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Perceived environmental, social, and policy influences on physical activity in rural Midwestern adults

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University of Iowa

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PERCEIVED ENVIRONMENTAL, SOCIAL, AND POLICY INFLUENCES ON
PHYSICAL ACTIVITY IN RURAL MIDWESTERN ADULTS

by
Matthew Scott Chrisman

An Abstract

Of a thesis submitted in partial fulfillment
of the requirements for the Doctor of
Philosophy degree in Community and Behavioral Health
in the Graduate College of
The University of Iowa

May 2013

Thesis Supervisor: Associate Professor Faryle K. Nothwehr

Rural adults engage in less physical activity and are less likely to meet activity recommendations than urban or suburban adults. Understanding determinants of this behavior can help design interventions for increasing activity levels. This series of studies examined the perceived determinants of physical activity in the social, physical, and policy environments of rural adults, using the following aims:

Aim 1: A secondary analysis was conducted of a cross-sectional survey among 407 adults from two rural towns to examine determinants of physical activity separately by the domain in which this behavior occurs (i.e. home care, active living, etc.). Multiple regression analyses found that social characteristics (such as support from friends), policy attitudes (such as workplace incentives for exercise), and physical environmental factors (such as an activity-friendly neighborhood) were positively associated with total physical activity, active living, and sport. Barriers were negatively associated with these domains. No factors were associated with physical activity in work or home care. Physical activity determinants are specific to the domain of physical activity, and more research needs to be done to determine factors associated with physical activity in home or work.

Aim 2: Measurement tools should be culturally relevant to a specific population for accurate measurement. Three focus groups were conducted (n=19) in a rural Midwestern county to tailor existing measurement tools to this population. Focus group members were asked about the activities they engaged in and facilitators and barriers to those activities. Important factors associated with physical activity include social support and modeling active behavior. Focus group members desired to see community buildings be open to the public for exercise. This study revealed contextual issues and cultural language for tailoring physical activity measurement tools for rural adults.

Aim 3: Ecological models propose that the environment impacts behavior on several different levels. Using a tailored survey instrument, this study examined social, environmental, and policy-level determinants of physical activity at different levels of an ecological approach. A cross-sectional survey was given to 143 individuals residing in a rural Midwestern county. Test-retest reliability was examined using correlations and kappa statistics, and was found to be very good to substantial. Multiple regression analyses were conducted using general linear modeling. Social factors were associated with total physical activity; environmental factors were associated with active transport, house and yard work, vigorous activity, and walking; and policy factors were associated with physical activity at work, and moderate-intensity activity. Findings can be used to tailor physical activity interventions using an ecological approach in rural adults, based on the specific domain and intensity in which the activity occurs.

These studies provide insight into the contextual factors that are associated with physical activity in rural Midwestern adults, and provide evidence that determinants should be examined and presented by the domain and intensity in which this behavior occurs. It is clear that social and physical environments and policy attitudes are associated with domain- and intensity-specific physical activity in this population.

Abstract Approved: _____

Thesis Supervisor

Title and Department

Date

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Graduate College
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CERTIFICATE OF APPROVAL

PH.D. THESIS

This is to certify that the Ph.D. thesis of

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has been approved by the Examining Committee
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CHAPTER 1 –INTRODUCTION

Background

Obesity levels have reached epidemic proportions in the United States, with over 35% of adults estimated to be obese based on height and weight measurements (Ogden, Carroll, Kit, et al., 2012). One major factor that contributes to this epidemic is a lack of physical activity. Evidence supports physical activity as a means of reducing morbidity and mortality associated with chronic conditions, such as obesity (Bouchard, Blair, & Haskell, 2007). Benefits of physical activity include reductions in body weight and the percentage of body fat, and decreases in blood pressure, blood lipid levels, and lowered blood glucose, all of which have implications on health status. Physical inactivity has been associated with increased risk of coronary artery disease, obesity, hypertension and diabetes (Bouchard, et al., 2007; Patterson, Moore, Probst, et al., 2004). Thus, promoting physical activity has been identified as a major priority for improving public health (Haskell, Blair, & Hill, 2009).

Despite the well-reported benefits of being active, rates of physical activity have remained steady in adults in the past decade (Centers for Disease Control and Prevention [CDC], 2008). Approximately half of American adults are not participating in recommended levels of physical activity, including 25% who do not participate in any leisure time physical activity at all (CDC, 2008). In addition, studies have shown that rural populations exhibit lower rates of physical activity participation than urban or suburban populations (Patterson et al, 2004; Parks, Housemann, & Brownson, 2003), including one showing approximately 46% of rural adults to be sedentary (Eaton,

Nafziger, Strogatz, et al., 1994), which is defined as the absence of participation in any physical activity at least once per week (Eaton, et al, 1994). Rural adults may have less access to physical activity facilities, and decreased walkability of their communities, and are also older, less educated, and poorer than their urban counterparts (Shores, West, Theriault, et al., 2009; Patterson, et al., 2004), thus potentially contributing to the lower rates of physical activity seen in rural areas. Moreover, rural adults have higher levels of chronic disease than their urban counterparts, which may also influence levels of physical activity participation (Jones, Parker, Ahearn, et al, 2009).

While a large number of studies have focused on individual determinants (such as motivation or self-efficacy), less has been available in the physical activity literature regarding influences of the perceived social environment (such as social support), the perceived physical environment (such as the presence of sidewalks), and perceived role of local or state policies (such as using government funds to build walking trails).

Research on these determinants of physical activity is particularly needed in rural adults because there are a number of demographic, physiological, social, environmental, and policy level factors that determine participation in physical activities. Such factors have not been completely understood, and interactions between them have largely been ignored or unexamined (McMurdo, Argo, Crombie, et al., 2012).

Research has shown that there are differences in some perceived determinants for physical activity between rural and urban adults (Plotnikoff, Mayhew, Birkett, et al., 2004; Frost, Goins, Hunter, et al, 2010; Parks, et al., 2003), as well as between rural males and females (Nothwehr, Snetselaar, & Wu, 2006; Chrisman, Nothwehr, & Schultz, 2011). Multiple instruments exist to measure these determinants of physical activity;

however, there have not been any instruments developed specifically for a rural population. Rural areas may be considerably different from their urban and suburban counterparts, and require their own tools for measuring and promoting physical activity. Additionally, Brownson and colleagues suggest that some variables in existing surveys may be irrelevant to rural areas, and that identifying environmental variables related to physical activity in rural settings should be a priority in future research (Brownson, Chang, Eyler, et al, 2004).

Few studies have specifically examined the determinants of physical activity unique to rural areas. From the social and behavioral science perspective, determinants of physical activity are measurable items that are thought to be associated with participation in this behavior, and once identified, can be targeted for change in intervention studies. Social determinants are measurable items related to a person's social environment, including social support from family and friends, and which have been found to be associated with participation in physical activity. Environmental determinants are measurable items surrounding an individual that are thought to be associated with participation in physical activity, and may include things such as access to neighborhood parks. Policy determinants are measurable items related to policy-level factors that may influence participation in physical activity, including attitudes towards using government funds for improving access to physical activity facilities.

It is important to note that the term "determinants" is being used to describe social, environmental and policy variables associated with physical activity due to the use of this word in the existing literature, as well as the measurement tools that capture these variables. It is recognized that there is a difference between determinants, which more

specifically refers to a well-established *cause* of behavior, versus a correlate, which is more specifically defined as a measure of association consistently reported (Bauman & Bull, 2007). Although the variables are typically assessed using cross-sectional methods, they may be referred to as determinants because they are hypothesized to be causally related to physical activity (Bauman, Sallis, & Owen, 2002). Therefore, the term determinants will be used throughout here as the variables of interest are thought to be causally related to physical activity. In addition, it is also recognized that using self-report measures to capture perceived determinants of physical activity is a proxy measure for what actually exists in the social and physical environments. For example, measuring the perceived access to sidewalks is purported to be a measure of the actual access to sidewalks. The reader should be aware that the use of “perceived social, environmental, and policy factors” through self-reported means is a best guess as to what exists in reality. As Brownson and colleagues (2009) point out, some perceived environmental variables may be analogous to objective measures of reality.

Little is known about the types and patterns of physical activity practiced specifically by rural adults. It has been traditionally hypothesized that rural adults may participate in more physical activity than their urban and suburban counterparts, due in part to the physical nature of rural occupations (farming, mining, etc.). One study examined the occupational activity of farmers and found that they engage in heavy carrying and lifting for an average of 1.5 hours each day during crop growing seasons (Racine, Laditka, Dmochowski, et al., 2012). However, there is otherwise a lack of evidence supporting the hypothesis that rural occupations are more active. Only one study has shown higher levels of overall physical activity in rural adults due to

occupational physical activity (Eaton, et al., 1994), and more recent technological advances (e.g. computerized farm machinery) since that study was published may have changed the amount of physical labor that those rural adults engage in.

In several studies of rural adults, getting enough exercise at their job was one of the top barriers to engaging in leisure time physical activity, and this has been reported more often by men than women (Brownson, Hagood, Lovegreen, et al., 2005; Chrisman, et al., 2011). However, the physical activity associated with rural farm work has declined in the past few decades, due to increased automation and mechanization of the agriculture industry (Hill & Melanson, 1999; Racine, et al., 2012), thus limiting opportunities for rural adults to be physically active through their occupation. Occupations that may include more physical activity, such as fishing, forestry and farming, have been shown to be more available in rural settings than urban or suburban settings, but only account for approximately 0.7% of the jobs and 5% of the economy in rural areas (Martin, Kirkner, Mayo, et al., 2005; Patterson, et al., 2004). The largest proportion of industry in rural areas is accounted for by consumer services, such as health care and retail (Patterson, et al., 2004), which are occupations that traditionally do not require large amounts of physical activity. Thus, the changing occupational landscape of rural areas provides a new challenge for increasing physical activity in rural residents.

Rural communities are sufficiently different from their urban and suburban counterparts, and require their own special considerations for assessing and enhancing the relationship between the physical environment and engaging in physical activity (Yousefian, Ziller, Swartz, et al., 2009). Neighborhood environment attributes, including social factors and physical access to exercise facilities, have been associated with obesity

and physical activity (Casey, Elliot, Glanz, et al., 2008). One review showed differences in perceived built environment correlates of physical activity in rural versus urban settings (Frost, Goins, Hunter, et al., 2010). Among rural communities and neighborhoods, positive associations were found between aesthetics, recreational facilities, safety from crime or traffic, the presence of walking trails, and participation in adult physical activity. In contrast, in urban areas, positive associations were found between sidewalks, parks, and walk-able destinations in the community or neighborhood (Frost et al., 2010). Because perceptions of the social and physical environment appear to be associated with the actual behavior of engaging in physical activity (Addy, Wilson, Kirtland, et al., 2004), it is important to understand how these perceptions are associated with this behavior.

The perceived social and physical environments have been shown to be related to physical activity in several studies. Social factors that have been associated with physical activity include areas in which many people were exercising, having friends who encouraged exercise, having at least one friend with whom to exercise, and having trusting neighbors (Brownson, et al., 2001; Addy et al., 2004; Parks et al., 2003). The physical environment provides cues and opportunities for physical activity (Giles-Corti & Donovan, 2002). Physical features of the environment that have been associated with physical activity include access to locations and facilities where people can be active (such as parks, walking/jogging trails, playgrounds, sports fields, schools and worship facilities), better street lighting, having sidewalks available, and using a mall for walking (Brownson et al., 2001; Addy et al., 2004; Parks et al., 2003).

Policy determinants of physical activity have also been shown to be associated with physical activity. Believing that employers should provide time during the day for exercise, supporting that local schools require physical education, and supporting the use of government funds for building walking/jogging trails, swimming pools, and biking paths have all been associated with greater odds of being physically active in a national sample of adults (Brownson et al., 2001). This support is consistent across gender and income groups.

A study that examined the correlates of physical activity in rural older adults found that perceived safety, perceived social support, and having an activity area close to home helped explain the variance in rural older adults who met Centers for Disease Control and Prevention (CDC) and American College of Sports Medicine (ACSM) guidelines for weekly physical activity (Shores, et al., 2009). Eyster (2003) found several correlates associated with physical activity in rural adult women, including being younger, employed, being in good health, having high self-efficacy and having higher income. In addition, attending religious services was associated with being more likely to meet physical activity recommendations (Eyster, 2003). Osuji, and colleagues (2006) found that rural women who reported a greater number of barriers to physical activity had a greater likelihood of not meeting physical activity recommendations, showing a dose-response relationship between the numbers of barriers and not meeting recommendations. That same study also found that personal barriers were more frequently cited than were environmental barriers, suggesting that interventions target personal or social factors.

While this current series of studies may examine some factors that could be considered non-modifiable (such as weather), the major focus of this dissertation work

will be on finding factors that can be modified in order to potentially increase rates of physical activity in rural adults. In addition, factors that enable or inhibit physical activity in rural neighborhoods and communities will be highlighted for their potential to be targeted for intervention.

Purpose

The purpose of this dissertation is therefore to examine and describe the perceived social, environmental, and policy determinants of physical activity in rural adults in order to provide a clearer understanding of what enables and inhibits physical activity in this population. Results can be used to inform future interventions.

The following specific aims will be examined:

1. To determine associations between perceived social environment, perceived physical environment, and perceived policies and physical activity in home care, work, active living, and sport, using existing data on rural adults.
2. To modify an existing instrument measuring perceived social environment, physical environment, and policy determinants of physical activity, and to validate the instrument among rural adults using qualitative methods (e.g. definitional evidence of validity and cultural sensitivity).
3. To determine the relationships between perceptions of the social environment, physical environment, and policy determinants and actual physical activity in a sample of rural adults, using the revised instrument.

Significance

Approximately two-thirds of American adults are carrying more weight than is considered healthy (Flegal, Carroll, Ogden, et al., 2010). Evidence supports physical activity as a means of reducing morbidity and mortality associated with chronic conditions such as obesity (Bouchard, et al., 2007). Rural adults are an understudied population (Nothwehr & Peterson, 2005) and have higher rates of overweight and obese individuals (Patterson, et al., 2004), and the rural environment for physical activity has not been studied extensively.

Brownson and colleagues (2004) suggested a need for improving the measurement of environmental and policy variables that are potentially related to physical activity, ensuring that instruments can be administered by multiple modes and are reliable for broad populations. The qualitative approach that will be used here to address this research question is innovative, and the work done will be specifically tailored to the rural population. Programs that target the specific needs and concerns of rural adults are needed to enhance physical activity in these adults, and the developmental work may help inform such programs in the future. This project will therefore be in line with *Healthy People 2020's* goals of achieving health equity, eliminating disparities, and improving the health of all groups (U.S. Department of Health and Human Services [USDHHS], 2010).

Awareness of objectively-identified, local physical activity resources is a potential new determinant of physical activity that will be measured here. Few studies have examined awareness of physical activity resources as a determinant of physical activity, and the studies that do exist have primarily looked at college student or adolescent populations. The present study offers the opportunity to examine the contributions of this new measure, along with environmental and personal barriers and facilitators to physical activity behavior in the rural adult population in one survey. Testing the reliability of the

survey that will be modified here in rural adults will help in determining its usefulness in measuring perceived physical activity determinants in this population. Accurate measurement is important for all physical activity studies, which means that instruments should have adequate measurement properties, including reliability (Terwee, Mokkink, van Poppel, et al., 2010).

