – intensity that requires energy expenditure of 6.0 METs or greater.[2]

5. Physical environment – built (e.g., architectural features, community design) or natural (e.g., weather and open space) space outside of the person.[38]
6. Neighborhood – for purposes of data analysis, a diameter encompassing a 20-minute walk around an individual's home[14]; neighborhood was not defined for participants.
7. Walkability – the ability to walk to nearby destinations.[39]
8. Density – amount of activity in a given area.[40]
9. Aesthetics – attractiveness and appeal of a place.[40]
10. Destination – relates to the availability of community and commercial facilities in neighborhoods.[41]
11. Safety – reflects the need to provide safe physical environments for individuals; incorporates personal and traffic elements.[41]
12. Land use mix – proximity of different land uses, or the distribution of activities across space.[40]
13. Walking for transportation – walking to get to and from places.[42]

CHAPTER II

REVIEW OF LITERATURE

In 2007, the ACSM and the AHA recommended that adults should accumulate at least 30 minutes of moderate intensity aerobic physical activity on 5 days, at least 20 minutes of vigorous intensity aerobic physical activity on 3 days, or a combination of activities weekly in order to achieve health benefits.[4] However, recent statistics demonstrate that 55 to 70% of American adults are still not sufficiently active to attain health benefits, and levels of physical activity continue to decline with age.[5, 6]

Physical activity is a behavior, and many factors influence an individual's choice to engage in this particular behavior. Recent research has focused on the impact of the physical environment on an individual's choice to be physically active. This chapter discusses the importance of being physically active, how the environment is associated with physical activity participation and walking for particular purposes, and how investigators measure both attributes of the environment and physical activity.

Physical Activity

Defining Physical Activity

Physical activity refers to any bodily movement performed by the musculature that requires energy.[7] Physical activity recommendations state that adults should engage in activities of at least moderate intensity.[2, 4, 43, 44] Moderate intensity physical activity refers to activities that require 3 to 5.99 METs to perform.[2] One MET is equal to the amount of energy that an individual uses at rest, which is 3.5 ml of oxygen per kilogram body mass per minute.[37] Thus, a moderate intensity activity is one that requires at least 3 times the amount of resting energy to perform.

Physical Activity Recommendations

The most recent national public health recommendations for physical activity state that healthy adults aged 18 to 65 years should engage in moderate intensity aerobic physical activity for a minimum of 30 minutes on five days or vigorous intensity aerobic activity for a minimum of 20 minutes on three days weekly to promote and maintain health.[4] This recommendation also states that activity should be performed in bouts lasting at least 10 minutes in duration, and that combining moderate and vigorous intensity activity provides sufficient health benefits if individuals perform 450 to 750 MET-minutes per week of these combined activities.[4]

Specific to older adults, the ACSM recommends regular participation in physical activity to promote healthy aging and to maintain and improve physical and psychological functioning.[45] The ACSM suggests performing exercise with such specific goals as gaining muscular strength and hence bone mineral density to lower risk of osteoporosis, improving balance and postural stability to prevent falls, and enhancing cardiovascular functioning. The national public health recommendation for physical activity includes a second recommendation for adults aged 65 years and older.[46] In addition to the recommendation made for those aged 65 years and younger, older adults should perform flexibility exercises to enable performance of regular physical activity and activities of daily life. They should also include balance activities to reduce the risk of falling.

Prevalence of Physical Activity Participation

Recent government statistics demonstrate that 55 to 70% of American adults are not sufficiently active to attain health benefits.[5, 6, 33] Levels of physical activity continue to decline with age as the proportion of individuals who engage in no leisure-time physical activity increases.[5, 6, 33] Additionally, females are less active and report greater levels of inactivity than males at all age groups.[5, 6, 33, 36] In a study of adults aged 50 years and older, investigators observed a marked decline in activity scores as the age category increased, with females yielding lower activity scores than their male counterparts.[47]

Physical Activity and Health Benefits

Whether an individual is meeting physical activity recommendations is important because regular participation in physical activity has many health benefits.[1-4, 27, 48-50] Some of the earliest studies assessing the impact of physical activity on health demonstrated decreased risk of mortality due to coronary heart disease among men who were active versus inactive on the job.[51-54] The national physical activity recommendation that was published in 1995 was developed from evidence supporting the link between physical activity and a variety of chronic illnesses.[2] This recommendation has been revised recently,[4] and as the evidence supporting the benefits of physical activity on health continues to grow, physical activity recommendations to improve health status will be updated.

Physical Activity and All-cause Mortality

Physical inactivity is one of the leading causes of preventable death in the United States, along with poor diet.[55] The association between physical activity and mortality has been well documented, beginning with early studies of occupational physical activity[51-54] and later emphasizing leisure-time physical activity.[56] Many of the early studies were performed with men as the participants, though recent studies have expanded to include evaluations of physical activity and mortality among women.[27, 50, 57-59]

The Women's Lifestyle and Health study is a large, population-based study of women between the ages of 30 to 49 years at recruitment.[50] Participants were asked to rank their overall physical activity levels (household, occupational, and leisure-time) at ages 14 and 30 years, and were followed for an average of 11.4 years. Results demonstrated a decreased risk of mortality among women who self-reported greater levels of physical activity at recruitment, with no associations evident with respect to earlier physical activity participation. This same study found that women who were active also had a lower body mass index (BMI) and were less likely to be smokers. Another population-based study observed that women aged 65 years and older who engaged in leisure-time physical activity just once a week had a 41% reduction in mortality risk compared to those who did not participate in any physical activity.[59] Interestingly, participation in 2 or more days of physical activity compared with 1 day of activity did not result in additional risk reductions for this sample.

The Nurses' Health Study, was initiated in 1976 among a large population of female registered nurses aged 30 to 55 years.[27] Results from data collected between 1980 and 1996 demonstrated a 24% decline in all-cause mortality risk for women who engaged in 1-1.9 hours of weekly leisure-time physical activity compared to those who did less than 1 hour of activity. Additional benefits were noted with increasing levels of physical activity, but the benefits were less and were similar across other activity levels. In this sample, physical activity was more strongly related to respiratory deaths than deaths from other causes, with the most active group experiencing a 77% reduced risk of death from respiratory causes compared to those in the least active group.

The Study of Osteoporotic Fractures showed that women at least 65 years of age who performed between 1046 and 1906 kcal weekly of leisure-time physical activity had lower risk of all-cause mortality compared to peers who performed less than 163 kcal of activity weekly.[57] Mortality attributed to cardiovascular disease (CVD) was also lower when comparing these same groups. In addition, women who were sedentary at baseline but became active also demonstrated a 50% reduction in all-cause mortality risk and a 36% reduction in risk of mortality from cardiovascular incidents.

A large prospective study followed men and women for a mean follow-up period of 17.7 years, assessing occupational and leisure-time physical activity participation and mortality.[58] Women who engaged in physical activities such as walking, cycling, and light gardening for more than 4 hours per week experienced a reduced risk of total mortality by 36% compared to women who were primarily sedentary. Women who engaged in vigorous activities for at least 3 hours per week had a 42% reduced risk of mortality compared to women who were inactive. While women who were classified as obese (body mass index ≥ 30 kg/m^2) had a higher risk of mortality compared to their non-obese counterparts, women who were not obese and not physically active had a higher hazard ratio than women who were obese and active (1.59 versus 1.12, respectively).

Physical Activity and Cardiovascular Disease

Cardiovascular disease is the leading cause of death and is a large contributor to disability in the United States.[60, 61] Physical inactivity is a modifiable risk factor for CVD and for many of the other risk factors of CVD, and performing 30 minutes of moderate intensity activity is recommended as a form of secondary prevention.[62, 63] Over the years, several studies have demonstrated the link between physical activity participation and lower risk of CVD, particularly coronary heart disease and stroke.[48, 51-54, 56, 64, 65]

Several studies assessing physical activity and CVD have been performed specifically in women. Data from the Nurses' Health Study indicated that women in the two highest activity level groups had reduced risk of coronary events by 26-34% compared to those in the least active group.[66] The benefits attained by being active were also evident in women who had other risk factors for CVD, such as smoking, high BMI, and familial history of myocardial infarction. The Women's Health Study was a prospective study of female health professionals who were aged 45 years and older at the time of enrollment.[48] After 5 years of follow-up, relative risk of developing coronary heart disease was reduced by 45% for women who expended 600 to 1499 kcal each week in all physical activities compared to women who expended less than 200 kcal weekly. Expending additional energy did not provide further benefits. The Women's Ischemia Syndrome Evaluation examined the effects of physical fitness on CVD, and researchers found that women with lower fitness levels were significantly more likely to have obstructive coronary artery disease and other adverse cardiovascular events.[67]

Hu, Stampfer and colleagues[64] demonstrated a decreased risk of ischemic stroke with increasing levels of physical activity in women. Specifically, women who obtained at least 7 hours of moderate-to-vigorous physical activity reduced their risk of stroke by 40%. Ellekjaer et al[68] implemented a prospective study assessing the relationship between self-reported leisure-time physical activity and stroke mortality in women at least 50 years of age. After an average of 9.8 years of follow-up, women in the high- and medium-active groups had reduced risk of mortality from stroke by 48% and 23%, respectively, compared to women in the low-active group.

A meta-analysis of 52 articles examined the dose-response relationship between physical activity and reduced risk of coronary heart disease, stroke, and overall CVD in women.[69] In general, higher levels of physical activity related to reduced risk of coronary heart disease compared to the least active group, and only the most active women experienced reduced risk of stroke compared to those who were inactive. In addition, women who accumulated the most time walking per week had reduced risk of coronary heart disease, stroke, and overall CVD compared to those who were least active.

Physical Activity and Cancer

Cancers are the second leading cause of death in the United States.[55] Physical activity is believed to reduce the risk of developing colon and breast cancers and may reduce risk of developing lung and prostate cancers.[70] Results of a prospective study of Japanese men demonstrated that those who had higher levels of cardiorespiratory fitness also had almost a 60% lower risk of mortality from lung, stomach, liver, colon, esophageal, and rectal cancers when compared to those who were least fit. Smokers with higher fitness levels also experienced similar reductions in cancer mortality.

Studies have demonstrated a beneficial relationship between physical activity participation and colon cancer. Researchers with the Nurses' Health Study observed that women who expended more than 21 metabolic equivalent-hours (MET-hours) per week in leisure-time physical activity had reduced their risk of colon cancer by 46% compared to women who expended less than 2 MET-hours per week in activity.[71] This level of activity is quite high, however; it is the equivalent of walking at a pace of 3 mph for an hour every day. More recent results from the Nurses' Health Study support the earlier findings, and show that engaging in at least 4 hours of moderate-to-vigorous intensity physical activity each week reduced risk of colon cancer by 55%.[72] Results of a case-control study demonstrated a 20-40% reduction in risk of colon cancer among adults aged 30 years and older.[73] Interestingly, researchers of the Miyagi Cohort Study noted that walking more than one hour daily decreased risk of colon cancer in men by more than 40%, but walking did not have beneficial effects for women in this sample.[74]

Studies have generally demonstrated a beneficial relationship between physical activity participation and breast cancer. Friedenreich and associates[75] evaluated the relationship between intensity of physical activity and breast cancer in a case-control study examining occupational, household, and recreational physical activity across the lifetime. Researchers observed a 30% reduction in breast cancer risk among postmenopausal women who performed the high levels of household activity (minimum of 13.9 hours/week per year) and 33 to 40% reduced risk for those who performed mid-range levels of occupational activity (12.4 to < 21.4 hours/week per year). Results of the Women's Health Initiative Cohort Study demonstrated a 14% reduced risk of breast cancer in women who performed strenuous recreational physical activity in the past (at age 35 years) and a 21% risk reduction in women who engaged in more than 7 hours of moderate or strenuous physical activity at the time of study enrollment (aged 50 to 79 years).[76] In a separate cohort study, women aged 40 to 65 years at enrollment who were followed for a mean of 11.4 years experienced reduced risk of breast cancer when they reported engaging in vigorous recreational activity, such that even one to two hours per week reduced risk by 12% and five or more hour per week reduced risk by 38%.[77]

Performing the equivalent of a minimum of 7.4 hours per week of a 3.0 MET, moderate-intensity recreational activity resulted in a 12 to 19% reduction in breast cancer risk.

Physical activity may also improve survival rates from breast cancer. Holmes et al[78] showed that women diagnosed with breast cancer who performed a minimum of 9 MET-hours of physical activity each week had lower risk of mortality. Women with hormone-responsive tumors who performed the equivalent of 3 hours of moderate intensity activity weekly were 50% less likely to die from breast cancer compared with those who did 1 hour or less of weekly moderate activity. Investigators concluded that women with breast cancer had the best chances of survival if they performed the equivalent of 3-5 hours of moderate-intensity walking each week.

There are also studies that have found no link between physical activity and breast cancer. For example, results of the Women's Health Study demonstrated no significant associations between risk of breast cancer and total amount of energy expended or vigorous physical activity performed during leisure time in women aged 45 years and older.[79]

Physical Activity and Type 2 Diabetes

There are several recent studies that have demonstrated that participation in physical activity is related to a reduced risk of developing type 2 diabetes. For example, Kriska et al[80] observed that Pima Indian men who performed the equivalent of a brisk walk for 30 minutes each day during their leisure time reduced their risk of developing diabetes by 34%. Women who performed a similar amount of activity during their leisure time or while at work reduced their risk of diabetes by 25 to 30%. Results of a 5-year follow-up of multi-ethnic, postmenopausal women in the Women's Health Initiative study showed that women who walked regularly had a 13-26% reduction in diabetes risk.[81] In addition, women who were the most active during their leisure time (in the three highest quintiles of energy expenditure) reduced their risk of incident cases of diabetes by 25 to 33%.

Folsom et al[82] implemented a 12-year follow-up of the Iowa Women's Health Study to determine if physical activity reduced the incidence of type 2 diabetes among postmenopausal women who were aged 55 to 69 years at the time of study enrollment. Researchers observed that participants who reported engaging in regular physical activity reduced their risk of incident diabetes by 14-31%, with those engaging in greater levels of activity experiencing more benefits. Participants who performed moderate intensity activity more than 4 times per week had a 27% reduced risk, while those who performed vigorous intensity activity more than 4 times per week had a 36% reduced risk, of developing diabetes. Results of a 6.9-year follow-up of the Women's Health Study assessing women who were aged 45 years or older at time of study enrollment demonstrated that expending 1500 kcal per week in recreational activity translated into an 18% risk reduction of incident diabetes.[83]

Hu, Li et al[84] evaluated walking and television viewing in a 6-year follow-up of the Nurses' Health Study. Researchers observed that watching television for a minimum of 6 hours per week increased the risk of developing diabetes by 30%; the risk increased with greater levels of television viewing. They found that the risk of diabetes increased by 14% for each additional 2 hours per day that participants watched television. Conversely, each 1-hour increment of brisk walking per day resulted in a 34% reduction in diabetes risk.

Physical Activity and Other Chronic Conditions

Goodwin[85] observed a beneficial relationship between physical activity and mental disorders. She found that there were fewer individuals suffering from conditions such as major depression, phobias, and other anxiety disorders who reported regular participation in physical activity compared to those who reported no regular activity. Regularly active individuals had 25 to 35% lower odds of suffering from major depression or anxiety disorders compared to those who were not active. Weuve et al[86] concluded that physical activity is associated with better cognitive functioning and less cognitive decline in women aged 70-81 years. Nelson et al[87] observed that physically active postmenopausal women reported less stress and fewer symptoms of depression compared to their counterparts who were not physically active. Hu, Li and associates[84] found that watching 2 hours of television each week increased women's risk of obesity by 22%, and the risk increased with more hours of television viewing. Conversely, each 1-hour increment of brisk walking daily reduced the risk of obesity by about 25%.

Walking for Health

Walking is the most common form of physical activity.[24, 25, 88] One study noted that 57.6% of adults who engaged in some amount of walking each week reported walking as their only form of leisure-time physical activity, and the proportion of only-walkers was highest among women and older adults.[89] In a follow-up study of older women, 78% of participants reported walking in the last year, with more than half of their physical activity energy expenditure attributable to walking.[14] Twenty-five percent of the women reported walking as their only source of physical activity.

The risks of walking for physical activity are low.[90] Walking is easy, requires little skill, and can be performed by most individuals and in a variety of places. Walking can be performed in all domains of physical activity: while at work, around the house, for transportation, and during leisure time. According to the Compendium of Physical Activities,[91] most types of walking are considered to be of at least moderate intensity (METs $\geq$ 3.0). Thus, walking should confer health benefits to individuals who regularly walk for at least 30 minutes a day on most days of the week.

Several studies have documented the positive association between walking activity and health. Manson, Hu et al[66] observed that women who engaged in 90 minutes of walking at a brisk pace each week had a similar reduction in risk of coronary events compared to women who engaged in a similar amount of vigorous intensity activity. In addition, women who walked at a pace of at least 2.0 mph reduced their risk of coronary events by 25 to 36%. Rockhill and colleagues[27] observed that middle-aged and older women who walked regularly achieved reductions in all-cause mortality risk similar in magnitude to engaging in vigorous physical activity. Gregg and associates[57] found that expending a minimum of 187 kcal weekly reduced all-cause mortality risk and cardiovascular-specific mortality risk in older women. Manson, Greenland et al[26] demonstrated that walking reduced the risk of CVD in postmenopausal women aged 50 to 79 years irrespective of ethnicity, age, and BMI category. Women who walked 2.5 hours weekly benefited from a 30% reduced risk of CVD. A separate cohort study of women aged 45 years and older found that 1 hour of walking each week lowered the relative risk of coronary heart disease by approximately 50% compared to those who did no walking.[48] The association was also evident in women who were overweight, had high cholesterol levels, and were smokers. Results of the Nurses' Health Study demonstrated that 1 to 3.9 hours of walking each week reduced risk of colon cancer by 36 to 41%, with risk reductions primarily occurring for cancers of the proximal colon.[72]

Individuals walk for a variety of reasons, and participation in walking activity has been associated with a variety of sociodemographic factors. Rafferty and colleagues[89] evaluated BRFSS data from 1998 and observed that walking activity increased with age until 65 to 74 years, and walking was more common in women, Caucasians, and those of higher socioeconomic status. Eyler et al[28] and Simpson et al[88] also observed that greater walking participation occurred among Caucasians and those of higher socioeconomic status. Ham and associates[92] reported that short walking trips of less than one mile in length are more common among individuals younger than 30 years, those with lower incomes, and those who live in urban areas. Whitt et al[29] found that accumulation of walking was different based on ethnicity and domain of physical activity.

Walking has also been associated with a variety of physical environmental factors, such as aesthetics,[20, 93, 94] convenience and accessibility of facilities,[20, 21, 93-97] and safety issues.[21, 94, 97] The neighborhood environment is of particular importance because much of the walking that individuals do is in their own neighborhoods. In one study, more than 60% of walkers reported using neighborhood streets for walking.[28] In this same study, 45% of regular walkers and 50% of occasional walkers stated that they walked more since they began using their neighborhood resource, which was their main place for walking. A walking intervention targeting low-income women demonstrated that those who walked did so in the neighborhood and that the majority of increased walking was done for leisure or exercise.[98] Suminski and colleagues[21] reported that a larger proportion of women compared to men walked for exercise in their neighborhood (52.6 versus 38.5%, respectively). Of this sample, approximately 52% of women reported walking for transportation, though only 32% report doing so in their neighborhood.

Environmental Correlates of Physical Activity and Walking

Some theories of behavior change, including the ecological model put forth by McLeroy et al[99] and Bandura's Social Cognitive Theory,[100] recognize that what occurs outside of the individual may impact the behavior of the individual. With such a large proportion of American adults not attaining sufficient levels of activity to attain health benefits, interventions promoting physical activity participation and targeting large numbers of individuals at the same time have the potential to influence behavior change in anyone who encounters the intervention. Such interventions include modifications to the environment and public policy.[101] An example of how the environment could be modified to promote physical activity participation is to create or improve access to places where people can be active,[10] such as neighborhood streets and parks.

Identifying factors in the physical environment that affect an individual's choice to be physically active is necessary for the design of communities that support active lifestyles. Investigation of the relationship between environmental attributes and physical activity participation has expanded in recent years. The literature identifies several common factors, though the manner in which the factors are defined and measured may not always be in agreement. Some of these factors are discussed below, including neighborhood aesthetics, convenience to places to be active, accessibility and number of destinations, and safety.

Neighborhood Aesthetics

Several studies have evaluated various aspects pertaining to the attractiveness and appeal of neighborhoods and whether these aspects influence an individual's choice to be active in the neighborhood. In a review of multiple studies, Owen and co-workers[42] stated that perceptions of the environment's aesthetics constitute the attribute that is most often evaluated. They concluded that aesthetics is related to walking for exercise or recreation and with overall walking, but is not associated with walking for transportation.

King, Castro and associates[22] observed a positive correlation between the presence of hills and enjoyable scenery in the neighborhood and physical activity in a group of women aged 40 years and older. However, the correlations changed when the analysis was performed for each racial/ethnic group separately. Only the presence of hills was positively correlated in White (OR = 1.48; 95% CI: 1.04, 2.10) and Hispanic (OR = 1.89; 95% CI: 1.21, 2.93) women but not in African American or Native American women. Enjoyable scenery was no longer significant for any group.

Lee[36] observed that women aged 60 to 75 years compared to their male counterparts perceived the presence of fewer hills and less enjoyable scenery in their neighborhood. Ball, Bauman et al[93] found that 59% of females who reported positive perceptions of neighborhood friendliness, attractiveness, and pleasantness were recreational walkers compared to 41% who reported the least positive perceptions of these aesthetic features. Those with poor perception of neighborhood aesthetics were the least likely to walk for exercise in the past two weeks. Suminski and co-workers[21] observed an inverse relationship between neighborhood aesthetics and walking for transportation in men and no significant relationship between aesthetics and activity in women although men and women did not differ on their perceptions of the neighborhood environment. Aesthetics was defined differently in this study, and referred to cleanliness and views of local buildings and scenery.

Humpel, Owen, Iverson et al[20] found that neighborhood aesthetics were positively associated with walking activity among men and demonstrated no relationship among women when friendliness of people and enjoyable scenery were used as measures of aesthetics. They observed that 67% of neighborhood walkers were those with more positive perceptions of neighborhood aesthetics. Of interest is that aesthetics was associated with neighborhood walking and walking for exercise among men, but demonstrated no relationship among women in this sample. Men who had the highest positive perception of neighborhood aesthetics were 7.4 (95% CI: 1.9, 28.8) times more likely to be classified as high neighborhood walkers and 3.9 (95% CI: 1.0, 14.5) times more likely to be high exercise walkers. Similarly, Humpel, Owen, Leslie and associates[94] observed that moderate and highly positive perceptions of neighborhood aesthetics was associated with neighborhood walking among men but was not related to walking or general physical activity among women. Humpel, Marshall and colleagues[35] noted that improved perceptions of aesthetics related to twice the odds of men increasing weekly walking activity by 30 min, though again, the relationship was insignificant in women.

Accessibility of Places to be Active

Having access to places where one can be physically active is related to greater levels of physical activity and walking participation among adults. Among adults aged 65 years and older, the perceived presence of malls and pedestrian trails near their homes was associated with neighborhood walking, and objectively determined presence of malls was related to an increased odds of walking by 4.7 times ($p = .04$).[19] Among individuals of the same age group, walking levels declined less in neighborhoods where participants reported access to physical activity facilities across a 12-month period.[102] Adults who reported using a private recreational facility were seven times more likely to be active compared with those who were not active (OR = 7.3, 95% CI: 3.5, 15.0) and four times more likely to be insufficiently active compared with those who were inactive (OR = 4.4, 95% CI: 2.2, 8.8).[95] Use of parks and the presence of sidewalks were also associated with walking and obtaining some amount of physical activity. Conversely, Wendel-Vos, Schuit et al[103] reported that objectively measured access to green and recreational spaces was not significantly associated with walking for recreation or transportation among men and women aged 20 to 59 years.