While the reliability of the modified instrument will be tested, it is recognized that it may be more difficult to measure the instrument's validity. However, efforts were made to use validated questions when developing the original survey instrument and the qualitative work that will be done here will ensure that the modified survey is culturally sensitive and relevant to the rural population. Resnicow and colleagues (1999) have developed a multidimensional model of cultural sensitivity, which posits that cultural sensitivity has two dimensions: surface structure and deep structure. Surface structure refers to the observable social and behavioral characteristics of a target population, including language and locations familiar to and preferred by the target audience (Resnicow, Jackson, Braithwaite, et al., 2002). It also refers to the extent to which research corresponds to the needs and preferences of the target population; in this sense, it may be analogous to face validity, a necessary prerequisite for construct validity (Resnicow et al., 2002). On the other hand, deep structure refers to how cultural, social, and environmental factors influence health behaviors differently across different populations (Resnicow, et al., 2002). Deep structure may convey salience or impact of research programs. The qualitative work done here will elicit the surface structure (and therefore, face validity) in an attempt to modify the original survey and assure that it is culturally sensitive to the needs and preferences of rural adults for physical activity.

Finally, many studies of physical activity behavior have focused on a single community, or a group of communities in close proximity. The work done here focuses on an entire rural county that includes multiple communities and a variety of land-use

patterns. This approach provides an in-depth look at a larger geographical region's physical activity patterns and determinants of this behavior.

To achieve a greater understanding of the perceived determinants of physical activity in rural adults, the specific aims listed above will be pursued. The expected outcome should determine which perceived social environment, physical environment, and policy factors are most associated with physical activity in rural adults, and should examine whether a survey of those determinants modified for rural adults has sufficient reliability in this population. This should increase the understanding of the determinants of physical activity in rural adults, as well as the knowledge of what factors can be targeted for an intervention, increasing the likelihood that rates of physical activity can be increased in this population. The results of this study can inform health education and policy development, and may serve as a guide for future interventions in this area.

Approach

Among the most commonly applied frameworks for studying determinants of physical activity are ecological models and Social Cognitive Theory. Ecological models propose that the most effective behavioral interventions occur on multiple levels (USDHHS, 1996). An ecological model theorizes that addressing behavior change should be behavior-specific, and is accomplished through targeting interpersonal, intrapersonal, organizational, community, and public policy level factors (Sallis, Owen & Fisher, 2008). Sallis and colleagues (2008) mention that interventions should be most effective when they change the person, the social environment, the built environment, and policies. Social ecological models have increasingly been applied to understand the determinants of physical activity and inactivity, and there is a growing body of evidence showing that characteristics of the physical environment have a significant influence on the active lifestyle choices of adults (Giles-Corti & Donovan, 2002; Sallis, et al., 2008). Since physical activity occurs in specific places and contexts, ecological models are well-suited

for researching this behavior, especially as ecological models should be domain- and context-specific (Ding, Sallis, Conway, et al., 2012).

In addition, Social Cognitive Theory provides a useful framework for explaining and predicting physical activity behavior. This theory proposes that behavior is affected by environmental influences, personal factors, and attributes of the behavior itself (Bandura, 1977). The theory also proposes that these factors interact with and influence each other, a term known as *reciprocal determinism* (McAlister, Perry, & Parcel, 2008). Combining the components of the Social Cognitive Theory with an ecological approach can guide the study of a wide range of determinants of physical activity, including environmental, social, and policy determinants. These determinants occur at different levels of an ecological framework.

To increase population levels of physical activity, it may be essential to understand and eventually intervene on environmental and policy factors. A better understanding requires improved accuracy in measuring environmental and policy variables (Brownson et al., 2004). The Social Cognitive Theory emphasizes examining the relationship between the social and physical environments and physical activity, and is thus useful for guiding this study. Some of the specific constructs from the Social Cognitive Theory that are relevant to this study include facilitation, which refers to the provision of structures or resources that enable behaviors or make them easier to perform (Bandura, 1998), and social and structural impediments, which include barriers to behavior (Bandura, 2004). Facilitation can be thought of as empowering individuals to engage in physical activity, and includes aspects of the environment, including sidewalks, parks, and walking and jogging trails. In this study, the facilitators will be considered synonymous with neighborhood characteristics.

Bandura proposes that personal behavior change, such as increasing one's level of physical activity, would be likely to occur if there were no impediments to surmount (Bandura, 2004). In addition, the perceived facilitators and obstacles are determinants of

health habits (Bandura, 2004). It is therefore important to consider these facilitators and impediments (or barriers) when examining the environmental influences on behavior. The relationship between specific demographic characteristics (age, gender, etc.) and physical activity might be stronger for those with access to places to exercise. Questions about both barriers and facilitators will be asked during cognitive interviews and focus groups in order to gain insights from the study participants about these constructs. It is important to note that Figure 1 (see Appendix A), showing the graphical depiction of the conceptual model, will differ between Specific Aim's 1 and 3 by the addition of new variables in Specific Aim 3. Specifically, the new variables will include: a measure of the perceived physical activity facilities and programs available, in order to determine how the awareness of these resources is associated with actual physical activity behavior; and new variables examining attitudes towards policies that favor more activity-friendly environments.

Another key concept from the Social Cognitive Theory is that of observational learning, also thought of as modeling, which refers to the capacity to learn behavior from observing the behavior of others, and then enacting those behaviors (Viswanath, 2008). This learning occurs through channels in the social environment, such as friends and family members. Observational learning, or modeling, is assessed in the survey by asking the level of agreement to the statement "a lot of people are physically active in your neighborhood"; it is thought that the presence of others being active would serve to increase one's own participation in physical activities.

CHAPTER 2 – PERCEIVED DETERMINANTS OF DOMAIN-SPECIFIC PHYSICAL ACTIVITY IN RURAL ADULTS

Abstract

In response to calls for more specificity when measuring determinants of physical activity, this study examined determinants of physical activity in rural adults separately by the domain in which this behavior occurs (i.e. home care, work, active living, and sport). Design and sample: Cross-sectional survey of 407 adults from two rural towns in the Midwest. Analysis: Multiple regression analyses were conducted using general linear modeling. Results: Having a favorable attitude towards using government funds for exercise, and activity-friendly neighborhood characteristics were positively associated with active living. Friends encouraging exercise was positively associated with participation in sport. Barriers were negatively associated with active living and sport. Total physical activity was positively associated with workplace incentives for exercise, favorable policy attitudes towards supporting physical education schools, and supporting government funds be used for biking trails, and negatively associated with barriers. There were no factors associated with physical activity in the domains of work or home care. Conclusions: Determinants of physical activity are specific to the domain in which this behavior occurs. Targeting domain-specific social, physical, and policy environments may help increase physical activity.

Introduction

Rising rates of obesity in rural areas have driven increasing amounts of research examining how to prevent or treat this condition (Yousefian, Hennessy, Umstatted, et al., 2009; Patterson, Moore Probst, et al., 2004). A lack of physical activity is one contributing factor to increasing levels of obesity (Patterson, et al., 2004). Rural populations have lower rates of physical activity than their urban and suburban counterparts (Martin, Kirkner, Mayo, et al., 2005) and rural adults are also less likely to meet physical activity recommendations than adults living in urban or suburban areas (Parks, Housemann, & Brownson, 2003). Rural areas tend to be sufficiently different from their urban and suburban neighbors, and recent calls in the literature suggest that one priority of future research should be to identify ways in which the rural environment is related to physical activity (Brownson, Chang, Eyler, et al., 2004).

Ecological models identify multiple levels of influence on physical activity (Giles-Corti & Donovan, 2002). These influences can occur through intrapersonal, interpersonal, organizational, community and public policy level factors (Sallis, Owen & Fisher, 2008). Evidence suggests that the environment, including physical, social and policy environments, may impact the lifestyle choices where one lives (Giles-Corti & Donovan, 2002; Sallis, et al., 2008), and also offer explanatory power beyond intrapersonal factors (Sallis, Bauman, & Pratt, 1998). Several studies have looked at differences in environmental factors related to physical activity in rural versus urban settings. Neighborhood environment attributes, including social factors and physical access to exercise facilities, have been found to be associated with physical activity behavior (Casey, Elliot, Glanz, et al., 2008; Parks, Housemann, & Brownson, 2003). Among rural communities and neighborhoods, positive associations were found between safety from crime or traffic, the presence of walking trails, and adult physical activity. In contrast to rural areas, positive associations were found between sidewalks, parks, and walk-able destinations in urban communities or neighborhoods (Frost, Goins, Hunter, et

al., 2010). A study of urban Canadian adults showed that perceived access to physical activity facilities and observing others engaging in physical activity in one's neighborhood were associated with physical activity in women, and aesthetics and having convenient destinations within walking distance were associated with physical activity in men (Bengoechea, Spence, & McGannon, 2005).

Many studies of physical activity examine either total physical activity, or only activities that occur during leisure time. However, physical activity may occur in multiple domains, such as home care or during work-related requirements, and the determinants of this behavior may differ for each domain. Considering the broad nature of ecological models, detailed descriptions of the determinants of particular physical activity behaviors are needed. Additionally, experts have called for more specificity when measuring factors influencing physical activity (Bauman & Bull, 2007), making it necessary to measure physical activity and its determinants separately by each domain in which this behavior can occur.

The purpose of this study is therefore to describe the association between perceived environmental, social, and policy determinants and physical activity occurring in different domains and different levels of an ecological model among a sample of rural Midwestern adults.

Methods

Data Collection and Study Population

Data for this study are taken from a larger cross-sectional study that examined nutrition, physical activity, and other health and social factors in rural adults. More detailed information on sampling and recruitment for the larger study can be found elsewhere (Nothwehr, Snetselaar, & Wu, 2008). In summary, a survey was administered to 407 adults aged 18 and over from two rural communities located in southeastern Iowa. Each community had a population of approximately 2,300 and was demographically

similar (Nothwehr, et al., 2008). Individuals living within three miles of each community were recruited for sampling using information from the telephone book, a school contact list, and the county home ownership list.

The response rate using eligible persons reached by telephone as the denominator was 25% (Nothwehr, et al., 2008). These 407 participants were more likely than the general population of the state to be older than 45, have a higher income, and to have more than a high school degree (Nothwehr, et al., 2008). Data on these 407 adults, including height and weight used for Body Mass Index (BMI) calculations, were collected in person at a local church in 2003 by the University of Iowa's Prevention Research Center for Rural Health. At the time, rural was defined as a county that does not contain a principal city with 50,000 or more residents. Approval from the University of Iowa's Institutional Review Board and Human Subjects Office (IRB & HSO) was obtained before the study was carried out.

Instruments

Perceived determinants of physical activity were measured using a questionnaire developed by Brownson and colleagues (2001). It uses a combination of questions from the Behavioral Risk Factor Surveillance System (BRFSS), the National Health Interview Survey (NHIS), and existing literature. The survey instrument was designed for a national sample of adults, and includes questions on walking behavior, neighborhood characteristics for and barriers to being active, social assets for being active, community assets for being active, and policy attitudes. The survey was administered by a trained interviewer to the participants who came in for this study. In previous work, psychometric properties of this questionnaire, along with two others, were measured with moderate to high test-retest reliability on most of the questions related to the built environment (Brownson, Chang Eyster, et al., 2004). Questions related to the social environment showed lower reliability. This questionnaire was reported to have the

highest reliability in rural adults among all three instruments, although no reliability statistics were given (Brownson, et al., 2004). Validity has not been reported for this survey; however, attempts were made to use validated questions when developing the survey (Brownson, et al., 2001).

This study focused on the following sections of the questionnaire: social determinants (e.g. Do you usually exercise alone or with someone?); environmental determinants (e.g. Do you have access to places to exercise?); and policy determinants (e.g. Does your workplace provide support or incentives for you to exercise?). Barriers to exercise and neighborhood characteristics were also assessed for their potential role in affecting physical activity. A summary score for the total number of barriers and the total number of neighborhood characteristics was calculated and used in the analysis. The questions on walking behavior were excluded since physical activity was measured in a separate instrument (see below), and the questions on community assets were excluded since a previous analysis showed no associations with these questions and physical activity in rural adults (Chrisman, Nothwehr, & Schultz, 2011).

Factors that were examined as covariates included BMI, age to the nearest year, gender, education (10 categories from no schooling to post-graduate degree), and marital status (6 categories including married, widowed, divorced, separated, never married, and live with domestic partner) as these have been shown to be associated with physical activity (Patterson, et al., 2004; Bauman & Bull, 2007).

The Kaiser Physical Activity Survey, also known as the modified Baecke survey, was self-administered and captured physical activity across four domains: home care, work, active living, and sport. A total sum of physical activity across those four domains was also calculated. A unit-less index score is calculated for each domain in this survey by summing the activities in each domain using specified values that indicate categories of intensity or time spent in that activity, and dividing that sum by another specified value. The total sum of physical activity across all domains was calculated by summing

all of the domain-specific scores together. Ainsworth and colleagues (2000) found that this survey instrument was reliable for measuring women's physical activity in home care and sport ($r=0.50$ or greater). Active living and work showed lower correlations ($r = 0.22-0.35$). Criterion validity using accelerometers showed moderate correlations with home care ($r=0.44$), active living ($r=0.34$), work ($r=0.30$), and sport ($r=0.57$), depending on whether the accelerometer counts were expressed as kilo-calories per day, or MET-minutes per day (Ainsworth, Sternfeld, Richardson, et al., 2000). Test-retest reliability values were high ($ICC = 0.79-0.85$)

Data Analysis

Distributions and frequency counts (means, standard deviations, and proportions) were examined for each variable. The presence and patterns of missing data was examined for the variables that contained missing data, and data plots and histograms were examined for outliers. Correlations were examined between independent variables to identify potential co-linearity. Data were distributed normally and no outliers existed. Multiple regression analyses were then conducted using General Linear Modeling in SAS (version 9.2, SAS Institute, Cary, North Carolina) to examine the associations among the perceived social, environmental, and policy determinants and physical activity in each domain, including a summary score for all of the domains combined. Residuals were examined for the regression models, and goodness of fit tests were conducted. There was no evidence of assumptions being violated and no evidence of lack of fit.

Results

Characteristics of the study population are presented in Table B-1 (see Appendix B). The sample was entirely non-Hispanic white, 57% were female, 76% were married, and the mean age was 56 years. In comparison, for the entire state of Iowa, 94% are non-Hispanic white and 50.4% female (U.S. Census Bureau, 2011). Due to a lack of variance, the proportion of non-Hispanic whites could not be tested for differences with the state

proportion. The proportion of females in the sample was not significantly different from the state ($p = 0.45$). Approximately 76% were classified as overweight or obese according to their Body Mass Index (BMI) (> 25), which is higher than the state average of 63% (U.S. Census Bureau, 2011), but not significantly different ($p = 0.38$). Men were slightly more likely to be overweight or obese than women (Chi-square = 4.3; $p = .038$). Fifty-nine per cent of the sample had attended at least some college. Over half of the sample reported walking as their most common form of exercise, and approximately 85% of the sample reported having access to places to exercise. Age was negatively associated with physical activity in all domains. Table B-2 in Appendix B shows the means and standard deviations of quantitative independent and dependent variables.

Tables B-3 through B-7 presents the associations between perceived determinants and physical activity by domain. Few environmental factors were associated with physical activity in the domains of work and homecare, and thus results in the text will mainly be presented for the domains of active living and sport.

Physical activity examined in the active living domain ($n=356$) was positively associated with having a positive attitude towards using government funds for biking trails ($p<0.001$) and a summary score of neighborhood characteristics ($p=0.015$), and negatively associated with barriers to exercise ($p<0.0001$) (Table 1).

Table 1 – Predictors of physical activity in the active living domain

Variable	Slope	F-value	P-value	Adj. R-square
Barriers	-0.10	17.49	0.0001	0.1257
Gov't funds for bike trails	0.51	10.25	0.0016	
Neighborhood characteristics	0.10	7.12	0.0081	

Physical activity examined in the domain of sport (n=367) was positively associated with friends encouraging exercise ($p=0.0023$) and negatively associated with barriers to exercise ($p<0.0001$) (Table 2).

Table 2 – Predictors of physical activity in the domain of sport

Variable	Slope	F-value	P-value	Adj. R-square
Barriers	-0.21	41.01	0.0001	0.1880
Age	-0.02	13.88	0.0002	
Friends encourage exercise	0.44	3.71	0.0056	
Marital Status	1.13	2.67	0.0220	
BMI	-0.01	4.07	0.0443	

Being married was positively associated with physical activity in the sport domain, whereas BMI and age were negatively associated with physical activity in sport.

Factors that were associated with the physical activity summary score (n=333) included workplace incentives for exercise ($p<0.001$), and supporting physical education in the schools ($p=0.0474$). The sum total of physical activity was negatively associated with barriers ($p=0.0044$), and an interaction effect of age and supporting government funds being used to build bike trails ($p=0.0231$) (Table 3).

Table 3 – Predictors of physical activity across all domains

Variable	Slope	F-value	P-value	Adj. R-square
Work incentives to exercise	2.03	19.33	0.0001	0.3229
Barriers	-0.33	8.33	0.0044	
Age* Gov't funds for bike trails	-0.04	6.85	0.0014	
Schools should have PE	2.20	3.57	0.0302	

Discussion

Examining the perceived determinants of physical activity by the domain in which the behavior occurs is unique and is responsive to calls in the literature for more specificity in this area. The research done here provides insight into the different factors influencing physical activity in active living and sport. It should be noted that this study did not assess intrapersonal factors (such as self-efficacy) and their association with domain-specific physical activity.

There were few factors associated with physical activity in the work and home care domains. In addition, there is a general lack of evidence of environmental factors that are associated with physical activity in these domains, suggesting a need for further research in this area. Due to the nature of this secondary data analysis, it was not possible to further explore the types of factors that may be associated with physical activity at work and during home care. Additionally, physical activity done at work or in home care may be more obligatory and determined by other factors than those measured here. Future research should use qualitative strategies to examine the types of factors associated with physical activity in these domains.

Perceived factors positively associated with physical activity in active living and sport domains included having a positive attitude towards using government funds for biking trails, a summary score of neighborhood characteristics, and having friends who encouraged exercise. While there are numerous other factors that could be studied for their associations with physical activity, these findings provide unique insight into the domain-specific variables that could be targeted in intervention research. This also provides evidence that factors at multiple levels of ecological models influence physical activity in rural adults.

Demographic factors that were associated with physical activity included age, BMI, and marital status. Interventions to improve physical activity in rural adults could target older adults, adults with a higher BMI, and adults who are not married or living with a domestic partner. These findings are supported in the literature (Patterson, et al., 2004; Bouchard, Blair, & Haskell, 2007; Parks, et al., 2003). Age was negatively associated with sport, indicating that levels of sport participation drop as one gets older. Education and gender did not have any significant effects on any of the regression models, and were dropped from the models, as the reduced models had a better fit.

Barriers to exercise were negatively associated with exercise, as expected. The barriers measured in this study included others discouraging exercise, being self-conscious about appearance, afraid of injury, don't have time, too tired, no safe place to exercise, no child care, bad weather, not in good health, don't have energy, get enough exercise at their job, no motivation, and don't like to exercise. Previous research has shown that the most common barriers to exercise in rural adults are no time, no motivation, getting enough exercise at their job, and being too tired (Chrisman, et al., 2011; Osuji, Lovegreen, Elliott, et al., 2006). These are also the most common barriers reported in a national sample of adults (Brownson, et al., 2001). Interventions may want to target those commonly reported personal barriers. Future research should examine whether there are barriers to exercise that are more specific to rural adults, such as the

presence of gravel roads or farm equipment on the roads. In addition, Osuji and colleagues (2006) found a dose-responses relationship between the number of barriers and the likelihood of not meeting physical activity recommendations among rural women, and they suggest that more research should focus on reducing barriers to exercise in rural populations.

The overall number of neighborhood characteristics was only associated with physical activity in the domain of active living. This makes intuitive sense since neighborhood characteristics like sidewalks may influence active living in the form of walking for transportation. This also indicates that there are factors other than the neighborhood characteristics measured which are associated with being active in sport within a rural neighborhood. Rural neighborhoods may be less likely to have sport-related equipment, or have no parks nearby where one can participate in sport-related activities.

There was an interaction effect of age on having a positive attitude towards using government funds for biking trails and physical activity, with younger persons more likely to support this. Interventions to increase physical activity in younger rural adults could examine ways to increase the amount of biking trails in rural communities, or possibly promote existing trails better.

A lack of association between some of the perceived determinants and physical activity is somewhat surprising, as some of the factors have previously been found to influence physical activity. Social support from friends was found to only influence physical activity in the domain of sport; however, other studies have shown that social support is important for encouraging rural adults to exercise or be active in their daily living (Gangeness, 2009; Eyler, 2003).

Future research should use qualitative means to examine the types of things that may influence neighborhood physical activity in rural adults. There were no differences in perceptions between normal weight and overweight or obese participants on any of the

items on the survey instrument. This is an interesting finding, and might be explained by the high proportion of overweight adults in this sample.

Limitations

The cross-sectional data for this study were collected by self-report, thus limiting the ability to determine casual relationships and being vulnerable to social desirability bias. In addition, this study is limited by the extent to which the findings may be generalized to the whole of Iowa and/or the Midwest. The high proportion of overweight individuals may limit generalizability to normal-weight individuals, and may also explain a lack of differences between overweight and normal weight groups. Also, the sample was racially homogenous, which may limit generalizability to all individuals in the communities. The variability explained by the regression model for physical activity in the domain of active living was low, indicating that there may be other variables that were not captured by this analysis that may explain whether one is active in that domain. Finally, as this analysis was based on data previously collected, there may be some data lacking that might also be associated with domain-specific physical activity in this population (e.g. whether one lives in town or in the country). In addition, other environmental variables, such as prompts for taking the stairs instead of an elevator, which have been shown to increase physical activity (Sallis, Bauman, & Pratt, 1998), were not measured here but may be associated with physical activity in the rural population.

Conclusion

Recent physical activity research has called for more specificity in outcome variables (Bauman & Bull, 2007), and this study is an attempt to answer that call and provide more clarity on the determinants of physical activity by the domain in which this behavior occurs.

Additionally, this study provides support for using ecological approaches to increase physical activity in rural adults. There is some evidence (Brownson, Hagood, Lovegreen, et al., 2005; Kaiser, Brown, & Baumann, 2010) for using multilevel interventions to increase physical activity in this population. Sallis, et al. (1998) mention that interventions targeting environmental or policy levels are promising because of their potential to influence the behavior of large groups or populations. Findings here suggest physical activity programs should target policy attitudes, neighborhood characteristics, and social support from friends while also working to decrease personal barriers to exercise. Results of this study of domain-specific perceived environmental, social, and policy level determinants perceived by rural adults can be used to tailor specific interventions in that population.

CHAPTER 3 – REFINING AN INSTRUMENT TO BETTER EXAMINE THE RURAL ENVIRONMENT USING QUALITATIVE RESEARCH

Abstract

Few measurement tools have been developed specifically for rural adults, and qualitative data can be used to help tailor existing measurement tools to the rural adult population. Design and sample: Three focus groups were conducted among 19 residents of multiple towns in a rural Midwestern county. Measures: Focus group members were asked to define physical activity, exercise, community and neighborhood. They were asked about the activities they engaged in and facilitators and barriers to those activities. Analysis: A guide book was developed to capture major themes and common patterns that emerged in the responses to the topics discussed. The data were reviewed for repeated statements and points that were agreed upon by multiple participants. Results: Important factors associated with physical activity include the importance of social support and modeling physical activity behavior. Also, the influence of pets and children was important for engaging these adults in physical activity. The focus group members did not mind driving to exercise facilities, and desired to see community buildings be open to the community for exercise. Conclusions: This study revealed contextual issues and culturally relevant language for use in tailoring physical activity measurement tools for a rural adult population. Social support (specifically, seeing others being active and using pets as motivators for being active) and policy attitudes may be targeted for interventions to increase physical activity in rural adults.

Introduction

Rural adults are less physically active than urban and suburban residents (Patterson, Moore, Probst, et al., 2004). Insufficient physical activity is one factor contributing to obesity and other chronic diseases (Bouchard, Blair, & Haskell, 2007, Patterson, et al., 2004). Exposure to limited access to exercise facilities, limited incomes, and less available information regarding specific benefits of physical activity puts the typical rural adult at risk for being sedentary (Whaley & Haley, 2008). These cultural factors must be considered when trying to understand or influence behavior (Aronson & Oman, 2004). Thus, programs that target the specific needs and concerns of rural adults are needed to enhance the physical activity of this population.

Research has shown a link between environmental factors (physical and social) and physical activity (Nelson, Wright, Lowry, et al., 2008). However, most of the research in this area has been conducted in urban areas. Approximately 75% of the counties in the United States are classified as rural, and these contain roughly 20% of the population (Glasser, Holt, Hall, et al., 2003). There is a need for more in-depth studies of the rural population. Rural communities are notably different from urban and suburban communities, and unique consideration should be given to rural areas when assessing the relationship between the environment and physical activity (Yousefian, Ziller, Swartz, et al., 2009). For example, in some rural settings, low population or development density, long distances between destinations, and a lack of walking facilities may combine to discourage active transportation by walking (Yousefian, Hennessy, Umstatted, et al., 2010), all issues that may not be as common in more urbanized areas.

Establishing measurement tools that are culturally relevant to a specific population is important for accurate measurement. Qualitative research, including focus groups, may be useful for exploring a variety of issues in one's community that influence behavior (Aronson & Oman, 2004). Cognitive interviewing, another form of qualitative research, involves eliciting the thought processes behind subjects' responses to survey

questions and discussing the ways that they arrive at their answers (Altschuler, Picchi, Nelson, et al., 2009). These formative processes may be helpful for determining what questions to include or exclude when developing a survey instrument that accurately assesses cultural variables in a community. Community members should be involved when conducting formative research, and research has shown that increased community involvement in rural areas may help facilitate the effectiveness of programs that utilize social resources to develop a subjective norm that promotes physical activity (Zizzi, Goodrich, Wu, et al., 2006). This is especially pertinent given the finding that rural community members are more likely to be involved in their communities than are residents of urban areas (Greiner, Li, Kawachi, et al., 2004).

The purpose of this study is therefore to identify the language that rural adults use to define physical activity, exercise, neighborhood, and community, the activities that this population engages in, and also context-specific social and physical environmental factors that inhibit and facilitate physical activity among rural-dwelling community members using qualitative research methods. Results will be used to inform the refinement of a survey to examine associations between the rural environment and physical activity, and may also be used to inform future interventions.

Methods

Individuals who resided in one rural county (defined as a county with no principal city with a population of over 50,000 people) were invited to participate in one of three focus groups. Eligible participants were all independent-living, English-speaking adults over the age of 18 residing within county limits. Community leaders from all of the towns in the county were asked to provide names of individuals they knew who might be interested in participating. Also, a county-wide obesity prevention task force was solicited for assistance in locating participants. These community leaders and task force members were also sent recruitment flyers to post around their workplace or town. In

addition, flyers were posted in other recommended worksites, churches, and libraries and news releases were sent to the four newspapers in the county. Interested individuals were asked to contact the researchers from information located on the flyers and news releases, and participants were screened over the phone to determine eligibility (English-speaking adults over the age of 18 and living in the county for at least one year) and to schedule the focus groups.

The three focus groups were held at a YMCA in a town that was located centrally to the county, so as to limit the amount of travel for participants. Krueger and Casey (2009) suggest that at least three focus groups are needed to compare and contrast findings among groups. In addition, it is suggested that a mix of same-sex and mixed-sex focus groups be conducted to produce different, yet complementary insights (Stewart & Shamdasani, 1990). The three focus groups conducted here consisted of one mixed-gender group, one males-only group, and one females-only group. All participants were given a \$10 gift card to a local retailer and were provided with a small meal to compensate them for their time. A trained research assistant was present at two of the focus groups to assist with taking notes. Participants were given an informed consent form and filled out a brief demographic questionnaire before the focus groups began. The focus groups were audio recorded and transcribed. All procedures were approved by the Institutional Review Board (IRB) of the University of Iowa.

Interview Guide

The interview guide used in this study was developed from preliminary interviews with rural community members, and from expert advice (See Appendix C). To begin, participants were asked to define physical activity and exercise, as these two terms have been used interchangeably in the literature, and may cause some confusion. Aronson and Oman (2004) noted that rural adults trying to distinguish between the two had somewhat contradictory insights, and that the differences between the terms may not be explicit.

The often-used definition of physical activity is “bodily movement produced by skeletal muscles that results in energy expenditure; and exercise is defined as “a subset of physical activity that is planned, structured, or repetitive and has the purpose of improving or maintaining one or more components of physical fitness” (Caspersen, Powell, & Christenson, 1985). A more common “lay” definition of physical activity that was used here was “any body movement or action that expends energy”; a lay definition of exercise used here was “a specific type of physical activity designed to increase fitness or get someone in shape.” These definitions were provided to the focus groups.

The participants were also asked to define and/or describe their neighborhood and community. Previous research has shown that rural adults may have different perceptions regarding these terms (Whaley & Haley, 2008), and it is important to explicitly define them in order to measure environmental perceptions within a neighborhood or community. Li and colleagues (2005) suggest that it is critical to accurately characterize the context in which physical activity occurs in order to delineate factors that may be attributed to neighborhood or individual levels of influence.

Finally, participants were asked to comment on the features and characteristics of their neighborhoods and communities which may facilitate or inhibit participation in physical activity. When necessary, they were given prompts of examples of the types of things that may influence whether one is active (i.e. the presence of sidewalks), and the types of things that may create a barrier to being active (i.e. bad weather).

Qualitative Data Analysis

A guide book was developed to capture major themes and common patterns that emerged in the responses to the topics discussed. The data were reviewed for repeated statements and points that were agreed upon by multiple participants. Lists of responses were created for each group, and the data were then collapsed into meaningful categories. All data were verified by another trained reviewer.

Results

There were 19 total participants at the 3 focus groups, which included groups with 2, 7, and 10 participants, respectively. Of the participants, 11 were female. They ranged in age from 27 to 75 years (mean age was 51 years), and all were Caucasian. Five out of the eight towns incorporated in the county were represented at the focus groups. The focus groups lasted on average 49 minutes.

Each of the three focus groups mentioned similar definitions of physical activity and exercise, and they were able to distinguish differences between the terms. Physical activity was considered anything that was not just sitting, and many examples of daily activities (gardening, cleaning, and mowing) were given as examples of physical activity. Exercise was considered as requiring more effort, causing you to sweat, and was more structured than physical activity.

Each of the three focus groups also mentioned similar descriptions of neighborhoods and communities, and they were able to distinguish differences between the terms. Neighborhoods were considered the surrounding blocks around where one lives, and in more rural areas the neighborhood was often considered one's property line. Neighborhoods were also defined by natural boundaries, such as parks or schools. Communities were collectively described as the city or town, and in cases of more rural areas, as the general geographic region where one lives. In the survey instrument, these terms were combined to refer to the broader context of community, since some of the participants defined their neighborhood narrowly, which may limit their perceived access to physical activity resources and facilities.

Neighborhood or Community Facilitators

The participants mentioned several factors that facilitated or enabled physical activity in their neighborhoods and communities. Facilitators for physical activity in both neighborhoods and communities are reported here to show the language used by the

focus group participants. Chief among these was the social aspect of the presence of others being active. Seeing others being active prompted the thought that “I could do that too.” In addition, being able to meet and chat with friends was mentioned as a motivator for being active.

Having a pet was mentioned several times as a factor that contributed to being active. This was explained as contributing to the motivation to be active, “because it (walking a pet) has to be done.”

Several participants mentioned using neighborhood streets for walking or biking because sidewalks were too narrow. Other participants mentioned a lack of traffic made it safer to walk or bike on streets, whereas some mentioned busy streets where traffic created a barrier to walking on streets. Additionally, several participants mentioned that sidewalks provided access for walking or biking, whereas others mentioned a lack of sidewalks made it difficult to walk in their community.