Several studies evaluated access to places to be active in terms of convenience of walking facilities and resources. One study found that those who reported low convenience scores were 40% less likely to have walked for exercise during the past 2 weeks.[93] In this same study, 58% of women who scored convenience as high and 51% who scored convenience as moderate reported walking for exercise. A walking intervention study determined that more positive perceptions of convenience were related to increased levels of walking in both men and women.[35] In another study, an increased odds of being in a higher category of neighborhood walking participation was associated with women who reported moderate (OR = 3.2, 95% CI: 1.8, 5.6) to high (OR = 3.8, 95% CI: 2.1, 6.7) scores on convenience of walking opportunities.[94] This same study saw a similar trend in men, whereby neighborhood walking and total physical activity was related to more positive perceptions of convenience.

Destinations

Several studies have found a positive association between physical activity and accessibility to destinations such as shops and public transportation, while other studies have demonstrated opposing results. One study observed that women who perceived an average number of destinations (compared to few or many destinations) within walking distance were almost six times more likely to walk for transportation.[21] Low-income women in a walking intervention study engaged in greater levels of physical activity when they perceived that they had a place to walk within their neighborhood.[98] Of those women who reported places to walk near their home (n=8), 38% increased their daily steps by 2000 per day. The most common destinations reported by these women were parks and schools where grounds were open to the public. King and associates[14] assessed convenience of destinations and walking levels in older women aged 50-65 years at the time of their original entry into the study 17 years earlier. Women in this sample infrequently walked to destinations that were more than 20 minutes away. Pedometer data showed that women who lived within walking distance of a biking/walking trail, a park, or a department/discount/hardware store accumulated more steps than women who did not live within walking distance of these places. Generally, women who lived within walking distance of two or more destinations were more active.

Humpel, Owen, Leslie et al[94] found that women's walking in the neighborhood was inversely related to positive perceptions of accessibility of destinations, whereas men's walking in the neighborhood and total walking were directly related to positive perceptions of accessibility to shops and public transportation. Conversely, Humpel, Owen, Iverson and associates[20] observed that positive perceptions of accessibility were related to a 70% reduction in the likelihood of men engaging in greater levels of walking in the neighborhood, while moderate perceptions of accessibility increased likelihood of women walking for pleasure (OR = 3.5; 95% CI: 1.6, 9.2).

Safety

Perceptions of safety can refer to traffic conditions, neighborhood crime, and conditions of walking and physical activity facilities. It seems intuitive that more negative perceptions of safety would relate to decreased activity participation. Taylor , Sallis and co-workers[23] reported that safety was a primary concern among low income, urban women aged 50 years and older. Suminski et al[21] reported that an average safety rating of neighborhood traffic, lighting, and crime was related to increased odds of women walking for exercise (OR = 4.6, $p < 0.05$) and walking their dog (OR = 3.3, $p < 0.05$). In their walking intervention study, Miles and Panton[98] observed that low-income female participants who did not increase their physical activity were concerned with safety and security within their neighborhood. In their 12-month longitudinal study, Li et al[102] found that adults aged 65 years and older experienced less of a decline in walking in neighborhoods when they deemed the neighborhoods to be safe for walking. Humpel, Marshall and colleagues[35] demonstrated that women who changed their perceptions of traffic to not being a problem were 1.8 times (95% CI: 1.0, 3.0) more likely to increase their weekly walking participation by 30 minutes. The opposite relationship occurred for men, with more positive perceptions of traffic reducing the odds of increasing walking participation by 60-70% compared to men whose perceptions of traffic did not change or were more negative. Likewise, Humpel, Owen, Iverson et al[20] found that men aged 40 years and older were less likely to walk for pleasure when they believed that traffic was not a problem.

Other factors

The effects of various other environmental factors on physical activity and walking participation have been evaluated. For example, weather that was reported as not being an influence on walking activity was associated with a greater likelihood of women walking in the neighborhood (OR = 3.8, 95% CI: 1.7, 8.8) and walking for exercise (OR = 7.7, 95% CI: 3.0, 19.5).[20] Weather was also strongly related to higher walking levels for men.[20] King, Brach et al[14] reported that neighborhoods with higher walkability ratings were associated with greater levels of pedometer-measured and self-reported physical activity in older women. Other studies have demonstrated positive associations between street networks that are better connected and physical activity.[12, 15]

Measuring Physical Activity

Physical activity behavior is difficult to measure because there are several domains in which an individual can be active and many ways to quantify physical activity. Investigators can measure physical activity directly or indirectly, and measurements can include outcomes related to energy expenditure (i.e., kcal) or the behavior itself (i.e., minutes of walking).[104] An example of an indirect measure of physical activity is a questionnaire, and an example of a direct measure of physical activity is an accelerometer.

Questionnaires

Questionnaires are commonly used to subjectively estimate physical activity. Advantages of questionnaires include their simplicity, the ability to gather data on large groups of people, their relatively low cost, and unobtrusive nature.[37, 104] Questionnaires require little effort to complete, are non-reactive, practical to use, and can be adapted for use in any population to assess all domains of physical activity.[37, 104] Some of the disadvantages of using questionnaires include their dependence on the ability of the respondent to accurately recall physical activity and bias from social desirability.[37, 104]

There are three classifications of questionnaires: global, recall, and quantitative history.[104] Global questionnaires consist of fewer than 5 items and ask general questions regarding physical activity participation. Recall questionnaires consist of 10-30 items and usually refer to behavior during the past month or less. They enable calculation of energy expenditure or physical activity performed during the time period assessed. Quantitative history questionnaires are more detailed records of physical activity done during the past year or longer.

The *International Physical Activity Questionnaire (IPAQ)* is a recall questionnaire that estimates physical activity performed during the past seven days.[105] The long form of the *IPAQ* asks respondents to record the frequency and duration of moderate, vigorous, and walking activity performed in bouts of at least 10 minutes. Separate items exist for physical activity done while at work, for transportation, around the home, and during leisure time. Time spent sitting on an average day is also recorded. From this information, time, MET-minutes, and energy expenditure relating to the varying intensities of physical activity can be estimated.

Reliability and validity of the *IPAQ* long form were assessed in a large population of adults aged 18 – 69 years living in 12 countries.[106] Test-retest reliability (pooled r_s = 0.8; 95% CI: 0.79 - 0.82) and convergent validity with an accelerometer (pooled $r_s = 0.3$; 95% CI: 0.3 - 0.4) were deemed acceptable and comparable to other physical activity measurement questionnaires.

Accelerometers

Accelerometers directly measure physical activity in laboratory and field settings. Accelerometers are non-invasive, unobtrusive, and are not subject to reporting errors.[107] In addition, they can store large amounts of data depending on their cycle mode. Accelerometers provide the user with no feedback, as the data must be uploaded to a computer with specific software.

Accelerometers are valid and reliable instruments for monitoring ambulatory physical activity. The Computer Science and Applications, Inc. (CSA) accelerometer demonstrated good reliability across three trials of treadmill walking with an intraclass correlation coefficient of $\rho_I = 0.8$.[108] Counts from the CSA accelerometer demonstrated similar trends with a 3-day activity diary and produced correlations of $r = 0.5$ for total activity minutes pooled across the 3 days and $r = 0.5$ for total kcal pooled across the 3 days.[109] Correlations between CSA counts and METs derived from a portable metabolic system were higher among walking trials ($r = 0.8$) when compared with trials involving a combination of activities ($r = 0.6$).[110] Comparisons of three different accelerometers and the Yamax pedometer with indirect calorimetry among adults who performed various moderate-intensity tasks in the field and in the lab resulted in a range of correlation coefficients from $r = 0.3$ to $r = 0.6$.[111]

Accelerometer data are represented by a count that is the summation of all accelerations that occur within a specified time interval. To make it easier to utilize accelerometer counts, researchers have developed regression equations that classify each minute of monitored data into light, moderate, hard, or very hard intensity categories.[110, 112] However, none of the established equations to predict energy expenditure or intensity level based on raw accelerometer counts accurately measure all types of physical activity. Crouter and associates[113] have recently developed a two-regression model that can distinguish between walking and running activity and lifestyle activity. Their method uses physical activity data that is recorded in 10-second intervals to calculate the coefficients of variation for each 10-second interval within a 60-second period. The regression model chosen to compute energy expenditure (METs) is based on the resulting coefficient of variation. Correlations between the predicted METs from this new two-regression model and METs measured by indirect calorimetry were excellent ($r = 0.96$, SEE = 0.73, $p < 0.001$).[113]

Accelerometers have their disadvantages for use in research. They are costly, and it can take an extensive amount of time to manage the resulting data.[114] Accelerometers are also unable to detect increased intensity of physical activity due to changes in grade or to carrying loads.[111, 115] Also, past prediction equations underestimate energy expenditure in the field and are better at estimating activity (walking and running activity, in particular) in the lab. The two-regression model developed by Crouter and associates may offset the latter disadvantage.

Assessment of Physical Activity in Previous Environmental Studies

Various methods of measuring physical activity have been used in studies of environmental correlates. The most common method has been self-report questionnaires. Many studies have used questionnaires whereby respondents report the frequency and duration of neighborhood walking in order to calculate weekly minutes of walking.[20, 35, 93] Other studies have assessed physical activity and specifically neighborhood walking by creating summary scores from respondents having rated on a 5-point Likert scale how much they agree with specific statements.[19, 34, 102, 116] Suminski et al[21] used a past seven day recall to estimate physical activity. If a participant reported walking, then investigators probed with additional questions to determine if walking was performed in the neighborhood for transportation, to walk the dog, and for exercise. Several studies have also used the short or long forms of the *IPAQ*.[16, 17, 94, 96, 117, 118]

A few studies have used objective monitors of physical activity. For example, Miles and Panton[98] used the Yamax DigiWalker pedometer as part of an intervention to increase walking in low-income women. Two studies have used the DigiWalker pedometer to estimate physical activity in women over the age of 50 years.[13, 14] Researchers used an accelerometer to validate the *Neighborhood Environment Walkability Scale* (*NEWS*), which is a questionnaire that evaluates perceptions about environmental factors in the neighborhood that are related to walking.[119] Other studies have used accelerometers to assess the relationship between subscales from *NEWS* and physical activity in a random sample of adults from neighborhoods deemed high-walkable and low-walkable[11] and in older women.[15]

Measuring Attributes of the Environment for Physical Activity

The physical environment can be measured subjectively using self-report questionnaires and objectively using audit instruments and GIS. Many environmental attributes have been assessed in both the health-related and urban planning literature. Pikora and co-workers[41] have suggested that four key features of the environment – functionality, safety, aesthetics, and destinations - be considered in any assessment instrument. Functionality refers to the basic structural components of streets and pedestrian pathways. Safety relates to both personal and traffic safety. Aesthetics include features that pertain to the attractiveness of the area, such as the presence of trees and parks. Destinations refer to any facilities in the area to which individuals may travel. Each key feature consists of items that can be changed to improve the individual components of the feature.[41] For example, improvements in path type will influence perceptions of walking surface and hence the functionality of the environment for walking.

Perceptions of Environmental Attributes

Many studies have utilized questionnaires consisting of 10 items or less that generally ask about neighborhood aesthetics, safety, and convenience or accessibility of destinations and facilities.[8, 21, 34, 35, 93, 94, 102] Responses are generally reported on a 5- or 10-point Likert scale, and summary statistics are calculated. While test-retest reliability statistics are sometimes reported for questionnaire items,[34, 102] the validity of many of the surveys is unknown.

The *NEWS* is one of several larger-scale surveys that have been developed in recent years. *NEWS* is a 98-item questionnaire consisting of 7 subscales assessing respondents' perceptions of the following factors: residential density, land use mix-diversity, land use mix-access, street connectivity, walking/cycling facilities, aesthetics, traffic safety, and crime safety.[119] The abbreviated version of *NEWS (NEWS-A)* has combined the two safety subscales into a single subscale and consists of fewer items.[118] Reliability and validity of the *NEWS* and *NEWS-A* have been assessed. Initial evaluation of the psychometric properties of *NEWS* demonstrated ICC test-retest reliability scores ranging from 0.6 to 0.8 for the individual subscales and acceptable construct validity.[119] Acceptable psychometrics were found in a study that utilized most of the individual *NEWS* items.[17] ICCs ranged from 0.4 for four items assessing perceived traffic safety to 0.96 for diversity of land use mix, and validity measured against crime reports and rater reports yielded Pearson r ranging from 0.2 to 0.9. Cerin, Saelens et al[118] observed stronger correlations between *NEWS* and walking items from the long form of the *IPAQ* when the associations were made at the blockgroup compared with the individual level.

Objective Measures of Environmental Attributes

Investigators have begun to utilize objective measures of the environment, specifically audit instruments and GIS, to assess the walkability of communities. Audit instruments are essentially tools that are used to inventory and evaluate specific characteristics of the environment, and they are designed with specific purposes in mind.[120] For example, Moudon and Lee[120] evaluated several audit instruments which they categorized as either inventories used for research purposes, route quality assessment tools, area quality assessment tools for policy and planning, or tools used to estimate demand for active transportation.

GIS is a computer system that integrates geographically-referenced information for analysis and display.[121] GIS consists of a series of shapefiles, which are layers of different types of information. Each observation within each layer corresponds to a specific point or coordinate, enabling analysis of trends. Using GIS, Leslie et al[122] created a walkability index based on such factors as residential and retail density, connectivity, and land use. Investigators validated the index in the field, finding that most of the attributes of the selected areas coincided with the area's walkability classification.

Objective measures enable investigators to make comparisons of neighborhoods and their supports for active living in ways that translate into policy and community changes. New communities promoting physical activity can be designed in accordance with what investigators conclude to be environmental moderators of physical activity based on information gathered from objective sources. It is interesting to note, however, that reality and perceptions often do not coincide. Several studies have observed little agreement between perceptions and objectively measured environmental attributes as they relate to physical activity.[19, 95, 123] One explanation for the lack of agreement between the two types of measures may be that individuals cannot accurately estimate distance. Also, individuals who are not active in their environment may not be aware of certain neighborhood characteristics. Finally, there are other factors (e.g., personal beliefs, culture) that may impact how an individual perceives their environment in such a way that may not accurately reflect reality.

Summary

Regular participation in physical activity and specifically walking activity confers health benefits to individuals, yet many individuals still are not engaging in sufficient levels of physical activity to achieve these benefits. Generally, older women are less active than men and younger women. While many factors relate to participation in physical activity, factors in the physical environment have been found to be related to physical activity and walking in the neighborhood. However, different factors correlate with recreational walking compared with walking for transportation. In addition, the relationship between these factors and walking are different in men and women. Based on the evidence, environmental correlates of physical activity and walking for particular purposes should be evaluated separately for men and women.

Studies assessing the relationship between environmental factors and physical activity have utilized a combination of subjective and objective measures of the environment. However, the majority of such studies used subjective, self-reported measures of physical activity. Objective measures reduce bias from recall and social desirability; thus, more studies utilizing objective measures of physical activity should be performed. This study utilized subjective measures of the environment and both subjective and objective measures of physical activity to assess the relationship between environment and physical activity participation in a sample of women aged 50 to 75 years.

CHAPTER III

METHODOLOGY

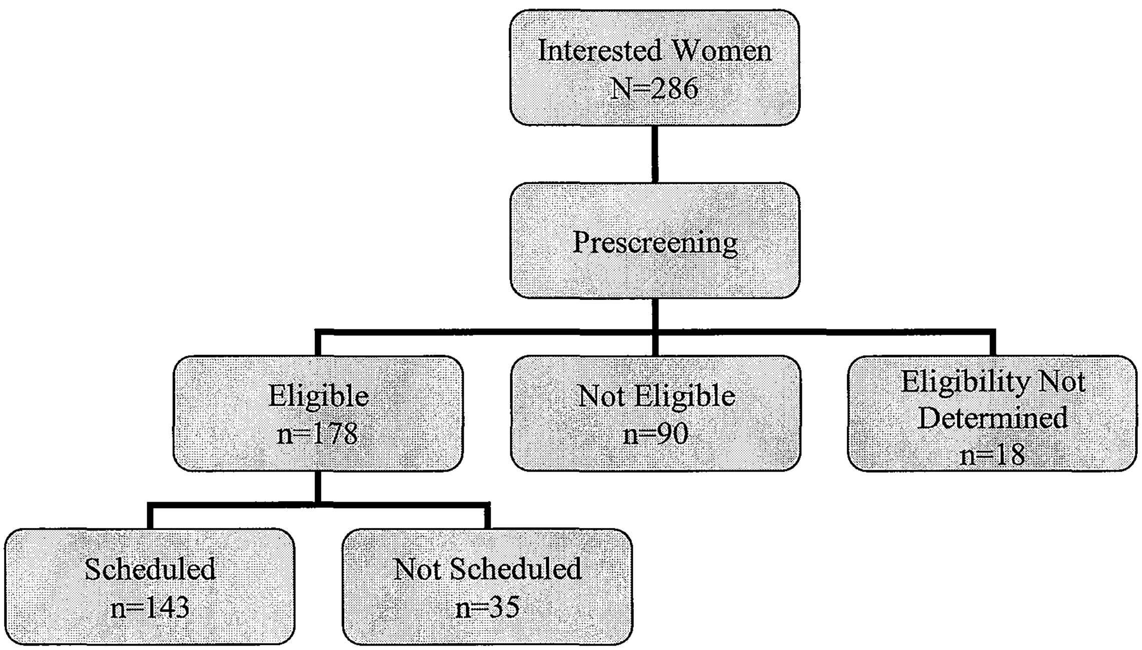
The purpose of this study was to assess the relationship between perceptions of the neighborhood environment with subjectively monitored neighborhood walking during leisure time and for transportation as well as with objectively monitored ambulatory activity in women aged 50 to 75 years. Specifically, the ability of environmental factors to accurately predict physical activity and walking for particular purposes was investigated. This study was approved by the Institutional Review Board at the University of Oklahoma – Norman campus (Appendix A).

Participants

This study utilized a convenience sample of female volunteers from the Norman, Oklahoma City, and surrounding areas. Criteria for inclusion in this study were being female, aged 50 to 75 years, apparently healthy, community-dwelling, and ambulatory. Participants were recruited from the Norman and Oklahoma City metro areas via several methods. Advertisements were placed on the University of Oklahoma's television and radio stations and in newsletters (OU Retirees, Parkview Neighborhood Association), and were electronically mailed to employees on the Norman and Health Sciences Center campuses. Announcements were made at community organization meetings (Senior Vitality meeting, etc.), an informational booth was established at a senior health fair, and flyers were distributed on campus and at public facilities in Norman and Oklahoma City. Recruitment materials are presented in Appendix B. In addition, three reporters published short editorial items in the Daily Oklahoman and the Norman Transcript newspapers.

Two-hundred eighty-six individuals contacted the researcher via telephone or electronic mail expressing interest in the study. Potential participants were pre-screened for eligibility, and the researcher scheduled appointments for 143 volunteers who met the inclusion criteria. Thirty-five women were eligible but did not respond to repeated attempts to schedule an appointment. Potential participants who attended the senior health fair were given the option of completing a pre-screening questionnaire on site or contacting the researchers at a later date for pre-screening via telephone or electronic mail.

Figure 1. Flow chart of participant recruitment.



Research Design

This was a descriptive-correlational study. This study described the physical activity levels of healthy, community-dwelling women, their perceptions of their neighborhood environment, and the relationship between perceived environmental attributes and physical activity participation. Threats to internal validity included testing, instrumentation, and selection bias. Threats to external validity included use of a convenience sample and the reactive effects of testing.

Instrumentation

Nine instruments were utilized in this study. Five questionnaires were completed by participants and three measures were completed by researchers. Participants also wore an accelerometer for 1 week.

Prescreening Questionnaire

The prescreening questionnaire consisted of 11 items that evaluated inclusion criteria, including seven items from the Physical Activity Readiness Questionnaire (PAR-Q; Appendix C).[124]

Demographic Questionnaire

The demographic questionnaire consisted of 11 items such as age, ethnicity, marital status, education, and employment status (Appendix D).

Height

Participants' height was measured with a portable stadiometer. Each participant was instructed to remove her shoes and any heavy clothing (i.e., jackets). The participant stood with her back and feet against the stadiometer, looked straight ahead, placed her hands on her hips, and inhaled. The researcher then lowered the measuring device so that it touched the top of the participant's head and recorded her height to the nearest ½ inch.

Weight

Participants were weighed using a physician's balance-beam scale. With shoes and heavy clothing still removed, each participant stood on the scale and remained still. The researcher recorded her weight to the nearest ½ pound.

Body Composition

Body composition was measured using bioimpedance analysis (BIA) with a BC-418 Body Composition Analyzer (Tanita, Tokyo, Japan). The BC-418 Body Composition Analyzer provides estimations of lean soft tissue and percent body fat that are highly correlated with dual-energy x-ray absorptiometry (r = 0.95-0.98 and r = 0.8-0.9, respectively).[125] Each participant removed her socks and stepped onto the weighing platform, with her feet spread apart so that her inner thighs were not touching. The participant grasped the hand grips and held her arms straight down at her sides, not touching her body. A small, undetectable, high frequency current (50 kHz) passed through the participant's body to assess the resistance to the electrical current. Because electricity flows easily through water and water is associated with lean tissue, body composition was inferred from the electrical resistance.

International Physical Activity Questionnaire

The long form of the *IPAQ* was used to assess self-reported physical activity (Appendix E). The *IPAQ* recalls physical activity performed during the past 7 days. It consists of 27 items asking respondents to record the frequency and duration of moderate, vigorous, and walking activity performed in bouts of at least 10 minutes while at work, for transportation, around the home, and during leisure time, as well as time spent sitting and in a car on an average day.[105]

The *IPAQ* long form demonstrates good test-retest reliability (pooled $r_s = 0.8$; 95% CI: 0.79, 0.82) and acceptable validity with an accelerometer, with indices comparable to other physical activity measurement questionnaires.[106]

Neighborhood Walking Scale

The *Neighborhood Walking Scale (NWS)* was designed for use in this study to assess walking for specific purposes within the participant's self-described neighborhood in a usual week (Appendix F). The *NWS* consists of 2 items that have been used in prior studies[20, 35, 94]: "How many times a week do you go for a walk for any reason in and around your neighborhood?" and "How much time would you usually spend when you do go for a walk in and around your neighborhood?" These two items resulted in excellent agreement of women's total neighborhood walking in a reliability study (ICC = 0.95, 95% CI: 0.90, 0.97).[35] The *NWS* also consisted of 2 similar groupings of items that modified "walk for any reason" to read as "walk for recreation" and "walk for transport."

Accelerometer

The ActiGraph GT1M (ActiGraph, Pensacola, FL) was used to objectively assess ambulatory physical activity. The GT1M is an updated version of the ActiGraph Model 7164, which has acceptable test-retest reliability (ICC = 0.8)[108] and validity with counts (the summation of the acceleration signals per cycle) significantly correlated with energy expenditure and relative oxygen consumption during ambulatory activity.[110, 112]

The GT1M is a uniaxial accelerometer capable of storing more than 1 MB of data, measuring 1.5 x 1.44 x .70 in, and weighing 27 g. The GT1M detects vertical accelerations ranging in magnitude from 0.05 to 2.0 g. 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 to 2.5 Hz are recorded. The resulting counts are summed over a user-specified interval of time.[126] Ten-second cycles were used for this study, and data were downloaded directly to the computer for management and analysis.

Neighborhood Environment Walkability Scale

The abbreviated version of the *NEWS (NEWS-A)* was used to assess perceptions of the physical environment related to physical activity, walking for leisure, and walking for transportation (Appendix G). The *NEWS-A* consists of 7 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.[118, 119] Items from the 7 sections are used to create 12 subscales, which were determined by factor analysis from the original *NEWS*.[118] Residential density refers to the number of individuals living in an area, and the subscale asks respondents to report how common specific types of residences are within their immediate neighborhood. Diversity of land use mix refers to the proximity of businesses and facilities, and the subscale 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 ($\rho_I = 0.6 - 0.8$) and construct validity for the individual subscales.[119]

Validity of individual items measured against crime reports and rater reports in a separate study yielded Pearson correlations ranging from 0.2 to 0.9.[17] Concurrent validity of the *NEWS-A* with the *NEWS* resulted in strong correlations between subscales at the individual level (r = 0.8 - 0.9).[118]

Procedures

Orientation

During the orientation session, participants signed and received a copy of the Informed Consent (Appendix H) and HIPAA Authorization form (Appendix I). Participants also completed the prescreening items again to ensure eligibility. Participants were given sufficient time to read the forms and provide consent; the consent process typically took 10-15 minutes.

After obtaining consent and ensuring eligibility, researchers assessed participants' height with a portable stadiometer, weight with a physician's balance beam scale, and body composition with the BC-418 Body Composition Analyzer. These assessments took approximately 10-15 minutes. Following these assessments, participants completed the demographic questionnaire, the *IPAQ*, the *NWS*, and the *NEWS-A*. Completion of these questionnaires took approximately 25-35 minutes.

Participants then received a demonstration by the researcher 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 7 days. They also completed an accelerometer log sheet (Appendix J) each evening when they removed the accelerometer. Participants were instructed to maintain their normal levels of physical activity during the week they wore the accelerometer.

Follow-Up

After wearing the accelerometer for 7 consecutive days, participants returned to the lab for a follow-up visit. During this visit they returned the accelerometer and log sheet, and again completed the *IPAQ*, the *NWS,* and the *NEWS-A*. This visit lasted approximately 20 minutes. All individuals who participated in the study and wore the accelerometer as instructed received a physical activity and body composition report, as well as a $10 gift card.

Data Reduction and Analysis

Data Reduction

Ten-second epochs were utilized to calculate the intensity of each minute using a two-regression model.[113] Intensity was characterized by a MET value, which typically estimates the absolute (as opposed to relative) energy expenditure of an activity. One MET is equal to the resting metabolic rate of an individual, which is defined as 3.5 ml of oxygen per kilogram body mass per minute.[37] Prior to determining the MET value for each minute, the coefficient of variation [CV; (SD/mean)*100] for the minute must first be calculated.[113] For each 10-sec epoch, the counts for that epoch and the following 5 epochs were summed to represent the total counts per minute, and the CV for each minute was calculated. A CV greater than 10 represented a minute of lifestyle activity, and the lifestyle equation was used to estimate METs per minute. A CV greater than 0 but less than or equal to 10 represented a minute of walking or running, and the walk/run equation was used to estimate METs per minute. If the total counts per minute were 50 or less, a MET value of 1.0 was assigned to the minute. Each minute was then categorized into an intensity category as follows: moderate $\geq$ 3.0 METs and < 6.0 METs, vigorous $\geq$ 6.0 METs, moderate-to-vigorous $\geq$ 3.0 METs.

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 4 or more days.[127] Both non-wear and wear time were calculated.[128] Valid non-wear time consisted of bouts of at least 60 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. Counts per minute, total counts per day, total accumulated time and accumulated time in bouts of at least 10 minutes spent engaging in moderate, vigorous, and moderate-to-vigorous physical activity were determined.[128]

Self-reported weekly time walking for leisure and walking for transportation as described on the *IPAQ* were calculated by multiplying the activity frequencies by their corresponding durations, and recommended data processing guidelines were implemented.[129] Self-reported weekly time spent walking in the neighborhood for specific purposes as described on the *NWS* were also calculated by multiplying the frequency and duration of each type of activity.

The percentage of participants meeting physical activity recommendations as defined by accumulating, in bouts of at least 10 minutes, 30 minutes of moderate intensity activity on 5 or more days, 20 minutes of vigorous intensity activity on 3 or more days, or a combination of activities using accelerometer-derived data[4] was determined. The percentage of participants who were regular walkers, i.e., were walking for leisure and walking for transportation for at least 30 minutes on 5 days, was also determined. *NEWS-A* subscales were scored according to *NEWS-A* scoring procedures.[130] The walking distances from home to each of 23 destinations listed in *NEWS-A* and the total number of the 23 destinations that were within a 20-minute walk from home were computed.

Data Analysis

The proposed sample size for this study was 150 participants, and the researcher enrolled 143 volunteers. Two women did not complete the study. One woman was uncomfortable wearing the belt, and another woman had an accident in her home. The accelerometers malfunctioned for seven women. Another eight women did not meet the *a priori* criteria of wearing the accelerometer for at least 12 hours per day on 4 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 BMI (25.4 and 26.6 kg/m^2, respectively; $p = 0.01$).

Participants (n = 126) wore the accelerometer for 14.6 ± 0.8 hours on 6.2 ± 1.0 days, exceeding the *a priori* criteria for accelerometer wear time. Using the definition of a standard day as being the length of time that 70% of the sample wore the accelerometer,[127] participants in the final sample wore the device for 97% of the sample's standard day of 15.1 hours. Additionally, participants wore the device on 89% of their designated days. 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 1 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 self-reported walking data and 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 recommendations, regular versus non-regular walking). Univariate and multivariate regression analyses were performed to assess the relationship between perceptions of the environment and accelerometer-derived physical activity. Logistic regression was performed to assess the relationship between perceptions of the environment and engaging in regular walking for particular purposes. Data reduction and analysis was performed using SAS version 9.1 (SAS Institute Inc., 2002).

CHAPTER IV

RESULTS

Despite the numerous health benefits that are associated with regular participation in physical activity,[1, 4, 27, 48-50] many individuals are still not regularly active.[6] Older women are among the least active group in the U. S. population, with fewer than 46% of 45-64 year-olds and 36.3% of those aged 65 years and older engaging in recommended levels of physical activity.[6] Several studies have demonstrated a relationship between factors in the physical environment and physical activity participation,[13, 14, 17, 20, 22, 93, 131, 132] though only three studies have assessed this relationship in a population of older women while utilizing objective measures of physical activity.[13-15]

The purpose of this study was to assess the relationship between subjectively measured factors in the environment with objectively monitored ambulatory activity as well as with subjectively monitored walking during leisure time and for transportation in women aged 50 to 75 years. Specifically, the ability of the environmental factors to accurately predict physical activity and walking for particular purposes was investigated.

Participants

Participants were aged 59.9 ± 6.9 years, weighed 69.9 ± 12.8 kg, and had a BMI of 26.2 ± 4.3 kg/m^2. One hundred fourteen (90.5%) of the participants were Caucasian, and 87 (69.0%) were married. The majority of participants had a household income of at least $50,000 per year, had received a post-secondary education, and were employed. The participants' demographic characteristics are presented in Tables 1 and 2.

Table 1. Physical Characteristics of the Participants, n=126.

Age (years): mean ± sd	59.9 ± 6.9
Weight (kg): mean ± sd	69.9 ± 12.8
Height (cm): mean ± sd	163.0 ± 6.0
BMI (kg/m^2): mean ± sd	26.2 ± 4.3
Body Fat (%): mean ± sd	34.7 ± 7.2
Current Smoker[a]: count (%)	
Yes	5 (4.0)
No	120 (96.0)
Chronic Illness[a]: count (%)	
Yes	34 (27.0)
No	91 (72.2)
Experienced Menopause[a]: count (%)	
Yes	114 (91.2)
No	11 (8.8)
Hormone Replacement Therapy[b]: count (%)	
Yes	35 (30.4)
No	80 (69.6)

[a]No response from one participant. [b]No response from 11 participants.

Table 2. Socio-demographic Characteristics of Participants, n = 126.

Race/Ethnicity: count (%)	
Caucasian	114 (90.5)
Other	12 (9.5)
Marital Status: count (%)	
Married	87 (69.0)
Other	39 (31.0)
Children Living in the Home[a]: count (%)	
None	116 (92.8)
≥ 1	9 (7.2)
Education: count (%)	
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]: count (%)	
Employed for wages or self-employed	78 (62.4)
Other	47 (37.6)
Household Income[b]: count (%)	
Less than $10,000	2 (1.6)
$10,000 to less than $35,000	16 (13.1)
$35,000 to less than $50,000	26 (21.3)
$50,000 or more	78 (63.9)

[a]No response from one participant. [b]No response from 4 participants.

Time Engaging in Physical Activity

Three methods of quantifying participants' physical activity were utilized. The Actigraph GT1M accelerometer objectively monitored participants' physical activity. The *IPAQ* measured self-reported walking during leisure-time and walking for transportation. The *NWS* measured self-reported neighborhood walking for any reason, for recreation, and for transportation.

Accelerometer. A two-regression model was applied to the accelerometer count data to estimate intensity for each valid minute that the device was worn. Participants engaged in 72.5 ± 55.5 minutes of moderate, 1.3 ± 4.8 minutes of vigorous, and 77.5 ± 59.3 minutes of moderate-to-vigorous intensity physical 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 per day when summing all minutes within each intensity category without the constraint of the minimum 10-minute bout (Table 3).

IPAQ. Four items from the long form of the *IPAQ* measured walking in the leisure and transportation domains. Ninety (71.4%) participants reported doing at least 10 minutes of walking and 57 (45.2%) reported walking for at least 150 minutes during their leisure time in the previous week. Sixty-three (50%) participants indicated that they had done some walking for transportation purposes, with 27 (21.4%) having walked for at least 150 minutes for transportation purposes in the past week. Overall, participants reported spending more time walking for leisure [120.8 (IQR = 180.0) minutes] than for transportation purposes [20.0 (IQR = 120.0) minutes; S = 677, $p = 0.0173$]. Because the distributions of the *IPAQ* walking variables were positively skewed according to the

Shapiro-Wilk test for Normality ($p < 0.0001$ for both variables), median values and interquartile ranges (IQR) are presented in Table 3.

NWS. Six items from the *NWS* were used as measures of walking for particular purposes within the participant's self-described neighborhood. Eighty-nine (70.6%) participants indicated that they did some walking within their neighborhood in a usual week, and 46 (36.5%) of them walked for 150 minutes or more. Seventy-three (57.9%) participants walked for recreational or leisure purposes within their neighborhood, with 33 (26.2%) walking for more than 150 minutes. Twenty-one (16.7%) walked for transportation, with only 4 (3.2%) walking for 150 minutes or more. The majority of the time that participants spent walking in their neighborhood in a usual week was for recreational purposes [50.0 (IQR = 180.0) minutes], and very little time was spent walking for transportation [0.0 (IQR = 0.0) minutes]. Because the distributions of the neighborhood walking variables were positively skewed according to the Shapiro-Wilk test for Normality ($p < 0.0001$ for all variables), medians and IQRs are presented in Table 3.

Table 3. Physical Activity of Participants, n=126.

Accelerometer[a]: mean ± sd	
Counts/minute	282.3 ± 124.7
Total counts/day	248,828.7 ± 113,156.1
Daily minutes of moderate physical activity	
Accumulated	159.8 ± 64.7
10-minute bouts	72.5 ± 55.5
Daily minutes of vigorous physical activity	
Accumulated	4.3 ± 6.8
10-minute bouts	1.3 ± 4.8
Daily minutes of moderate-to-vigorous physical activity	
Accumulated	164.1± 67.8
10-minute bouts	77.5 ± 59.3
IPAQ: median (IQR)	
Weekly minutes of leisure-time walking[b]	120.0 (180.0)
Weekly minutes of walking for transportation[c]	20.0 (120.0)
Neighborhood Walking Scale: median (IQR)	
Weekly minutes of walking for any reason[c]	100.0 (190.0)
Weekly minutes of walking for recreation[c]	50.0 (180.0)
Weekly minutes of walking for transportation[b]	0.0 (0.0)

[a]Data based on n=126. [b]Data based on n=118. [c]Data based on n=117.

Meeting Physical Activity Recommendations

The percentage of participants meeting physical activity recommendations [4] was determined using data from the accelerometer. In addition, the percentage of participants who were regular walkers, i.e., were walking for leisure and/or for transportation for at least 30 minutes on 5 days as reported on the *IPAQ*, and who were regular neighborhood walkers as reported on the *NWS*, was determined.

Accelerometer. Sixty (47.6%) participants met the current physical activity recommendations, defined as accumulating, in bouts of at least 10 minutes, 30 minutes of moderate intensity physical activity on at least 5 days, 20 minutes of vigorous intensity activity on at least 3 days, or a combination of the two intensities of activity during the 7-day monitoring period. Only one participant engaged in less than 10 minutes of physical activity during the week.

IPAQ. According to self-report with the *IPAQ*, 39 (31.0%) participants walked for leisure and 24 (19.0%) walked for transportation purposes for more than 30 minutes on at least 5 days. Overall, 51 (40.5%) participants were classified as regular walkers by walking for leisure and/or transportation.

NWS. According to self-report with the *NWS*, 36 (28.6%) participants walked in their neighborhoods for a minimum of 30 minutes on 5 or more days in a usual week, and thus were classified as regular neighborhood walkers. Twenty-three (18.2%) participants reported regular neighborhood walking for recreational purposes and 4 (3.2%) participants reported regular neighborhood walking for transportation. Cross-tabulating the frequencies of those classified as regular neighborhood walkers for any reason (n = 36) with those who engaged in regular neighborhood walking for recreation or for transportation showed that 22 participants reported sufficient levels of walking for recreation, 4 participants reported sufficient levels of walking for transportation, and 10 participants did not report sufficient levels of walking for either purpose.

Cross-tabulation of Accelerometer and IPAQ. Cross-tabulating the frequencies of those classified as meeting recommendations via objective monitoring with those who reported regular walking via the *IPAQ* indicated some differences. Whereas 26 participants were accumulating sufficient levels of physical activity according to both accelerometer data and self-reported walking, 34 participants were meeting physical activity recommendations by engaging in activities other than or in addition to walking. Alternatively, 25 participants reported sufficient amounts of walking, though were not classified as meeting recommendations using accelerometer data.

Perceptions of the Environment

Perceptions of the environment were examined with the *NEWS-A*. The residential density subscale asks respondents to report how common are specific types of residences 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. The diversity of land use mix subscale asks respondents to indicate how long it takes to walk to each of 23 destinations, and scores can range from 1 (more than 30 minutes) to 5 (1 to 50 minutes). The other sections include items that are scaled from 1 (strongly disagree) to 4 (strongly agree), with higher scores representing perceptions of high walkability on the subscales of land use mix-access, street connectivity, infrastructure and safety for walking, aesthetics, lack of parking, and lack of cul-de-sacs. Higher scores on the subscales for traffic hazards, crime, hilliness, and physical barriers represent perceptions of lower walkability. Data for each of the 12 *NEWS-A* subscales was skewed according to Shapiro-Wilk tests for Normality (p = 0.0006 for infrastructure and safety subscale; $p <$ 0.0001 for all other subscales). Median values, corresponding interquartile ranges, and the range of participants' actual scores are presented in Table 4.

Table 4. Participants' *NEWS-A* Subscale Scores.

Subscale	**Median (IQR)**	**Participants' Range**
Residential 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 = 125)	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 (0.0)	1.0 - 4.0

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.
[a]Higher scores indicate lower walkability.

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 to 3 stories high to be the only type of home in their neighborhood. No one reported the presence of apartments or condos higher than 6 stories in their immediate neighborhood. Using *NEWS-A* scoring procedures,[130] the median residential density subscale score was 177.0 (IQR = 0.0; Table 4).

Participants described how long it would take to walk from their home to 23 specific destinations such as stores, parks, and schools. The number of participants who lived within walking distance, defined as a 20-minute walk from home,[14] of the 23 specific destinations is presented in Table 5. On average, participants described 8.1 ± 7.0 destinations to be within walking distance of home. The most commonly reported destinations within walking distance from home were parks (58.7%) and grocery stores (75.4%). Participants most often described the other destinations as being more than a 30-minute walk from home. Eighteen (14.3%) participants perceived none of the 23 destinations to be within walking distance of their home. The median subscale score for diversity of land use indicates that, overall, destinations were more than a 21-minute walk from home.

Table 5. Participants Living Within Walking Distance (20 min) of Specific Destinations.

Destination	**Count (%)**
Convenience or small grocery store	95 (75.4)
Park	74 (58.7)
Fast food restaurant	64 (50.8)
Bank or credit union	59 (46.8)
Coffee place	58 (46.0)
Non-fast food restaurant	57 (45.2)
Elementary school	55 (43.7)
Laundry or dry cleaners	53 (42.1)
Pharmacy or drug store	53 (42.1)
Supermarket	51 (40.5)
Salon or barber shop	48 (38.1)
Video store	43 (34.1)
Post office	38 (30.2)
Bus or train stop	37 (29.4)
Other schools (not elementary)	36 (28.6)
Gym or fitness facility	36 (28.6)
Clothing store	30 (23.8)
Fruit or vegetable market	27 (21.4)
Hardware store	26 (20.6)
Bookstore	25 (19.8)
Library	20 (15.9)

Table 5 Continued.

Destination	**Count (%)**
Recreation center	20 (15.9)
Participant's job or school	10 (7.9)

Participants' median subscale scores for aesthetics, crime, hilliness, and physical barriers indicate more walkable neighborhoods, while lower subscale scores for land use mix-access and lack of parking at local shopping areas denote less walkable neighborhoods. Median subscale scores for street connectivity, infrastructure and safety for walking, traffic hazards, and lack of cul-de-sacs were in the middle of the possible range of scores, indicating neither more or less walkability (Table 4).

Perceptions of the Environment According to Activity Status

Median *NEWS-A* subscale scores were compared for 60 participants who met current physical activity recommendations and 66 who did not, as classified by accelerometer-derived physical activity. Median scores of the environmental subscales were also compared for those who were classified as regular walkers versus non-regular walkers based on self-report from the *IPAQ*, and regular neighborhood walkers versus non-regular neighborhood walkers based on data from the *NWS*.

Accelerometer. NEWS-A subscale scores did not differ ($p \geq 0.05$) between those classified as meeting recommendations and those not meeting recommendations based on accelerometer-derived physical activity (Table 6).

Table 6. Comparison of Median (IQR) *NEWS-A* Subscale Scores by Activity Status (Accelerometer-derived Physical Activity).

	Meeting Physical Activity Recommendations n = 60	Not Meeting Physical Activity Recommendations n = 66	*p*-value
Residential Density	177.0 (9.5) [b]	177.0 (0.0)	0.05
Land Use Mix:			
Diversity	1.9 (3.5) [c]	1.9 (1.6) [d]	0.41
Access	2.3 (2.2)	2.3 (2.0)	0.52
Street Connectivity	3.0 (1.5) [b]	3.0 (1.5)	0.65
Infrastructure and Safety for Walking	2.3 (1.2) [d]	2.7 (1.3) [b]	0.65
Aesthetics	3.5 (1.0)	3.5 (1.0)	0.77
Traffic Hazards[a]	2.0 (0.7) [b]	2.0 (1.0)	0.17
Crime[a]	1.0 (0.3) [b]	1.0 (0.3) [b]	0.33
Lack of Parking	1.0 (1.0)	1.0 (1.0)	0.33
Lack of Cul-de-sacs	2.5 (1.5)	4.0 (3.0)	0.77
Hilliness[a]	1.0 (0.5)	1.0 (1.0)	0.27
Physical Barriers[a]	1.0 (0.0)	1.0 (1.0)	0.20

Note: All comparisons were made by Wilcoxon Rank Sum Test. [a]Higher scores indicate lower walkability. [b]Missing data from 1 participant. [c]Missing data from 6 participants. [d]Missing data from 3 participants.

IPAQ. *NEWS-A* subscale scores did not differ ($p > 0.05$) between those classified as regular walkers compared to non-regular walkers based on *IPAQ* data.

NWS. Table 7 compares *NEWS-A* subscale scores according to self-reported neighborhood walking for any reason. Three subscale scores differed between regular neighborhood walkers engaging in sufficient levels of neighborhood walking for any reason and non-regular walkers. Those who walked regularly for any reason reported a lower median score for the lack of cul-de-sacs subscale (mode = 1), thus indicating that neighborhood streets had more cul-de-sacs compared to those who were not regular neighborhood walkers (mode = 4). Differences also existed for the hilliness (Wx = 2605.5; m = 90; n = 36; $p = 0.03$) and physical barriers (Wx = 2006.0; m = 90; n = 36; $p = 0.04$) subscales. Though the median scores for hilliness and physical barriers were the same between the neighborhood walking groups, the IQR values (score that reflects the difference between the 25th and 75th percentiles) were not. A larger IQR represents greater dispersion of reported scores. For example, almost 56% of the regular walkers reported a score of 1 on the hilliness subscale and another 25% reported a score of 2 (score at 25% = 1, score at 75% = 2; IQR = 1), whereas 76% of the non-regular walkers reported a score of 1 (score at 25% = 1, score at 75% = 1; IQR = 0). Those who reported regular neighborhood walking for transportation purposes reported a lower median score for the subscale of land use mix-diversity compared to those who were not walking for transportation [1.0 (IQR = 0.6) versus 1.9 (IQR = 1.5), respectively; Wx = 98.5; m = 113; n = 4; $p = 0.04$]. A lower median score for land use mix-diversity represents greater walking distance to destinations. No other differences in subscale scores were observed between groups according to neighborhood walking.

Table 7. Comparison of Median (IQR) *NEWS-A* Subscale Scores by Walking Status (Self-reported Neighborhood Walking for Any Reason).

	Regular Neighborhood Walkers n = 36	Not Regular Neighborhood Walkers n = 90	*p*-value
Residential Density	177.0 (0.0) [b]	177.0 (0.0)	0.62
Land Use Mix:			
Diversity	1.7 (1.0) [c]	2.0 (1.5) [d]	0.13
Access	2.2 (2.0)	2.3 (2.0)	0.62
Street Connectivity	3.0 (1.0) [b]	2.5 (1.5)	0.63
Infrastructure and Safety for Walking	2.7 (1.5) [d]	2.5 (1.2) [b]	0.31
Aesthetics	3.6 (1.0)	3.2 (1.0)	0.17
Traffic Hazards[a]	2.0 (1.0) [b]	2.0 (1.0)	0.11
Crime[a]	1.0 (0.3) [e]	1.0 (0.3)	0.83
Lack of Parking	1.0 (1.0)	1.0 (1.0)	0.77
Lack of Cul-de-sacs	2.0 (2.0)	3.0 (2.0)	**0.04**
Hilliness[a]	1.0 (1.0)	1.0 (0.0)	**0.03**
Physical Barriers[a]	1.0 (0.0)	1.0 (1.0)	**0.04**

Note: All comparisons were made by Wilcoxon Rank Sum Test. [a]Higher scores indicate lower walkability. [b]Missing data from 1 participant. [c]Missing data from 6 participants. [d]Missing data from 3 participants. [e]Missing data from 2 participants.

Relationship between Perceptions of the Environment and Physical Activity

Perceptions of the neighborhood environment were examined using the *NEWS-A*. The relationship between data from each of the twelve subscales of *NEWS-A* and accelerometer-derived physical activity were assessed using multivariate linear regression analysis. The relationship between environmental perceptions and regular walking were assessed using logistic regression. Associations between proximity of destinations and physical activity and regular walking was examined for each destination individually, as well as for the mean number of destinations within a 20-minute walk from home.