In addition to sidewalks and streets, several participants mentioned a local trail as providing access to being active. The trail was discussed as a destination itself, and as a means to a variety of other destinations, including neighboring communities. While not explicitly stated, it was implied that having destinations nearby influenced how much community members walked. For example, participants described locations such as the library or bank that were convenient and accessible as places that they would walk to.

Neighborhood or Community Barriers

Some of the factors that were discussed as possibly inhibiting physical activity included narrow sidewalks, lack of resources and facilities, roads that were muddy or had loose gravel, and being self-conscious. It was mentioned that many people walk with another person, and narrow sidewalks could not accommodate that. There were several mentions of difficulties associated with cycling, including loose gravel on the roads, rumble strips on the shoulder of roads, and a lack of bike racks.

At the policy level, two interesting findings were mentioned. First, a lack of community planning was mentioned as potentially limiting the number of parks and facilities available. Second, there was a desire to use school facilities that members of the public did not have access to. Not only could the participants not use some of the facilities paid for with local tax dollars, but several of the facilities, such as swimming pools, were reserved for school team practices during desired time periods, further limiting access to these facilities.

Two factors were discussed as being both potential facilitators and barriers to being active. Children were mentioned as a possible motivator for modeling active behavior; however, it was pointed out that while many community resources exist for children to be active, such as youth sports programs, few of those resources are accessible to adults.

Also, safety was mentioned as being a facilitator for being active because community members can get out in the streets if they are safe; however, for others, crime and a lack of safety have also inhibited the ability of residents to get out and be active.

Discussion

The goals of this study were to examine the types of factors that may influence physical activity in rural adults, as well as to determine culturally-appropriate language for future physical activity research in this population. Participants here defined physical activity as similar to activities of daily living where one is moving around and not just sitting. Exercise was defined as more structured and included more effort and sweating. In contrast, one study showed that older rural adults viewed physical activity as more strenuous (Aronson & Oman, 2004). The implications of this discrepancy point to the need to consider the language used when designing physical activity studies in rural adults, and also points to the need to examine this issue in other communities (Aronson & Oman, 2004; Hooker, Wilson, Griffin, et al., 2005).

Several of the results from these focus groups support previous research findings. A lack of sidewalks was supported by rural-dwelling senior citizens and a random sample of rural adults (Aronson & Oman, 2004; Whaley & Haley, 2008). The adults in this study mentioned walking in the streets in places where the sidewalks were too narrow, a finding supported by Gangeness (2009), who reported that rural adults adapted to poorly maintained and limited sidewalks by also walking on the streets. Other results related to sidewalks were inconsistent here, showing a need for further research looking at the associations between the perceived presence of sidewalks and physical activity in rural areas.

Environmental factors that were suggested as influencing whether these rural adults were active include the availability of facilities and resources for being active, such as trails and schools. Frost and colleagues (2010) found that the presence of recreational facilities, trails, or parks was among the most relevant environmental elements associated with physical activity in rural adults. It would appear then, that improving access to places to be active might therefore improve rural adults' participation in physical activity pursuits. Also, for communities that already have several existing resources where residents can be active, increasing awareness of these resources may be a cost-effective method for increasing physical activity (Addy, Wilson, Kirtland, et al., 2004).

Having destinations, including walking trails being considered a destination, seemed important to these participants. Destinations refer to land uses that can be accessed in daily life for shopping, education, work, and recreation purposes, and have been positively associated with active transportation (Sallis, Floyd, Rodriguez, et al., 2012). Interestingly, having to drive to places for exercise or to be active was also mentioned several times, although this did not seem to be a barrier to being active. The rural adults mentioned that they were used to driving to get to places, indicating that this may be a unique characteristic of rural culture.

One social factor that was mentioned several times was the presence of other persons being active. This is supported by Dye and Wilcox (2006), who found that older rural women often preferred to be motivated by others being active. Hooker and colleagues (2005) found that white rural adults who perceived their neighbors as being active were twice as likely to meet physical activity recommendations, compared with white adults who did not perceive their neighbors as being active. It has also been found that reporting more perceived social support seems important for increasing the likelihood of meeting physical activity recommendations (Parks, Housemann, & Brownson, 2003). Taken together, these findings suggest that changing the social norms for physical activity may help increase rates of physical activity in rural adults in the Midwest. A previous analysis of a sample of rural Midwestern adults found that women were more likely to exercise with someone than men, and they usually exercised with their friends (Chrisman, Nothwehr, & Schultz, 2011). Men who exercised with someone usually did so with their spouse or partner, and these areas of social support could be targeted for intervention in rural adults. Additionally, a key concept from the Social Cognitive Theory is that of observational learning, or modeling, which refers to the capacity to learn behavior from observing others, and then enacting those behaviors (Viswanath, 2008). It was clear from this study that rural adults value seeing others being active, and interventions could examine ways to focus more attention on active individuals being more visible in their communities.

Other studies have found that social support from children plays a role in encouraging physical activity in rural adults (Kegler, Escoffery, Alcantara, et al., 2008; Laroche & Snetselaar, 2011). In addition, Laroche and Snetselaar (2011) found that some rural parents report that children interfered with their ability to exercise. The participants here mentioned that as parents, they were often busy taking their children to various activities, and yet these activities were not available to them. Interventions could provide activities for adults to participate in while their children are at recreational or competitive

activities, so that parents could present a model of active behavior to their children and adults peers.

Pets were mentioned here as possibly creating a motivation for being active, a finding supported from a review by Toohey and Rock (2011). In addition, a weight-loss intervention that was designed for overweight adults and was centered on people and pets exercising together was found to be effective for creating weight loss through physical activity and social support (Kushner, Blatner, Jewell, et al., 2006). Therefore, future research could examine the efficacy of using pets to increase physical activity in rural adults. Interestingly, it was the men who suggested pets as a providing a means to be active; whereas, women expressed the sentiment that loose or wild animals often prevented them from being active. It is not clear as to why only men suggested pets as influencing physical activity, but this observation does provide a possible variable to target for intervention, especially as the focus groups suggested the necessity of taking their pet for a walk. Considering the importance of social support for physical activity in rural adults, and the lower population density of rural areas versus urban areas, there is potential for pets to increase support for physical activity in rural adults.

Safety from crime and traffic were discussed here as influencing when and where community members were active. Frost and colleagues (2010) found that safety from crime and traffic was positively associated with physical activity in rural adults. In addition, Hooker and colleagues (2005) found that white rural adults who reported their neighborhood as safe were almost twice as likely to report meeting physical activity recommendations than those who reported their neighborhood as not safe. Whaley and Haley (2008) found that rural adults felt safe from crime, but few felt that it was safe to ride a bike, and thus more research should examine ways to increase feelings of safety in rural areas, perhaps by making the sidewalks wider or increasing the number of pedestrian-friendly street signs.

There was one major finding that has not been discussed extensively in the literature. The rural adults in these focus groups desired access to the public schools and facilities paid for with tax dollars, which shows the need for policy-level interventions to create shared-user agreements between local governments, schools and communities. This is an interesting area of study that was mentioned several times during the focus groups, and future research should examine attitudes towards opening schools or other facilities to the public for access to those seeking to become more physically active. One study showed that rural adult women viewed public schools as a safe place for physical activity (Gangeness, 2009), and Eyler and Swaller (2012) point out that community use agreements between schools and a city or private organization can help increase opportunities for physical activity among community members.

Limitations

This study was limited by the relatively small, yet diverse sample. Additionally, it appeared that the participants were well aware of the physical activity resources and facilities available to them in their county, and they might have been more likely than the general population in the county to use these resources for being active. The physical activity levels of the participants were not assessed in this study, and therefore it is not possible to determine whether the findings generalize to both active and inactive individuals. Participants were encouraged to disclose any opinions on the discussion topics, but statements made may have been socially desirable or inaccurate. Finally, only three focus groups were conducted, leaving open the possibility that different themes would have emerged with more focus groups or more participants.

Conclusion

This study revealed important contextual issues that can help guide future physical activity research for rural adults. Future research designed to increase physical activity in rural adults could be improved by conducting a qualitative assessment of the

types of things that may influence physical activity in this population. It may also be important for future researchers to define technical terms such as physical activity and exercise, as well as neighborhood and community, in order to ensure that measurement tools are using appropriate language that accurately portrays how community residents define these terms.

Researchers and practitioners working with rural adult populations can draw on the findings of this study when identifying options for interventions. Increasing social support in the community (including support from children and the use of pets for increasing physical activity), having and maintaining destinations for active transport (including sidewalks and trails), and creating policies that allow for public use of existing facilities such as schools can all be targeted for increasing physical activity in this population.

CHAPTER 4 – ASSOCIATIONS BETWEEN PERCEIVED
ENVIRONMENTAL, SOCIAL AND POLICY DETERMINANTS AND
DOMAIN-SPECIFIC PHYSICAL ACTIVITY IN RURAL ADULTS

Abstract

Ecological models propose that several levels of influence, including individual and environmental factors, impact behavior. Using a modified survey instrument, this study examined perceived social, environmental, and policy determinants of physical activity. Design and sample: Cross-sectional survey of 143 individuals residing in a rural county in the Midwest. Analysis: Test-retest reliability was examined for the modified instrument using correlations and *kappa* statistics. Multiple regression analyses were conducted using logistic regression and general linear modeling. Results: Reliability was very good to substantial, with an average reliability value of $r = 0.72$ for all questions. Predictors of physical activity at work included employers providing time for exercise ($F = 8.86$; p -value = 0.0003); for active transport: exercising at shopping malls ($F = 6.07$; $p = 0.0032$) and activity-friendly community aspects ($F = 8.82$; $p = 0.0048$); for house and yard work: favorable policy attitudes and using community resources ($F = 3.19$, $p = 0.0018$); for leisure time: participation in sports ($F = 28.24$; $p < 0.0001$); for all physical activity: encouragement from friends ($F = 3.70$; $p = 0.0136$) and activity-friendly community aspects ($F = 6.01$; $p = 0.0156$); for vigorous physical activity: awareness ($F = 10.5$; $p = 0.0015$) and use ($F = 6.62$; $p = 0.0113$) of community resources; for moderate physical activity: use of community resources ($F = 6.13$; $p = 0.0147$) and hills ($F = 4.4$; $p = 0.0371$); and for walking: use ($F = 6.11$; $p = 0.0147$) and awareness ($F = 4.66$; $p = 0.0328$) of community resources. Conclusions: Factors at different levels of an ecological model are associated with physical activity in various domains in rural adults. Findings from this study can be used to tailor physical activity interventions in rural adults, with respect to the specific domains and intensity in which the physical activity occurs.

Introduction

Physical activity is often examined in research studies as an individual-level influence on behavior. However, an individual-level perspective may overlook the broader context in which the physical activity of an individual occurs (Li, Fisher, Bauman, et al., 2005). Ecological frameworks stress that there is a relationship between one's environment and the behaviors individuals choose to engage in (Sallis, Owen, & Fisher, 2008). Regarding physical activity, there is evidence of a relationship between levels of engaging in this behavior and the natural, built, and social environment (Brownson, Baker, Housemann, et al., 2001). These environments, along with personal beliefs, attitudes, and skills towards physical activity, play an important role in determining whether one will engage in regular physical activity (Loprinzi & Cardinal, 2013). It is therefore important to understand the role of these environments in promoting physical activity because physical activity has been associated with positive health outcomes and is being targeted as a public health priority.

To increase the rate of physical activity in the population, it may be essential to understand and eventually intervene on environmental and policy factors and issues. Moreover, it is important to examine those factors in the specific context or setting in which they occur. Physical activity most often takes place in a community or neighborhood setting, such as walking in neighborhoods and participating in physical activity programs offered through local organizations (Li, et al., 2005). However, much research has examined physical activity in urban or suburban communities. It is well-established that rural areas are significantly different from their urban and suburban counterparts (Yousefian, Ziller, Swartz, et al., 2009), and there is a need for research specifically examining rural environments.

Investigating environmental supports for physical activity, Brownson and colleagues (2001) showed that perceived access to physical activity resources was associated with being twice as likely to meet physical activity guidelines. However,

access to these facilities may be more limited in rural areas (Parks, Housemann, & Brownson, 2003). There is a need to examine what types of facilities and resources exist in rural communities, and whether the perception of these facilities and resources is associated with being active.

Additionally, in the social environment, population density, which refers to the number of individuals or households living in a particular area, has been associated with higher rates of active transportation (Sallis, Floyd, Rodriguez, et al., 2012). Higher population density supports shops, services and schools, providing more destinations that residents can reach by active transportation. Rural areas generally have lower population densities and may have fewer destinations within walking or biking distance, and there is a need to further examine this and other social factors that may be related to physical activity in rural environments.

A study of policy attitudes showed some associations with physical activity. Believing that employers should provide time during the day for exercise, supporting that local schools require physical education, and supporting the use of government funds for building walking/jogging trails, swimming pools, and biking paths were all associated with greater odds of being physically active in a national sample of adults (Brownson et al, 2001). This support was shown to be consistent across gender and income groups. In rural adults, one study showed widespread support for policies that increase physical activity (Brownson, Schmid, King, et al., 1998).

Awareness of objectively-identified, local physical activity resources may potentially influence levels of physical activity. Few studies have examined awareness of physical activity resources as a determinant of physical activity, and the studies that do exist have primarily looked at college student or adolescent populations. Rural adults' awareness of existing resources for physical activity was measured in a study from Whaley and Haley (2008), and it was found that over half were not aware of walking

trails in their community. However, this awareness was not examined for its association with physical activity behavior.

Frost and colleagues (2010) suggested that researchers look to refine measures that capture elements of the environment that may influence physical activity in rural areas. Thus, the purpose of the current study is to examine associations between physical activity and perceived determinants (environmental, social, and policy) in a sample of Midwestern rural adults. This study used a focus on the environment instead of individual-level influences in order to examine the broader context of what may be associated with physical activity. Data were gathered using a survey instrument that has been modified to be more culturally relevant to the rural population. It was hypothesized that the social environment, physical environment, and policy environment determinants would be positively associated with physical activity in the domains of transportation, occupation, house or yard work, recreation or leisure, and sport, and that barriers to these environmental determinants would be negatively associated with physical activity.

Methods

Design and Sample

A cross-sectional survey was carried out in 2012 using a self-administered, mailed instrument. Adults aged 18 and above who had lived in their community for at least one year were recruited from a rural county in southeast Iowa. Potential survey participants were randomly selected (every 20th number), stratified by town, from the county-wide public telephone book. The county phone directory includes approximately 9,000 listings. Adults were screened for eligibility over the phone, and the survey was mailed to those who agreed to complete it. In addition, recruitment flyers were posted around the sampled towns, and press releases advertising the study were published in local newspapers and newsletters. Participants seeing these sources were asked to contact the researchers if they were interested in completing a survey. In exchange for completing a

survey, participants were mailed a \$10 gift card to a local retailer. If the survey was not returned after 2 weeks, a follow up call was made, and up to two more follow up calls were made every two weeks thereafter. Participants who decided not to participate after being mailed a survey were asked to send back a blank survey. There were 30 participants who completed the survey a second time in order to determine the test-retest reliability. Power analyses indicated that at least 138 individuals were needed to complete the survey to detect an effect at an alpha level of 0.05.

Measures

Demographics

Demographic information included standard questions on: age, height/weight, gender, education level, income (eight categories from less than \$10,000 to \$75,000 or more), employment status, marital status, self-rated health status (five categories from poor to excellent), and residing in town or in the country. Those living in the country were asked to further provide whether they lived on a farm, acreage, or in a subdivision. Age was stratified into five categories: <30, 30-39, 40-49, 50-59, and >60 years because the relationship between age and physical activity is not linear (Patterson, Moore, Probst, et al., 2004).

Physical activity

The survey included a validated measure of physical activity behavior, the International Physical Activity Questionnaire Long Version (IPAQ), which assesses physical activity behavior over the past seven days across the domains of occupation, transportation, house and yard work, and recreation and leisure (see the supplemental file for the entire survey instrument). Extensive reliability and validity testing of the IPAQ has been conducted, including samples from 12 countries (Craig, Marshall Sjostrom, et al., 2003). For the IPAQ Long Form, which includes 31 questions, the test-retest

reliability coefficients ranged from 0.46 to 0.96, with a majority of the scores being above 0.70 (Craig, et al., 2003). Criterion validity of the IPAQ, using accelerometer data for comparison, showed fair to moderate validity (pooled Spearman's coefficient = 0.33) (Craig, et al., 2003). Completion time for the IPAQ Long Form has been estimated at 15 minutes (Maddison, Mhurchu, Jiang, et al., 2007). One advantage to using the IPAQ long form is that it includes several questions on activities done while sitting (reading, watching television, and desk work). Physical activity by domain (which can be measured as a continuous variable in MET-minutes per week, or as a categorical variable consisting of low, moderate and high levels of physical activity) was this study's outcome of interest using the IPAQ. A MET is the ratio of energy expenditure of an activity to the energy expenditure at rest. Both continuous and categorical variables were used in analyses here. The IPAQ can be self-administered, and was developed for young and middle-aged adults (ages 15-69), making it appropriate for the present study sample. The IPAQ is generally accepted as being an adequate population measure of physical activity (Craig, et al., 2003).

The Sport Index of the Kaiser Physical Activity Survey was included in the survey instrument to provide more descriptive information on the types of activities that participants engaged in. The Sport Index has shown the highest correlation with physical activity, and the highest criterion validity, among the domains measured in the Kaiser survey (Ainsworth, et al, 2000). Question #38 ("In comparison with others my own age and gender, I think my physical activity during the past year was..."), was excluded due to its similarity to question #24.

Perceived social, environment, and policy determinants

Brownson and colleagues (2004) developed a survey instrument using a combination of questions from the Behavioral Risk Factor Surveillance System (BRFSS), the National Health Interview Survey (NHIS), and other surveys, and which measures the

perceived social, environmental, and policy determinants of physical activity. This survey instrument was designed for a national sample of adults, and includes questions on walking and physical activity behaviors (six questions), neighborhood characteristics and barriers to being active (four questions), social assets for being active (twelve questions), community assets for being active (two questions), and policy attitudes (seven questions). Scoring varied for each question. Some of the possible response options were: yes or no, a 5-point scale from never to very often, a 4-point scale from not at all true to very true, and a 4-point scale from strongly disagree to strongly agree.

Modifications were made to this survey instrument for the purposes of this study. Questions that were excluded from the 31 questions on the survey instrument include question #2: “How many days do you walk at least 10 minutes at a time,” which was excluded because physical activity was measured in a separate set of items; questions #3 and 4, which ask about the type of physical activity engaged in the most and second most and were excluded because this was assessed using the Sport Index of the Kaiser Physical Activity Survey; and question #23 (Community Assets), which was excluded because previous research found no relationships with these items and physical activity in rural adults (Chrisman, Nothwehr, & Schultz, 2011).

Other changes include revising the scoring responses for some existing questions related to policy attitudes towards physical activity. The previous responses were yes or no, and the revised responses were a 4-item Likert-type scale from strongly disagree to strongly agree. This was done to increase the sensitivity of the measure.

Previously conducted focus groups provided data on rural life that was used to consider the inclusion or exclusion of items on the survey instrument, as well as helping to develop additional items. This formative work revealed the perception that schools and other community buildings should be open to the public to enable community members to use their facilities for exercise or being active. Thus, three new questions were developed to assess the prevalence of this perception in this sample of rural adults.

The list of items for questions #2, 13, and 14 were modified to include the option of exercising at home as an answer choice. Question #15 was modified to include farm equipment on the roads and hunting or conservation areas as answer choices, and foul air from factories was changed to foul air from cars or confinements. Gravel, muddy, and/or dusty roads were added as answer choices for questions #14 and 16. Additional barriers for question #16 included no sidewalks available, unsure of how to use exercise equipment, and farm equipment on the roads.

Awareness of community physical activity resources

Previous research has shown that rural adults may lack awareness of community physical activity resources (Whaley & Haley, 2008), and a new question was developed to measure this awareness and its associations with physical activity. A list of county-wide physical activity resources was created and sent out to multiple community stakeholders for review and additional suggestions. A final list of 35 resources and facilities in the county were included in the final survey. One question was added to determine what resources the participants would like to see in their community that would help improve diet and exercise behaviors.

Pre-Testing

Five personal interviews with members of the community were conducted to examine the survey instrument and ensure that it was comprehensible. These did not reveal any major structural changes needed for the survey questions, as all questions were answered easily and without confusion. The average administration time for the entire survey was 30 minutes.

Data Analyses

For the test-retest phase of the reliability assessment of the modified instrument, quantitative data were analyzed using Pearson's correlation coefficients and kappa statistics, as appropriate, to examine variability within participants. Spearman

correlations were also examined for data that were skewed. This was done for each individual variable in the survey instrument, with the exception of demographic items. Validity for this survey instrument was not tested in this study; however, it was thought that using qualitative work for consideration of modifications to the survey instrument would increase the cultural sensitivity and therefore, help maintain some degree of validity.

For the survey instrument, distributions and frequency counts were examined for each variable. The presence and patterns of missing data was examined for the variables that contained missing data. Correlations were examined between independent variables to identify potential co-linearity. Physical activity scores were cleaned and truncated following IPAQ guidelines to ensure realistic levels of physical activity. In viewing the histograms, data were generally normally distributed and no outliers existed. The quantitative data were then analyzed using multiple regression using both continuous and categorical measures of physical activity. Factors that were examined as covariates included Body Mass Index (BMI), age, gender, income, and education, as these have been shown to be associated with physical activity (Patterson, et al., 2004; Bauman & Bull, 2007). Additional covariates included employment status, health status and whether or not the rural adults live “in town.” These additional covariates were included because they may be relevant for influencing levels of physical activity in rural areas (Patterson, et al., 2004; Jones, Adaire, Parker, et al., 2009). Chi-square analyses and correlation matrices were examined among independent and dependent variables to determine which variables to include in the model selection analyses. First, variables were considered in the regression model if they were univariately significant at an alpha level of 0.05. Then, model selection was conducted using stepwise selection. This two-step model selection process was conducted due to the large number of variables that were included in the survey. Residuals were examined, and goodness of fit tests were conducted on the final models with no evidence of assumptions being violated and no lack of fit.

The environmental barriers were initially scored on a 5-point scale from “never” to “very often,” but these were re-coded into a dichotomous variable in concordance with the literature; Parks and colleagues (2003) re-coded the five-item responses into “often” or very often” as a yes, and “sometimes”, “never”, or “rarely” as a no. Then, for each participant, the total sum of their reported barriers was added and a new continuous variable was created for this summary score. Individuals with 2 or fewer missing data points for the barriers were included in the analysis; all others with missing data were excluded.

A p-value of 0.05 was used for tests of significance. All quantitative analyses were conducted using SAS, version 9.3 (SAS Institute, Cary, North Carolina), and the unit of analysis was the individual.

Results

Response Rate

Overall, 775 phone calls were made during the recruitment of participants. Through those calls, 202 individuals were reached. Of those 202, 143 consented to complete the survey and 72 refused. There were 13 participants who did not return a survey, and 130 participants sent back a completed survey, giving a response rate of 64% (130 out of 202). In addition to these totals, 13 other participants contacted the researchers to participate after either hearing about the study by word of mouth, seeing flyers posted around town, or reading a press release in a local newspaper or newsletter. Only three participants sent back a blank survey indicating that they did not wish to participate; substitutes were randomly chosen from the same town of the individual declining to participate, using the same criteria as described above. The total number of completed surveys was 143. None of the variables were dropped due to high correlations; however, some variables were collapsed into fewer categories for use in the analyses.

Reliability

In order to examine the test-retest reliability of the survey, 30 participants completed the survey a second time, within 7 to 30 days of initially completing the survey. Retest surveys averaged 13 days between the first and second completion, with a range of 7 to 29 days. Correlation coefficients for the entire survey ranged from -0.06 to 1.0, with the majority (75%) of values falling above 0.58. Kappa coefficients were also examined for all categorical variables, and these ranged from -0.052 to 1.0, with the majority (75%) falling above 0.46. Using the ratings from Landis and Koch (Landis & Koch, 1977), which are 0 – 0.2 (poor), 0.2-0.4 (fair), 0.4-0.6 (moderate), 0.6-0.8 (substantial), and 0.8-1.0 (almost perfect), the levels of agreement were determined for each question, and will be discussed in the sections below.

Neighborhood and community aspects

Kappa coefficients for questions asking about neighborhood and community characteristics and access to places to exercise ranged from 0.256 – 1.0, with a mean of 0.642 indicating substantial agreement. Out of the 105 variables measuring neighborhood and community aspects, 33 of these were not useable for computing a reliability or kappa coefficient due to a lack of variation (meaning that participants answered the same way both times). Of those 33 variables, 17 included no variation whatsoever (all participants answered the same both times), and the remaining 16 had included either only one or two variables that changed over time.

Social support

The kappa coefficients for social support variables ranged from -0.034 to 1.0, with a mean of 0.624 indicating substantial agreement. Out of the 30 variables measuring characteristics of social support, seven variables were unable to compute a reliability or kappa coefficient due to a lack of variation. Of those seven, five included no variation whatsoever, and two included just one variable that changed over time.

Barriers

The kappa coefficients for the barriers variables ranged from 0.154 to 0.699, with a mean of 0.414, indicating moderate agreement.

Policy attitudes and workplace aspects

The kappa coefficients for policy attitudes and workplace aspects ranged from 0.214 to 1.0, with a mean of 0.665, indicating substantial agreement. One question was unable to compute a reliability or kappa coefficient due to a lack of variation, and only one score changed over time for that variable.

Kaiser Sport Index (KSI)

The kappa coefficients for the Kaiser Sport Index ranged from 0.423 to 0.655, with a mean of 0.51, indicating moderate agreement.

IPAQ

The reliability of the IPAQ has been extensively examined in multiple populations and has been shown to have high reliability, with correlation coefficients ranging from 0.46 to 0.96 and a majority of the scores being above 0.70 (Craig, Marshall, Sjostrom, et al., 2003). The correlation coefficients here ranged from 0.38 to 0.96, with a mean of 0.72, indicating very good test-retest reliability and offering further support for the use of the IPAQ in physical activity research, including research involving rural adults.

Survey Results

Sample

Characteristics of the study population are shown in Table D-1 of Appendix D. Of the 143 participants, 63% were female, 97% were white, 83% were married, and the mean age was 51 years. In comparison, the state of Iowa is 94% white and 50.4% female

(U.S Census Bureau, 2011). Approximately 56 % were classified as overweight or obese according to their BMI (> 25), which is lower than the state average of 63 % (U.S. Census Bureau, 2011).

Descriptive analyses

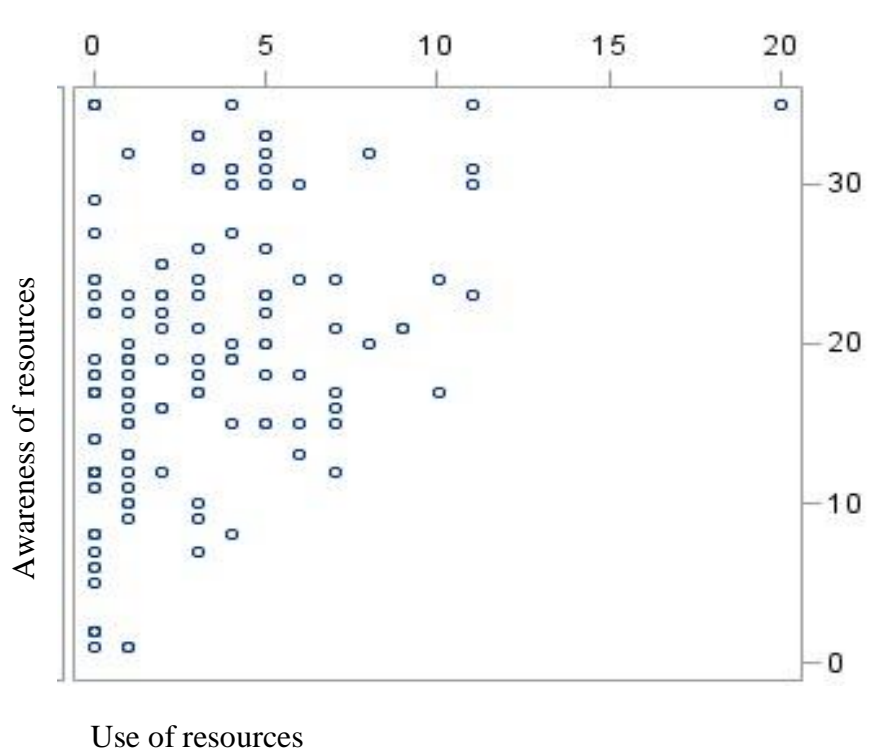
Neighborhood and community aspects combined

There were 116 participants (84%) that reported having access to both indoor and outdoor places to exercise. An additional 14 participants (9%) reported having access to only outdoor places to exercise. Neighborhood streets or sidewalks and using space or equipment at home were the most common reported place participants often exercised (see Table D-2). Participants most frequently reported exercising in the evening between the hours of 5 and 9 p.m., or in times that varied each day (see Table D-3). The characteristics that the participants liked the most about where they exercise were: location/convenience, free place to exercise, and the ability to exercise at home (see Table D-4). The characteristics that the participants liked the least about where they exercise were: gravel or muddy roads and having to pay to use facilities (see Table D-5). The features of the environment that were most prevalent in the participants' community included enjoyable scenery, street lights, hills, sidewalks, and farm equipment on the roads (see Table D-6).

The mean number of physical activity resources that participants reported being aware of in their county was 19 (standard deviation 8.6, median 19), and the mean number of physical activity resources that participants reported using was 2.9 (standard deviation 3.3, median 2). A greater awareness of physical activity resources was moderately, but significantly correlated with greater use of those resources (Pearson's $r = 0.414$; $p = 0.000$) (see Figure 1 on next page). The Spearman correlation was also conducted, which led to the same result.

Finally, when asked what resources the participants would like to see in their community to improve diet and exercise behavior, the most common responses were educational programs in the schools to encourage healthy eating and physical activity (n= 82), planning and building biking and walking trails (n= 71), and sidewalks and safety planning to ensure children and adolescents can walk or bike to school (n= 69).

Figure 1 Scatter plot of awareness and use of resources



Barriers

Based on the dichotomous barriers variable, the mean number of barriers reported was 7.34 (standard deviation was 3.7, median 7.0). The most common barriers reported were not having time (75% indicated this was a barrier), being too tired (72%), not having motivation to exercise (68%), not having the energy to exercise (63%), and bad

weather (62%). The most common social and environmental barriers reported were having no one to exercise with (39%) and gravel/unpaved/muddy/dusty roads (35%) (Table D-7).

Social determinants

Most participants reported feeling safe while exercising, with 83% reporting that they felt “quite safe” or “extremely safe” (Table D-8). Reasons for feeling unsafe were reported at frequencies of less than 10% and thus will not be discussed. A majority of participants reported exercising alone (61%). When asked whom participants exercised with (if anyone), the most frequently reported response was spouse/partner (24%), followed by friends and children (16% and 14%, respectively) (Table D-9). Most participants felt unsure or did not know whether people in their neighborhood would assist them if they needed a ride to get to a place to exercise, and most participants felt that a lot of people in their neighborhood were physically active (Tables D-10 and D-11). Participants reported getting most of their information about exercise from computer websites and friends (Table D-12). High levels of social support from friends and family were reported (Table D-13), with greater than half reporting agreement for the five social support variables. Almost all of the participants (94%) felt that their neighborhood was safe from crime (Table D-14).