NEWS-A Subscales and Accelerometer-derived Physical Activity

Linear regression preceded by univariate analysis assessed the relationship between subscales of *NEWS-A* and counts/minute, total counts/day, and time spent engaging in moderate and moderate-to-vigorous physical activity in bouts of at least 10 minutes. Univariate analysis resulted in few significant associations. Univariate analyses demonstrated associations between the lack of parking subscale and counts/minute (β = -29.1, 95% CI: -54.6, -3.6; model R^2 = 0.04), total counts/day (β = -26535, 95% CI: -49692, -3378.3; model R^2 = 0.04), and minutes of moderate-to-vigorous physical activity performed in bouts of at least 10 minutes (β = -12.5, 95% CI: -24.7, -0.4; model R^2 = 0.03). Stepwise multivariate regression analysis demonstrated that no additional variables entered the models predicting counts/minute, total counts/day, and minutes of moderate-to-vigorous physical activity. There were no significant associations between *NEWS-A* subscales and minutes of moderate intensity physical activity.

NEWS-A Subscales and Regular Walking (IPAQ)

Logistic regression assessed the relationship between subscales of *NEWS-A* and regular walking as reported on the *IPAQ*. Univariate analyses demonstrated significant associations between regular leisure-time walking and two subscales. More positive perceptions of having an infrastructure and safety for walking increased the odds of being a regular leisure-time walker by 1.7 times (95% CI: 1.02, 2.9). More negative perceptions of traffic hazards decreased the odds of being a regular leisure-time walker by 50% (OR = 0.5; 95% CI: 0.3, 0.9). No significant regressive models related *NEWS-A* subscales and regular walking for transportation purposes.

NEWS-A Subscales and Regular Neighborhood Walking (NWS)

Logistic regression assessed the relationship between subscales of *NEWS-A* and regular neighborhood walking as reported on the *NWS*. An inverse relationship existed between regular neighborhood walking for any reason and lack of cul-de-sacs (OR = 0.7, 95% CI: 0.5, 0.98); those who perceived that their neighborhoods have few cul-de-sacs were less likely to walk. A positive relationship existed between regular neighborhood walking for any reason and hilliness (OR = 1.6, 95% CI: 1.02, 2.4); those who agreed more strongly with the statement "The streets in my neighborhood are hilly, making my neighborhood difficult to walk in" were more likely to walk regularly in the neighborhood. No other associations were detected between *NEWS-A* subscales and regular neighborhood walking for any reason, for recreation, or for transportation purposes.

Proximity to Destinations and Accelerometer-derived Physical Activity

Univariate linear regression was performed to assess the relationship between proximity of destinations and accelerometer data (counts/minute, total counts/day, and time spent engaging in moderate and moderate-to-vigorous physical activity in bouts of at least 10 minutes). The mean number of destinations within walking distance of home did not predict of counts/minute ($\beta = -0.8$, $p = 0.6$; model $R^2 = 0.00$), total counts/day ($\beta = -749.1$, $p = 0.6$; model $R^2 = 0.00$), or time spent engaging in moderate ($\beta = -0.5$, $p = 0.5$; model $R^2 = 0.00$) and moderate-to-vigorous ($\beta = -0.5$, $p = 0.5$; model $R^2 = 0.00$) physical activity. Neither did the presence of each of 23 destinations within walking distance of home predict counts/minute, total counts/day, nor time spent engaging in moderate and moderate-to-vigorous physical activity ($p > 0.05$).

Proximity to Destinations and Regular Walking (IPAQ)

Logistic regression was performed to assess the relationship between proximity of destinations and regular walking as reported on the *IPAQ*. Univariate analyses detected a positive relationship between the presence of a recreation center within walking distance of home and regular leisure-time walking (OR = 3.0, 95% CI: 1.2, 7.9); those who lived within a 20-minute walk to a recreation center were 3 times more likely to walk regularly for leisure. Stepwise multivariate logistic regression adjusted the model, with the presence of a recreation center increasing the odds [OR = 10.0; 95% CI: 2.1, 48.6] and the presence of a bookstore decreasing the odds [OR = 0.2; 95% CI: 0.03, 0.8] of engaging in regular leisure-time walking. Univariate analyses detected an inverse relationship between the presence of an elementary school within walking distance of home and regular walking for transportation (OR = 0.3, 95% CI: 0.1, 0.9). As above, stepwise multivariate analysis adjusted the model. The presence of an elementary school decreased the odds [OR = 0.2; 95% CI: 0.05, 0.6] while the presence of a bookstore increased the odds [OR = 5.1; 95% CI: 1.4, 18.5] of engaging in regular walking for transportation purposes. The mean number of destinations within walking distance of home was not related to regular walking.

Proximity to Destinations and Regular Walking (NWS)

Logistic regression was performed to assess the relationship between proximity of destinations and regular walking as reported on the *NWS*. Univariate analyses demonstrated that the presence of an elementary school within walking distance of home was inversely related to regular neighborhood walking for any reason (OR = 0.4, 95% CI: 0.2, 0.9) and for recreational purposes (OR = 0.3, 95% CI: 0.1, 0.8). Stepwise multivariate analysis did not result in any additional models. Also, the mean number of destinations within walking distance of home was not related to regular neighborhood walking.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Factors of the physical environment are related to physical activity participation and walking for specific purposes.[19-21, 34] While studies have demonstrated differences in these relationships according to gender,[8, 35, 36] few studies have examined environmental correlates of physical activity solely in a population of older women.[13-15, 18, 22, 23] Three studies targeting middle and older-aged women objectively monitored physical activity.[13-15] Two of these studies utilized a pedometer,[13, 14] which is a small device that counts the number of steps accumulated during a specified time period, and the third study used an accelerometer.[15] An accelerometer is an objective physical activity monitor that provides more detailed information than a pedometer, enabling discrimination of the duration and intensity of ambulatory physical activity. The purpose of this study was to assess the relationship between perceptions of the neighborhood environment with objectively monitored ambulatory activity as well as with subjectively monitored walking during leisure time and for transportation in women aged 50 to 75 years. Specifically, the ability of the environmental factors to accurately predict physical activity and walking for particular purposes was investigated.

Results of this study estimated that fewer than half of the participants were meeting physical activity recommendations when using data from the accelerometers, and 40.5% reported walking for leisure and/or transportation purposes for a minimum of 30 minutes on at least 5 days. Participants who walked regularly in their neighborhoods for transportation purposes perceived less diversity of land use mix within their neighborhoods compared to non-regular transportational walkers, and those who walked regularly in their neighborhoods for any reason perceived more cul-de-sacs, more hilliness, and fewer physical barriers compared to non-regular neighborhood walkers. Regression analyses demonstrated significant relationships between environmental factors and physical activity participation. One subscale from *NEWS-A*, lack of parking, was inversely related to accelerometer-derived physical activity, and two subscales, traffic hazards and infrastructure and safety for walking, were associated with self-reported leisure-time walking. Negative perceptions of traffic hazards decreased the likelihood of walking and positive perceptions of infrastructure and safety for walking increased the likelihood of walking. Two additional subscales were related to self-reported neighborhood walking. Perceptions of more hills and cul-de-sacs increased the likelihood of neighborhood walking. The presence of specific destinations within a 20-minute walk from home were related to general, past-week self-reported walking for transportation and leisure as well as usual neighborhood walking.

Meeting Physical Activity Recommendations

Meeting physical activity recommendations was evaluated using accelerometer-derived physical activity, such that individuals who were accumulating in 10-minute bouts at least 30 minutes of moderate intensity activity on 5 or more days, at least 20 minutes of vigorous intensity activity on 3 or more days, or a combination of moderate and vigorous activities were classified as meeting recommendations.[4] Additionally, those who reported walking via the *IPAQ* and separately via the *NWS* for specific purposes for at least 30 minutes on 5 or more days were classified as being regular walkers. These classifications enabled more detailed analysis of objectively monitored physical activity, self-reported walking for leisure and transportation, and self-reported walking for any reason, for leisure, and for transportation that occurred specifically within the participant's neighborhood.

Fewer than half of this study's participants were meeting physical activity recommendations when using accelerometer-derived data. However, 47.6% were accumulating amounts of moderate or greater intensity physical activity in bouts of at least 10 minutes that were sufficient to elicit health benefits. A larger percentage of participants were meeting recommendations compared to women in a national surveillance study.[6] Though the national sample demonstrated that 14.1 to 27.3% of women aged 45 years and older were inactive,[6] or engaged in fewer than 10 minutes of moderate or greater intensity activity each week, only one participant in this sample was classified as inactive using accelerometer-derived physical activity.

Participants in the current study reported amounts of moderate-to-vigorous physical activity and leisure-time walking that were much greater than a sample of adults representing several communities throughout the United States,[132] though amounts of leisure-time walking were similar to a separate national sample of women aged 18 years and older.[88] Approximately 40% of participants reported via the *IPAQ* that they walked for leisure and/or transportation purposes for a minimum of 30 minutes on 5 or more days of the previous week, thus meeting national physical activity recommendations solely by walking. This proportion is larger than that of a national telephone survey of 1816 individuals (67% female), in which 33.6% of female respondents accumulated 30 minutes of walking on 5 or more days weekly.[28] Almost 29% of participants reported via the *NWS* that they regularly walked within their neighborhood. This proportion represents approximately 70% of those meeting physical activity recommendations solely by walking, according to self-report with the *IPAQ*. Interestingly, the percentage of regular walkers that use their neighborhood for walking is similar to the proportion of regular walkers in national samples who reported using primarily their neighborhood streets for walking and physical activity (66-70%).[9, 28]

Perceptions of the Neighborhood Environment

Almost 75% of participants reported living in neighborhoods that consisted solely of detached, single family homes. Participants indicated low levels of access to and diversity of stores and other facilities in the neighborhood, with the average facility being a 21 to 30-minute walk from home, and they noted that plenty of parking was available at local shopping areas. On the other hand, participants had positive perceptions of their neighborhoods' aesthetics and street connectivity, and indicated that traffic hazards and crime were not prevalent. Hilliness and physical barriers did not present a challenge to walking. Perceptions regarding having an infrastructure and safe environment for walking were generally neutral.

Participants who met physical activity recommendations did not perceive their neighborhood environments differently than those who were not meeting recommendations. These findings conflict with results from a study in which individuals in walking-friendly neighborhoods, whose *NEWS* subscale scores reflected 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, who reported less positive perceptions of their environment.[119]

Participants who walked regularly for transportation in the neighborhood (i.e., regular neighborhood walkers for transportation) reported lower and less varied scores for the land use mix-diversity subscale compared to those who walked less or not at all for transportation in the neighborhood. This was an interesting finding because higher scores on this subscale typically indicate more walkable neighborhoods. Thus, those who walked more in their neighborhoods for transportation did so in less walkable environments. This finding conflicts with the findings of another study in which those who self-reported greater amounts of walking for transportation, or specifically walking for errands outside of the home, lived in more walkable neighborhoods.[119] However, only four participants regularly walked in their neighborhood for transportation purposes, so conclusions should be drawn cautiously.

There were interesting differences in perceptions between those who reported regular walking for any reason in the neighborhood and those who walked less or not at all in their neighborhood. Higher scores on the lack of cul-de-sacs subscale are thought to indicate higher walkability, yet those who walked more in their neighborhoods reported lower scores for this subscale, meaning their neighborhoods had more cul-de-sacs and were presumed to be less friendly for walking. Regular neighborhood walkers also reported a greater presence of hills in their neighborhoods, which denotes a less walkable environment according to *NEWS-A* scoring.[130] Conversely, regular neighborhood walkers reported no major physical barriers to prevent them from walking. These findings are not consistent with Saelens et al,[119] whose participants reported different perceptions of neighborhood walkability using NEWS but did not report differing amounts of total time spent walking.

Relationship between Environmental Factors and Physical Activity

Discussion of the relationship between perceived environmental factors and physical activity is difficult because there are many ways of measuring and reporting both the environment and physical activity. Studies that have assessed the relationship between the two are not consistent with the tools utilized to quantify the outcomes. For example, questionnaire items referring to aesthetics may simply ask if the environment is pleasant, or may be more detailed and ask about the presence of greenery and other nice things to observe. Likewise, physical activity can be quantified by a variety of questionnaires that may provide measures of energy expenditure, time, or simply a score. Physical activity can also be monitored objectively via a pedometer that counts steps per minute or an accelerometer that can produce counts per minute (a measure of intensity) or time. The following discussion of the current study's findings regarding the relationship between perceptions of the environment and physical activity will begin with the associations with accelerometer-derived physical activity, continue with self-reported physical activity measured via the *IPAQ*, and will finish with self-reported neighborhood walking.

Objectively monitored physical activity. This study is one of the few studies of environmental correlates that utilized accelerometers to quantify physical activity. Interestingly, results of the current study demonstrated that only the lack of parking subscale from *NEWS-A* was significantly associated with accelerometer-derived physical activity. The lack of parking subscale consists of a single item asking participants if they agree with the statement, "Parking is difficult in local shopping areas." The thought is that if parking is difficult, then individuals may be inclined to walk to local shopping areas. In this study, stronger agreement with this statement was inversely related to counts/minute, total counts/day, and minutes of moderate-to-vigorous physical activity performed in bouts of at least 10 minutes. This means that participants who engaged in greater levels of physical activity as measured by the accelerometer had the perception that parking is easy in local shopping areas. This finding is opposite what would be expected; i.e., that active people perceive that parking is difficult. One should question how well this subscale predicts physical activity, however. A previous study that evaluated the relationship between the lack of parking item and self-reported physical activity found no significant relationship between the two ($pr = 0.04$),[118] and other studies have not used or have not discussed the lack of parking item as its own subscale.[11, 17, 132, 133] Brownson, Chang and colleagues[134] assessed the reliability of *NEWS* items and observed only fair inter-rater agreement of the lack of parking item, with the item having an intraclass correlation coefficient of 0.22.

Other studies have demonstrated associations between *NEWS* subscales and accelerometer-derived physical activity. Saelens et al[119] observed that individuals who lived in more walking-friendly neighborhoods reported more positive perceptions of residential density, diversity of land use mix, street connectivity, aesthetics, and pedestrian/traffic safety when compared to individuals who lived in neighborhoods that were less walking-friendly. Atkinson et al[11] found that street connectivity correlated with moderate-to-vigorous physical activity ($r = 0.21$) in a random sample of adults from neighborhoods deemed either high-walkable or low-walkable; no other significant associations were evident with respect to moderate or moderate-to-vigorous physical activity. Morris, McAuley and co-workers[15] demonstrated correlations between total counts per day and street connectivity ($r = 0.25, p < 0.01$), access to walking/cycling facilities ($r = 0.21, p < 0.05$), and aesthetics ($r = 0.21, p < 0.05$) in a population of older women. However, street connectivity was the only factor that remained in the regressive model after controlling for other factors (self-efficacy and functional limitations).

Two other studies using other means to evaluate environmental factors demonstrated associations with accelerometer-derived physical activity. Oakes and colleagues[16] observed that street connectivity, or specifically, larger block lengths, increased the odds of total activity (total counts per day) by 44% (OR = 1.4, 95% CI: 1.03, 2.0) in a sample of adults aged 25 years and older. Frank et al[12] found that minutes of moderate intensity activity was associated with objective measures of residential density ($pr = 0.18, p < 0.01$), intersection density (i.e., street connectivity; $pr = 0.11, p < 0.01$), and land-use mix ($pr = 0.14, p < 0.01$) in a sample of adults aged 20 to 70 years.

The current study found no associations between objectively monitored physical activity and mean number of destinations within walking distance of home or presence of specific destinations within walking distance of home. These findings contradict King, Belle and associates[13] and King, Brach and co-workers.[14] King, Belle and associates[13] used objective measures of the environment to determine that the presence of a golf course and the presence of a post office within a 20-minute walk from home were related to a greater accumulation of steps per day in a sample of women aged 52 to 62 years. In a 15-year follow-up to a separate study, King, Brach and co-workers[14] evaluated subjective rather than objective measures of the environment, specifically, convenience of walking to different destinations and overall quality of the neighborhood for walking, in a sample of women aged 74.2 ± 4.2 years at follow-up. They observed that the number of destinations within a 20-minute walk from home was related to accumulated steps per day, though the correlation was not very strong ($r^2 = 0.25$).

That only one environmental factor was significantly related to objectively monitored physical activity was surprising, considering other studies have shown associations with a variety of environmental characteristics and with proximity to destinations. It was also unexpected considering the many advantages of using an objective measure of physical activity. An accelerometer worn at the hip, as 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.[107] In addition, the researcher utilized the most current methods of managing the accelerometer data in order to provide a more accurate estimation of intensity level and more accurate estimates of time spent engaging in moderate and vigorous physical activity.[113, 128] 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.

Self-reported walking for leisure and transportation (IPAQ). The current study observed that two subscales of *NEWS-A* were related to regular walking during leisure time. Specifically, more positive perceptions of having an infrastructure and safety for walking increased the odds of being a regular leisure-time walker, and more negative perceptions of traffic hazards decreased the odds of being a regular leisure-time walker.

There were no significant associations between *NEWS-A* subscales and regular walking for transportation purposes. These findings differ from the results of several studies.[9, 14, 17, 18, 22, 93, 95, 117, 132, 133, 135]

Few studies have assessed the relationship between self-reported physical activity and environmental perceptions with items from the *NEWS*, and results differed. McGuire[133] demonstrated correlations between several subscale items of a modified version of *NEWS-A* and past-month physical activity performed both within and outside of the neighborhood among adults aged 21 to 82 years. She observed that individuals were more likely to engage in physical activity outside of their neighborhood if they had positive perceptions of their neighborhoods' aesthetics, and were less likely to engage in activity if they perceived a high crime rate and poor accessibility to stores and other facilities. Other items relating to safety and traffic hazards were not associated with physical activity performed outside of the neighborhood. Using an early version of *NEWS* and the short form of the *IPAQ* in a study of adult women, De Bourdeaudhuij et al[17] observed that scores of the land use mix-diversity subscale were positively associated with self-reported walking ($pr = 0.15$), and scores from the land use mix-access subscale were positively related to self-reported moderate physical activity ($pr = 0.16$). However, the other subscales were not significantly associated with either form of activity.

King, Toobert and associates[132] used a modified version of *NEWS* to evaluate potential environmental moderators of physical activity interventions among mostly middle and older-aged adults in five U. S. cities. They observed that individuals who were most likely to be meeting physical activity recommendations according to self-report were those who reported higher scores on the aesthetics subscale in addition to being generally satisfied with their neighborhood. Analyses of data from the individual sites produced varied associations. For example, living in neighborhoods consisting of primarily detached, single-family homes was inversely related to leisure-time walking among adults aged 65 and older at one study site, whereas the associations were positive with respect to performing moderate-to-vigorous intensity physical activity among postmenopausal women at another study site. Researchers noted that physical activity performed for reasons other than to run errands was more likely to occur in low-density neighborhoods among middle and older-aged women. The perception that stores were within walking distance of home, referring to the land use mix-access subscale, was positively related to walking for errands at two sites and leisurely walking at a third site. In addition, better perceptions of street connectivity were related to walking for errands at two sites.

A positive perception of neighborhood aesthetics is the environmental factor that is most consistently associated with self-reported physical activity. In study of women aged 18 to 65 years, researchers used the long form of the *IPAQ* to evaluate walking for leisure and transportation purposes, and asked several questions regarding environmental aesthetics.[117] Respondents were categorized as having low, medium, or high perceptions of neighborhood aesthetics. Researchers observed that the highest perceptions of neighborhood aesthetics were related to increased odds that individuals engaged in any leisure-time walking (OR = 1.5, 95% CI: 1.2, 1.9). Sallis, King et al[135] observed that women aged 50 years and older who perceived pleasant scenery in their neighborhoods reported engaging in more minutes of moderate-to-vigorous physical activity when compared to peers who did not perceive pleasant scenery, and also when compared to younger women who did perceive pleasant scenery. In a study of women aged 40 years and older, Wilcox and co-workers[18] found that the perception of enjoyable scenery was positively related to doing some activity among rural (OR = 1.7, 95% CI: 1.2, 2.5) but not urban (OR = 1.3, 95% CI: 0.9, 1.9) women. Other neighborhood characteristics that were assessed, including the presence of sidewalks, heavy traffic, hills, street lights, and high crime, were unrelated to participation in leisure-time physical activity both in urban and rural areas. In another study of ethnically diverse women aged 40 years and older, King, Castro et al[22] found that the presence of hills and enjoyable scenery increased the odds by 1.5 (95% CI: 1.2, 1.8) and 1.4 (95% CI: 1.1, 1.8) times, respectively, that women self-reported sufficient levels of physical activity to be meeting national recommendations. However, researchers noted no relationships between self-reported physical activity and the presence of sidewalks, heavy traffic, streetlights, or high levels of crime in the neighborhood. Brownson, Baker and associates[9] demonstrated that the presence of hills (OR = 1.3, 95% CI: 1.04, 1.6) and enjoyable scenery (OR = 1.5, 95% CI: 1.1, 1.9) were both positively associated with meeting physical activity recommendations among a nationwide population of adult men and women. Ball, Bauman et al[93] observed the existence of a larger proportion of adult walkers among those who perceived their neighborhood aesthetics in a more positive manner. Those who reported moderate perceptions of neighborhood aesthetics were 16% less likely to walk for exercise (OR = 0.8, 95% CI: 0.7, 0.99), and those who reported poor perceptions of aesthetics were 41% less likely to walk for exercise (OR = 0.6, 95% CI: 0.5, 0.8).

Some studies demonstrated a positive association between the presence of sidewalks and self-reported physical activity. Brownson, Baker et al[9] observed that the presence of sidewalks (OR = 1.3, 95% CI: 1.02, 1.6) were positively associated with meeting physical activity recommendations among a nationwide population of adult men and women. Addy and co-workers[95] found that the presence of sidewalks in the neighborhood increased the odds of doing some walking compared to no walking by 2.2 times (95% CI: 1.3, 3.9). They noted that other factors such as having a pleasant neighborhood for walking, streetlights, traffic volume and crime were not related to physical activity or walking.

Other studies have shown associations between other environmental factors and self-reported physical activity. For example, Brownson, Baker and associates[9] made an unusual observation that the presence of heavy traffic increased the odds of meeting physical activity recommendations by 1.3 times (95% CI: 1.04, 1.6). Oakes et al[16] demonstrated that high residential density doubled the odds of walking for transportation purposes (OR = 2.0, 95% CI: 1.3, 3.1). Ball, Timperio et al[117] found that the highest perceptions of neighborhood safety were related to increased odds that adult women engaged in any leisure-time walking (OR = 1.6, 95% CI: 1.2, 1.9). In this same study, the third highest quartile of objectively measured street connectivity (i.e., the number of 4-way intersections) increased the odds of women walking for transport by 1.6 times (95% CI: 1.2, 1.9).

In addition to the two subscales of *NEWS-A,* the present study found significant associations between the presence of specific destinations within walking distance of home and regular walking reported on the *IPAQ*. Specifically, the presence of a recreation center increased the odds while the presence of a bookstore decreased the odds of engaging in regular walking during leisure time. Conversely, the presence of a bookstore increased the odds of engaging in regular walking for transportation purposes, while an elementary school resulted in a decreased likelihood of walking to get to places.

Studies have demonstrated different findings with respect to the presence of destinations near home and self-reported physical activity. For example, King, Brach and colleqgues[14] observed that the number of destinations within a 20-minute walk from home was related to self-reported walking ($r^2 = 0.17$) and total leisure-time physical activity ($r^2 = 0.16$) in a sample of older women aged 74.2 ± 4.2 years. McCormack et al[136] observed that the number of recreational and utilitarian destinations within close proximity to the home related to an increased odds that individuals engage in regular walking for recreation and for transportation purposes. Cerin, Leslie and co-workers[96] observed a positive association between perceived access to recreational destinations and walking for transportation among women, whereas Mowen and associates[137] noted a lack of association between self-rated physical activity level and distance to a park among a sample of adults at least 50 years of age. Wendel-Vos, Schuit and colleagues[103] found no association between the amount of objectively measured green space within 300-m and 500-m radii of participants' homes and self-reported walking in a sample of more than 13,000 adults when adjusted for age, gender, and education level.

Self-reported neighborhood walking (NWS). In addition to evaluating the relationship between perceptions of the neighborhood environment with both accelerometer-derived and self-reported physical activity, the current study also evaluated the relationship between environmental factors and walking for specific purposes within the neighborhood. The *NEWS-A*, as its name implies, asks participants to report their perceptions of factors in the neighborhood that are believed to be related to walking.

While perceptions of the neighborhood environment may not correlate well with general physical activity or walking performed outside of the neighborhood, researchers anticipate associations between the *NEWS-A* and neighborhood walking. Addy et al[95] observed in a study of almost 1200 adults at least 18 years of age that the neighborhood environment was a stronger predictor of physical activity and walking than variables corresponding to the larger community. However, just as the current study showed few associations between *NEWS-A* subscales and physical activity measured by accelerometer and self-report, it found few associations when examining walking in the neighborhood.

In this sample of women aged 50 to 75 years, factors pertaining to neighborhood design (lack of cul-de-sacs) and the natural landscape (hills) were important predictors of neighborhood walking. Participants who agreed that there were more cul-de-sacs were more likely to be classified as a regular neighborhood walker, which seems to contradict the literature. Typically, elements of street connectivity that indicate a grid-like network of streets rather than cul-de-sacs and loops are related to more activity.[12, 15, 119, 132] The researcher speculates that cul-de-sacs may provide participants with an environment that is more protected for walking. Interestingly, the item regarding cul-de-sacs is scored as a separate item in *NEWS-A,* though it is included in the street connectivity subscale of *NEWS.* Morris and colleagues[15] found that removal of the cul-de-sacs item from the street connectivity subscale improved the internal consistency of the subscale (i.e., the item did not seem to measure the same concept as the other items constituting the subscale).

The positive relationship demonstrated in this study between perceptions of hills and neighborhood walking is consistent with the literature.[9, 22] However, scoring procedures for *NEWS-A* consider the presence of hills to be a barrier to walking.[130] The

NEWS-A contains a single question that constitutes the hilliness subscale. Respondents are asked to agree or disagree with the following statement: "The streets in my neighborhood are hilly, making my neighborhood difficult to walk in." This statement is effectively asking the respondent to answer two distinct questions relating to hills. The first question asks if hills are present, and the second question asks if hills make it difficult to walk in the neighborhood. Some participants of the current study had difficulty in answering this question because there were hills present in their neighborhoods, yet the hills did not hinder their walking.

Studies that have utilized *NEWS* and other items to assess environmental correlates of neighborhood walking have demonstrated various associations.[20, 21, 94, 133] In a study of adults aged 21 to 82 years, McGuire[133] utilized subscale items of a modified version of *NEWS-A* and past-month physical activity performed in the neighborhood to produce results that differed somewhat from the current study. McGuire found that while having attractive views and landscapes was correlated with neighborhood physical activity participation, perceiving many interesting sites while walking was not. Similar to the current study, McGuire observed that items regarding safety and accessibility were not associated with neighborhood physical activity. Although her study participants reported that it was difficult to walk in their neighborhood with so much traffic along nearby streets and that drivers exceeded the speed limits, traffic hazards were not significantly correlated with neighborhood physical activity. Thus, factors relating to creating a safer environment for being active were not important. Contrary to McGuire's and the current study's findings are the observations from Suminski and associates[21] that women were more likely engage in neighborhood walking for exercise purposes if they perceived their neighborhood to be of average compared to below average safety.

The current study utilized the *NWS* to determine levels of walking within the neighborhood. The *NWS* consists of items adapted from the neighborhood walking questions in other environmental studies.[20, 35, 94] One such study examined some items from the *NEWS* in addition to other questions about environmental factors to inquire about perceptions of the walkability of the neighborhood in a sample of adults aged 40 years and older.[20] Researchers observed that factors pertaining to aesthetics and safety were not associated with neighborhood walking among women. While perceptions of moderate accessibility of walking facilities increased the odds of walking for pleasure by 3.5 (95% CI: 1.6, 9.2) times, accessibility was not associated with walking for transportation. Another such study assessed perceptions of aesthetics, convenience of walking opportunities, access to services, and traffic using eight items.[94] Women with more positive perceptions of convenience of walking opportunities were at least 3 times more likely to walk more in the neighborhood. Women who reported greater access to services actually had reduced odds (OR = 0.5, 95% CI: 0.3, 0.9) of walking in the neighborhood, while those reporting moderate access to services were more likely to report walking (OR = 1.9, 95% CI: 1.1, 3.4).

The current study showed no relationship between average number of destinations within walking distance from home and neighborhood walking, which contradicts the findings of a study of adult women who were 5.7 times (95% CI: 1.6, 19.7) more likely to walk for transportation within the neighborhood if they perceived that their neighborhood had an average number of destinations to which they could walk.[21] While total number of destinations was not important to neighborhood walking in the current study, the presence of an elementary school within walking distance of home decreased the odds of engaging in regular neighborhood walking for any reason and for recreational purposes.

While various environmental factors have been found to be associated with physical activity and walking, these factors play a small role in multivariate analyses of environmental, socio-demographic, and other predictors of activity. For example, De Bourdeaudhuij et al[17] stated that environmental variables accounted for only 3-4% of the variance of regression models. Ball, Timperio and colleagues[117] found that while neighborhood aesthetics, safety, and street connectivity were positively associated with walking, they lost their significance when cognitive factors such as self-efficacy and enjoyment of physical activity were entered into the models. In a recent review of 47 publications, Wendel-Vos, Droomers and associates[138] found very few significant associations between the physical environment and physical activity, particularly among women. In fact, convenience of facilities was the only physical environmental factor that was consistently associated with physical activity among women in the numerous studies analyzed. The current study is no exception. While some associations existed between specific *NEWS-A* subscales and destinations with physical activity, the overall variability that was accounted for by these factors in linear regression analysis was quite small (R^2 ranged from 0.03 to 0.04).

Participants of the current study reported very similar perceptions of their neighborhood environments, and few factors were associated with objectively measured physical activity and self-reported walking. It is possible that there are other environmental factors specific to this region and to this target population that were not evaluated in this study. For example, many streets in this area lack sidewalks, thus making it difficult to answer some of the items relating to infrastructure and safety for walking. Also, the weather may influence activity participation (e.g., too hot/rainy/windy). Other characteristics of this region that do not vary considerably from one part of town to another include low residential density and the presence of urban sprawl (poor diversity of land use mix).

Strengths of the Study

There are several strengths to this study. The sample's relative homogeneity may have reduced the influence of potential demographic confounders such as race and socioeconomic status. The use of an objective monitor of physical activity is a strength of the study in that it 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 current methods of managing accelerometer data is a strength of this study. Use of a recently developed two-regression model to determine METs for each minute of wear,[113] and improved techniques to determine wear time and bouts of physical activity[128] enabled more accurate estimation of objectively monitored physical activity. The use of the *NWS* is a strength of the study because it inquires about different types of walking within the participant's neighborhood. If researchers are attempting to determine which factors in the neighborhood influence walking for different purposes, then researchers need an instrument that specifically measures these activities. It is also important to utilize a standard instrument to compare studies. Items on the *NWS* have been used in other studies[20, 94] and slight modifications in wording produced the additional items specific to walking for recreation and transportation. Items from earlier versions of *NEWS-A* have been used in several studies.[17, 132, 133] While problems persist with a few of the *NEWS-A* items, as discussed earlier, the *NEWS-A* is still a comprehensive instrument that assesses many of the environmental factors that are believed to impact walking participation, and its use in future studies will undoubtedly continue.

Limitations

Limitations existed in this study. Participants were healthy volunteers and thus may have been more willing to participate and comply with the study protocol than those who were ineligible or did not express interest in study participation. Because participants were Caucasian, highly educated, had a household income of more than $50,000, and were relatively physically active, they may not be representative of the average female aged 50 to 75 years living in the Oklahoma City or surrounding areas. In addition, participants had very similar perceptions of their neighborhood environments, making it difficult to distinguish differences between groups.

Other limitations in this study relate to the questionnaire used to assess perceptions of the neighborhood environment. Though the *NEWS-A* is a comprehensive measure, it may not sufficiently describe all factors of the physical environment that are related to walking. As mentioned earlier, 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 for Future Research

Evaluation of the influence of the physical environment on physical activity and walking participation has been an important area of research in the past decade. There exists a plethora of information with much contradiction 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. *NEWS* and *NEWS-A* are two of the few environmental questionnaires that focus solely on the physical environment specific to walking. Further refinement 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 better represent neighborhood physical activity participation. In addition, the neighborhood should be defined for enhanced clarification, and consideration of what constitutes an acceptable walking distance should be made specific to the population of interest.

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 chose their environment because it was conducive to their already active lifestyle. Longitudinal studies that evaluate changes in physical activity in conjunction with changing neighborhood environments can answer such questions.

Summary and Implications

Engaging in moderate intensity physical activities such as walking on a regular basis provides health benefits.[4] Most individuals who walk regularly for physical activity do so within their neighborhoods.[9, 28] Researchers have demonstrated correlations between environmental factors and physical activity, though differences in environmental perceptions, activity level, and the relationship between the two are evident from one population to the next. Findings of the current study indicate that certain factors of the physical environment are associated with physical activity and neighborhood walking among women aged 50-75 years who live in Oklahoma City or surrounding areas. Perceptions of the availability of parking at local shopping areas and hills and cul-de-sacs in the neighborhood predicted physical activity, although R^2 was small. Perceptions of the presence of an elementary school, a recreation center, and a bookstore within a 20-minute walk from home also predicted walking for specific purposes. Although preliminary, findings suggest aspects of the environment that may be key to physical activity interventions targeting middle and older-aged women living in similar areas.

This study adds to the body of literature targeting middle and older-aged women, who tend to be among the least active groups in the U. S. population, and using objective measures of physical activity. A small number of studies of the environmental correlates of physical activity have utilized objective measures of physical activity. While few relationships between environmental factors and objectively monitored physical activity existed in this study, its findings suggest careful consideration of how an objective physical activity monitor may best be used to assess neighborhood physical activity.

Conclusions

Research Hypothesis 1. Less than 50% of participants will be meeting current national physical activity recommendations.

Sixty-six (52.4%) participants were not meeting current national recommendations for physical activity.

Research Hypothesis 2. Less than 50% of participants will engage in at least 30 minutes of recreational walking on five or more days weekly.

Eighty-seven (69.0%) participants engaged in less than 30 minutes of recreational walking on five or more days during the previous week, and 103 (81.8%) participants reported that they walk for lesser amounts in their neighborhood in a usual week. Participants accumulated 120.0 (IQR = 180.0) minutes of leisurely walking in the previous week as reported on the *IPAQ* and 50.0 (IQR = 180.0) minutes of recreational walking in the neighborhood in a usual week as reported on the *NWS*.

Research Hypothesis 3. Less than 50% of participants will engage in at least 30 minutes of walking for transportation on five or more days weekly.

One hundred and two (81.0%) participants engaged in less than 30 minutes of transportational walking on five or more days during the previous week, and 122 (96.8%) participants reported that they walk for lesser amounts in their neighborhood in a usual week. Participants accumulated 20.0 (IQR = 120.0) minutes of transportational walking in the previous week as reported on the *IPAQ* and 0.0 (IQR = 0.0) minutes of transportational walking in the neighborhood in a usual week as reported on the *NWS*.

Research Hypothesis 4. Individuals who report walking regularly in their neighborhoods will have positive perceptions of their neighborhood environment compared to those who walk less or do not walk in their neighborhood.

Those who were walking regularly in their neighborhoods reported more positive perceptions of the presence of physical barriers in their neighborhoods [1.0 (IQR = 0.0) versus 1.0 (IQR = 1.0), respectively; Wx = 2006.0; m = 90; n = 36; $p = 0.0427$], but more negative perceptions of their neighborhoods' hilliness [1.0 (IQR = 1.0) versus 1.0 (IQR = 0.0), respectively; Wx = 2605.5; m = 90; n = 36; $p = 0.0333$] and lack of cul-de-sacs [2.0 (IQR = 2.0) versus 3.0 (IQR = 2.0), respectively; Wx = 1912.5; m = 90; n = 36; $p = 0.0369$] compared to those who were not walking regularly. Those who reported walking regularly in their neighborhood for transportation purposes reported a more negative perception of their neighborhoods' diversity of land use mix compared to those who were not walking regularly for transportation [1.0 (IQR = 0.6) versus 1.9 (IQR = 1.5), respectively; Wx = 98.5; m = 113; n = 4; $p = 0.0398$]. No other differences in environmental perceptions were evident between neighborhood walking groups.

Research Hypothesis 5. The subscales on *NEWS-A* will be able to predict individuals who engage in regular physical activity.

Univariate regression analyses demonstrated a significant association between the lack of parking subscale and counts/minute (β = -29.1, 95% CI: -54.6, -3.6; model R^2 = 0.04), total counts/day (β = -26535, 95% CI: -49692, -3378.3; model R^2 = 0.04), and minutes of moderate-to-vigorous physical activity performed in bouts of at least 10 minutes (β = -12.5, 95% CI: -24.7, -0.4; model R^2 = 0.03). There were no significant associations between *NEWS-A* subscales and minutes of moderate intensity physical activity.

Research Hypothesis 6. The subscales on *NEWS-A* will be able to predict individuals who engage in recreational walking.

More positive perceptions of having an infrastructure and safety for walking increased the odds of being a regular leisure-time walker as described on the *IPAQ* by 1.7 times (95% CI: 1.02, 2.9). More negative perceptions of traffic hazards decreased the odds of being a regular leisure-time walker as described on the *IPAQ* by about 50% (95% CI: 0.3, 0.9). There were no statistically significant associations between *NEWS-A* subscales and regular neighborhood walking as described on the *NWS* for recreation purposes.

Research Hypothesis 7. The subscales on *NEWS-A* will be able to predict participants who engage in walking for transportation.

There were no significant models relating *NEWS-A* subscales and regular walking for transportation purposes as described on the *IPAQ* or on the *NWS*.

Research Hypothesis 8. The presence of destinations within a 20-minute walk from home will be able to predict participants who engage in regular physical activity. The mean number of destinations within walking distance of home was not a significant predictor of counts/minute (β = -0.8, p = 0.6; model R^2 = 0.00), total counts/day (β = -749.1, p = 0.6; model R^2 = 0.00), or time spent engaging in moderate (β = -0.5, p = 0.5; model R^2 = 0.00) and moderate-to-vigorous (β = -0.5, p = 0.5; model R^2 = 0.00) physical activity. Additionally, the presence of each of 23 destinations within walking distance of home was also not a significant predictor of counts/minute, total counts/day, or time spent engaging in moderate and moderate-to-vigorous physical activity ($p > 0.05$).

Research Hypothesis 9. The presence of destinations within a 20-minute walk from home will be able to predict individuals who engage in recreational walking. Univariate analyses resulted in a positive relationship between the presence of a recreation center within walking distance of home and regular leisure-time walking as described on the *IPAQ* (OR = 3.0, 95% CI: 1.2, 7.9). Stepwise multivariate analysis modified the model, with the presence of a recreation center increasing the odds [OR = 10.0; 95% CI: 2.1, 48.6] and the presence of a bookstore decreasing the odds [OR = 0.2; 95% CI: 0.03, 0.8] of engaging in regular leisure-time walking. The mean number of destinations within walking distance of home was not related to regular recreational walking as described on the *IPAQ*. Univariate analyses demonstrated that the presence of an elementary school within walking distance of home was inversely related to regular neighborhood walking for recreational purposes as described on the *NWS* (OR = 0.3, 95%

CI: 0.1, 0.8). The mean number of destinations within walking distance of home was not related to regular neighborhood walking.

Research Hypothesis 10. The presence of destinations within a 20-minute walk from home will be able to predict individuals who engage in transportational walking. Univariate analyses resulted in an inverse relationship between the presence of an elementary school within walking distance of home and regular walking for transportation as described on the *IPAQ* (OR = 0.3, 95% CI: 0.1, 0.9). Stepwise multivariate analysis modified the model, with the presence of an elementary school decreasing the odds [OR = 0.2; 95% CI: 0.05, 0.6] and the presence of a bookstore increasing the odds [OR = 5.1; 95% CI: 1.4, 18.5] of engaging in regular walking for transportation purposes. The mean number of destinations within walking distance of home was not related to regular transportational walking as described on the *IPAQ*. There were no significant associations between the presence of specific destinations or mean number of destinations within walking distance of home and walking for transportation in the neighborhood as described on the *NWS*.

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APPENDIX A

Institutional Review Board – Norman Campus Approval

The University of Oklahoma

OFFICE FOR HUMAN RESEARCH PARTICIPANT PROTECTION

IRB Number: **11738**
Approval Date: **May 31, 2007**

May 31, 2007

Mary Dinger
Health & Exercise Science
1401 Asp Avenue, HHC 117
Norman, OK 73019

RE: Physical Activity and Health-Related Quality of Life in Community-Dwelling Women

Dear Dr. Dinger:

On behalf of the Institutional Review Board (IRB), I have reviewed and granted expedited approval of the above-referenced research study. This study meets the criteria for expedited approval category 7. It is my judgment as Chairperson of the IRB that the rights and welfare of individuals who may be asked to participate in this study will be respected; that the proposed research, including the process of obtaining informed consent, will be conducted in a manner consistent with the requirements of 45 CFR 46 as amended; and that the research involves no more than minimal risk to participants.

This letter documents approval to conduct the research as described:

Advertisement Dated: May 29, 2007 Revised - flyer
Consent form - Subject Dated: May 29, 2007 Revised
Advertisement Dated: May 29, 2007 Revised - Group Recruiting announcement
Survey Instrument Dated: May 15, 2007 Quality of Life Questionnaire SF-36 version 2
Protocol Dated: May 15, 2007
Advertisement Dated: May 15, 2007 Newspaper Advertisement - OUHSC
Advertisement Dated: May 15, 2007 Radio Advertisement
Advertisement Dated: May 15, 2007 TV Advertisement
Letter Dated: May 15, 2007 Recruitment Letter
Survey Instrument Dated: May 15, 2007 Pre-Screening Instrument - Survey
IRB Application Dated: May 15, 2007
Survey Instrument Dated: May 15, 2007 International Physica Activity Questionnaire
Survey Instrument Dated: May 15, 2007 Neighborhood Envirnment Walkability Scale
Survey Instrument Dated: May 15, 2007 Perceived Barriers & Coping Strategies - Survey
Other Dated: May 15, 2007 Accelerameter Log
Priv - Research Auth 1 Dated: May 15, 2007
Survey Instrument Dated: May 15, 2007 Demographic Questionnaire

As principal investigator of this protocol, it is your responsibility to make sure that this study is conducted as approved. Any modifications to the protocol or consent form, initiated by you or by the sponsor, will require prior approval, which you may request by completing a protocol modification form. All study records, including copies of signed consent forms, must be retained for three (3) years after termination of the study.

The approval granted expires on May 30, 2008. Should you wish to maintain this protocol in an active status beyond that date, you will need to provide the IRB with an IRB Application for Continuing Review (Progress Report) summarizing study results to date. The IRB will request an IRB Application for Continuing Review from you approximately two months before the anniversary date of your current approval.

If you have questions about these procedures, or need any additional assistance from the IRB, please call the IRB office at (405) 325-8110 or send an email to irb@ou.edu.

Cordially,

Donald Baker, Ph.D.
Vice Chair, Institutional Review Board

660 Parrington Oval, Suite 316, Norman, Oklahoma 73019-3085 PHONE: (405) 325-8110 FAX: (405) 325-2373

The University of Oklahoma

OFFICE FOR HUMAN RESEARCH PARTICIPANT PROTECTION

IRB Number: 11738
Amendment Approval Date: August 10, 2007

August 13, 2007

Mary Dinger
Health & Exercise Science
1401 Asp Avenue, HHC 117
Norman, OK 73019

RE: IRB No. 11738: Physical Activity and Health-Related Quality of Life in Community-Dwelling Women

Dear Dr. Dinger:

On behalf of the Institutional Review Board (IRB), I have reviewed your protocol modification form. It is my judgement that this modification allows for the rights and welfare of the research subjects to be respected. Further, it has been determined that the study will continue to be conducted in a manner consistent with the requirements of 45 CFR 46 as amended; and that the potential benefits to subjects and others warrant the risks subjects may choose to incur.

This letter documents approval to conduct the research as described in:

Amend Form Dated: August 06, 2007
Survey Instrument Dated: August 06, 2007 Demographic Questionnaire - Revised
Survey Instrument Dated: August 06, 2007 Satisfaction With Life Scale
Advertisement Dated: August 06, 2007 Television - Revised
Advertisement Dated: August 06, 2007 Newspaper - Revised
Consent form - Subject Dated: August 06, 2007 Revised
Survey Instrument Dated: August 06, 2007 Neighborhood Walking Scale
Protocol Dated: August 07, 2007 Revised

Amendment Summary:

Change in procedure:
1) Revise demographic questionnaire to add and delete some questions.
2) Addition of 2 instruments to questionnaire packet: "Satisfaction With Life Scale" and "Neighborhood Walking Scale".
3) Expanding recruiting to include newspapers and television stations other than those previously approved for.
4) Correction in the title of mass email previously submitted for this announcement.
5) Revised Informed Consent form to reflect the requested changes.

This letter covers only the approval of the above referenced modification. All other conditions, including the original expiration date, from the approval granted May 31, 2007 are still effective.

Any proposed change in approved research including the protocol, consent document, or other recruitment materials cannot be initiated without IRB approval except when necessary to eliminate immediate hazards to participants. Changes in approved research initiated without IRB approval to eliminate immediate hazards to the participant must be promptly reported to the IRB. Completion of approved research must be reported to the IRB. If consent form revisions are a part of this modification, you will be provided with a new stamped copy of your consent form. Please use this stamped copy for all future consent documentation. Please discontinue use of all outdated versions of this consent form.

Ltr_Amend_Final_Appv_Exp

660 Parrington Oval, Suite 316, Norman, Oklahoma 73019-3085 PHONE: (405) 325-8110 FAX: (405) 325-2373

If you have any questions about these procedures or need additional assistance, please do not hesitate to call the IRB office at (405) 325-8110 or send an email to irb@ou.edu.

Cordially,

Lynn Devenport, Ph.D.
Chair, Institutional Review Board

Ltr_Amend_Final_Appv_Exp

The University of Oklahoma

OFFICE FOR HUMAN RESEARCH PARTICIPANT PROTECTION

IRB Number: 11738
Amendment Approval Date: August 20, 2007

August 21, 2007

Mary Dinger
Health & Exercise Science
1401 Asp Avenue, HHC 117
Norman, OK 73019

RE: IRB No. 11738: Physical Activity and Health-Related Quality of Life in Community-Dwelling Women

Dear Dr. Dinger:

On behalf of the Institutional Review Board (IRB), I have reviewed your protocol modification form. It is my judgement that this modification allows for the rights and welfare of the research subjects to be respected. Further, it has been determined that the study will continue to be conducted in a manner consistent with the requirements of 45 CFR 46 as amended; and that the potential benefits to subjects and others warrant the risks subjects may choose to incur.

This letter documents approval to conduct the research as described in:

Amend Form Dated: August 16, 2007
Survey Instrument Dated: August 16, 2007 Revised - Physical Activiy & Health-Related Life

Amendment Summary:

1) Addition of new question to Demographic questionnaire for this study.

This letter covers only the approval of the above referenced modification. All other conditions, including the original expiration date, from the approval granted May 31, 2007 are still effective.

Any proposed change in approved research including the protocol, consent document, or other recruitment materials cannot be initiated without IRB approval except when necessary to eliminate immediate hazards to participants. Changes in approved research initiated without IRB approval to eliminate immediate hazards to the participant must be promptly reported to the IRB. Completion of approved research must be reported to the IRB. If consent form revisions are a part of this modification, you will be provided with a new stamped copy of your consent form. Please use this stamped copy for all future consent documentation. Please discontinue use of all outdated versions of this consent form.