Policy attitudes and workplace assets

Over half of the participants agreed that employers should provide time during the work day for employees to exercise, even though only about 27% of participants reported that their workplace provided support or incentives for employees to exercise (Tables D-15 and D-16). The most common supports or incentives provided by employers included providing resources materials (e.g. brochures, posters, and videos), subsidizing health club memberships, providing facilities to exercise, and offering group services (Table D-17). Overall policy attitudes towards using government funds for building and

maintaining physical activity facilities, zoning regulations that include walking and biking paths, and the use of community buildings for physical activity were all positive (Table D-18), with at least 60% of the participants reporting agreement for each variable.

Kaiser Sport Index

Walking in any form was the most common sport or exercise reported by participants, and the second most common was gardening, followed by any form of bicycling. The mean KSI score was 2.9, with a median score of 3.5 and a range of 0 to 5. This index is a unit-less rank-order value, where 0 indicates no participation in sports during the course of a year, and 5 indicates high participation in sports during the course of a year.

IPAQ

Using the IPAQ coding guidelines, over half of the participants were considered to engage in high levels of physical activity (Table D-19), and only 12% reported low levels of physical activity. There were 72 participants who reported no physical activity at work or through transportation. Median scores (in MET-minutes per week) for physical activity in home and yard work, leisure time, and total activity were 1418 minutes, 233 minutes, and 4017 minutes, respectively. The median MET-minutes per week for moderate physical activity were 2205; for walking, the median MET-minutes per week were 594.

Regression analyses by domain and intensity

Domain of physical activity

A description of the results of the multiple regression analyses are discussed for each domain of physical activity below. The results are also shown in table D-20 in Appendix D.

Work

Since slightly over half of the sample (51%) did not report any physical activity done at work, this variable was re-coded into a dichotomous categorical variable of either no physical activity or some physical activity. Multivariate regression analyses with total physical activity in MET-minutes per week done in the domain of work showed that those who reported that their employers should provide support or incentives for exercise were more likely to be active at work (Beta = 0.051; $F = 8.86$; $p = 0.0003$). Also, those who were self-employed were more likely to engage in physical activity during work (Beta = 0.059; $F = 8.11$; $p < 0.0001$). The overall r-square of this model was 0.2517.

Active transportation

Similar to the domain of work, slightly over half of the sample (51%) reported no active transportation, and this variable was re-coded into dichotomous categories for use in multivariate analyses. Having a higher number of items in one's community that might be associated with physical activity was associated with more active transportation (Beta = 0.09; $F = 7.69$; $p = 0.0066$). Specific aspects of communities that were associated with active transportation included shopping malls (Beta = 0.08; $F = 6.07$; $p = 0.0032$), sidewalks (Beta = 0.27; $F = 8.22$; $p = 0.0048$) and hunting/conservation areas (Beta = 0.19; $F = 5.43$; $p = 0.0213$). The positive Beta-values indicate that active transportation increases with more available shopping malls, sidewalks, and hunting/conservation areas. The overall r-square of this model was 0.1615.

House/yard work

Physical activity in house or yard work was associated with the policy attitude of agreeing that local government funds should be used to build swimming pools (Beta = 1026.0; $F = 3.19$; $p = 0.0018$) and greater use of physical activity resources and facilities (Beta = 278.0; $F = 3.57$; $p = 0.0005$). Individuals who were employed full-time, part-time, or self-employed were less likely to engage in physical activity in house or yard

work than someone who was not employed (Beta = 526.2; $F = 2.64$; $p = 0.0095$). Women were more likely to engage in physical activity in house or yard work than men (Beta = 1039.9; $F = 2.09$; $p = 0.0389$). The overall r-square of this model was 0.2224.

Leisure time

In leisure time, being male (Beta = 434.4; $F = 4.25$; $p = 0.0413$) and married (Beta = 558.9; $F = 4.30$; $p = 0.0401$) was associated with physical activity. Married males were most active, and single females were least active. In addition, having a higher KSI score was associated with physical activity in leisure time (Beta = 361.3; $F = 28.24$; $p < 0.0001$). The overall r-square of this model was 0.2366.

Total physical activity

Total physical activity, as measured by summing physical activity from the previous four domains, was positively associated with a greater number of positive community aspects (Beta = 1009.0; $F = 6.01$; $p = 0.0156$), especially having street lights (Beta = 4066.5; $F = 8.41$; $p = 0.0044$). Additionally, having friends that encourage exercise was positively associated with total physical activity (Beta = 5027.2; $F = 3.70$; $p = 0.0136$). The overall r-square of this model was 0.1357.

Intensity of physical activity

A description of the results of the multiple regression analyses for each intensity of physical activity are discussed below. The results are also shown in table D-21 in Appendix D.

Total vigorous physical activity

The total vigorous activity, as measured by summing vigorous intensity activity across all domains, was positively associated with greater awareness (Beta = 49.9; $F = 10.50$; $p = 0.0015$) and use (Beta = 150.1; $F = 6.62$; $p = 0.0113$) of physical activity resources. In addition, vigorous physical activity was negatively associated with having

street lights (Beta = -1196.8; $F = 9.36$; $p = 0.0027$). The overall r-square of this model was 0.1771.

Total moderate physical activity

The total moderate activity, as measured by summing moderate physical activity across all domains, was positively associated with greater use of physical activity resources (Beta = 228.7; $F = 6.13$; $p = 0.0147$), and hills (Beta = 1191.0; $F = 4.44$; $p = 0.0371$). In addition, moderate physical activity was negatively associated with more positive policy attitudes towards physical activity (Beta = -306.9; $F = 5.38$; $p = 0.0221$) as well as having street lights (Beta = -1610.6; $F = 5.48$; $p = 0.0210$). The overall r-square of this model was 0.1537.

Total walking physical activity

The total activity done through walking in all domains was positively associated with greater use (Beta = 60.2; $F = 6.11$; $p = 0.0147$) and awareness (Beta = 36.4; $F = 4.66$; $p = 0.0328$) of physical activity resources. The positive Beta-values indicate that increasing walking corresponds to increases in use and awareness of community resources and facilities. The overall r-square of this model was 0.0776.

Kaiser Sports Index

The Kaiser Sports Index was positively associated with greater use of physical activity resources (Beta = 0.127; $F = 12.63$; $p = 0.0005$), and negatively associated with barriers to exercise (Beta = -0.144; $F = 23.42$; $p < 0.0001$). The r-square of this model was 0.2296.

Discussion

This survey conducted among rural adults identified a number of perceived social, environmental, and policy determinants of physical activity. Through new measures, the survey also captured determinants that were unique to the rural population that should

help inform future interventions. This study, which focused only on environmental factors associated with physical activity (rather than individual-level factors), found that ecological frameworks are useful for examining factors associated with physical activity in rural adults due to their multi-level nature, and also provided evidence of reliability for using modified measures of determinants of physical activity that were tailored for rural adults.

Demographics

Results of this study echo some findings in the literature. Other studies have found that rural adults in the Midwest are predominantly white and married (Nothwehr, Snetselaar, & Wu, 2008), which may influence levels of physical activity. In addition, the majority of respondents to the survey used here were female, which is also supported in the rural literature (Nothwehr, et al., 2008), and future research could examine ways to increase participation by rural adult males.

This study examined whether an individuals' residency in town or in the country was associated with their physical activity, especially as those living in town may have more access to exercise facilities or well-maintained sidewalks. The study participants were almost evenly divided between those living in town or in the country; however, this was not found to be associated with any of the physical activity outcome variables. Further research is needed to examine whether where one resides within a rural area may impact their levels of physical activity.

Despite the well-reported associations among gender, BMI, and age with physical activity, these variables were not associated with physical activity in this sample, and thus were not included in any of the final models, with the exception of gender in leisure time and house and yard work. It is possible that these variables had few associations with physical activity due to low variability.

Neighborhood and Community Aspects

Regarding neighborhood and community aspects in rural areas, Whaley and Haley (2008) reported that rural adults desire to see more walking and biking trails, which was also found in this study. Community resources, especially hills, sidewalks, shopping malls, and hunting/conservation/park areas were all associated with physical activity in these rural adults, which is supported by a review from Frost and colleagues (2010).

Although it was not measured in this study, having walkable destinations was found to be associated with physical activity in rural adults (Frost, et al., 2010). Focus groups among members of the communities in this study revealed the perception that having a destination was important for rural adults, and future research could examine this factor in more detail. In addition, this study found that walking was positively associated with greater use and awareness of physical activity resources in the community, and future research could examine ways to increase awareness of existing resources, especially resources that could be considered destinations for walking.

In addition to walking, greater awareness and use of physical activity resources in the community was also positively associated with physical activity in different domains and at different intensities. Addy et al. (2004) suggested that increasing awareness of environmental supports and opportunities for physical activity may be an effective strategy for community-based interventions for increasing physical activity. Findings from this study showed that there was a moderate but significant correlation between awareness and use of resources, which offers support for increasing awareness of physical activity resources. This may be especially pertinent in rural areas, as rural adults may be unaware of the existing resources in their community (Whaley & Haley, 2008). Moreover, promoting existing resources would save time and money spent on developing new resources for being active.

Barriers

The four most common barriers to physical activity reported by the participants in this study (no time, too tired, no motivation, and no energy) are also the most common barriers reported in a national sample of Americans (Brownson, et al., 2001), and have also been found to be the most common barriers reported by other rural adults (Chrisman, et al., 2011). Although the focus of this study was on social, environmental, and policy-level determinants of physical activity, these barriers indicate that personal-level interventions may be needed to help reduce impediments to physical activity in order to increase levels of this behavior in rural adults.

Social Determinants

The participants here reported getting most of their information about exercise from websites and their friends. Previous findings showed that rural adults get most of their information about exercise from magazines and newspapers (Chrisman, et al., 2011). This may represent a change in the use of technology for informing health behaviors, and future interventions could examine the use of the internet (including web-based magazines and newspapers) for increasing physical activity. Additionally, this provides evidence that friends may be important for informational support and could also be targeted for intervention to increase physical activity. Whaley and Haley (2008) reported high levels of safety and low fear of crime in rural adults, both of which were supported by results of this study, and both of which could influence whether one is physical active.

Policy Attitudes and Workplace Assets

At the policy level, some of the findings may have implications for rural communities. The finding that rural adults prefer free places to exercise and dislike having to pay to use facilities indicates that rural communities may consider developing policies to reduce the cost of gym memberships, or providing support for developing

walking trails or for using existing school facilities. In addition, employers providing support or incentives to exercise were associated with more physical activity at work, and this area that has not been studied much.

Rural adults who were self-employed were more likely to be more active at work, which is likely due to the nature of their employment. Although specific occupations were not measured here, it is likely that self-employed rural adults engaged in farming or agricultural practices, which likely require more activity than more urbanized occupations.

Support for policies aimed at increasing physical activity were overall positive for the participants in this study. Brownson and colleagues (1998) also found positive support for policy attitudes. These combined findings indicate policy interventions may be an effective method for increasing physical activity in rural adults. In this study, 53% of participants agreed that employers should provide time during the workday for employees to exercise; in comparison, Brownson et al. (1998) found that almost 59% of participants supported work time for physical activity. One thing to note about policy attitudes is that these attitudes may be independent of available resources for implementing any policy changes to increase physical activity. As Brownson and colleagues (1998) mention, insufficient resources may prevent the development or implementation of policies for improving participation in physical activity.

Physical Activity

Physical activity levels reported by participants in this study are high, especially as only 12% of the participants were included in the low category of physical activity based on IPAQ cut-off points. As mentioned previously, use of the IPAQ Long Form can result in overestimation of physical activity levels (“Guidelines”, 2005), and it is possible that overestimation occurred in this study. Additionally, the participants had lower levels of overweight and obesity, which combined with higher levels of reported physical

activity, may indicate that the sample was healthier than average. Levels of physical activity may be over-reported when using the IPAQ (“Guidelines”, 2005) due to the greater specificity of detail in the questions asked. To reduce measurement error in future studies of rural adults’ physical activity, objective measures of activity, such as accelerometers, should be used to validate self-reported levels of physical activity.

The variability explained by the regression model for total physical activity was lower than the variability in domain-specific models. This is possibly explained by the findings here that determinants of physical activity are specific to the domain being measured, as well as possible measurement error for the levels of physical activity. Other findings that warrant attention for their relevance to the rural environment include unpaved/gravel/dusty roads as a barrier to exercise. Focus groups among members of the rural county revealed that unpaved/gravel/dusty roads were common, and that they inhibited physical activity by making it difficult to ride bicycles on them. In addition, these roads did not contain shoulders, which may contribute to perceived feelings of the roads being unsafe for use for physical activity. Also, participants were asked to identify physical activity resources that they were aware of and use in their county, and while awareness of the resources was high, the use of the resources was not. Future studies may want to focus on awareness within just one community or neighborhood, since some resources may not be feasible for residents in other rural communities to use. The surprising finding that street lights were negatively associated with physical activity should be examined more in-depth. Frost and colleagues’ (2010) review of the rural built environment and its effects on physical activity found that overall, street lighting was not associated with physical activity, or there were negative associations between street lighting and physical activity. Future research should examine ways to better measure this variable.

Limitations

The generalizability of these data and results is limited to adults over the age of 18 living in the rural Midwest. Using the public telephone book for recruitment may limit the representativeness of some sub-groups of the population (for example, younger adults may be more likely to use mobile phones or to have their phone numbers unlisted). Individuals who are more active might have been more likely to participate in this study, indicating a self-selection bias. In addition, the sample was predominantly white, female, and most of the participants were married, which may limit the generalizability towards males, other ethnic groups or individuals who are not married.

Recruitment occurred over a period of three months (August through October), which was done to account for possible seasonal changes in physical activity levels. Physical activity levels were likely higher in the warmer months, especially as exhibited by the levels of gardening activity that were reported in this sample, and this may have influenced the total amounts of physical activity reported, as well as the domain-specific amounts of physical activity reported. In addition, the variability explained by the regression model for physical activity in the domains of walking and active transportation was low; this indicates that there may be other variables that were not captured by this analysis that may explain whether one is active in those domains.

Finally, the survey was self-administered, which may introduce self-report bias, especially regarding height and weight data and reporting of physical activity levels. It has been reported that asking more detailed questions about physical activity using the IPAQ Long Form is likely to result in higher estimates of physical activity among each of the four domains measured (“Guidelines”, 2005).

Conclusions

The modified survey here was shown to be reliable over multiple measurements, and moderate to substantial agreement was found for the majority of the questions. This

indicates support for using this instrument when measuring physical activity and determinants of this behavior in rural adults.

In addition, multiple factors at different levels of influence of an ecological model were found to be related to domain-specific levels of physical activity in this study. This provides support for targeting multiple levels of influence when attempting to increase physical activity. Specifically, this study provides support for increasing social support for physical activity, increasing awareness of existing community resources, and developing policy-level approaches to increasing physical activity.

CHAPTER 5 – CONCLUSION

Significance

The findings from this series of studies offer new insights into the factors that may influence physical activity in rural adults. First, findings indicate that perceived determinants and correlates of physical activity differ by the domain in which physical activity occurs. Many research studies have examined physical activity in general terms such as overall physical activity levels, or only in one domain, such as leisure time physical activity. This can limit the explanatory power and reduce the specificity of analyses of determinants and correlates of physical activity. Future physical activity research should consider the domain of physical activity being measured. Additionally, only about half of the rural adults in this study reported any physical activity in the domains of work and active transportation, and more research needs to be conducted to identify the most salient domains in which physical activity occurs in this population.

Second, the qualitative research conducted here provides some support for previous findings of perceived determinants of physical activity in rural adults, and also provides new areas to explore for their associations with physical activity. For example, the importance of social support has been well-reported in regard to its influence on physical activity, and participants in the focus groups conducted here echoed that sentiment by stating that the presence of others influenced their own physical activity. In addition, the participants in the focus groups mentioned that pets might be an important source of support for physical activity, and also expressed a desire to see that community buildings such as schools, churches and Wal-Mart are open to the public to be used for physical activity and exercise. Following up on that, the results from the survey provided evidence that these rural adults were in support of having community buildings open to the public for exercise. Business leaders, church leaders, and school board members in rural towns can assess their policies towards encouraging and allowing the public to use

their facilities for exercise, and consider whether any changes can be made in favor of promoting physical activity in this manner. Allowing access to school physical activity spaces and facilities through joint agreements is a recommended strategy in the *Healthy People 2020* goals for improving the nation's health (USDHHS, 2010). These joint use agreements provide an opportunity to combine resources and work together to meet a community's needs. Such agreements may be particularly relevant in rural areas, where schools may be regarded as a central focus in the communities. As Eyler and Swaller (2012) point out, allowing communities to use school facilities where few other physical activity opportunities exist is a feasible option for improving access, especially as these publicly-owned facilities are often under-utilized. There are many examples of joint-use agreements and the positive effects of these agreements on physical activity levels (North Carolina Department of Public Instruction and Division of Public Health, 2012; Spengler, 2012; Eyler & Swaller, 2012), and the studies conducted here found that the rural population offers potential for implementing such agreements.

Frost and colleagues (2010) suggested that researchers should seek to refine measures that capture elements of the rural environment that may influence physical activity. The series of studies conducted here were an attempt to do just that, as well as provide a clearer picture of the social, environmental, and policy factors that affect whether rural adults are physically active.

Finally, findings here demonstrate that different levels of an ecological model may influence the levels of physical activity that rural adults engage in. The qualitative data collected in Aim 2 provided insight into different levels of influence on rural adults' physical activity. Important findings that were highlighted include social factors such as the importance of seeing others being active, and using pets a means to be active; environmental factors such as having adequate sidewalks; and policy attitudes such as being able to use schools and community buildings for exercise. The quantitative findings from Aim 1 and Aim 3 also provide support for targeting multiple levels of influence. For

example, having employers who provide support or incentives to exercise was associated with more physical activity at work, and community aspects such as hills were positively associated with physical activity.

Implications for Practice

Rural adults are a unique population, and the studies conducted here provide contextual clues for how environmental, social, and policy level variables may influence whether they participate in physical activity. There has been a need for research examining this understudied population (Nothwehr & Peterson, 2005; Dye & Wilcox, 2006); as well as a need to examine physical activity by the domain in which it occurs (Bauman & Bull, 2007) and to improve the accuracy in measuring environmental and policy variables that may be associated with physical activity (Brownson, et al., 2004). It is also important to assess environmental factors associated with physical activity. It has been found that physical environmental influences on physical activity do not surface spontaneously in research studies of rural adults, and that these adults may not be aware of the influence of their environment on their physical activity behavior (Dye & Wilcox, 2006). This series of studies has addressed those issues. Findings from these studies can be used to tailor culturally-relevant, behavior-specific interventions designed to increase physical activity in rural adults.

Social Cognitive Theory purports that the environment influences one's behavior (Bandura, 1977), and the studies conducted here provide support for using a social cognitive approach when examining factors associated with physical activity. For example, the qualitative data collected here revealed the importance of having others model physical activity behavior. This is consistent with the Social Cognitive Theory construct of observational learning (Dye & Wilcox, 2006), and provides support for using this theory when studying physical activity and its determinants in rural adults.

By exploring perceived social, environmental, and policy level factors, the understanding of multidimensional influences that may affect physical activity behaviors in a rural community has been expanded. Ecological models propose that multiple levels of influence should be addressed when trying to change a behavior like physical activity. Making the built environment friendly for physical activity (such as by adding sidewalks or making it safe to exercise), combined with increasing social support from friends and family, might be one example of multilevel approaches to increasing physical activity.

Ding and colleagues (2012) found that improving the environment for physical activity might be most helpful for those least inclined to be active. This suggests that future research could focus on communities with low rates of physical activity, or on populations that are more sedentary, in order to create the largest benefit for the health of the public. Although physical activity rates were not low in this study, other rural adults may engage in lower rates of physical activity than urban or suburban adults (Patterson, et al., 2004), and rural communities might make ideal settings for future physical activity interventions. Participants in this study were found to engage in high levels of physical activity, and lower levels of overweight and obese individuals were also reported. This may indicate that the sample was healthier than average or that over-reporting of physical activity and underreporting of body weight occurred. Recent findings indicate that rural adults have higher rates of obesity and other chronic diseases than their urban counterparts (Befort, Nazir, & Perri, 2012), and obesity deserves greater attention in rural America.

The studies conducted here were focused on social, environmental and policy level variables, yet the most commonly reported barriers from the survey (no time, no energy, no motivation, and being too tired) were personal level barriers. These barriers to physical activity are well-supported in the literature (Brownson, et al., 2001), and may indicate that more research needs to be done to overcome them. Osuji and colleagues (2006) also report that personal and social barriers are more frequently cited than

environmental barriers, suggesting that interventions targeting personal and social obstacles to physical activity may be useful in the future.

Walking was the most common form of physical activity reported in these studies, which is consistent with other research (Dye & Wilcox, 2006). Brownson et al. (2000) found that walking trails may be beneficial in promoting walking behavior in rural communities. In addition, a multi-level intervention to increase walking was moderately successful through interpersonal and community support (Brownson, et al., 2005). Other findings from this series of studies suggest potential areas for intervention to improve walking in rural adults.

Finally, this set of studies found factors associated with physical activity that occurred in different domains. This is in response to calls in the literature for more specificity when measuring determinants and correlates of physical activity. These findings contribute to the literature in several ways. First, the findings show that multiple social, environmental and policy variables that are associated with physical activity in different domains in rural adults. Second, the findings provide further evidence that multi-level approaches should be used to increase physical activity in this population (Kaiser, Brown, & Baumann, 2010). Third, the Aim 3 study showed that using the IPAQ to measure physical activity in rural adults was reliable over multiple measurements. Finally, the findings provide new areas for researching perceived determinants of physical activity in rural areas, such as improving the ability to ride bicycles or creating joint-use agreements between communities and school facilities.

Implications for Future Research

Frost and colleagues (2010) suggested that more research should examine the influence of the rural environment on health behaviors to potentially inform the development of new policies, design tailored interventions, and improve the health and quality of life in this population. The Brownson survey instrument that was modified in

this study was used to focus on examining associations between environmental, social, and policy factors in a rural population. The modified instrument here should be tested in other rural populations as well.

Whaley and Haley (2008) discuss how researchers are likely to have different ideas, expectations and values from the participants they are studying, especially in a rural environment. Thus, it is important to collaborate with members of the community of interest in order to determine what works when collecting information and gathering perceptions of needs and barriers to physical activity present in the community (Whaley & Haley, 2008). Future research in this population should consider the language and culturally relevant factors when measuring physical activity and environmental variables.

Studies that examine environmental influences of physical activity in rural adults should use measurement tools that have been shown to be valid and reliable, such as the survey instrument that was assessed here. Frost and colleagues (2010) suggest that researchers work to refine measures to better capture elements of the environment that influence physical activity. Additionally, future research using the instruments from this study should attempt to obtain a larger and more representative sample.

Future interventions could attempt to increase physical activity in this population by focusing on the social environment, such as social support and increasing public events that help make physical activity more visible in rural communities. Stahl and colleagues (2001) found that individuals who perceived having low social support were more than twice as likely to be sedentary compared to those reporting high levels of perceived social support. Shores and colleagues (2009) found that rural older adults who had a partner with whom to be active were more likely to meet physical activity recommendations. Social Cognitive Theory provides a theoretical basis for using behavioral modeling to change the behavior of others. In this study, rural adults desired to see members of their communities being active, and felt that this would encourage more activity in their own lives. In addition, policy changes focusing on making it easier for

rural adults to be active can be considered. For example, participants in this series of studies did not like having to pay to use facilities, and rural employers could consider subsidizing health club or fitness center memberships.

The most common places where participants exercised in the Aim 3 study were neighborhood streets and space or equipment at home. This supports evidence from Addy and colleagues (2004), who found that neighborhood variables were stronger predictors of physical activity than community variables. This has important implications for future research in this population, and interventions to increase environmental support for physical activity in rural adults may want to focus on proximal locations, such as neighborhood streets (Addy et al., 2004).

Additionally, the participants in the survey indicated that they get most of their information about exercise from websites and friends. Future research could examine ways to integrate the internet or mobile technology into physical activity interventions, as well as using friends for different types of support (informational, emotional, etc.). This may be a promising area for intervention in rural areas, where a lack of access may necessitate other means of connecting with community members, such as through email and mobile phones. Technological advancements are commonplace, even in rural areas (Atkinson, 2007), and have the potential to be used for increasing physical activity.

Seasonal changes in physical activity have also not been examined in depth in rural communities. Bad weather was mentioned as one of the top five most common barriers in the rural adults in this study, and it is unknown how exactly this affects participation in physical activity throughout the year. Future studies are needed to examine the effect of seasonal changes on weather and how this is related to whether rural individuals are active. The survey conducted here attempted to control for some of the seasonal weather changes by collecting data over a period of several months; however, a long dry season, coupled with atypical warm and mild temperatures may have

diminished some of the seasonal changes that may have occurred in normal weather conditions.

Finally, awareness of physical activity resources in one's community was found to be associated with greater participation in physical activity in the survey conducted here. Future interventions could examine ways to increase awareness of existing resources (and thus save time and money spent planning and building new resources), and how to most effectively increase awareness among different sub-groups of the rural population. Considering the findings here that multiple levels of an ecological model may influence physical activity, interventions to increase awareness of existing resources and facilities should attempt to target multiple levels of influence. Future studies should continue to examine physical activity by the domain in which it occurs, and report determinants separately by domain.

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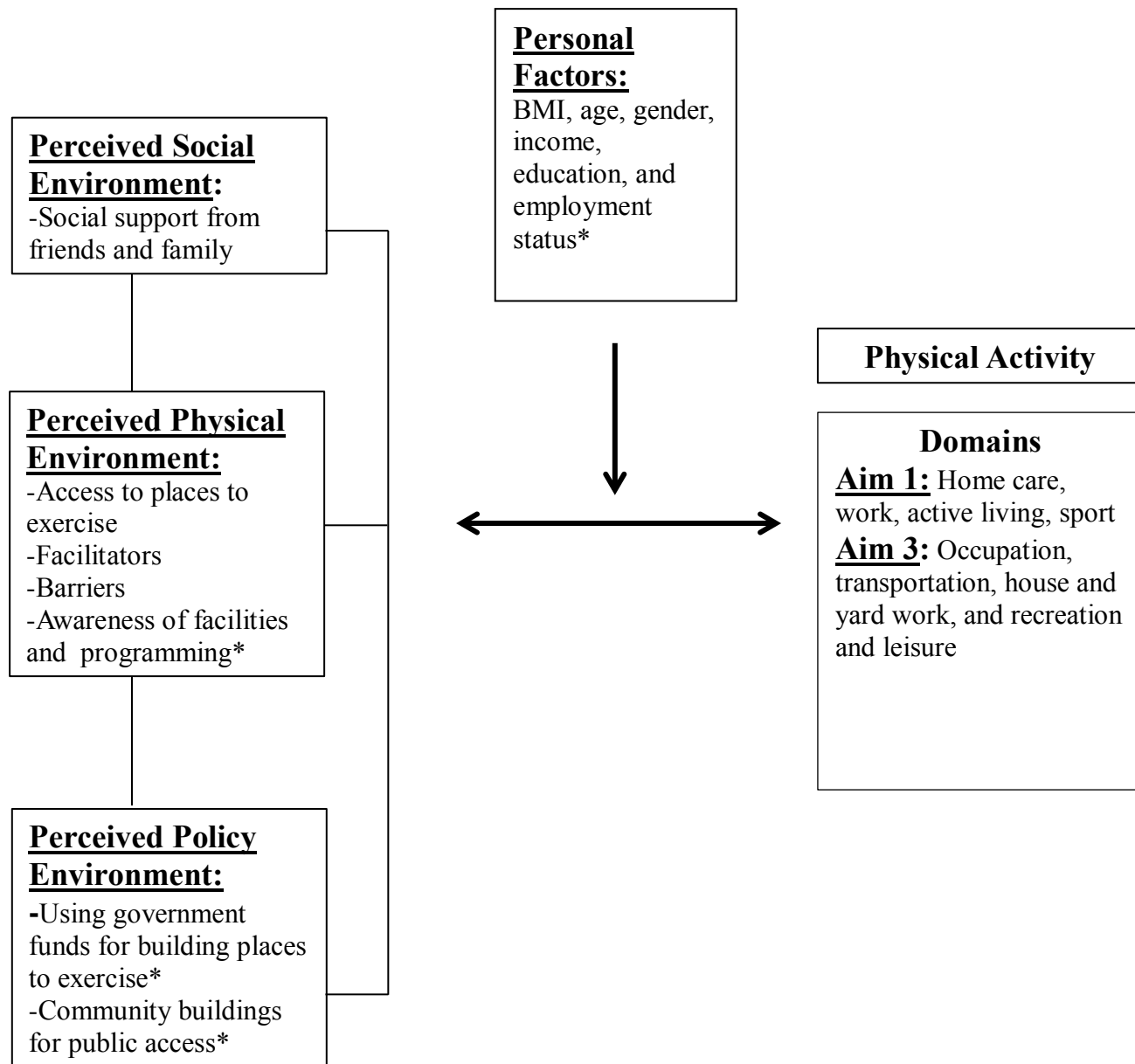
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APPENDIX A CONCEPTUAL MODEL

Figure A-1 Conceptual Model



*Aim 3 only

APPENDIX B AIM 1 DESCRIPTIVES

Table B-1 – Demographics of Aim 1 participants

Variable	Number (%)
Women	232 (57.0)
Men	175 (43.0)
<i>Age</i>	
20-39	60 (14.7)
40-49	95 (23.3)
50-59	81 (19.9)
60-69	81 (19.9)
70 and above	90 (22.1)
<i>BMI</i>	
Overweight or obese (25 or greater)	306 (76.3)
Normal or underweight (24.9 or less)	95 (23.7)
<i>Marital Status</i>	
Married	306 (75.6)
Not married	99 (24.4)
<i>Education</i>	
Less than high school	25 (6.1)
High school	143 (35.1)
Some college	133 (32.7)
Bachelor's or higher	106 (26.0)

Table B-2 Means and variability of independent and dependent variables

Variable	N	Mean	Standard deviation
Homecare	407	2.27	0.46
Work	272	2.97	0.72
Active living	404	2.62	0.78
Sport	406	2.71	1.06
Summary PA	407	9.54	2.46
Age	407	56.22	15.6
BMI	402	29.41	5.76
Gov't funds for trails	365	1.19	0.39
Gov't funds for pool	394	1.05	0.23
Gov't funds for rec	363	1.26	0.44
Gov't funds for bike	373	1.21	0.41
Barriers	375	1.35	1.73
Neighborhood characteristics	393	3.18	1.01

Table B-3 – Bivariate General Linear Model for Home Care

Determinant	F-value	p-value
Neighborhood safety	2.86	0.0379
Info about exercise	0.67	0.8293
Friends encourage	1.38	0.2408
Friend to exercise with	0.90	0.4676
Relatives encourage	1.61	0.1733
Relative to exercise with	1.00	0.4111
Support PE in schools	0.16	0.8515
Barriers summary score	4.69	0.0316
Neighborhood characteristics	0.90	0.3447

Table B-4 – Bivariate General Linear Model for Work

Determinant	F-value	p-value
Access to places to exercise	1.55	0.1882
Friends encourage	1.79	0.1316
Friend to exercise with	0.23	0.9188
Relatives encourage	1.08	0.3676
Relative to exercise with	0.34	0.8515
Employers provide time to exercise	0.79	0.4547
Work provides incentives to exercise	1.44	0.2217
Barriers summary score	1.02	0.3149
Neighborhood characteristics	2.16	0.1431