If you have any questions about these procedures or need additional assistance, please do not hesitate to call the IRB office at (405) 325-8110 or send an email to irb@ou.edu.

Cordially,

Lynn Devenport, Ph.D
Chair, Institutional Review Board

Ltr_Amend_Final_Appv_Exp

660 Parrington Oval, Suite 316, Norman, Oklahoma 73019-3085 PHONE: (405) 325-8110 FAX: (405) 325-2373

The University of Oklahoma

OFFICE FOR HUMAN PARTICIPANT PROTECTION

IRB Number: 11738
Amendment Approval Date: September 21, 2007

September 24, 2007

Mary Dinger
Health & Exercise Science
1401 Asp Avenue, HHC 117
Norman, OK 73019

RE: IRB No. 11738: Physical Activity and Health-Related Quality of Life in Community-Dwelling Women

Dear Dr. Dinger:

On behalf of the Institutional Review Board (IRB), I have reviewed your protocol modification form. It is my judgement that this modification allows for the rights and welfare of the research subjects to be respected. Further, it has been determined that the study will continue to be conducted in a manner consistent with the requirements of 45 CFR 46 as amended; and that the potential benefits to subjects and others warrant the risks subjects may choose to incur.

This letter documents approval to conduct the research as described in:

Amend Form Dated: September 14, 2007
Protocol Dated: September 14, 2007 Revised
Advertisement Dated: September 14, 2007 Newsletter and Websites

Amendment Summary:
Change in procedure:
1) Request to expand prescreening procedures to include these to be conducted face-to-face.
2) Addition of placing advertisements in newsletters and websites. Specifically, advertise study at organization/health/information fairs.

This letter covers only the approval of the above referenced modification. All other conditions, including the original expiration date, from the approval granted May 31, 2007 are still effective.

If consent form revisions are a part of this modification, you will be provided with a new stamped copy of your consent form. Please use this stamped copy for all future consent documentation. Please discontinue use of all outdated versions of this consent form.

If you have any questions about these procedures or need additional assistance, please do not hesitate to call the IRB office at (405) 325-8110 or send an email to irb@ou.edu.

Cordially,

Aimee Franklin, Ph. D
Vice Chair, Institutional Review Board

Ltr_Amend_Final_Appv_Exp

660 Parrington Oval, Suite 316, Norman, Oklahoma, 73019-3085 PHONE: (405) 325-8110 FAX (405) 325-2373

APPENDIX B

Recruiting Materials

OU Norman Campus Mass E-mail

How Active Are You?
Women 50 to 75 years of age are being sought for a physical activity research study. Participants will complete several questionnaires and wear a small, pager-sized device for 1 week. At the end of the study participants will receive a physical activity and body composition report, and a $10 gift card. To participate or for more information, contact Jennifer Han or Lindsey Mallow in the Department of Health and Exercise Science, University of Oklahoma Norman Campus, at 641-1458 or physactlab@ou.edu.

OUHSC Campus Mass E-mail and newspapers

How Active Are You?
Women 50 to 75 years of age are being sought for a physical activity research study. Participants will complete several questionnaires and wear a small, pager-sized device for 1 week. At the end of the study participants will receive a physical activity and body composition report, and a $10 gift card. To participate or for more information, contact Jennifer Han or Lindsey Mallow in the Department of Health and Exercise Science, University of Oklahoma Norman Campus, at 641-1458 or physactlab@ou.edu.

Radio

How Active Are You?
Women 50 to 75 years of age are being sought for a physical activity research study. Participants will complete several questionnaires and wear a small, pager-sized device for 1 week. At the end of the study participants will receive a physical activity and body composition report, and a $10 gift card. To participate or for more information, contact Jennifer Han or Lindsey Mallow in the Department of Health and Exercise Science, University of Oklahoma Norman Campus, at 641-1458, or p-h-y-s-a-c-t-l-a-b at o-u dot e-d-u.

Channel 22

How Active Are You?
Women 50 to 75 years of age are being sought for a physical activity research study. For information contact Jennifer Han or Lindsey Mallow in the Department of Health and Exercise Science, University of Oklahoma Norman Campus, at 641-1458 or physactlab@ou.edu.

Physical Activity and Health-Related Quality of Life
in Community-Dwelling Women
Group Recruiting Announcement

Hi my name is ____________ and I am with the Department of Health and Exercise Science on the University of Oklahoma Norman Campus. I am recruiting women, ages 50-75 years to participate in a study to examine physical activity and health-related quality of life in community-dwelling women.

Participants will need to visit the Physical Activity Assessment Laboratory on the OU Norman Campus twice. During the first visit, participants will complete several questionnaires and have their height, weight and body composition measured. The first visit will last approximately 1-1.5 hours. Participants will wear an accelerometer, which is a small pager-like device, during all waking hours for 1 week. During this week participants will maintain their normal levels of physical activity. At the end of the week, participants will return to the laboratory to hand-in their accelerometers and complete a few questionnaires. The second visit will last approximately 30 minutes. Your participation in the study will last 9 total days.

All participants who complete the entire study and wear the accelerometer as instructed will receive a physical activity and body composition report, as well as a $10 gift card at the end of the study.

If you are interested in participating in this study, or would like to receive additional information, please call 405-641-1458, or email physactlab@ou.edu to see if you meet the eligibility requirements.

Thank you for your time and consideration.

Questions?

How Active Are You?

- Women between the ages of 50 and 75 are being sought to participate in a 9-day research study to examine physical activity and health-related quality of life.
- If interested please contact Lindsey Mallow or Jennifer Han at the University of Oklahoma, Norman Campus, Department of Health and Exercise Science at 405-641-1458 or physactlab@ou.edu

Participants will receive a physical activity and body composition report and a $10 gift card at the end of the study.

HOW ACTIVE ARE YOU?
Lindsey Mallow or Jennifer Han
405-641-1458
physactlab@ou.edu

HOW ACTIVE ARE YOU?
Lindsey Mallow or Jennifer Han
405-641-1458
physactlab@ou.edu

HOW ACTIVE ARE YOU?
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405-641-1458
physactlab@ou.edu

APPENDIX C

Prescreening Questionnaire

Physical Activity and Health-Related Quality of Life in Community-Dwelling Women

1. What is your age? ____________ years

2. Do you have any physical problems that limit your ability to participate in ambulatory activities like walking for at least 10 minutes at one time?
   _____ No
   _____ Yes

3. Are you pregnant?
   _____ No
   _____ Yes

4. Do you have a Pacemaker in your heart?
   _____ No
   _____ Yes

5. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
   _____ No
   _____ Yes

6. Do you feel pain in your chest when you do physical activity?
   _____ No
   _____ Yes

7. In the past month, have you had chest pain when you were not doing physical activity?
   _____ No
   _____ Yes

8. Do you lose your balance because of dizziness or do you ever lose consciousness?
   _____ No
   _____ Yes

9. Do you have a bone or joint problem that could be made worse by a change in your physical activity?
   _____ No
   _____ Yes

10. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
    _____ No
    _____ Yes

11. Do you know of *any other reason* why you should not do physical activity?
    _____ No
    _____ Yes

APPENDIX D

Demographic Questionnaire

Physical Activity and Health-Related Quality of Life in Community-Dwelling Women

Directions: Please fill in the blank or circle the letter that represents your response. Please select only ONE response for each item.

1. What is your age?
   ____________ years

2. Think about your participation in physical activity during a typical week. Do you participate in vigorous physical activity (exercise) for at least 20 minutes a day on at least 3 days a week?
   _____ No
   _____ Yes

3. Think about your participation in physical activity during a typical week. Do you accumulate at least 30 minutes of moderate intensity physical activity on at least 5 days of the week? Examples of moderate intensity physical activity include: brisk walking, bicycling, pushing a mower, and mopping floors.
   _____ No
   _____ Yes

4. How do you describe yourself?
   A. American Indian or Alaska Native
   B. Asian
   C. Black or African American
   D. Hispanic or Latino
   E. Native Hawaiian or Other Pacific Islander
   F. White or Caucasian
   G. Other (specify) ________________________

5. Are you...?
   A. Married
   B. Divorced
   C. Widowed
   D. Separated
   E. Never married
   F. A member of an unmarried couple

6. How many children less than 18 years of age live in your household?
   A. 0
   B. 1
   C. 2
   D. 3
   E. 4
   F. 5

7. What is the highest grade or year of school you have completed?
   A. Never attended school or only attended kindergarten
   B. Grades 1 through 8 (Elementary)
   C. Grades 9 through 11 (Some High School)
   D. Grade 12 or GED (High School Graduate)
   E. College 1 year to 3 years (Some college or technical school)
   F. College graduate
   G. Graduate School (Some Graduate school)
   H. Graduate School graduate

8. Are you currently…?
   A. Employed for wages
   B. Self-employed
   C. Out of work for more than 1 year
   D. Out of work for less than 1 year
   E. A homemaker
   F. A student
   G. Retired

9. Your annual household income from all sources is:
   A. Less than $10,000
   B. $10,000 to less than $15,000
   C. $15,000 to less than $20,000
   D. $20,000 to less than $25,000
   E. $25,000 to less than $35,000
   F. $35,000 to less than $50,000
   G. $50,000 to less than $75,000
   H. $75,000 or more

10. Have you experienced menopause?
   ______ No **(STOP)**
   ______ Yes **(PLEASE RESPOND TO THE FOLLOWING QUESTION)**

11. Are you taking hormone replacement therapy?
   ______ No
   ______ Yes

PARTICIPANTS - PLEASE DO NOT WRITE BELOW THIS LINE

Date_______________ Height______________ inches

Weight______________ pounds

Body Fat______________ percent

APPENDIX E

International Physical Activity Questionnaire –Long Form

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** and **moderate** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

PART 1: JOB-RELATED PHYSICAL ACTIVITY

The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in Part 3.

1. Do you currently have a job or do any unpaid work outside your home?

   ☐ Yes

   ☐ No → ***Skip to PART 2: TRANSPORTATION***

The next questions are about all the physical activity you did in the **last 7 days** as part of your paid or unpaid work. This does not include traveling to and from work.

2. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, heavy construction, or climbing up stairs **as part of your work**? Think about only those physical activities that you did for at least 10 minutes at a time.

   _____ **days per week**

   ☐ No vigorous job-related physical activity → ***Skip to question 4***

3. How much time did you usually spend on one of those days doing **vigorous** physical activities as part of your work?

   _____ **hours per day**
   _____ **minutes per day**

4. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads **as part of your work**? Please do not include walking.

   _____ **days per week**

   ☐ No moderate job-related physical activity → ***Skip to question 6***

LONG LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised October 2002.

5. How much time did you usually spend on one of those days doing **moderate** physical activities as part of your work?

_____ **hours per day**
_____ **minutes per day**

6. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **as part of your work**? Please do not count any walking you did to travel to or from work.

_____ **days per week**

☐ No job-related walking → ***Skip to PART 2: TRANSPORTATION***

7. How much time did you usually spend on one of those days **walking** as part of your work?

_____ **hours per day**
_____ **minutes per day**

PART 2: TRANSPORTATION PHYSICAL ACTIVITY

These questions are about how you traveled from place to place, including to places like work, stores, movies, and so on.

8. During the **last 7 days**, on how many days did you **travel in a motor vehicle** like a train, bus, car, or tram?

_____ **days per week**

☐ No traveling in a motor vehicle → ***Skip to question 10***

9. How much time did you usually spend on one of those days **traveling** in a train, bus, car, tram, or other kind of motor vehicle?

_____ **hours per day**
_____ **minutes per day**

Now think only about the **bicycling** and **walking** you might have done to travel to and from work, to do errands, or to go from place to place.

10. During the **last 7 days**, on how many days did you **bicycle** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

☐ No bicycling from place to place → ***Skip to question 12***

11. How much time did you usually spend on one of those days to **bicycle** from place to place?

_____ **hours per day**
_____ **minutes per day**

12. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

☐ No walking from place to place → ***Skip to PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY***

13. How much time did you usually spend on one of those days **walking** from place to place?

_____ **hours per day**
_____ **minutes per day**

PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY

This section is about some of the physical activities you might have done in the **last 7 days** in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

14. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, chopping wood, shoveling snow, or digging **in the garden or yard**?

_____ **days per week**

☐ No vigorous activity in garden or yard → ***Skip to question 16***

15. How much time did you usually spend on one of those days doing **vigorous** physical activities in the garden or yard?

_____ **hours per day**
_____ **minutes per day**

16. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, sweeping, washing windows, and raking **in the garden or yard**?

_____ **days per week**

☐ No moderate activity in garden or yard → ***Skip to question 18***

17. How much time did you usually spend on one of those days doing **moderate** physical activities in the garden or yard?

_____ **hours per day**
_____ **minutes per day**

18. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, washing windows, scrubbing floors and sweeping **inside your home**?

_____ **days per week**

☐ No moderate activity inside home → ***Skip to PART 4: RECREATION, SPORT AND LEISURE-TIME PHYSICAL ACTIVITY***

19. How much time did you usually spend on one of those days doing **moderate** physical activities inside your home?

_____ **hours per day**
_____ **minutes per day**

PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the **last 7 days** solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

20. Not counting any walking you have already mentioned, during the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **in your leisure time**?

_____ **days per week**

☐ No walking in leisure time → ***Skip to question 22***

21. How much time did you usually spend on one of those days **walking** in your leisure time?

_____ **hours per day**
_____ **minutes per day**

22. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like aerobics, running, fast bicycling, or fast swimming **in your leisure time**?

_____ **days per week**

☐ No vigorous activity in leisure time → ***Skip to question 24***

23. How much time did you usually spend on one of those days doing **vigorous** physical activities in your leisure time?

_____ **hours per day**
_____ **minutes per day**

24. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis **in your leisure time**?

_____ **days per week**

☐ No moderate activity in leisure time → ***Skip to PART 5: TIME SPENT SITTING***

25. How much time did you usually spend on one of those days doing **moderate** physical activities in your leisure time?

_____ **hours per day**
_____ **minutes per day**

PART 5: TIME SPENT SITTING

The last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting in a motor vehicle that you have already told me about.

26. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekday**?

_____ **hours per day**
_____ **minutes per day**

27. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekend day**?

_____ **hours per day**
_____ **minutes per day**

This is the end of the questionnaire, thank you for participating.

LONG LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised October 2002.

APPENDIX F

Neighborhood Walking Scale

Neighborhood Walking Scale

We are interested in finding out how much walking you do **in your neighborhood** in a usual week. The following questions ask about walking for any reason, and walking specifically for transport and recreation purposes.

In answering the following questions,

- **Walking for transport** refers to walking to get to and from places or walking for errands
- **Walking for recreation** refers to walking that you do for exercise or during your leisure time

****

1. How many times a week do you go for a **walk for any reason** (e.g., for exercise, doing errands, walking for transport) in and around your neighborhood?

   ____ **days per week**

   a. How much time would you usually spend when you do go for a walk in and around your neighborhood?

      ____ **minutes per day**

2. How many times a week do you go for a **walk for recreation** in and around your neighborhood?

   ____ **days per week**

   a. How much time would you usually spend when you do go for a walk for recreation in and around your neighborhood?

      ____ **minutes per day**

3. How many times a week do you go for a **walk for transport** in and around your neighborhood?

   ____ **days per week**

   a. How much time would you usually spend when you do go for a walk for transport in and around your neighborhood?

      ____ **minutes per day**

APPENDIX G

Neighborhood Environment Walkability Scale - Abbreviated

ID # ______________________

Neighborhood Environment Walkability Scale (NEWS) - Abbreviated

We would like to find out more information about the way that you perceive or think about your neighborhood. Please answer the following questions about your neighborhood and yourself.

A. Types of residences in your neighborhood

Please circle the answer that best applies to you and your neighborhood.

1. How common are detached single-family residences in your immediate neighborhood?

1	2	3	4	5
None	A few	Some	Most	All

2. How common are townhouses or row houses of 1-3 stories in your immediate neighborhood?

1	2	3	4	5
None	A few	Some	Most	All

3. How common are apartments or condos 1-3 stories in your immediate neighborhood?

1	2	3	4	5
None	A few	Some	Most	All

4. How common are apartments or condos 4-6 stories in your immediate neighborhood?

1	2	3	4	5
None	A few	Some	Most	All

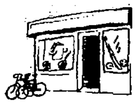
5. How common are apartments or condos 7-12 stories in your immediate neighborhood?

1	2	3	4	5
None	A few	Some	Most	All

6. How common are apartments or condos more than 13 stories in your immediate neighborhood?

1	2	3	4	5
None	A few	Some	Most	All

1



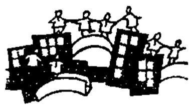
B. Stores, facilities, and other things in your neighborhood

About how long would it take to get from your home to the nearest businesses or facilities listed below if you walked to them? Please put only one check mark (√) for each business or facility.

	1-5 min	6-10 min	11-20 min	20-30 min	30+ min	don't know
example: gas station	1. ___	2. ___	3. √	4. ___	5. ___	8. ___
1. convenience/small grocery store	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
2. supermarket	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
3. hardware store	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
4. fruit/vegetable market	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
5. laundry/dry cleaners	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
6. clothing store	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
7. post office	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
8. library	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
9. elementary school	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
10. other schools	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
11. book store	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
12. fast food restaurant	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
13. coffee place	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
14. bank/credit union	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
15. non-fast food restaurant	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
16. video store	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
17. pharmacy/drug store	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
18. salon/barber shop	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___
19. your job or school [check here ___ if not applicable]	1. ___	2. ___	3. ___	4. ___	5. ___	8. ___

2

	1-5 min	6-10 min	11-20 min	20-30 min	30+ min	don't know
20. bus or train stop	1. ____	2. ____	3. ____	4. ____	5. ____	8. ____
21. park	1. ____	2. ____	3. ____	4. ____	5. ____	8. ____
22. recreation center	1. ____	2. ____	3. ____	4. ____	5. ____	8. ____
23. gym or fitness facility	1. ____	2. ____	3. ____	4. ____	5. ____	8. ____



C. Access to services

Please circle the answer that best applies to you and your neighborhood. Both local and within walking distance mean within a 10-15 minute walk from your home.

1. Stores are within easy walking distance of my home.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. Parking is difficult in local shopping areas.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. There are many places to go within easy walking distance of my home.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

4. It is easy to walk to a transit stop (bus, train) from my home.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

5. The streets in my neighborhood are hilly, making my neighborhood difficult to walk in.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

6. There are major barriers to walking in my local area that make it hard to get from place to place (for example, freeways, railway lines, rivers).

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

D. Streets in my neighborhood

Please circle the answer that best applies to you and your neighborhood.

1. The streets in my neighborhood <u>do not</u> have many cul-de-sacs (dead-end streets).

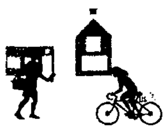
1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. The distance between intersections in my neighborhood is usually short (100 yards or less; the length of a football field or less).

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. There are many alternative routes for getting from place to place in my neighborhood. (I don't have to go the same way every time.)

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree



E. Places for walking and cycling

Please circle the answer that best applies to you and your neighborhood.

1. There are sidewalks on most of the streets in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. Sidewalks are separated from the road/traffic in my neighborhood by parked cars.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. There is a grass/dirt strip that separates the streets from the sidewalks in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

F. Neighborhood surroundings

Please circle the answer that best applies to you and your neighborhood.

1. There are trees along the streets in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. There are many interesting things to look at while walking in my neighborhood.

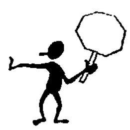
1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. There are many attractive natural sights in my neighborhood (such as landscaping, views).

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

4. There are attractive buildings/homes in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree



G. Neighborhood safety

Please circle the answer that best applies to you and your neighborhood.

1. There is so much traffic along <u>nearby</u> streets that it makes it difficult or unpleasant to walk in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

2. The speed of traffic on most nearby streets is usually slow (30 mph or less).

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

3. Most drivers exceed the posted speed limits while driving in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

4. My neighborhood streets are well lit at night.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

5. Walkers and bikers on the streets in my neighborhood can be easily seen by people in their homes.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

6. There are crosswalks and pedestrian signals to help walkers cross busy streets in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

7. There is a high crime rate in my neighborhood.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

8. The crime rate in my neighborhood makes it unsafe to go on walks during the day.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

9. The crime rate in my neighborhood makes it unsafe to go on walks at night.

1	2	3	4
strongly disagree	somewhat disagree	somewhat agree	strongly agree

APPENDIX H

Informed Consent Form

701-A-6

University of Oklahoma
Institutional Review Board
Informed Consent to Participate in a Research Study

Project Title:	Physical Activity and Health-Related Quality of Life in Community-Dwelling Women
Principal Investigator:	Mary K. Dinger
Department:	Health and Exercise Science

You are being asked to volunteer for this research study. This study is being conducted at The Physical Activity Assessment Laboratory on the University of Oklahoma Norman Campus. You were selected as a possible participant because you responded to an advertisement and you meet the inclusion criteria to participate in the study.

Please read this form and ask any questions that you may have before agreeing to take part in this study.

Purpose of the Research Study
The purpose of this study is to describe physical activity of community-dwelling women and explore the relationships among physical activity, health-related quality of life, perceived environment, and perceived barriers to being physically active.

Number of Participants
About 150 people will take part in this study.

Procedures
If you agree to be in this study, you will be asked to do the following:

On the first visit to the Physical Activity Assessment Lab:
- You will complete the informed consent, HIPAA form, and screening items.
- You will have your height and weight measured by the researchers.
- You will have your body composition assessed using bioimpedance analysis (BIA), which involves having a small, undetectable electrical current pass through your body.
- You will complete 7 questionnaires, which should take approximately 30-45 minutes.
- You will receive a demonstration by the researchers on how to wear the accelerometer (a small, pager-sized device) and will be fitted with a belt that will be used to attach the accelerometer to your body.

During the next 7 days:
- You will wear the accelerometer over your right hip during all waking hours (except when bathing, showering, or swimming).
- You will complete the accelerometer log sheet each evening when you remove the accelerometer.

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- You will maintain your normal participation in physical activity.

On the second visit to the Physical Activity Assessment Lab:
- At the end of the 7 day period, you will return to the Physical Activity Assessment Lab to return the accelerometer, belt, and log sheet.
- You will complete 5 questionnaires. The second visit will take approximately 30 minutes.

Length of Participation
You participation in the study will last 9 total days.

This study has the following risks:

No foreseeable risks, beyond those present in routine daily life, are anticipated in this study.

Benefits of being in the study:

At the end of the study, all participants who complete the entire study and wear the accelerometer as instructed will receive a physical activity and body composition report. This study will provide additional insight into physical activity levels of community-dwelling women and the associations among physical activity, perceived health-related quality of life, perceived environment, and barriers to being physically active.

Injury
In case of injury or illness resulting from this study, emergency medical treatment is available. However, you or your insurance company may be expected to pay the usual charge from this treatment. The University of Oklahoma Norman Campus has set no funds to compensate you in the event of injury.

Confidentiality
In published reports, there will be no information included that will make it possible to identify you without your permission. Research records will be stored securely and only approved researchers will have access to the records.

There are organizations that may inspect and/or copy your research records for quality assurance and data analysis. These organizations include the Department of Health and Exercise Science and the OU Institutional Review Board.

Costs
There is no cost to participate in the study.

Compensation
At the end of the study, all participants who complete the entire study and wear the accelerometer as instructed will receive a physical activity and body composition report, as well as a $10 gift card.

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Rights

Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You can discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled.

Voluntary Nature of the Study

Participation in this study is voluntary. If you decline to participate, you will not be penalized or lose benefits or services unrelated to the study. If you decide to participate, you may decline to answer any question and may choose to withdraw at any time.

Waivers of Elements of Confidentiality

Your name will not be linked with your responses unless you specifically agree to be identified. Please select one of the following options

_____ I consent to being quoted directly.

_____ I do not consent to being quoted directly.

Contacts and Questions

If you have concerns or complaints about the research, the researcher(s) conducting this study can be contacted at phone: 405.325.5211, or email: physactlab@ou.edu.

Contact the researcher(s) if you have questions or if you have experienced a research-related injury.

If you have any questions about your rights as a research participant, concerns, or complaints about the research and wish to talk to someone other than individuals on the research team or if you cannot reach the research team, you may contact the University of Oklahoma – Norman Campus Institutional Review Board (OU-NC IRB) at 405-325-8110 or irb@ou.edu.

You will be given a copy of this information to keep for your records. If you are not given a copy of this consent form, please request one.

Statement of Consent

I have read the above information. I have asked questions and have received satisfactory answers. I consent to participate in the study.

Signature Date

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APPENDIX I

HIPAA Authorization Form

UNIVERSITY OF OKLAHOMA – NORMAN CAMPUS
INSTITUTIONAL REVIEW BOARD

AUTHORIZATION TO USE or DISCLOSE PROTECTED HEALTH INFORMATION FOR RESEARCH

An additional Informed Consent Document for Research Participation may also be required.

Title of Research Project:	**Physical Activity and Health-Related Quality of Life in Community-Dwelling Women**
Principal Investigator:	**Mary K. Dinger**
IRB Number:	
Address:	**Department of Health and Exercise Science, University of Oklahoma, Norman, OK 73019**
Phone Number:	**405-325-5211**

If you decide to join this research project, University of Oklahoma (OU) researchers may use or share (disclose) information about you that is considered to be protected health information for their research. Protected health information will be called private information in this Authorization.

Private Information To Be Used or Shared. Federal law requires that researchers get your permission (authorization) to use or share your private information. If you give permission, the researchers may use or share with the people identified in this Authorization any private information related to this research from your medical records and from any test results. Information, used or shared, may include all information relating to any tests, procedures, surveys, or interviews as outlined in the consent form, medical records and charts, name, address, telephone number, date of birth, race, and government-issued identification number.

Purposes for Using or Sharing Private Information. If you give permission, the researchers may use your private information to analyze the data from the project and present the information in aggregate form.

Other Use and Sharing of Private Information. If you give permission, the researchers may also use your private information to develop new procedures or commercial products. They may share your private information with the research sponsor, the OU Institutional Review Board, auditors and inspectors who check the research, and government agencies such as the Food and Drug Administration (FDA) and the Department of Health and Human Services (HHS). The researchers may also share your private information with all researchers collaborating on this project.

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Confidentiality. Although the researchers may report their findings in scientific journals or meetings, they will not identify you in their reports. The researchers will try to keep your information confidential, but confidentiality is not guaranteed. Any person or organization receiving the information based on this authorization could re-release the information to others and federal law would no longer protect it.

YOU MUST UNDERSTAND THAT YOUR PROTECTED HEALTH INFORMATION MAY INCLUDE INFORMATION REGARDING ANY CONDITIONS CONSIDERED AS A COMMUNICABLE OR VENEREAL DISEASE WHICH MAY INCLUDE, BUT ARE NOT LIMITED TO, DISEASES SUCH AS HEPATITIS, SYPHILIS, GONORRHEA, AND HUMAN IMMUNODEFICIENCY VIRUS ALSO KNOWN AS ACQUIRED IMMUNE DEFICIENCY SYNDROME (AIDS).

Voluntary Choice. The choice to give OU researchers permission to use or share your private information for their research is voluntary. It is completely up to you. No one can force you to give permission. However, you must give permission for OU researchers to use or share your private health information if you want to participate in the research and if you revoke your authorization, you can no longer participate in this study.

Refusing to give permission will not affect your ability to get routine treatment or health care from OU.

Revoking Permission. If you give the OU researchers permission to use or share your private information, you have a right to revoke your permission whenever you want. However, revoking your permission will not apply to information that the researchers have already used, relied on, or shared.

End of Permission. Unless you revoke it, permission for OU researchers to use or share your private information for their research will end when all data from the project have been analyzed and all reports have been published. You may revoke your permission at any time by writing to:

Privacy Official
University of Oklahoma
1000 Stanton L. Young Blvd., STE 221, Oklahoma City, OK 73117
If you have questions call: (405) 271-2511

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Giving Permission. By signing this form, you give OU and OU's researchers led by Mary K. Dinger, Ph.D., *permission to share your private information for the research* project called Physical Activity and Health-Related Quality of Life in Community-Dwelling Women.

Subject Name: ______________________________

______________________________ ____________

Signature of Subject Date
or Parent if Subject is a child

Or

______________________________ ____________

Signature of Legal Representative** Date

**If signed by a Legal Representative of the Subject, provide a description of the relationship to the Subject and the Authority to Act as Legal Representative:

____

OU may ask you to produce evidence of your relationship.

A signed copy of this form must be given to the Subject or the Legal Representative at the time this signed form is provided to the researcher or his representative.

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APPENDIX J

Accelerometer Log Sheet

Study ID ____________

Accelerometer Log Sheet

Date	Time On (am/pm)	Time Off (am/pm)	Work Day? # of Hours Worked	Exercise or Sports Day? Type, Intensity, and Duration	Walk/Bike for Transportation? Type, Intensity, and Duration	Comments
Wed 9/5						
Thurs 9/6						
Fri 9/7						
Sat 9/8						
Sun 9/9						
Mon 9/10						
Tues 9/11						
Wed 9/12	Return all equipment and this log to the Physical Activity Assessment Lab (146 Collums Bldg.)					

** If you forget to wear your accelerometer at any time during the day, please put it on as soon as you remember and record this in the Comments section.

** Please remember to remove your accelerometer while swimming, bathing or showering. It is important that the accelerometer does not get wet.

** If you remove your accelerometer to go swimming or to participate in some other type of activity, please record the type of activity, intensity and duration in the Comments column.

APPENDIX K

Data

id	Age	Race	Mar	Kid	Educ	Empl	Inc	Smo	Chro	Meno	HRT	Height	Weight	Fat	BMI	vald	mn_mv	mn_mv1	mn_m	mn_m1	mn_v	mn_v1	mn_cnt_	mn_hr	resden
id001	58	6	1	0	5	7	8	0	0	1	1	64	140	33.7	24.03	6	89.667	174	64.5	154	8.17	20	550.73	13.43	177
id004	60	6	1	0	5	7	8	0	0	1	0	68	146	30.5	22.2	7	133.43	229.857	131.7	227	0	2.657	356.14	14.73	177
id005	75	6	3	0	3	7	1	0	1	1	0	65.5	155	37.8	25.4	6	5.3333	47.6667	5.333	47.5	0	0.167	86.588	13.56	213
id006	70	6	1	0	7	5	8	0	0	1	0	62.5	161	41	26.97	5	2.2	46.8	2.2	46.8	0	0	106.32	13.02	184
id007	57	6	6	0	5	1	8	0	0	1	1	66.5	136	25.5	21.62	7	52.571	149.857	44.71	145.57	0	4.286	288.63	14.55	196
id008	52	6	1	0	7	1	8	0	0	0		61.5	134	34.2	24.91	6	21.333	82.3333	16.5	78	0	4.333	202.97	13.94	177
id009	62	6	1	0	4	1	8	0	0	1	0	63.5	147	27.3	25.63	7	46.571	123.857	46.57	123.86	0	0	153.4	16.43	177
id011	54	6	2	0	3	2	6	0	0	1	0	65	125	23.3	20.8	7	197.29	309.143	171.1	287.29	12.4	21.86	502.88	16.31	202
id012	63	6	1	0	7	1	8	0	0	1	0	65.5	133.5	23.5	21.88	5	168.6	277	140.4	253.4	0	23.6	750.67	14.62	177
id013	57	6	1	0	5	1	8	0	0	1	0	68	193	42.1	29.34	6	19.333	127.667	13.5	120.5	0	7.167	201.33	15.77	186
id015	63	6	1	0	5	7	8	0	0	1	1	58	115	18.9	24.03	7	115.14	215.714	94.71	202.43	12.1	13.29	363.2	15.65	196
id016	60	6	2	0	5	2	6	0	0	1	0	63	130	24.6	23.03	6	151.17	247.5	117	221	20.3	26.5	462.13	15.77	177
id017	57	6	1	0	7	1	8	0	1	1	0	65	151	35.3	25.13	7	155.29	221.286	129.1	202.71	3.71	18.57	418.78	14.01	177
id018	54	6	1	0	7	1	8	0	0	1	0	64	177	40.4	30.38	6	106.67	182.667	89.67	173.5	0	9.167	295.36	14.02	177
id019	63	6	1	0	7	7	8	0	1	1	1	65	194	48.4	32.28	7	53.429	154.857	42.43	146.14	0	8.714	223.42	14.24	177
id020	55	4	5	0	7	1	7	0	0	1	0	64	158	39.2	27.12	7	174.57	268.571	147.3	249.57	3.14	19	403.59	14.85	177
id021	55	6	2	0	7	1	6	0	0	1	1	62.5	166	40.9	29.87	6	59.833	165.167	42.33	151.67	5.67	13.5	207.85	14.89	198
id022	50	7	2	1	7	1	4	0	1	0		64.5	162	33.7	27.37	6	79.667	202.5	56.17	184.67	0	17.83	262.32	15.3	198
id023	55	7	1	0	7	1	8	0	1	1	0	63	139	33	24.62	6	61.833	139.167	28.83	114.5	21	24.67	442.97	14.23	177
id024	56	6	1	0	4	7	4	0	1	1	0	66	195	37.5	31.47	7	129.14	220.143	122.7	215.14	1.86	5	353.02	14.4	177
id025	54	6	5	0	7	1	7	0	0	1	0	66	186	42.7	30.02	7	109.29	197	107.7	195.29	0	1.714	367.01	14.9	177
id026	57	6	1	0	4	1	8	0	0	1	0	68	152	34.3	23.11	6	41.167	139.333	41.17	139.33	0	0	185.99	14.92	177
id027	60	6	1	0	7	5	2	0	0	1	0	62.5	172.5	38.8	31.04	7	232.57	335.429	232.6	334.43	0	1	427.51	14.91	177
id029	52	6	1	0	7	1	8	0	0	1	0	62	140	30.9	25.6	7	113	192.714	103.3	180.14	0	12.57	384.3	16.39	177
id030	73	6	1	0	4	7	7	0	1	1	0	67	176	42.4	27.58	6	25.833	97.6667	25.83	97.667	0	0	174.42	13.62	177
id031	52	6	1	0	4	1	8	0	0	0		67.5	170.5	36.7	26.31	7	115.43	233.286	111.9	229.86	0	3.429	345.44	15.34	177
id032	64	2	2	0	7	1	6	0	0	1	1	59	107	27.7	21.61	6	85.333	202.167	73	193.67	2	8.5	374.99	14.82	198
id034	64	6	3	0	4	1	6	0	0	1	0	66	198	44.8	31.95	7	155.86	263.143	155.9	261.71	0	1.429	371.41	15.94	177
id035	56	4	1	0	4	1	8	0	0	1	0	59	162		32.72	6	192.5	302.5	192.5	301	0	1.5	423.32	14.56	186
id037	59	6	1	0	4	1	8	0	0	1	1	65	154	35.9	25.62	7	21.286	73.5714	21.14	73.286	0	0.286	156.98	14.28	177
id039	54	6	1	0	7	1	8	0	0	1	0	63	128.5	30.1	22.76	7	87.143	167.571	77.29	159.71	0	7.857	389.24	14.46	228
id040	51	6	1	0	4	1	8	0	0	1	0	65	149	53.4	24.79	5	52.2	154.6	51.2	153.2	0	1.4	256.87	15.04	177
id041	54	6	1	2	5	1	7	0	0	1	0	61.5	122	31.5	22.68	7	130.86	245	130	242.14	0	2.857	426.57	14.12	198
id042	55	6	1	0	5	1	7	0	1	1	0	69.5	141	27.8	20.52	6	97.5	200.5	97.5	200	0	0.5	279.97	14.63	177
id043	69	7	1	0	7	7		0	0	1	1	65	114	26.6	18.97	7	34.571	80.5714	34.57	80.571	0	0	126.67	15.13	177
id044	55	6	1	0	5	1	8	0	1	1	0	65	168	40.5	27.95	7	97.143	167.286	80.29	157.14	5.71	10.14	408.87	14.92	177
id045	56	6	1	1	7	1	8	0	1	1	0	64.5	155.5	32.5	26.28	6	158.67	257.5	154.7	253	0	4.5	416.41	14.89	177
id046	66	6	1	0	7	7	8	0	1	1	0	69	207	42.3	30.57	6	61.5	130.167	60.17	129.67	0	0.5	177.43	14.82	177
id047	67	1	1	0	7	1	6	0	1	1	0	60	172	46	33.59	7	33.857	109.286	33.86	109	0	0.286	166.13	14.6	177
id048	65	6	2	0	7	1	5	0	0	1	0	66	171	32.7	27.6	5	159	246	159	241	0	5	526.87	15.87	197
id049	65	6	1	0	7	7	8	0	0	1	0	66	182	38.4	29.37	7	80.714	151.714	80.71	151.57	0	0.143	244.3	14.43	208
id050	63	6	1	0	4	2	6	0	0	1	0	67	229	48.3	35.86	4	19	67.5	19	67.5	0	0	141.94	12.94	177
id051	53	6	1	0	4	7	8	0	1	1	1	68	168	36.5	27.11	6	108.5	193.167	103.7	191.67	0	1.5	296.49	13.72	177
id052	56	6	1	0	4	1	8	0	0	1	0	65	147	37	24.46	7	98.286	181	93.86	174.71	0	6.286	380.79	14.08	177
id053	70	6	1	0	7	7	7	0	0	1	1	64	143	35.7	24.54	7	52.714	134.571	52.71	134.43	0	0.143	196.53	14.1	173
id054	62	6	1	0	6	2	6	0	0	1	1	66	155.5	35.4	25.1	6	170.5	266	168.2	263.67	0	2.333	430.36	13.56	173
id055	55	6	2	0	5	7	8	0	0	1	0	63	115	23	20.37	7	59.714	158.857	59.71	157.86	0	1	234.44	13.81	177
id056	59	6	1	1	6	1	6	0	0	1	0	65.5	164	32.6	26.87	7	88.286	210.143	87.14	209	0	1.143	333.28	14.58	177
id057	55	6	2	0	5	1	6	0	0	1	0	63	182	40	32.24	7	61	168.143	59.43	164.57	0	3.571	258.59	15.11	186
id058	64	6	1	0	5	5		0	0	1	0	63.5	126	28.4	22.32	7	42.571	140.429	38.43	135.71	0	4.714	295.18	15.85	177
id059	59	6	1	0	7	1	8	0	1	1	1	63	146	31.7	25.86	6	128.17	235.5	122.8	231.5	0	4	438.86	15.24	177
id060	58	6	1	0	4	5	8	0	0	1	1	66.5	156	33	24.8	7	83.714	168.143	73.86	163	3.86	5.143	337.39	15.82	177
id061	71	6	1		4	7	7	0	0	1	0	65.5	143	33	23.43	4	50.75	131.25	50.75	131.25	0	0	274.49	14.13	173
id062	74	6	1	0	4	7	6	0	1	1	1	66	156	31.5	25.18	4	61	147.75	57.25	144.5	0	3.25	299.85	13.87	173
id063	73	6	2	0	5	2	6	0	0	1	0	67	173	35.7	27.09	4	14.25	91.25	14.25	91.25	0	0	141.19	13.62	177
id064	75	6	2	0	7	7	2	0	1	1	1	59.5	96	26.2	19.06	4	103.75	164.75	97.75	161.5	0	3.25	268.45	13.95	177
id066	51	1	6	0	7	1	8	0	0	0		64	136	27.6	23.34	4	16.75	70.25	16.75	68	0	2.25	185.67	13.5	176
id068	69	6	3	0	3	7	5	0	0	1	1	62	127	22.5	23.23	7	71.714	137.571	71.71	137.57	0	0	195.94	14.14	177
id069	69	6	1	0	7							63.5	161	42.4	28.07	5	71	160.8	71	160.2	0	0.6	248.74	13.05	177
id070	50	6	1	0	4	1	5	0	1	0		62	231	48.2	42.25	7	129.29	209.143	129.1	207	0	2.143	318.68	13.96	177
id071	61	6	1	0	7	1	6	0	0	1	0	64	170	42.6	29.16	7	48	134	46.71	132	0	2	210.53	14.62	177
id072	69	6	1	0	3	7	6	0	0	1	0	62	206	43.8	37.67	7	39.286	155	39.29	155	0	0	190.1	14.66	177
id074	64	6	1	0	7	7	8	0	1	1	1	61.5	156	43.1	29	7	30.714	111.714	30.71	111.29	0	0.429	170.01	14.29	177
id075	54	6	1	0	5	2	8	0	0	1	0	65.5	226	49	37.03	7	29.714	113.571	29.71	113.57	0	0	161.79	14.33	177
id076	54	6	1	0	4	1	6	0	0	1	1	63	210	45.2	37.2	6	24.333	69.5	24.33	69.167	0	0.333	135.26	14.27	177
id077	55	1	1	0	6	1	8	0	1	1	0	65	138	34.4	22.96	7	43.429	139.429	40.29	135.71	1.43	3.714	244.24	15.26	177
id078	59	6	1	0	7	1	8	0	0	1	0	61.5	127	34	23.61	6	17.167	72.8333	17.17	72.667	0	0.167	154.72	13.82	177
id079	70	6	1	0	8	7	7	0	0	1	0	66	126	22.8	20.33	7	61.857	170.571	61.43	169.57	0	1	233.88	15.06	177
id080	51	6	2	1	5	1	7	4	0	1	0	66	210	47.7	33.89	4	79.5	180.75	79.5	180	0	0.75	299.94	12.95	177
id081	50	6	1	1	7	1	8	0	1	1	0	67	141	31.7	22.08	7	185.71	286.429	171.3	275	0	11.43	448.34	16.39	177
id082	61	6	1	0	4	1	8	0	0	1	0	63.5	168.5	34.9	29.38	7	92.857	195.714	91	193	0	2.714	318	14.89	177
id083	52	1	3	0	5	1	6	0	0	1	1	66.5	145	29.4	23.05	7	52.143	141.857	49.29	137.43	1.14	4.429	235.91	16.22	187
id084	62	6	3	0	7	1	6	0	0	1	1	64	169	41.6	29.01	6	23.333	144.667	23.33	144.67	0	0	164.44	15.16	177
id086	60	6	1	0	2	1	5	4	0	1	0	63	125	30.4	22.14	6	100.5	190.167	99.33	187.83	0	2.333	402.39	13.81	177
id088	54	6	1	3	3	1	7	0	0	1	1	63.5	153	33.4	26.67	7	47.857	165.714	45.29	164.29	0	1.429	236.12	15.28	177
id089	54	6	1	0	2	2	6	0	0	1	0	64	158	34.2	27.12	7	290.57	364.571	290.6	363.71	0	0.857	496.21	15.24	220
id090	51	6	1	0	6	5	8	0	0	0		64.5	121	25.8	20.45	5	133.6	210.4	109.4	195.6	0	14.8	484.92	14.58	177
id091	62	6	1	0	4	1	7	0	0	1	0	62	145.5	36.2	26.61	7	64.571	148.571	62.86	146	0	0.571	195.07	16.11	177
id092	50	6	1	0	4	1	6	0	0	1	1	63.5	142	35.2	24.76	7	52.143	158.429	49.14	154.43	2.43	4	222.98	16.01	177

id093	62	6	2	0	4	2	6	0	0	1	0	65.5	195	43.1	31.95	5	39.4	142.4	39.4	142.2	0	0.2	215.74	15.41	177
id094	55	6	2	0	6	1	6	0	1	1	0	67	233	45	36.49	6	46.167	118.333	46.17	118.33	0	0	184.11	14.56	177
id095	60	6	1	0	7	7	7	0	1	1	1	64	136	35.2	23.34	7	87.857	165.143	87.86	164.86	0	0.286	298.43	15.09	177
id096	60	6	1	0	7	6	2	6	1	1	0	66	197	42.5	31.79	7	14.286	85.2857	14.29	85.143	0	0.143	158.13	13.06	188
id097	57	6	1	0	7	1	8	0	0	1	1	70.5	180	34.7	25.46	5	2	68	2	68	0	0	118.01	14.8	177
id098	57	6	2	0	5	2	6	0	0	1	0	63	143	33	25.33	7	178.29	251	178.3	249.86	0	1.143	329	15.25	187
id099	59	6	4	0	6	7	5	0	0	1	0	59.5	125	33.7	24.82	7	29.857	95.7143	26.71	92.857	0	2.857	181.38	15.39	187
id100	55	6	1	1	7	3	7	0	0	1	1	64	152	31.3	26.09	4	40.75	132	38.75	131.25	0	0.75	184.98	14.78	177
id101	50	6	1	0	5	2	6	0	0	0		64	159	38.2	27.29	7	57.571	141.714	57.57	141	0	0.714	276.24	15.77	176
id103	72	8	1	0	4	5	6	0	0	1	0	62.5	131	27.3	23.58	7	7.5714	61.7143	7.571	61.714	0	0	100.99	15.9	177
id104	53	6	1	0	6	7	6	0	1	1	1	61.5	124	29.1	23.05	7	216.86	297.714	216.9	297	0	0.714	388.49	14.06	177
id106	59	6	3	0	6	1	5	0	0	1	1	68	150	31.6	24.21	5	40.2	101	40.2	100.2	0	0.8	185.47	14.88	227
id107	60	6	2	0	5	1	8	0	0	1	1	63	149	35.6	28.39	7	9.5714	74.4286	9.286	73.143	0	1.286	151.25	14.1	177
id108	53	6	5	0	7	1	8	0	0	1	0	67	209	44.8	32.73	5	114.8	237.8	111	234.6	0	3.2	416.74	13.42	173
id109	59	6	2	0	4	1	7	0	1	1	1	61	130	31.5	24.56	7	26.571	104.143	26.57	103.57	0	0.571	177.02	13.39	177
id110	72	8	1	0	4	7	8	0	0	0		65	137	32.4	22.8	5	124.2	180.4	124	179.6	0	0.8	376.8	13.16	177
id111	74	6	1	0	3	1	1	0	0	1	0	60.5	108	28.5	20.74	6	10.5	64.3333	10.5	64.333	0	0	119.56	15.81	177
id112	53	6	1	1	3	5	8	0	0	1	0	87.5	141	26.1	21.76	7	303	375	246.3	332	39	43	716.91	15.46	177
id113	51	4	1	0	4	7	8	0	0	0		62.5	118	15	21.24	5	49.6	179	45.8	176.8	0	2.2	257.06	14.26	176
id114	62	6	1	0	7	7	8	0	0	1	0	65	141	36.1	23.46	6	178.33	246.667	160.2	232.17	7.67	14.5	493.33	13.8	177
id115	64	6	2	0	7	2		0	0	1	0	67	158	33.6	24.74	7	19.429	92.8571	19.43	92.714	0	0.143	145.88	14.35	177
id116	65	6	1	0	6	7	7	0	1	1	0	63	137	33.3	24.27	6	46.167	118.667	46.17	118.67	0	0	184.76	15.63	177
id117	71	6	3	0	4	7	6	0	0	0	0	63.5	151	40.8	26.33	7	46.286	146.286	46.29	145.86	0	0.429	221.69	13.47	200
id118	53	6	1	0	4	1	7	6	0	1	0	63	138	35.4	24.44	6	23.833	168.5	22.17	167	0	1.5	264.88	14.46	
id119	69	6	1	0	5	7	8	0	1	1	1	62.5	133.5	33.6	24.03	5	59	165.6	59	165.6	0	0	226.99	14.11	177
id120	52	6	1	0	6	1	8	0	0	1	1	64	146	32.4	25.06	7	45.714	130.429	43.71	128.43	0	2	302.85	14.97	177
id121	71	6	1	0	7	7	8	0	0	1	0	61	103	16.8	19.46	7	106.86	201.286	105.3	195.57	0	5.714	459.61	14.94	177
id122	58	6	2	0	7	1	7	0	1	1	1	65	125	28.6	20.8	4	32.75	134.25	32.75	130.5	0	3.75	246.43	13.87	210
id123	65	6	2	0	6	1	6	0	0	1	0	66.5	156	32.6	24.8	6	13.333	61.8333	13.33	61.667	0	0.167	126.25	13.91	189
id124	60	6	1	0	7	7	8	0	1	1	0	66	167	45.1	30.18	5	24.4	91.2	24.4	91.2	0	0	140.99	14.69	177
id125	65	6	1	0	5	1	8	0	0	1	0	63	139	34.8	24.62	6	31.5	125.167	31.5	124.67	0	0.5	216.61	14.53	177
id126	62	6	3	0	3	1	5	0	1	1	0	64	159	36.4	27.29	7	89.714	160	87.43	158.43	0	1.571	263.44	13.26	177
id128	75	6	1	0	3	7	5	0	0	1	0	57	128	37.6	27.7	7	5.7143	67.4286	5.714	67.429	0	0	126.71	14.94	197
id129	59	6	1	0	7	7	8	0	0	1	1	60.5	154.5	37.7	29.67	7	141.71	240.714	140.7	239.71	0	1	342.4	15.38	177
id130	68	6	3	0	3	7	3	0	0	0		66.5	211	50.7	33.54	4	9.25	51	9.25	61	0	0	94.056	13.62	203
id131	54	1	2	0	5	1	7	0	0	1	1	65	142	31	23.63	7	102.71	189	96.86	182.43	0	6.571	347.55	14.02	177
id133	63	6	2	0	3	7	5	0	0	1	0	61	134	26	25.32	7	104.43	205.714	100.4	201.71	0	4	473.26	14.69	261
id134	71	6	1	0	4	7	7	0	1	1	0	62	144	38.7	26.34	6	53.667	132.833	53.67	132.5	0	0.333	231.29	12.92	174
id135	72	6	3	0	3	7	4	0	0	1	0	61.6	158	36.8	28.37	5	47.4	163.4	47.4	163.4	0	0	221.59	14.52	177
id136	58	6	2	0	5	1	8	1	0	1	0	65	158	38.1	28.29	7	18.429	80.1429	18.43	80	0	0.143	140.03	14.3	177
id137	58	6	1	0	5	7	7	0	1	1	1	63	116	24.6	20.55	7	122.86	247	104.3	233.14	9.57	13.86	381.93	15.52	177
id138	57	6	1	0	7	1	8	0	0	1	0	62	141	33.2	25.79	5	37.2	153.2	35.4	152.2	0	1	223.54	14.46	177
id139	52	6	2	0	7	1	7	0	0	1	0	65	132	29.2	21.96	7	73.571	191.714	70.71	188.14	0	3.571	300.22	15.65	186
id140	56	6	1	0	7	1	6	0	1	1	0	67	189	43.2	29.6	5	48.6	131.6	43.2	125.4	1.8	6.4	326.14	14.78	177
id141	52	6	1	0	6	1	8	0	1	1	0	65.5	138	27.5	22.61	6	30.333	125.333	28.33	123.17	0	2.167	207.79	15.66	177
id142	57	6	1	0	5	1	8	0	0	1	0	63.5	133	32.9	23.19	7	68	141.429	53.71	127.14	5.71	14.29	272.74	15.44	173
id143	51	6	1	0	5	1	6	0	0	1	0	67.5	128	28.5	19.75	7	28.429	116.143	26.86	115.29	0	0.857	191.92	15.26	173