Table B-5 – Bivariate General Linear Model for Active Living

Determinant	F-value	p-value
Access to places to exercise	0.07	0.9917
Neighborhood safety	1.50	0.2050
Zoning should include paths	1.27	0.2857
Schools should have PE	0.35	0.7072
Friends encourage	0.43	0.7896
Friend to exercise with	1.67	0.1574
Relatives encourage	1.06	0.3758
Relative to exercise with	1.30	0.2706
Gov't funds for trails	0.52	0.4732
Gov't funds for pools	0.93	0.3353
Gov't funds for rec centers	0.25	0.6182
Gov't funds for bike trails	0.54	0.4619
Barriers summary score	6.27	0.0131
Neighborhood characteristics	5.98	0.0154

Table B-6 – Bivariate General Linear Model for Sport

Determinant	F-value	p-value
Access to places to exercise	0.51	0.7301
Friends encourage	3.62	0.0067
Friend to exercise with	1.28	0.2765
Relatives encourage	0.87	0.4843
Relative to exercise with	0.26	0.9037
Barriers summary score	30.81	0.0001
Neighborhood characteristics	0.70	0.4044

Table B-7 – Bivariate General Linear Model for Summary PA

Determinant	F-value	p-value
Access to places to exercise	2.46	0.0372
Neighborhood safety	0.49	0.6895
Zoning should include paths	0.92	0.4344
Schools should have PE	0.80	0.4524
Friends encourage	0.42	0.7905
Friend to exercise with	0.08	0.9871
Relatives encourage	1.07	0.3748
Relative to exercise with	1.18	0.3249
Gov't funds for trails	1.38	0.2426
Gov't funds for pools	1.06	0.3058
Gov't funds for rec centers	0.02	0.8987
Gov't funds for bike trails	0.15	0.6954
Barriers summary score	7.63	0.0067
Neighborhood characteristics	0.35	0.5543
Where get info about exercise	1.27	0.2292
Employers provide time to exercise	1.21	0.3011
Work provides incentives to exercise	7.40	0.0001

APPENDIX C INTERVIEW GUIDE FOR AIM 2

Focus Group Interview Guide

My name is Matt Chrisman and I am from the University of Iowa's College of Public Health. Thank you for being here. I am attempting to develop a survey that measures things in the rural environment that are related to physical activity. You have been asked to participate because you live in a rural community. Would you be willing to answer a few questions to help me understand what things in your community may influence whether you are active or not? Everyone's ideas are important and everyone has a right to speak. All comments are confidential and only summarized information will be communicated. There are no "wrong" answers. You are free to stop participating at any time.

(opening question: Tell us your name, and what you enjoy doing in your free time in Washington County)

First, I would like to understand how you define physical activity and exercise: (prompts: give lay definition of PA as any body movement that expends energy; exercise defined as a specific type of PA designed to increase fitness or get you in shape). What comes to mind when hearing these terms? How would you define them?

Second, I would like to understand how you define your "neighborhood" or "community." Can you comment on what makes up your neighborhood, and what makes up your community?

Third, I would like to understand where you are active, or engage in exercise in your community/neighborhood. For example, do you use sidewalks to walk somewhere? Please tell me if you use parks/playgrounds/sports fields, and schools that are open for public recreation facilities. "Do you use nearby waterways such as creeks, rivers, and lakes for water-related physical activities such as canoeing, kayaking, swimming, or

skiing?” (From Ainsworth et al., 2002). (Follow-up: are there any existing facilities/resources that you do not use that you are aware of?)

Fourth, I would like to understand how some things may help you be active or exercise, and how some things may prevent you from being active or exercising. What types of things helps you (or makes it easier) be active?

What types of things prevents you from (or makes it harder to) being active (no energy, bad weather)?

Finally, I would like to see if some things do not apply to rural areas. For example, high crime, foul air, and indoor walking tracks/gyms/malls. Are there other aspects of rural areas that have not been discussed in their relation to physical activity (prompts: unpaved roads, presence of farm equipment on the roads)?

APPENDIX D AIM 3 DESCRIPTIVES AND RESULTS

Table D-1 – Demographics of Aim 3 participants

Variable	Number (%)
Women	88 (63%)
Men	51 (37%)
<i>Age</i>	
20-39	33 (23%)
40-49	35 (25%)
50-59	30 (20%)
60-69	25 (18%)
70 and above	14 (10%)
<i>BMI</i>	
Overweight or obese (25 or greater)	80 (56%)
Normal or underweight (24.9 or less)	55 (39%)
<i>Marital Status</i>	
Married	117 (83%)
Not married	24 (17%)
<i>Education</i>	
High school diploma or less	39 (27%)
Some college	29 (21%)
Associate's or Bachelor's degree	50 (36%)
Post-graduate degree	22 (16%)

Table D-2 – Places where study participants exercise most often

Variable	Yes (n, %)	No (n, %)	Not available (n, %)
Walking/jogging trail	56 (44%)	53 (42%)	17 (14%)
Neighborhood streets/sidewalks	85 (64%)	35 (27%)	13 (10%)
Park	37 (32%)	65 (57%)	13 (11%)
Shopping mall	10 (9%)	58 (50%)	47 (41%)
Indoor gym/fitness center	34 (29%)	69 (59%)	13 (11%)
Use space or equipment at home	81 (64%)	37 (29%)	8 (6%)

Table D-3 – Times when participants exercise most often

Time	Number (%)
Early morning (5-8 a.m.)	31 (22%)
Morning (8-11 a.m.)	16 (11%)
Midday (11 a.m.-2 p.m.)	4 (3%)
Afternoon (2-5 p.m.)	17 (12%)
Evening (5-9 p.m.)	36 (26%)
Varies	37 (26%)
Other	1 (1%)
I do not exercise	17 (12%)

Table D-4 – What participants like the most about where they exercise

Variable	N, %
Free place to exercise	36 (27%)
Other people exercising	5 (4%)
Fitness stations available	3 (2%)
Parking	0 (0%)
Distances are marked	3 (2%)
No crowds	11 (8%)
Location/convenience	37 (27%)
Lighting	1 (1%)
Trail design	2 (1%)
Safe surface	3 (2%)
Scenic beauty	9 (7%)
I like everything about the place	13 (9%)
Can exercise at home	28 (20%)
I like nothing about the place	1 (1%)
Sidewalks	8 (6%)
Other	12 (9%)

Table D-5 – What participants like the least about where they exercise

Variable	N, %
Having to pay to use facilities	16 (12%)
Trail design	0 (0%)
Fitness stations not available	5 (4%)
Too many people	3 (2%)
Distances are not marked	6 (5%)
Unappealing	1 (1%)
Poor location/inconvenient	0 (0%)
Unsafe surface or area	5 (4%)
Poor lighting	3 (2%)
Other people exercising	2 (2%)
No sidewalks	6 (5%)
Gravel or muddy roads	24 (18%)
No parking	0 (0%)
Not enough people exercising	6 (5%)
Lack of scenic beauty	4 (3%)
I like everything about the place	41 (30%)
I like nothing about the place	1 (1%)
Other	16 (2%)

Table D-6 – Characteristics of participants' communities

Variable	Yes (n, %)	No (n, %)
Sidewalks	94 (67%)	47 (33%)
Heavy traffic	28 (20%)	111 (80%)
Hills	98 (71%)	40 (29%)
Street lights	101 (73%)	37 (27%)
Dogs that are unattended	55 (39%)	86 (61%)
Foul air from cars or confinements	36 (26%)	103 (74%)
Enjoyable scenery	128 (91%)	13 (9%)
Walking/jogging trail	81 (58%)	60 (42%)
A lot of people exercising	45 (32%)	95 (68%)
High crime	5 (4%)	135 (96%)
Unpaved roads	83 (60%)	57 (40%)
Farm equipment on the roads	90 (65%)	50 (35%)
Hunting areas/Conservation areas	65 (47%)	74 (53%)

Table D-7 – Barriers reported by participants

Barrier	Yes (n,%)	No (n,%)
Others discourage me	8 (6%)	132 (93%)
I am self-conscious about my looks	55 (39%)	84 (59%)
I am not fit enough	68 (48%)	73 (51%)
I am afraid of injury	29 (20%)	118 (78%)
I don't have time	106 (75%)	35 (25%)
I am too tired	102 (72%)	37 (26%)
I don't have a safe place to exercise	16 (11%)	123 (87%)
I have no child care assistance	27 (19%)	107 (75%)
The weather is bad	88 (62%)	53 (37%)
I am not in good health	31 (22%)	110 (76%)
I don't have the energy to exercise	89 (63%)	51 (36%)
I get plenty of exercise at my job	53 (37%)	80 (56%)
I don't have the motivation to exercise	96 (68%)	44 (31%)
I don't like to exercise	69 (49%)	70 (49%)
Unpaved/gravel/muddy/dusty roads	50 (35%)	90 (63%)
Farm equipment on the roads	40 (28%)	98 (69%)
I have no one to exercise with	56 (39%)	85 (60%)
No sidewalks available	39 (28%)	101 (71%)
Unsure of how to use exercise equipment	27 (19%)	109 (77%)

Table D-8 – How safe participants feel when exercising

Variable	Number (%)
Extremely safe	58 (41%)
Quite safe	60 (43%)
Slightly safe	11 (8%)
Not at all safe	1 (1%)
I do not exercise	11 (8%)

Table D-9 –Whom participants exercise with

Variable	Number (%)
Friends	19 (16%)
Club or class	11 (9%)
Spouse/partner	29 (24%)
Children	17 (14%)
Pets	13 (11%)
Other family members/relatives	13 (11%)
Other	12 (10%)
I do not exercise	13 (11%)

Table D-10 –Neighbors would provide assistance for exercising

Variable	Number (%)
Not at all true	31 (22%)
Somewhat true	36 (26%)
True/very true	32 (23%)
Do not know/not sure	40 (29%)

Table D-11 –A lot of people in participants’ neighborhoods are physically active

Variable	Number (%)
Not at all true	27 (19%)
Somewhat true	55 (39%)
True/very true	41 (29%)
Do not know/not sure	18 (13%)

Table D-12 –Where participants get most of their information about exercise

Variable	Number (%)
Friend	23 (16%)
Coworker	4 (3%)
Family member/relative	22 (16%)
Employer	3 (2%)
Neighbor	2 (1%)
Fitness trainer or instructor	10 (7%)
Doctor	15 (11%)
Other health professional	4 (3%)
Magazine/newspaper	16 (11%)
Health literature	11 (8%)
Local health agency	0 (0%)
A health coalition	0 (0%)
Minister/clergy	0 (0%)
Television	16 (11%)
Radio	2 (1%)
Computer websites	28 (20%)
Other	6 (4%)
Don't get any information	19 (14%)

Table D-13 –Social support reported by participants

Variable	Strongly agree	Agree	Disagree	Strongly disagree
If you had someone like a friend or family member to exercise with, chances are that you would exercise more:	44 (31%)	68 (48%)	24 (17%)	5 (4%)
Your friends encourage you to exercise:	15 (11%)	67 (48%)	47 (33%)	12 (9%)
You have at least one friend who would commit to exercise with you:	30 (21%)	72 (51%)	25 (18%)	14 (10%)
Relatives encourage you to exercise:	24 (17%)	53 (38%)	48 (35%)	13 (9%)
You have at least one relative who would commit to exercise with you:	24 (17%)	50 (36%)	49 (35%)	16 (12%)

Table D-14 –How safe is participants' neighborhood from crime

Variable	Number %
Extremely safe	54 (38%)
Quite safe	80 (56%)
Slightly safe	6 (4%)

Table D-14 continued:

Not at all safe	2(1%)
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Table D-15 –Employers should provide time for exercise during the work day

Variable	Number, %
Strongly agree	20 (15%)
Agree	51 (38%)
Disagree	50 (37%)
Strongly disagree	13 (10%)

Table D-16 –Participants' workplace provides support or incentives for exercise

Variable	Number, %
Yes	37 (27%)
No	47 (35%)
Don't know/not applicable	51 (38%)

Table D-17 –Types of support or incentives provided by participants' workplace

Variable	Yes (N, %)	No (N, %)
I do not work/not applicable	50 (40%)	74 (60%)
Time or breaks during the day for exercise	19 (20%)	78 (80%)
Facilities to exercise	28 (29%)	69 (71%)
Equipment for exercise	23 (24%)	74 (76%)
Offer personal services	24 (25%)	72 (75%)
Offer group services	27 (28%)	69 (72%)
Provides resource materials	33 (34%)	63 (66%)
Subsidizes health club memberships	28 (29%)	68 (71%)
Sponsors sports teams	14 (15%)	81 (85%)
Offers reduced health insurance premiums for active employees	11 (12%)	84 (88%)
Provides other monetary incentives for exercise	12 (13%)	84 (88%)

Table D-18 –Participants’ policy attitudes towards physical activity

Variable	Strongly agree	Agree	Disagree	Strongly disagree
Local schools should require physical education:	103 (73%)	35 (25%)	4 (3%)	0 (0%)
Local government funds should be used to build and maintain walking/jogging trails:	43 (31%)	66 (47%)	28 (20%)	3 (2%)
Local government funds should be used to build and maintain swimming pools:	28 (20%)	74 (53%)	33 (24%)	5 (4%)
Local government funds should be used to build and maintain recreation centers:	29 (21%)	75 (53%)	32 (23%)	5 (4%)
Local government funds should be used to build and maintain bicycle paths:	27 (19%)	74 (54%)	30 (21%)	8 (6%)
Zoning regulations should include walking paths:	32 (23%)	81 (58%)	21 (15%)	6 (4%)
Zoning regulations should include biking paths	29 (21%)	81 (58%)	24 (17%)	5 (4%)
School facilities should be open to the public for exercise:	34 (24%)	74 (52%)	29 (21%)	4 (3%)
Community buildings should be open to the public for exercise:	18 (13%)	66 (47%)	47 (34%)	8 (6%)

Table D-18 continued:

You would use school facilities for exercise:	21 (15%)	61 (44%)	44 (31%)	14 (10%)
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Table D-19 –Participants’ levels of physical activity using IPAQ coding

Level	N, %
Low	17 (12%)
Moderate	47 (33%)
High	78 (55%)

Table D-20 Multiple regression models for domain-specific physical activity

Domain	Variable	F-value	p-value	Adj. r-square
Work (n=131)	Employers provide time/support for exercise	8.86	0.0003	0.2517
	Work status	8.11	<0.0001	
Active Transportation (n=137)	Exercising at shopping malls	6.07	0.0032	0.1615
	# of positive community aspects	7.69	0.0066	
	Sidewalks	8.22	0.0048	
House and yard work (n=124)	Hunting/Conservation areas	5.43	0.0213	0.2224
	Favorable attitude towards using government funds to build pools	3.19	0.0018	
	Total use of physical activity resources	3.57	0.0005	
	Work status	2.64	0.0095	
Leisure time (n=132)	Gender	2.09	0.0389	0.2366
	Kaiser Sport index	28.24	<0.0001	
	Marital status	4.30	0.0401	
Summary of all domains (n=133)	Street lights	4.25	0.0413	0.1357
	# of positive community aspects	6.01	0.0156	
	Friends encourage exercise	3.70	0.0136	

Table D-21 Multiple regression models for intensity-specific physical activity

Intensity	Variable	F-value	p-value	Adj. r-square
Vigorous (n=127)	Awareness of resources	10.50	0.0015	0.1771
	Use of resources	6.62	0.0113	
	Street lights	9.36	0.0027	
Moderate (n=123)	Use of resources	6.13	0.0147	0.1537
	Total policy attitude	5.38	0.0221	
	Hills	4.44	0.0371	
	Street lights	5.48	0.0210	
Walking (n=131)	Use of resources	6.11	0.0147	0.0776
	Awareness of resources	4.66	0.0328	
KSI (n=124)	Total barriers	23.42	<0.0001	0.2296
	Use of resources	12.63	0.0005	