lumdiv	lumac	stcon	infr	aest	traff	crim	lkpk	lkcul	hill	barr	dest20	nwsanyd	nwsanym	nwsrecd	nwsrecm	nwstrd	nwstrm	nwswlkany	nwswlkrec	nwswlktr	trwlk
4.304	2.67	3	3	2.25	2.33	1	1	3	1	1	21	0	0	0	0	0	0	0	0	0	0
2.565	2	3	2.67	3.75	1	1	3	1	1	1	13	4	40	4	40	0	0	160	160	0	45
3.478	3	4	2.33	2.5	2.33	1	2	1	2	1	22	7	30	6	30	0	0	210	180	0	0
2.261	2.33	2.5	2.17	2.75	2.67	1	4	4	1	1	10	0	0	0	0	0	0	0	0	0	45
2.261	2.67	3.5	1.67	4	1.33	1.33	1	4	1	1	9										
1.304	1	1.5	2	3.75	2	1	2	1	2	4	1	3	30	3	30	0	0	90	90	0	0
1.696	1	3.5	1.33	2.75	1.33	1	2	2	1	1	8	0	0	0	0	0	0	0	0	0	30
1.957	3	3	2.33	3	3.33	2.67	1	3	1	2	3	4	60	4	60	0	0	240	240	0	20
1.174	1	1	1.67	2.25	2	1	1	4	4	1	1	6	60	5	30	0	0	360	150	0	420
1.826	2	2.5	1.67	3.25	2.67	1	1	1	3	3	8										
3.522	4	2.5	3.67	3.25	3	1	3	4	1	1	19	1	30	0	0	0	0	30	0	0	30
2.783	3.67	3.5	3.5	3.25	1	1	1	2	1	1	12	7	15	2	50	0	0	105	100	0	210
2.087	2	1.5	1.83	3.75	2.33	1	2	4	1	1	9	7	20	7	20	0	0	140	140	0	0
1.043	1	1	1.83	3.75	2	1	1	2	1	1	0	3	30	3	30	0	0	90	90	0	0
	3	3.5	1.5	3.75	1.67	1	1	4	1	1	6	0	0	0	0	0	0	0	0	0	0
2.565	2.67	4	1.67	3	2	1.33	1	3	1	1	12	1	30	1	30	0	0	30	30	0	0
2.435	3.33	4	2.83	4	1.67	1.33	3	3	1	1	11	0	0	0	0	0	0	0	0	0	60
3.174	3	2	2	2.75	3.33	1.33	1	3	1	1	18	0	0	0	0	0	0	0	0	0	0
2.783	4	3	1.83	3.5	2	1.67	1	4	1	2	10	7	0	0	0	0	0	0	0	0	40
3.13	4	3.5	1.83	2.5	3.67	1	1	3	1	1	18	7	20	7	20	0	0	140	140	0	140
1.565	1	2.5	1.5	2.5	2	1.33	3	3	1	3	4	0	0	0	0	0	0	0	0	0	10
1.087	1	1	1.17	3.25	-0.67	1	2	2	4	1	1	7	60	0	0	5	80	420	0	300	40
1.826	3.67	3	3.83	3.5	2	1	1	2	1	1	7	7	40	7	40	0	0	280	280	0	280
1	1	1		4	1.33	1	1	1	2	1	0	5.5	45	5.5	45	0	0	247.5	247.5	0	420
2.478	3	3		3.75			3	1	1	1	10	7	25	5	20	1	40	175	100	40	210
3.217	3.33	2.5	2.5	3.75	3	3	3	2	1	1	18										
1.261	1	3	3	2.25	1.67	1	2	2	1	1	0	1	5	1	20	0	0	5	20	0	0
2.565	3	1	1.67	3.25	1.67	1.33	1	3	1	2	15	0	20	0	20	0	0	0	0	0	0
1.217	1	4	2.83	4	1	1	1	3	3	3	1										
3.435	2.33	2	2.5	4	1	1	1	1	1	1	17	5	40		0	0	0	200		0	0
4.435	3	3	3.83	3.75	1.67	1	1	4	1	1	23	7	60	7	60	1	30	420	420	30	225
1.087	1	2	1	4	2.33	1.33	2	4	2	2	0	5	45	5	45	0	0	225	225	0	15
2.043	3	2.5	2	2.5	1.67	1.33	1	3	1	1	11	7	30	7	30	0	0	210	210	0	0
1.348	1	3	2	2.75	3.67	1	1	1	2	2	2	3	60	0	0	0	0	180	0	0	0
1.087	1	2	3.17	3.5	1	1	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0
2.348	2.67	2	1.67	4	2.67	1	1	4	1	1	9	3	30	0	0	0	0	90	0	0	75
1.783	1.67	2	3	4	2	1	1	1	1	1	0	7	20	5	20	0	0	140	100	0	210
1	1	1	1	3.5	1.33	1	1	4	1	1	0	7	45	0	0	0	0	315	0	0	80
2.478	2.33	3	3.33	4	1.67	1	3	1	1	1	15	2	30	2	30	5	10	60	60	50	0
1.478	2	3	2.83	3.75	1	1	2	1	1	1	4	7	120	7	120	0	0	840	840	0	0
	4	3	3.17	4	1.67	1	1	1	1	1	22	4	65	4	65	0	0	260	260	0	120
	2	1	1.17	2.75	4	1	3	1	3	3	1	7	30	0	0	0	0	210	0	0	180
1	1	1	1	2.5	3	1	2	4	1	1	0	7	30	0	0	7	60	210	0	420	840
1.609	3.33	3.5	2.67	4	2.33	1.33	2	2	1	1	3	5	90	5	90	0	0	450	450	0	450
1.609	2.67	2	2.5	3.5	2.67	1	1	3	3	1	4	1	35	0	0	0	0	35	0	0	0
2.217	2	2	2.67	2.75	2	1	1	2	1	1	10	2	60	2	60	0	0	120	120	0	0
1.217	2	3.5	2.33	3	1	1	1	1	1	1	1	1	50	0	0	0	0	50	0	0	0
1.217	1	1.5	1.5	4	3.67	1	1	3	3	3	1	2	45	0	0	0	0	90	0	0	0
3.13	2.33	3	2	3	2.33	2	1	1	1	1	15	0	0	0	0	0	0	0	0	0	0
3.261	2.67	2.5	3	3.75	1.67	1	1	2	1	1	17	3	30	3	30	1	30	90	90	30	60
1.957	2.33	2.5	2.33	4	2	1	2	2	2	2	7	4	30	4	30	0	0	120	120	0	0
2.174	3.33	3.5	2.83	3.75	2	1	1	3	1	1	11	7	110	5	20	7	90	770	100	630	60
	1.67	2	1	3.5	3.67	2.67	3	4	3	2	0	1	45	1	45	0	0	45	45	0	0
1.261	1	1.5	3.5	2.75	1.33	1.67	2	2	1	1	2	6	20	2	30	0	0	120	60	0	0
1.435	3	2.5	2.67	3	2.33	2	2	2	1	2	3	2	30	2	30	0	0	60	60	0	20
2.217	1.67	4	2.83	3.5	2.33	1	1	2	2	2	10	2	10	0	0	0	0	20	0	0	0
3.826	4	3	3.33	4	2.33	1	1	4	1	1	19	5	60	5	60	0	0	300	300	0	840
1.609	2.67	3	1.33	1.75	2	1	1	4	1	1	4										
1.261	2.67	3	3.67	3.75	2	1	2	1	2	1	3	7	37.5	7	30	0	0	262.5	210	0	45
1	1	1	1	2.25	4	1.67	2	4	2	2	0										
2.696	3	3.5	3.17	4	1.67	1.33	1	3	1	1	13	7	30	3	45	1	20	210	135	20	180
1.043	1.33	3	3.33	3	2.33	1.33	1	3	3	3	1	7	10	0	0	2	10	70	0	20	90
	2	1.5	1.83	3.25	1	1	1	1	2	1	16	6	30	0	0	0	0	160	0	0	180
1.391	1	1.5	1.33	2.75	3.33	1	1	4	3	2	4	0	0	0	0	0	0	0	0	0	0
1.913	2.33	3	3.17	2.25	2.33	1.67	1	3	1	1	7	0	0	0	0	0	0	0	0	0	0
1	1	1	1.33	3.75	2.67	1	1	4	1	1	0	3	60	3	60	0	0	180	180	0	1260
1.783	3	4	2.83	4	2	1	1	3	1	1	5	4	25	4	30	1	30	100	120	30	0
1.043	1	1	1.33	3.5	2	1	1	1	3	1	0	7	20	0	0	0	0	140	0	0	20
3.87	4	4	3	3.5	2	1	2	4	1	1	20	0	0	0	0	0	0	0	0	0	0
3.043	3	2	1.67	3	1.67	1.33	1	1	1	1	14	1	60	1	60	0	0	80	60	0	60
1.913	2.67	3	1.33	3.75	2.33	1	1	2	2	4	5	7	30	5	30	3	1	210	150	3	900
1.391	1.67	4	2.83	3.25	2	1.33	3	1	1	1	2	1	50	1	50	0	0	50	50	0	30
2.261	1	1.5	1.5	4	3	1.33	3	3	2	2	10	0	0	0	0	0	0	0	0	0	0
2.957	3.67	2.5	2.83	3	2	1.33	3	2	1	1	13	7	45	7	45	3	15	315	315	45	210
1	1	2	1.67	3.5	2.67	1.67	2	4	2	1	0	7	30	0	0	7	30	210	0	210	30
	4	3	2.83	2.5	2	1	1	4	1	1	9										
2.478	3	3	2.83	4	1	1.33	1	1	1	1	12	5	45	5	45	0	0	225	225	0	0
	2.33	2.5	1.83	3	2.67	1	1	4	1	1	5	0	0	0	0	0	0	0	0	0	60
1	1	2	1.17	4	3	1	1	4	3	3	0	4	45	4	45	0	0	180	180	0	0

1.478	1.67	2	2.33	2.75	2	1.33	2	2	1	3	3	0	0	0	0	0	0	0	0	0	0
1.87	1	4	3.17	1.75	1.33	1	1	3	1	1	8	7	30	7	30	0	0	210	210	0	210
1.957	3.33	3	1.67	4	3.33	1	3	2	2	1	6	7	35	2	15	0	0	245	30	0	0
2.261	3.33	4	2.67	3.5	3	3	3	4	1	1	10	3	17.5	3	10	2	10	52.5	30	20	180
1.826	2	3	1.83	2.75	2	1	1	4	1	1	8	0	0	0	0	0	0	0	0	0	0
3.391	3.33	3.5	2.33	3.5	1.33		1	4	1	1	20	1	30	1	30	0	0	30	30	0	0
1.826	2.33	3	3.33	3.25	2.33	1	1	1	1	1	7	7	60	7	60	0	0	420	420	0	1260
3.174	4	4		4	1	1	1	4	2	1	16	4	20	2	20	2	20	80	40	40	40
1.261	1.67	3	2.67	3	2	1.33	1	3	1	1	2	5	90	5	90	0	0	450	450	0	0
4.13	3.33	3	2.83	4	3	1.67	1	3	3	1	22		30	3	30	0	0		90	0	840
1.696	2	3.5	3.17	3.5	2	1.33	2	1	4	1	2	7	30	7	30	2	20	210	210	40	40
2.652	4	4	2.67	3.5	2.33	1	2	4	1	1	15	3	60	3	60	0	0	180	180	0	120
3.13	3.67	2.5	2.5	2.75	3	1	3	2	1	2	16	2	30	2	30	0	0	60	60	0	60
1	1	1	1	3.25	3	1	1	4	1	1	0	7	15	5	15	0	0	105	75	0	140
1.87	2	3.5	2.67	2.5	2	1.33	1	3	1	1	5	0	0	0	0	0	0	0	0	0	0
1.652	2.67	2	1.67	4	1.33	1.33	2	4	1	1	6	6	30	6	30	0	0	180	180	0	0
2.87	2.67	4	2.5	2.5	2	1	1	4	1	1	16	6	15	3	15	0	0	90	45	0	0
1.217	1	2.5	1.83	4	1	1	1	1	4	1	2	6	90	6	90	7	20	540	540	140	210
4.696	2	3.5	2.67	3.25	2.67	1	2	4	1	1	23	3	20	4	45	4	30	60	180	120	240
0.957	1	1	1.33	3.5	1.67	1	1	3	1	1	0	1	20	1	20	0	0	20	20	0	0
2	3	3.5	2.83	4	2.33	1.33	3	1	1	1	9	2	30	2	30	0	0	60	60	0	0
3.391	1	2	1.5	3.75	3.67	1	4	4	3	1	17	0	0	0	0	0	0	0	0	0	420
	1	3	2.67	3.5	1	1.67	1	4	1	1	4	7	15	3	20	0	0	105	60	0	200
1.087	1	2.5	2.83	2	1.67	1.67	1	1	1	1	1	0	0	0	0	0	0	0	0	0	90
2.087	2.67	2.5		4	1.33	1	1	3	1	1	10	0	0	0	0	0	0	0	0	0	60
1.13	1	2	2.67	4	2	1	2	2	3	2	1	0	0	0	0	0	0	0	0	0	20
1.217	2.33	3	2.67	2.75	3	1.67	1	2	3	1	1	7	75	7	45	0	0	525	315	0	315
3.174	1	3.5	4	3.75	1.67	2	1	1	1	1	16	6	30	4	30	0	0	180	120	0	
1.87	4	2	3	4	1.67	1	4	4	1	1	5										
2.913	3.33	4	2.67	3.25	1	1.67	1	4	1	2	18	4	45	4	45	0	0	180	180	0	0
3.261	2.33	2.5	1.5	3	1.67	1	1	4	1	1	16	2	30	2	30	1	5	60	60	5	90
2.739	4	4	3.17	3	1.67	1	2	2	1	1	18	0	0	0	0	0	0	0	0	0	90
1.391	1.33	1.5	3	2.75	1	1	1	1	3	1	4	7	120	0	0	0	0	840	0	0	0
2.217	2.33	3.5	3	4	1.67	1	2	2	2	1	10	3	45	6	35	1	15	135	210	15	0
1.261	1	1	2.83	2	2.67	2	1	2	1	2	2	2	50	2	20	0	0	100	40	0	90
2.783	3.67	4	3.5	3	1.33	1	1	1	1	1	14	1	20	1	20	3	20	20	20	60	90
3.217	2.33	2	2.83	3	2	1	1	3	1	1	17	0	0	0	0	0	0	0	0	0	0
	1	2.5	3.17	4	1.67	1	1	2	1	1	3	7	60	4.5	60	0	0	420	270	0	1260
1	1	1	1	3	2.67	3.33	1	2	4	4	0	3	180	0	0	0	0	540	0	0	600
1.913	3	4	3.5	3	2	1	3	4	2	2	4	0	0	0	0	0	0	0	0	0	0
1.609	1	2.5	1.67	3	2.67	1	2	1	1	4	1	0	0	0	0	0	0	0	0	0	0
1	1	1.5	1	2	4	1	1	4	1	1	0	0	0	0.5	15	0	0	0	7.5	0	0
2.783	3		3.5	3.75	2.33	1.33	1	1	1	1	13	2	20	2	20	0	0	40	40	0	0
4.348	2.67	1.5	2	3.5	1	1	1	1	1	1	23	6	15	3	15	0	0	90	45	0	0
1.435	2.67	3.5	2.5	3.75	1.67	1	1	1	1	1	3	5	45	5	45	0	0	225	225	0	0
1.174	1	3.5	2.67	3.75	2	1	4	1	1	1	2	3	30	3	30	0	0	90	90	0	0
1.261	1.33	3	3.33	3.25	2	1.33	3	2	2	2	3	6	30	4	50	0	0	180	200	0	0

ltwlk	wknd	wtkg	htcm	mrecsum	vrecsum	meetrec	trwlkd	trwlkm	ltwlkd	ltwlkm	mncntday	lwlkmtrec	bwlkmtrec	nwanymtrec	nwrecmtrec	nwlmtrec	groc	super	hrdwr
120	1	63.64	162.56	5	2	1	0	0	4	30	443795.7	0	0	0	0	0	1	2	2
60	1	66.36	172.72	7	0	1	3	15	2	30	314780.1	0	0	0	0	0	2	3	4
180	1	70.45	166.37	0	0	0	0	0	6	30	70425.17	1	0	1	1	0	1	3	3
0	0	73.18	158.75	0	0	0	1	45	0	0	83079	0	0	0	0	0	2	4	5
	1	61.82	168.91	5	0	1					251891.7	0	0	0	0	0	3	4	5
120	1	60.91	156.21	2	0	0	0	0	4	30	169753	0	0	0	0	0	3	4	5
240	1	66.82	161.29	4	0	0	2	15	2	120	151207.1	0	0	0	0	0	2	8	8
120	1	56.82	165.1	7	2	1	1	20	2	60	492179.8	0	0	0	0	0	2	3	4
180	0	60.68	168.37	5	0	1	7	60	6	30	658467.8	1	1	1	1	0	5	5	5
	1	87.73	172.72	0	0	0					190527.3	0	0	0	0	0	3	3	5
60	1	52.27	147.32	6	3	1	1	30	1	60	340945.3	0	0	0	0	0	3	3	4
180	1	59.09	160.02	6	3	1	7	30	3	60	437333.2	0	1	0	0	0	1	1	5
280	1	68.64	165.1	7	0	1	0	0	7	40	350319.4	1	0	0	0	0	3	5	5
90	1	80.45	162.56	6	0	1	0	0	3	30	248498.2	0	0	0	0	0	4	5	5
0	1	88.18	165.1	3	0	0	0	0	0	0	190898	0	0	0	0	0	4	3	5
300	1	71.82	162.56	7	0	1	0	0	5	60	359542.6	1	0	0	0	0	2	2	3
0	1	75.45	158.75	5	0	1	3	20	0	0	185751.8	0	0	0	0	0	3	4	5
0	1	73.64	163.83	5	0	1	0	0	0	0	240808.5	0	0	0	0	0	2	2	2
40	1	63.18	160.02	2	2	0	2	20	2	20	378296.8	0	0	0	0	0	2	4	8
30	1	88.64	167.64	7	0	1	7	20	1	30	305056	0	0	0	0	0	2	2	2
50	1	84.55	167.64	7	0	1	1	10	1	50	328155.4	0	0	0	0	0	1	5	5
0	1	69.09	172.72	4	0	0	2	20	0	0	166464.5	0	0	1	0	1	3	5	5
280	1	78.41	158.75	7	0	1	7	40	7	40	382562.8	1	1	1	1	0	3	5	5
225	1	63.64	157.48	7	0	1	7	60	5	45	377878.7	1	1	1	1	0	5	5	5
90	1	80	170.18	4	0	0	7	30	3	30	142559.5	0	1	0	0	0	1	3	3
	1	77.5	171.45	6	0	1					317997.7	0	0	0	0	0	2	2	2
150	1	48.64	149.86	5	0	1	0	0	5	30	333428	1	0	0	0	0	4	5	5
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	1	73.64	149.86	6	0	1					369906.8	0	0	0	0	0	4	5	5
200	1	70	165.1	2	0	0	0	0	5	40	134462.6	1	0	1	0	0	1	2	1
360	1	58.41	160.02	7	0	1	5	45	6	80	337634.4	1	1	1	1	0	1	2	2
180	0	67.73	165.1	4	0	0	1	15	4.5	40	231847	0	0	1	1	0	5	5	5
120	1	55.45	156.21	7	0	1	0	0	4	30	361426.6	0	0	1	1	0	3	3	5
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210	1	70.68	163.83	8	0	1	7	30	7	30	371996.5	1	1	0	0	0	4	4	5
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240	1	74.55	166.37	7	0	1	0	0	6	40	291474.6	1	0	0	0	0	3	5	5
600	1	82.73	160.02	2	0	0	0	0	2	300	234466.3	0	0	0	0	0	1	1	1
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420	1	69.55	161.29	4	0	0	3	10	7	60	216453.6	1	0	1	0	1	5	5	5
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fruit	laund	cloth	mail	libr	elemsc	othersc	book	ffood	coffee	bank	nffood	video	pharm	salon	work	bus	park	rec	gym	groc20	market20	hrdwr20	fruit20	laund20
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